OPERATIONS, MAINTENANCE, AND MONITORING MANUAL
LNAPL RECOVERY AND GROUNDWATER TREATMENT SYSTEM

Review Avenue Development Site, RAD I and RAD II
Long Island City, Queens, New York
RAD I – BCA Site #C241089
RAD II – BCA Site #C241005

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Amendments/Revisions to Document

Version	Version Date	Reason for Amendment	Sections Amendment	Summary of Amendment
0	April 2015	Initial Draft Issue	N/A	N/A
1	December 2015	Final Issue	N/A	N/A

Acronyms and Abbreviations

AHA	Activity Hazard Analyses
BCS	Bureau of Customer Service
BWSO	Bureau of Water and Sewer Operations
BWT	Bureau of Wastewater Treatment
CFR	Code of Federal Regulations
COC	Contaminants of Concern
DDS	Detailed Dewatering Scheme
DOT	Department of Transportation
DP	Differential Pressure
Feet bgs	Feet below Ground Surface
GAC	Granular Activated Carbon
gpd	Gallons per Day
gpm	Gallons per Minute
GWTS	Groundwater Treatment System
HASP	Health and Safety Plan
HHLA	High-High Level Alarm
HLA	High Level Alarm
HMI	Human Machine Interface
HOA	Hand-Off-Auto
IPP	Industrial Pretreatment Program
JHA	Job Hazard Analyses
LGAC	Liquid-Phase Granular Activated Carbon
LNAPL	Light Non-Aqueous Phase Liquid
LOA	Letter of Approval
LRGTE	LNAPL Recovery and Groundwater Treatment Enclosures
mg/kg	Milligrams per Kilogram
MOC	Management of Change
NEC	National Electrical Code
NES	National Environmental Systems
NFPA	Nation Fire Protection Association
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
OCA	Open-Closed-Auto
O&M	Operation and Maintenance
OM&M	Operation, Maintenance, and Monitoring
OWS	Oil/Water Separator
PCB	Polychlorinated Biphenyls
PLC	Programmable Logic Controller
PSIG	Pounds per Square Inch Gauge
PVC	Polyvinyl Chloride
RAD	Review Avenue Development
RAI	Responsible, Accountable or Informed
SMP	Site Management Plan
SOPs	Standard Operating Procedures

SVE	Soil Vapor Extraction
TF	Total Fluids
VER	Vacuum-Enhanced Recovery
VGAC	Vapor-Phase Granular Activated Carbon
VOC	Volatile Organic Compounds

1 INTRODUCTION

This Operation, Maintenance, and Monitoring (OM&M) manual has been prepared to provide details and guidance for routine operations, maintenance, monitoring, and reporting of the light non-aqueous phase liquid (LNAPL) recovery system that was installed at the Review Avenue Development (RAD) sites RAD I and RAD II (collectively "Site").

The purpose of this manual is to aid operation, maintenance, and monitoring personnel in performing routine OM&M activities, including start-up, operation, shutdown, emergency shutoff, troubleshooting, ongoing inspections, monitoring, maintenance, sampling, and reporting. It is intended that this manual be used with the various site-specific documents listed in the Appendices.

1.1 FACILITY SUMMARY

The facilities covered by this OM&M Plan include: two 6,000 storage tanks, 2 treatment enclosures, and 60 recovery wells (30 equipped with skimmers and 38 total fluids recovery pumps). Components of the extractions system are installed on both RAD I and RAD II. RAD I is approximately 1.8 acres in size and located at 37-30 Review Avenue. 10 of Total Fluids/VER recovery wells and 23 skimmer wells with associated conveyance piping are located on the RAD I parcel. Preston Street, which separates the RAD I and RAD II property is actually within the limits of RAD I. RAD II, located at 37-80 Review Avenue, is approximately 2.7 acres in size and is the location of the LNAPL recovery/treatment system, 20 total fluids/VER recovery wells, and 15 skimmer wells. Specific information regarding the locations of equipment is provided in **Appendix A** – **Record Drawings.**

The Site is within a highly industrialized area of Long Island City, Queens, New York. To the North on the opposite side of Review Avenue is a cemetery, to the southeast is the parcel commonly referred to as the Phoenix Beverages property, to the southwest is the Southern Line of the Long Island Rail Road, and to the northwest by Allied Extruder.

1.2 KEY CONTACTS, ROLES, AND RESPONSIBILITIES

This section introduces the project team members, and provides their roles and responsibilities. **Figure 1-1** is a project organizational chart of project team members, and **Table 1-1** lists project personnel contact information. **Table 1-2** provides a description of who within the organization is Responsible, Accountable, or Informed (RAI) by task or role. Note that the project organization may change

over time. As such, these figures and tables should be reviewed each year and updated accordingly.

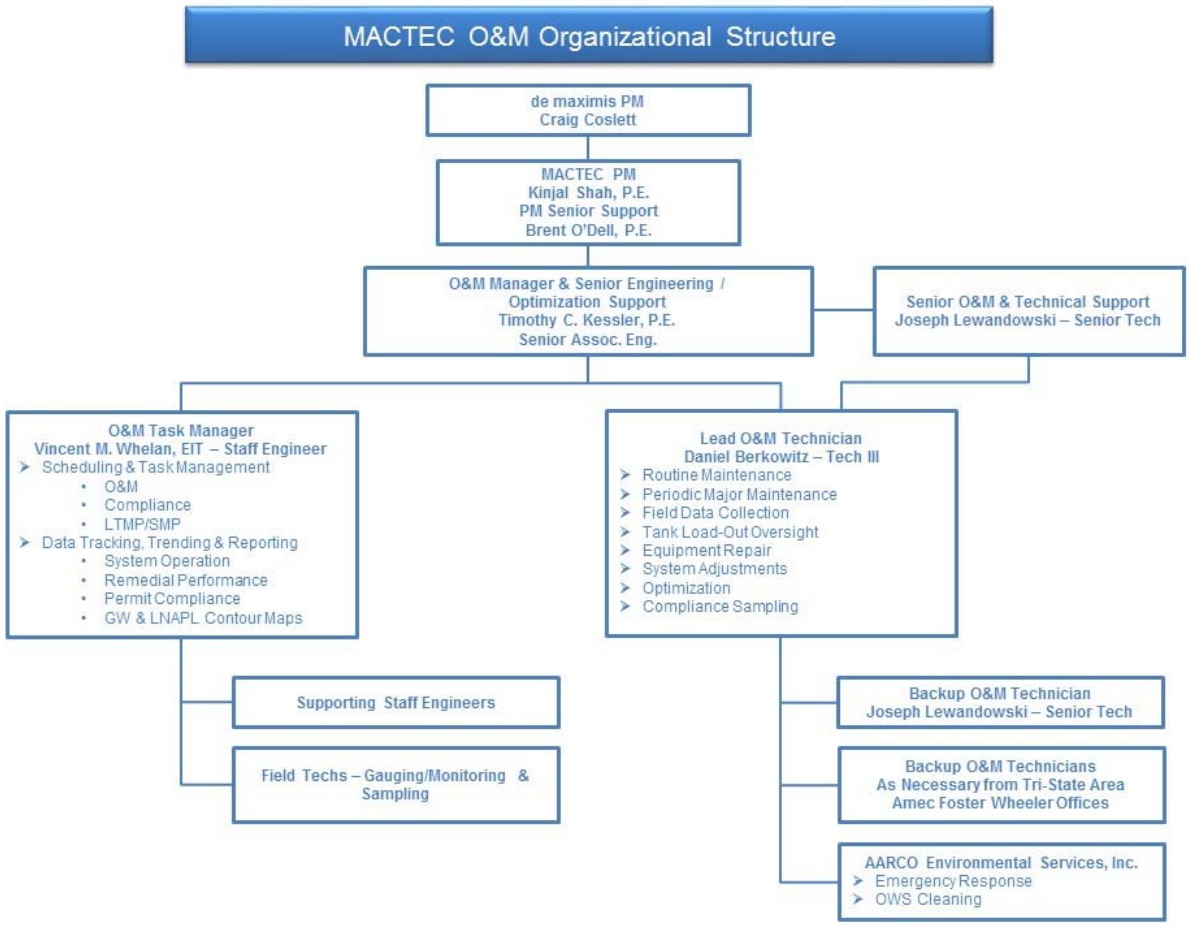


Figure 1-1: Organizational Structure

Table 1-1: Project OM&M Personnel Contact List

Company	Title	Name	Address	Office Phone	Mobile Phone	Email
de maximis	de maximis Project Coordinator	Craig Coslett	1550 Pond Road #120 Allentown, PA 18014	610-435-1151	610-360-7539	ccoslett@demaximis.com
MACTEC	MACTEC Program Director	William Weber	511 Congress Street #200 Portland, ME 04101	207-828-3530	207-289-4213	William.Weber@amecfw.com
MACTEC	MACTEC Project Manager, Engineer of Record (EOR)	Brent O'Dell	200 American Metro Blvd #113 Hamilton, NJ 08619	609-631-2915	908-285-1769	Brent.Odell@amecfw.com
MACTEC	MACTEC Health and Safety Officer	Cindy Sundquist	511 Congress Street #200 Portland, ME 04101	207-828-3309	207-650-7593	Cynthia.Sundquist@amecfw.com
MACTEC	MACTEC LTMP Manager	Kinjal Shah	200 American Metro Blvd #113 Hamilton, NJ 08619	609-689-2829	732-986-7432	Kinjal.Shah@amecfw.com
MACTEC	MACTEC Engineering Lead Support	Tim Kessler	200 American Metro Blvd #113 Hamilton, NJ 08619	609-631-2927	215-704-6592	Timothy.Kessler@amecfw.com
MACTEC	MACTEC OM&M Task Manager	Vincent Whelan	200 American Metro Blvd #113 Hamilton, NJ 08619	609-689-2832	609-815-6175	Vincent.Whelan@amecfw.com
MACTEC	MACTEC Senior OM&M Technician and Technical Support	Joe Lewandowski	751 Arbor Way #180 Blue Bell, PA 19422	610-341-0491	610-203-3484	Joseph.Lewandowski@amecfw.com
MACTEC	MACTEC Lead OM&M Technician	Dan Berkowitz	285 Davidson Ave #405 Somerset, NJ 08873	732-302-9500	848-702-9743	Daniel.Berkowitz@amecfw.com

Table 1-2: Project RAI Chart

Responsibility/Deliverable	de maximis Project Coordinator	MACTEC Project Director	MACTEC Project Manager	MACTEC LTMP Manager	MACTEC Engineering Lead	MACTEC OM&M Task Manager	MACTEC OM&M Technicians
Prepare Monthly System Operation Reports	I	I	A	R	I	R	I
Inquiries/Reponses with Regulatory Agencies	R,A	I	I	I	I	I	I
Operation and Maintenance Manual Revisions	I	-	I	I	A	R	I
Discharge Monitoring Reports	I	-	A	I	I	R	I
Quarterly LTMP & System Performance Reporting	I	I	A	R	I	I	I
System Performance	I	-	I	I	I	A	R
Routine Site Maintenance	-	-	I	I	I	A	R
LTMP Sampling	I	-	A	R	I	I	I
System Discharge Compliance Monitoring/Sampling	I	-	A	I	I	R	R
Sign Waste Manifests	A	-	I	I	I	R	R

R = Responsible: Owns Activity

A = Accountable: Signs off or approves

I = Informed: Needs to be informed of results

1.3 OM&M HEALTH AND SAFETY

Health and safety for OM&M personnel and visitors to the Site is of paramount importance. A site-specific Health and Safety Plan (HASP) has been developed, and is stored on-site. A visitor log is included in the HASP and should be signed when arriving on-site. The HASP also contains Safety Data Sheets (SDSs), which are specific to chemicals used as part of the treatment process, and site-specific Activity Hazard Analyses (AHAs). The HASP also provides information regarding Lockout/Tagout (LOTO) procedures, exposure monitoring, and confined space entry procedures.

AHAs associated with routine OM&M activities at the Site are stand-alone documents and are contained in **Appendix B**.

Table 1-3 lists the AHAs associated with routine operations at this Site. Note that the JHA project organization may change over time. As such, the table and **Appendix B** should be reviewed each year and updated accordingly.

Table 1-3: Routine AHAs

Routine Activity Hazard Analyses
Mobilization/Demobilization and Site Preparation
Field Work - General
Treatment System Inspection/Maintenance
Decontamination

1.3.1 Primary Contaminants of Concern

The primary contaminants of concern (COC) consist of petroleum hydrocarbons, chlorinated solvents, heavy metals, polychlorinated biphenyls (PCB), and poly aromatic hydrocarbons (PAH). The HASP lists the site specific COC and the appropriate action levels. Primary wastes that contain the COC are the recovered LNAPL, influent groundwater, sludge, and solids in the oil/water separator and other recovery and treatment equipment.

1.4 PERSONNEL TRAINING AND LICENSING REQUIREMENTS

There are no special licensing requirements for OM&M personnel to perform routine OM&M activities that are not covered by the current MACTEC HASP.

OM&M personnel are required to have passed an initial 40 hours of safety training and subsequent 8 hours of refresher safety training on an annual basis, in accordance with Code of Federal Regulations (CFR) 1910.120 Hazardous Waste Operations. **Table 1-4** provides a list of additional training requirements associated with this project.

Table 1-4: Licensing and Training Certification Summary

Licensing, Training, and Certification	Regulation	Frequency/Comments
40 Hour Hazardous Waste Operations Worker Training	OSHA 1910.120 CFR	Initial 40-hour, 8-hour annual refresher
RCRA/DOT and hazardous material waste management	-	Annual
Valid Driver's License	State Department of Motor Vehicles	Must be current and valid at all times

The Operation & Maintenance (O&M) contractor will have will have specific procedures for certain activities at the Site. This could include heavy equipment operation, confined space entry, landscaping machine operation, etc. Such activities and requirements will be addressed in the HASP and AHA, as applicable. No personnel shall engage in these or other activities without satisfying applicable training and certification requirements. Certificates of successful training for each of the individuals engaged in OM&M activities are contained onsite.

1.5 WASTE MANAGEMENT

LNAPL, groundwater, and other waste streams will be generated during the OM&M of the LNAPL recovery system.

Table 1-5 identifies potential landfill waste streams, other than recovered LNAPL that may be encountered during OM&M activity at the facility.

Table 1-5: Potential Landfill Site Waste Streams

Waste Stream	Source	Disposal Outlet
General Trash	General Site activities	Waste Management
Personal Protective Equipment	Generated from maintenance of the treatment system and sampling events	Clean Venture/Cycle Chem
Other non-hazardous debris	Generated from maintenance and repair activity; Fencing materials, pipe, electrical etc.	Waste Management
Oil/Sludge	Generated from the oil /water separator or settling of system water	TBD

Waste Stream	Source	Disposal Outlet
Granular Activated Carbon	Generated from treatment system, classified as F-002, F-003, and F-005 listed waste	TBD
Filter bags	Considered municipal waste	Waste Management
Purge Water	Generated from groundwater sampling, system maintenance, drilling, well development/rehabilitation	Clean Venture/Cycle Chem

1.6 PERMIT SUMMARY

The following permits have been obtained and are included in **Appendix D**.

1.6.1 New York City Department of Environmental Protection (NYCDEP) Bureau of Customer Service (BCS) Groundwater Discharge Permit

- Permit Number: 743197
- Issue Date: November 5, 2015

1.6.2 NYCDEP Bureau of Wastewater Treatment (BWT), Industrial Pretreatment Program (IPP) Inspection and Permit Section, Letter of Approval (LOA) Renewal for Groundwater Discharge:

- NYCDEP File Number: C-5652
- Renewal Issue Date: November 2, 2015
- Renewal Expiration: November 1, 2016
- Renewal required: Annually
- Outfall: New York City Wastewater System
- Sampling Frequency: Quarterly, submitted to NYCDEP BWT within 21 days after sampling date
- Analytical Requirements: Included in **Appendix D**.
- Discharge Limitation: 36,000 gallons per day (gpd) of treated groundwater.

1.6.3 NYCDEP Bureau of Water and Sewer Operations (BWSO) Detailed Dewatering Scheme (DDS) LOA

- NYCDEP File Number: C-5652
- Renewal Issue Date: December 15, 2015

- Renewal Expiration: December 14, 2016
- Renewal required: Annually
- Discharge Limitation: 36,000 gpd

1.6.4 NYSDEC Petroleum Bulk Storage Certificate

- PBS Number: 2-612454
- Issue Date: August 27, 2015
- Expiration Date: August 27, 2020
- Renewal required: every 5 years

1.7 OTHER

Original design concepts for the system had assumed that the Toxic Substance Control Act (TSCA) regulated materials would be collected from the VER system installation. LNAPL for the project LNAPL sampling for PCBs was conducted after installation of extraction wells in December of 2014. Of the 35 well locations that were sampled, one well had concentrations above 50 ppm; TF-6D had a concentration of PCBs at 54 PPM. It has been determined best to not connect the TF-6D recovery well to the overall system, and manually collect product in that location until such time as concentrations are below 50 ppm, at which point in time an evaluation will be done to determine if TF-6D should be added to the VER system operations. The results of this sampling are provided in a map attached as **Appendix I.**

Periodic sampling for PCBs concentrations shall be conducted throughout the LNAPL recovery system operation, at a minimum 6 recovery wells will be sampled for PCBs from selected total fluids (TF) wells annually, where PCB concentrations were generally higher at the site. However, during the initial 6 months of operation, sampling activities will focus on TF-6D to determine if PCB concentrations can be reduced thru regular LNAPL recovery. If concentrations are reduced to below 50 ppm at TF-6D, adding TF-6D to the TF recovery system will be evaluated.

2 SYSTEM DESCRIPTION/DESIGN BASIS/OPERATION

The primary purposes of using the skimmer pump and vacuum enhanced recovery (VER) is to recover LNAPL to the extent practical and support the achievement of the remediation goals of the Site. The LNAPL recovery system is comprised of two treatment plant enclosures and two 6,000 gallon LNAPL storage tanks located in the northeast portion of the site in a 90-foot by 90-foot fenced and secured treatment area (See **Figure 2-1**). The Northern enclosure (TE-2) contains LNAPL separation and water treatment equipment, the south enclosure (TE-1) contains air generation and handling equipment. When active, vapor recovery comes from the VER portion of the system, and will treat air coming from the VER system when the vacuum enhancement portion of the system is in operation. Air treatment consists of two 1,000 lb granular activated carbon (GAC) units (for volatile organic compounds [VOC] treatment) and a 1,000 lb. potassium permanganate resin unit for vinyl chloride treatment (if required) in series. The air treatment devices are installed to the south of the enclosures.

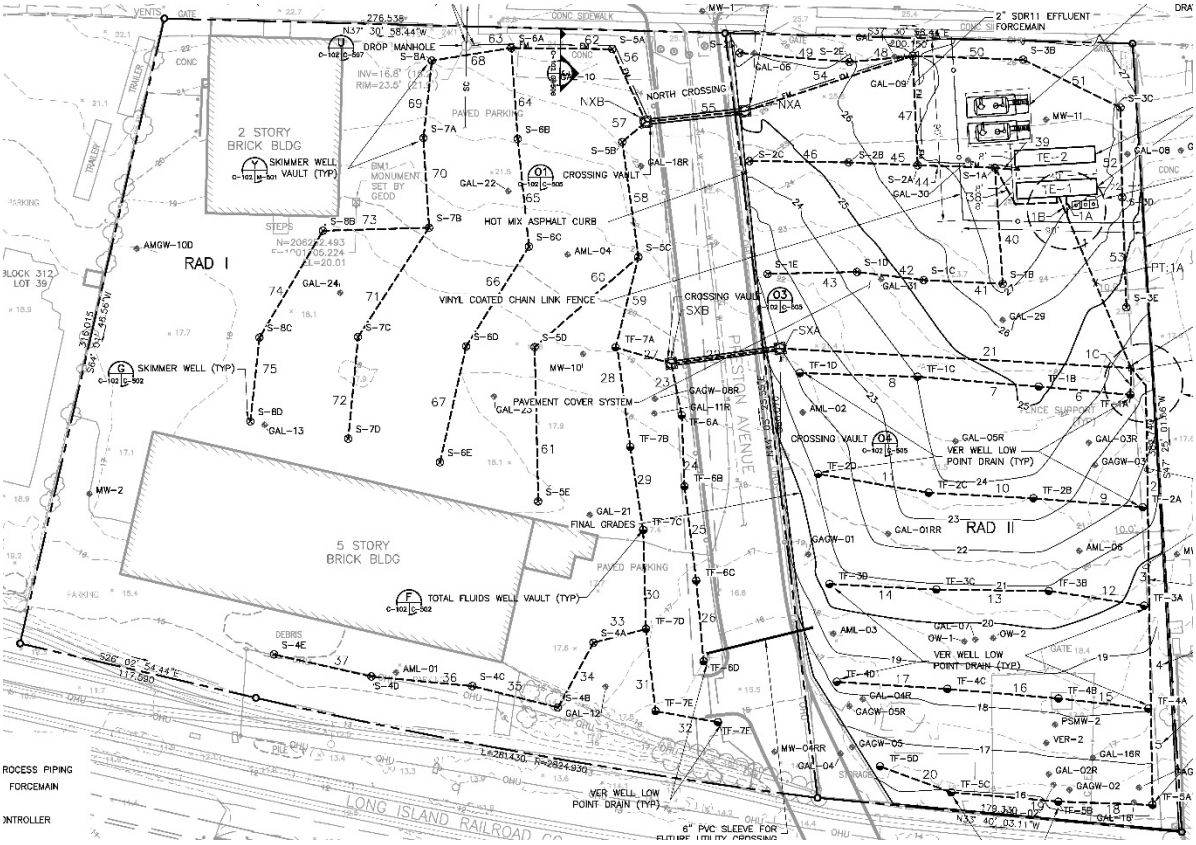


Figure 2-1: Site Diagram

The enclosures also contain LNAPL separation and water treatment equipment, consisting of a chemical feed system, Oil/water separation system, two sets of two bag filters installed in a parallel configuration, two 2,000 liquid-phase granular activated carbon (LGAC) vessels for VOC and PCB water treatment. Oil and water can be extracted and treated at a rate of 25 gallons per minute (gpm), assuming operation of 10 VER wells at any one time. Groundwater is treated thru the bag filters and carbon and discharges to combined sewer manhole located at the entrance to RAD I, eventually discharging to the NYCDEP POTW.

The system is designed to collect product from beneath the RAD I and RAD II sites. The system consists of two complimentary methods of collection: 38 pneumatically-operated skimmer wells that are equipped with skimmers that pump LNAPL to a 6,000 gallon storage tank (T-1401); and 30 Vacuum Enhanced Recovery (VER) wells that are equipped with Total Fluids pumps which are designed to pump LNAPL and groundwater to a recovery treatment system. The oil collected from the VER portion of the system is pumped to a second 6,000 LNAPL storage tank (T-801). See **Figure 2-2** for Treatment Area Blow up.

2.1 SYSTEM DESCRIPTION

The area selected for VER recovery represents that part of the Site with the highest viscosities and moderate to high volumes of LNAPL. This area may contain LNAPL with PCB concentrations above 50 milligrams per kilogram (mg/kg) which requires segregation, special handling and disposal separately from the LNAPL recovered from the remainder of the Site. Periodic sampling and analysis for PCBs in the LNAPL will be performed from select wells in the VER network as summarized in Section 1.6. The area selected for skimmer pump recovery represents those parts of the Site where the LNAPL has low to moderate viscosities and specific LNAPL volumes, and the recovered LNAPL is expected to contain PCB concentrations less than 50 mg/kg. Prior to offsite shipments LNAPL will be sampled and analyzed to determine disposal options as required by the approved disposal facility.

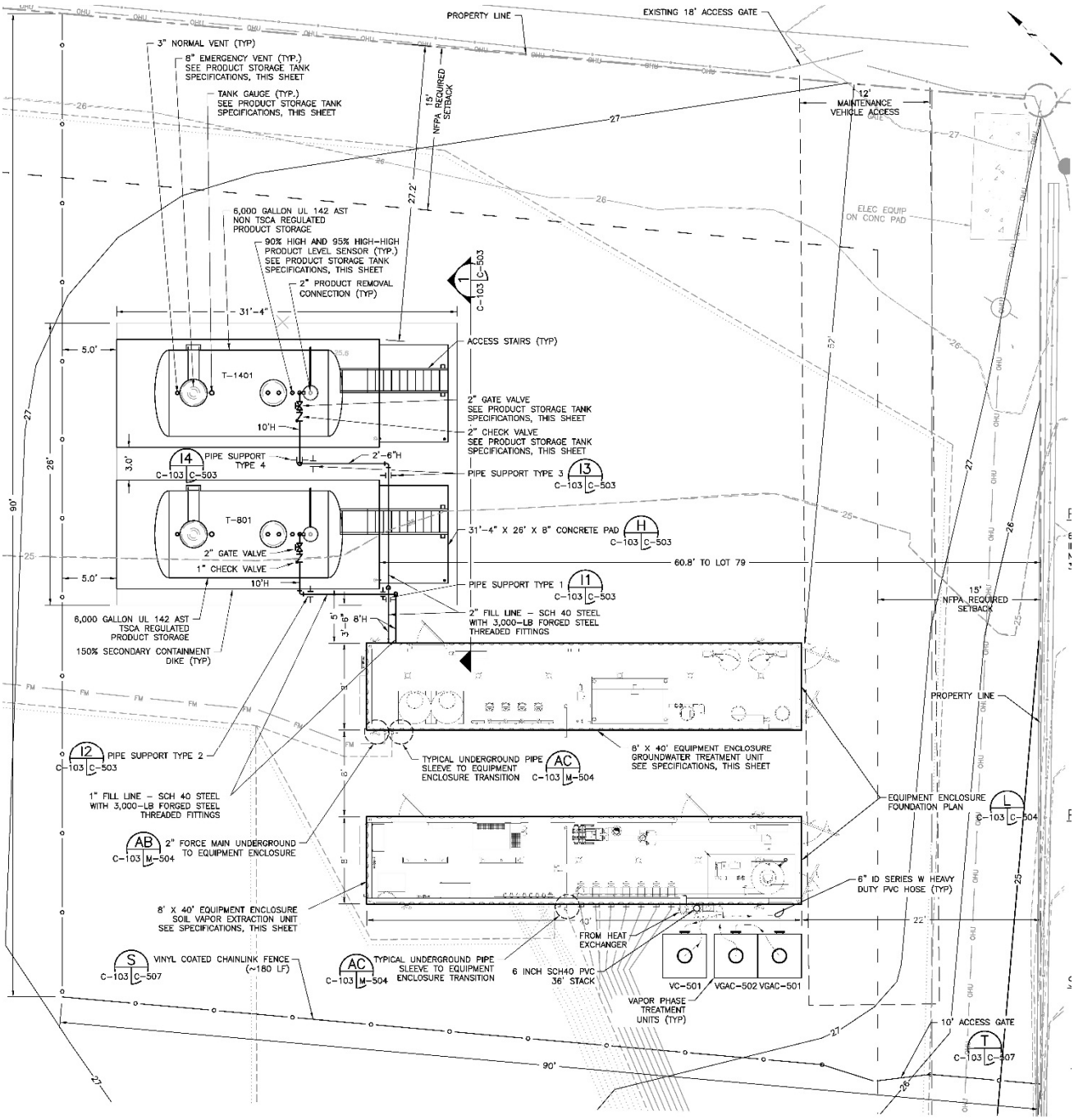


Figure 2-2: Treatment Area

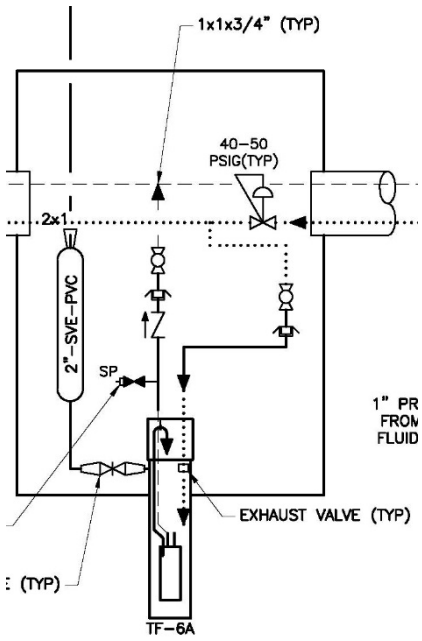


Figure 2-3: VER System

2.1.1 **Vacuum Enhanced Recovery (VER) System Description**

VER is the application of a vacuum to the subsurface by extracting air or soil vapor through the vadose zone to the extraction wells to enhance the recovery of LNAPL. A Regenerative Vacuum Blower capable of extracting 750 standard cubic feet per minute (SCFM) at 5" Hg inlet vacuum and associated control systems is utilized to apply the subsurface vacuum enhancement. The VER creates a reduced pressure around the recovery well and induces a pressure gradient from the relatively higher pressure in the surrounding subsurface to the lower pressure in the well as required to increase the rate and extent of product recovery. The pavement cap that has been installed (see **Appendix A** – Sheet C-102) has been determined (through pilot studies) to enhance the radius of influence (ROI) via vacuum of each of the recovery wells. Submersible Top Loading Total Fluids Pumps (TF Pumps) recover both LNAPL product and water and counteract the subsurface upwelling (and consequent LNAPL smearing) of LNAPL/Groundwater due to the applied vacuum. The applied vacuum also draws in soil vapor, which promotes soil air movement and some aerobic biodegradation in the vadose zone. The TF Pump settings can also be adjusted during operation to reduce/increase the degree of groundwater extraction and increase the % oil/water ratio in the recovered total fluids process stream. Soil vapor extraction rates can also be controlled by adjusting the vacuum and air flow rates to the VER subsystem zones.

The use of VER for LNAPL recovery creates a wider radius of influence and allows a larger extraction well spacing (relative to single phase LNAPL recovery wells) in the areas where higher viscosity LNAPL occurs. The spacing of the VER wells is approximately 50 feet, which allows overlapping of the anticipated ROI.

10 VER wells are installed on RAD I and 20 VER wells are installed on RAD II. The well heads are protected with steel recovery well vaults that are encased in a concrete pad and mounted flush with the ground surface. The wells are constructed to a depth of approximately 25 to 36 feet below ground surface (feet bgs) with Schedule 40 polyvinyl chloride (PVC) threaded 0.020-inch slot Vee-Wire screen and solid riser pipe. A well schedule and boring logs for each of the installed wells is provided in **Appendix H.** The screens extend from approximately

8 to 10 feet below the LNAPL/groundwater interface to approximately 5 to 8 feet into the vadose zone. The annuli of the VER well screens are filter packed with #00N silica sand to a depth of approximately 2 feet above the tops of the screens. 1-foot thick bentonite seals are emplaced above the filter packs and the remainder of the annuli are grouted with a bentonite and cement grout to just below the tops of casing.

Each VER extraction location (identified as TF-##) includes:

- Protective flush mount well vault and 4" PVC well
- Total Fluid Pump
- Air Supply (common header)
- Vacuum Conveyance piping (common header per X wells)
- Total Fluids conveyance piping (common header)
- Various controls

The VER subsystem extracts soil vapor while the Total Fluids subsystem extracts a mixture of groundwater and LNAPL from a total of 30 wells from the RAD I and RAD II properties using one medium vacuum regenerative blower and 30 pneumatically operated top loading total fluids pumps. The total fluids mixture is conveyed in the same piping to the LNAPL Groundwater Treatment System (located in Equipment Enclosure TE-2) while the extracted soil vapor is conveyed in the same piping to the SVE system (located in Equipment Enclosure TE-1). TE-1 and TE-2 both re-side in an equipment compound located in the northeastern portion of RAD II fronting Review Avenue. In TE-1 the soil vapor is separated from any moisture via knock-out tank discharged through a heat exchange to the vapor phase treatment system and 36 ft high exhaust stack. In TE-2 the LNAPL is separated from the groundwater prior to particulate filtration and removal of dissolved phase petroleum prior to discharge to the combined sewer. The vapor stream then goes thru a passive heat exchanger, out to the vapor-phase granular activated carbon (VGAC) and potassium permanganate impregnated zeolite vessels for treatment located south of the enclosures. Vapor discharges thru a discharge stack located at the southern treatment system enclosure (TE-1). The layout and depths of the extraction well process piping and sewer discharge force main is presented in the record drawings in **Appendix A**.

The groundwater and LNAPL extracted by the TF system is initially treated in an equalization/pre-separation tank to allow agglomeration and gravity separation of the LNAPL (complete with a rotary skimmer) followed by treatment with an oversized 40 gpm coalescing pack oil/water separator (complete with both a rotary skimmer and belt skimmer) to remove LNAPL from the extracted groundwater.

The agglomeration and pre-gravity separation of the LNAPL will improve the removal efficiency of the oil and water separator. A biocide will be fed into the equalization/pre-separation at a rate of 0.5 gpd (maximum) to kill identified iron bacteria and improve agglomeration/separation. An emulsification breaker will be fed into the process line at a rate of 3 gpd, just upstream of the coalescing pack oil/water separator, to break and separate any residual oil/water emulsification caused by the iron bacteria and the total fluids extraction process.

The LNAPL removed from the oil and water separator is collected and stored in one 6,000-gallon steel aboveground storage tank (T-801) located outside of the Groundwater Treatment System (GWTS). This tank, and the 6,000 gallon Skimmer Pump system Tank (T-1401) will be used to store LNAPL and are constructed, installed, and tested in conformance with the New York City Fire and building codes as well as National Fire Protection Association (NFPA) 30. These storage tanks are each equipped with a level gauge, high and high-high level alarms, normal and emergency vents, as well as connections for transferring the contents of the tank to a Department of Transportation- (DOT-) approved tanker truck to an approved disposal facility for disposal. The level sensors are integrated into the VER and skimmer pump control system to notify MACTEC of a high or high-high level condition. The high-high level condition will shut down the VER recovery system (and Skimmer Pump system) to prevent an overfill condition.

The groundwater from the oil/water separator is then filtered with bag filters and treated using LGAC adsorption to remove the volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), and any PCBs from the groundwater. The treated groundwater is discharged to the New York City Wastewater System via a 6-inch connection to the 12-inch combined sewer located at Review Avenue between 37th Street and Railroad Avenue. The soil vapor is treated with VGAC vessels. The process drawing of the VER system is presented in the record drawings (**Appendix A**) and the National Environmental Systems (NES) Operation & Maintenance Manual (**Appendix E**).

Operation of the VER system is expected to be dynamic throughout the operational period of the system with the ultimate goal of maximizing LNAPL removal while minimizing the management of groundwater removal. Operations during the first several months are expected to be the most dynamic with a high volume of LNAPL being removed. Once operations have stabilized the VER system zones will be pulsed to optimize recovery of LNAPL while minimizing the extraction of groundwater. The pulsing will be automatically controlled, with approximately one third of the 30 VER wells (10 wells) in operation every 4 to 6 hours or other schedule as required to optimize the product recovery production. Pulsing

frequency, in addition to readjustment of vacuum applications, within the flexibility of the VER subsystem, are to be made during the operation of the system.

2.1.2 **Skimmer Pump System Description**

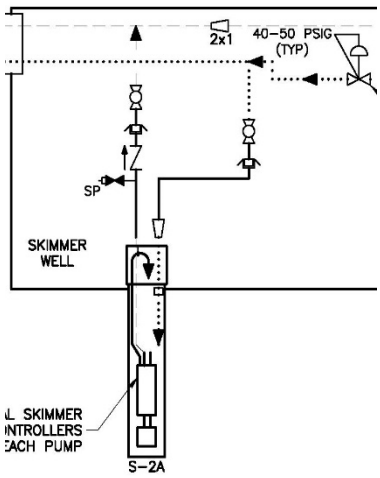


Figure 2-4: Skinner Pump System

Pneumatically driven specific gravity single phase LNAPL skimmer pumps are a well-accepted and conventional technology for recovering intermediate and lower viscosity LNAPL through extraction wells. LNAPL flow into the skimmer pumps is induced by the local gradient between the lowered LNAPL levels in the extraction wells and the higher LNAPL levels in the subsurface adjacent to the wells' screens. The spacing of the skimmer pump extraction wells is approximately 50 feet, as approved by the RAWP and can be configured to do perimeter skimming as required in the Record of Decision (ROD).

The skimmer pump system will recover LNAPL from a total of 38 wells combined from RAD I and RAD II. 23 skimmer pump wells are installed on RAD I and 15 skimmer pump wells are installed on RAD II. The wells are constructed to a depth of approximately 25 to 34 feet bgs with Schedule 40 PVC threaded 0.020-inch slot screen and solid riser pipe. The screens extend from below the LNAPL/groundwater interface to above the LNAPL capillary fringe, about 10 to 15 feet. The annuli of the skimmer pump wells' screens are filter packed with #00N silica sand to a depth of approximately 2 feet above the tops of the screens. 1-foot thick bentonite seals are emplaced above the filter pack and the remainder of the annuli are grouted with a bentonite and cement grout to just below the tops of casing (See **Appendix A** – Sheet C-502, and Well Construction Logs in **Appendix H**).

A single compressed air line supplies air to the skimmer pumps from a compressor located in TE-1. The LNAPL is conveyed from the skimmer pumps in the same product return piping to a second 6,000-gallon LNAPL aboveground steel storage tank for recovered LNAPL (T-1401). This tank is also be located outside of the LNAPL recovery and groundwater treatment enclosure. Like the other LNAPL storage tank, the tank is constructed, installed, and tested in conformance with the New York City fire and building codes as well as NFPA 30 as described above in the VER System Description. The skimmer system controls is equipped with a timer which allows the operator to vary the daily runtime of the skimmer system as

may be required in to allow the recovery wells to re-charge with LNAPL and therefore optimize compressed air consumption and energy efficiency.

2.2 EQUIPMENT DESCRIPTION AND FUNCTION

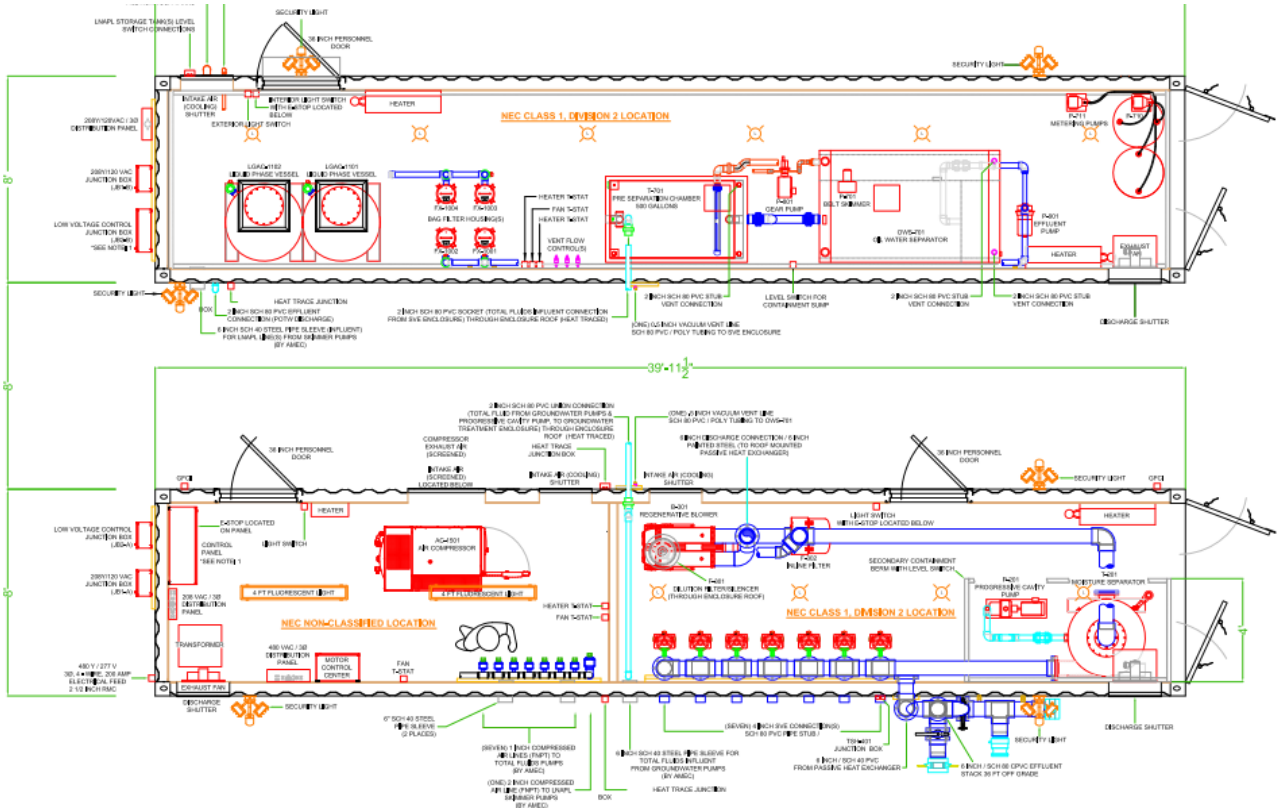


Figure 2-5: Treatment System Enclosures

2.2.1 Enclosure Construction

The LNAPL Recovery and Groundwater Treatment Enclosures (LRGTE) are manufactured by NES and are pre-engineered light gauge steel structures constructed on permanent concrete foundations. Each enclosure is 8 feet wide by 39 feet 11-1/4 inches long and 9 feet 6 inches tall at the enclosure eaves. The interior of the enclosures are insulated and heated. The enclosures include three 36-inch wide entrance doors on the eastern, western, and northern enclosure walls, and two 8-foot wide cargo doors. The interior of the enclosures have a hazardous classified area and a non-classified area to segregate process equipment that generates or stores LNAPL or flammable gases, such as the LNAPL/groundwater separator, LNAPL storage tank, soil vapor/liquid separator, etc., from equipment that does not process LNAPL or flammable gases, such as air compressors or parts. The enclosures are constructed in conformance to

national, state, and local requirements. Additional information on the LNAPL recovery and groundwater treatment enclosures is in Section 2 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.2 Heating and Ventilation

The LRGTE is heated by three (3) 3,600 watt, 208 VAC, single-phase electric heaters with fans and integral thermostats set at 65ºF, and one (1) 1,800 watt, 120 VAC, single-phase electric heater. Ventilation is provided by three (3) 115 VAC, enclosure wall exhaust fans with individual external adjustable thermostats. Manufacturer's information for the wall exhaust fan and thermostat are included in Sections 23 and 24 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.3 Heat Trace

As the above-grade portion of any piping located outside of the LNAPL recovery and groundwater treatment enclosures is subject to freezing conditions during winter operations, the piping has been fitted with self-regulating heat tracing and insulation.

2.2.4 Secondary Containment

The GWTS are equipped with secondary containment areas, complete with automatic leak detection float switches. More information can be found in the NES Operation & Maintenance Manual (**Appendix E**).

2.2.5 Safety Eye Wash

Wall-mounted eyewash units are installed inside the LRGTE for personnel safety. Manufacturer's information for the drench shower/eye wash unit can be found in **Appendix F**.

2.2.6 Access Vaults

30 Total Fluids/VER Well access vaults and 38 Skimmer Well access vaults have been installed on RAD I and RAD II. The recovery well vaults are 24"x24"x24" or 30"x30"24" concrete vaults, fitted with rigid insulation and H20 load-rated access hatches. Each recovery well access vault contains a recovery well, a skimmer or total fluids pump, and a product or total fluids extraction manifold with transfer piping running underground to the LRGTE. Each vault also contains an air supply line running from the air compressor in the LRGTE, with a pressure regulator located in the first vault of each Total Fluids zone and Skimmer zone ("A" wells).

More information, including detailed drawings and well locations, is included in the Record Drawings (**Appendix A**).

2.2.7 Vapor–Liquid Separator Transfer Pump

Liquids that have accumulated in the vapor–liquid separator tank will be transferred to the equalization/pre-separation chamber of the oil/water separator by a progressive cavity pump. The pump is a Moyno 34401 and manufacturer's information is included in Section 5 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.8 Vapor–Liquid Separator Transfer Blower

Vapors that have accumulated in the vapor–liquid separator tank will be transferred to the passive heat exchanger and vapor phase GAC units by a regenerative vacuum blower. The blower is a FPZ K10-TS and manufacturer's information is included in Section 6 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.9 Oil/Water Separator LNAPL Transfer Pump

Recovered LNAPL that has accumulated in the oil/water separator will be transferred to the LNAPL storage tank by a gear pump. The pump is a ¼-inch Dayton 4KHH8 rotary gear pump and manufacturer's information is included in Section 11 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.10 Oil/Water Separator Water Transfer Pump

Water that has accumulated in the oil/water separator will be transferred to the bag filters and liquid phase GAC units by a centrifugal pump. The pump is Goulds G&L Series NPE pump and manufacturer's information is included in Section 12 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.11 Biocide and Emulsification Breaker Feed Systems

The biocide feed system includes a 55-gallon drum of Verox-8 stabilized chlorine dioxide located in the LRGTE. The biocide is injected upstream of the pre-separation chamber by an electronic metering pump, LMI Model E71-1-363SI. Verox-8 is corrosive and should be handled with caution using the proper safety equipment. PPE should always be available on site and a Safety Data Sheet included in the Site HASP located onsite. More information about the biocide feed system is included in Section 10 of the NES Operation & Maintenance Manual (**Appendix E**).

The emulsification feed system includes a 55-gallon drum of Redux-910 located in the LRGTE. The emulsification breaker is injected upstream of the oil/water separator by an electronic metering pump, LMI Model E71-1-363SI. More information about the emulsification feed system is included in Section 10 of the NES Operation & Maintenance Manual (**Appendix E**).

2.2.12 **Suspended Solids Bag Filters**

The treatment system includes four bag filters. The bag filters are positioned after the oil/water separator and before the liquid phase GAC units. The system piping for the bag filters includes a valve arrangement allowing the filters to operate as four filters in series (lead-lag) or two sets of two filters in parallel. The operator must be fully aware of the piping system before altering any valves. The following are the general specifications for the bag filter units:

The choice of filter bag opening sizes and materials of construction must be re-evaluated as the system operates. The setting for the bag filters at the beginning of system operation was: parallel operation with primary (lead) 50-micron polypropylene filters, and secondary (lag) 25-micron polypropylene filters.

The bag filters influent and effluent piping includes visual indicator pressure gauges. The operator should use both visual indications (sample clarity) and back pressure readings to identify when to replace the filter bags. In general, a back pressure across the filter housing greater than 30 psi indicates a “plugged” bag unit. Most filter manufacturers however specify pressure drops as high as 60 psi across the bags are acceptable before change-out. Please refer to Section 13 of the NES O&M Manual (**Appendix E**) for more information on bag filter operation and maintenance.

Table 2-1: Filter Bags (FX-1001 thru FX-1004) General Specifications

Flow Capacity:	220 gpm maximum
Vessel Size:	#2 (6.7” diameter 30” high)
Vessel Construction:	Aluminum
ASME Pressure Rating:	150 psig
Normal System Operating Pressures	25-60 psig

2.2.13 **Granular Activated Carbon System**

Two liquid phase GAC units (LGAC-1101 and LGAC-1102) are installed in series following the bag filters to provide polishing. Included with the GAC piping are pressure gauges and sample ports on the influent and effluent sides of each vessel. The GAC vessels are ASME rated, carbon steel pressure vessels rated to

40 pounds per square inch gauge psig. The 36-inch diameter vessels include top and bottom ports. Each port is a flanged 2-inch opening with SCH 40 PVC internal piping. The GAC vessels are currently piped for down flow operation. Review Section 14 of the NES O&M Manual (**Appendix E**) for more detailed information on operation and maintenance of the Liquid Phase GAC Units (LGAC).

The following are general specifications for the GAC vessels:

Table 2-2: LGAC Units (LGAC-1101 and LGAC-1102) General Specifications

Flow Capacity:	60 gpm maximum
Vessel Size:	36-inch diameter x 74-inch height
Vessel Construction:	Carbon Steel (SA-36)
Internal Coating	Polyamide Epoxy Resin
External Coating	Epoxy Mastic
ASME Pressure Rating:	40 psig
Carbon Capacity:	1,000 lbs dry
Wet Vessel Weight:	3,100 lbs
Recommended Carbon Type:	8 x 30 mesh

Two vapor phase GAC units (VGAC-501 and VGAC-502) are installed in series following the passive heat exchanger. Included with the GAC piping are pressure gauges and sample ports on the influent and effluent sides of each vessel. The GAC vessels are ASME rated, polypropylene pressure vessels rated to 3 pounds per square inch gauge psig. The 4-ft x 4-ft vessels include top and bottom ports. Each port is a flanged 6-inch opening with polypropylene internal piping. The GAC vessels are currently piped for down flow operation. Review Section 8 of the NES O&M Manual (Appendix E) for more detailed information on operation and maintenance of the VGAC units.

The following are general specifications for the GAC vessels:

Table 2-3: Vapor Phase GAC Units (VGAC-501 and VGAC-502) General Specifications

Flow Capacity:	1600 CFM Maximum
Vessel Size:	48-inch x 48-inch x 80-inch height
Vessel Construction:	Polypropylene
Internal Coating	Polyamide Epoxy Resin
External Coating	Epoxy Mastic
ASME Pressure Rating:	3 psig
Carbon Capacity:	2,000 lbs dry
Wet Vessel Weight:	3,200 lbs
Recommended Carbon Type:	4x10 virgin media

2.3 POWER DISTRIBUTION, INSTRUMENTATION, AND CONTROLS

2.3.1 Power Distribution

The Product Recovery/Groundwater Treatment Systems are powered by a 480Y/277 VAC, 3-Phase, 4-Wire, 60Hz, 175A, service connection from existing site service entrance equipment drawing power through a CON Edison Electrical Service Meter. Equipment Enclosure TE-1 includes a 480Y/277V, 3 phase, 4-wire, 200AMP main breaker panel which serves 480V/3ph power directly to the 20HP Air Compressor, 30HP soil vapor extraction (SVE) blower, and a 45KVA 480V-208Y/120V Transformer, also located in TE-1. The 45KVA Transformer feeds power to a 208Y/120V, 3 phase, 4 wire, 125 Amp Main Breaker Panel with 30 slots for breakers. The 125 Amp Main Breaker Panel distributes power to the 0.5HP LNAPL Transfer Pump, 2 HP Oil/Water Separator Effluent Pump, 0.33 HP Belt Skimmer, and two (2) 1 AMP Chemical Feed/Metering Pumps. In addition, this panel also feeds a 60 Amp, 208Y/120V, 3-Phase, 4-Wire, 20 slot distribution panel which distributes power to Interior Lights, Exterior Lights, Heat Tracing, Exhaust Fans and Unit Heaters. A power meter is also provided to track and log electrical consumption and demand load vs. time.

2.3.2 Lighting

Both interior and exterior lighting have been installed at the enclosure. The exterior lighting includes 500 Watt exterior floodlights. The interior lighting includes 48-inch, dual bulb fluorescent light fixtures in the National Electrical Code (NEC) non-classified SVE control room and 150 Watt lights rated for use in hazardous locations in the NEC Class 1, Division 2 regulated groundwater recovery enclosure and SVE process room.

2.3.3 Instrumentation and Controls

More detailed information regarding Controls and Instrumentation can be found in Section 3 of the NES O&M Manual (**Appendix E**).

2.3.3.1 Main Control Panel

The main control panel which hosts the Programmable Logic Controller (PLC) and Human Machine Interface (HMI) screen is located in the control room LRGTE. More information and manufacturer's information are included in the NES Operation & Maintenance Manual (**Appendix E**).

2.3.3.2 Programmable Logic Controller

The product recovery/groundwater treatment system is controlled via a programmable logic controller (PLC) which interconnects the system pumps, solenoid valves, motor operated valves, tank level switches and alarms, the SVE blower, heat exchanger, feed systems and more. The detailed interlock schedule included in the NES Operation & Maintenance Manual (**Appendix E**) shows how the system components are connected and controlled by one another.

2.3.3.3 Human Machine Interface

The HMI consists of an 8-inch color TFT LCD Screen and is located on the front of the main control panel in the control room LRGTE. The HMI is C-more Model EA9-T8CL. The HMI allows the operator of the recovery system to control the various components of the system and monitor the system data. All system controls, including but not limited to turning pumps and valves on or off and changing timer settings, are performed using the HMI. Remote readings of flow rates and flow totalizers, trend graphs, and alarms can be viewed on the HMI. Manufacturer's information and screenshots of the HMI are included in the NES Operation & Maintenance Manual (**Appendix E**).

2.3.3.4 Hand-Off-Auto Selector Switches

Hand-Off-Auto selector switches are located on the HMI to control the SVE blower, moisture separator transfer pump, product removal pump, effluent transfer pump, belt skimmer, and the chemical feed pumps. Hand will allow the selected component to run for the amount of time set on the HMI; off will turn off the selected component; and Auto will allow the selected component to turn on and off automatically based on its connections in the interlock schedule included in **Appendix E**.

2.3.4 **Remote Monitoring**

More detailed information regarding Controls and Instrumentation can be found in Section 3 of the NES O&M Manual (**Appendix E**).

2.3.4.1 Cellular 3G Gateway / HMI

The C-more HMI is equipped with a Sierra Wireless Airlink LS300 cellular 3G gateway which allows the Operator to remotely access the system. The HMI is setup with two accounts for remote access: a limited access account that

allows the operator only to view and cycle through the HMI screens and menus, and a full access account that allows the operator full control of the HMI. The HMI can be accessed remotely using either a web-connected computer or the C-more mobile phone application for iPhone or Android. In addition to remote HMI monitoring and control, data logs can be downloaded from the HMI via FTP. The following daily data logs can be downloaded:

- Alarm History
- Power Consumption Trends
- FIT-201 Moisture Separator Effluent Air Flow Trends
- FIT-701 Total Fluids/VER Influent Flow Trends
- FIT-801 OWS Product Transfer Pump Total Flow Trends
- FIT-1201 Effluent Total Flow Trends
- FIT-1401 Skimmer Well Total Flow Trends

Remote access and data downloading instructions are included in the NES Operation & Maintenance Manual (**Appendix E**).

2.3.4.2 Power Monitoring

Power consumption (kWh) can be monitored remotely from the Main Menu screen or the Power Meter Trend screen on the HMI. Power Consumption data trend logs can also be downloaded daily from the FTP as described in **Section 2.3.4.1**.

2.4 OPERATION SEQUENCE

The LNAPL recovery and treatment system has a variety of electrical and mechanical equipment representing a number of potential hazards and challenges with operation. A process and instrumentation diagram is included with this manual which shows the process of treatment. The general flow of water through the system is detailed below:

- LNAPL and groundwater are pumped from the VER wells into the vapor – liquid separator. Operation (on/off) of the VER wells is controlled based on the levels in the separator.
- Groundwater from the vapor – liquid separator is pumped to the equalization chamber of the oil/water separator, where the LNAPL is separated from the groundwater. The LNAPL is pumped to the LNAPL storage tank and the groundwater is pumped through the bag filters and then through the LGAC

units. The effluent of the LGAC units is then discharged to the sanitary sewer.

- Vapor from the VER system – liquid is removed from the VER system through a liquid/vapor separator by a vacuum blower. Liquids are collected and processed through the LNAPL system via transfer pump P-201. The vapor is passed through a passive heat exchanger then through VGAC units and vented to the atmosphere.

2.5 STANDARD OPERATING PROCEDURES

The standard operating procedures (SOPs) associated with routine OM&M activities at this project are described in **Section 3**. Additional SOPs are provided in **Appendix C** for the following items:

- Bag Filter Media Installation and Removal
- Oil/Water Separator Cleaning
- Transfer of New Carbon to LGAC Units
- Transfer of New Carbon to VGAC Units
- Pumping Out LNAPL Tanks
- Refilling of Biocide and Emulsification Breaker Storage Drums

3 SYSTEM START-UP, OPERATION, AND SHUTDOWN PROCEDURES

These procedures are intended as guidance only. For detailed operations and maintenance information, manufacturers' literature and equipment manuals should be consulted. OM&M personnel need to be familiar with the requirements set forth in equipment manuals for all system units. Lockout/tagout procedures for conducting maintenance on individual system components are not included in this section but should be followed as required by the operator's standard operating procedures.

3.1 FACILITY AND SYSTEM HAZARDS

3.1.1 **Facility**

Typical routine activities and the associated hazards while at the Site may include, but are not limited to, the following:

- Slipping, tripping, and falling
- Operating motorized equipment – including vehicles
- Exposure to ticks, bees, and other biological pests
- Exposure to laceration, pinch points, flying debris, and dust
- Exposure to non-permitted confined space entry vaults
- Exposure to extreme heat and cold

3.1.2 **System**

Typical routine activities and the associated hazards while conducting OM&M at the facility may include, but are not limited to, the following:

- Slipping, tripping, and falling
- Exposure to biocide
- Exposure to laceration, pinch points, flying debris, pressurized lines, and dust
- Exposure to chlorinated compounds
- Utilizing ladders
- Shock and electrocution
- Back strain

- Pressurized lines

3.2 SYSTEM START-UP PROCEDURES

3.2.1 Skimmer Pump Start-up

Initial procedures necessary for start-up of the skimmer pump system are outlined below:

- At the Treatment System Equipment Trailers, perform the following steps:
  - At Equipment Enclosure TE-2, check the process piping flow path through the Skimmer System Discharge Line from where the line enters Equipment Enclosure TE-2 (Southwest Corner), to where it enters Product Storage Tank T-1401 (North Tank closest to Review Ave.). Make sure all isolation valves are open and sample taps are closed. Make sure the product Flow Meter FIT-1401 is installed (or removed w/ spool piece installed). Clean the Y-Strainer immediately upstream of FIT-1401.
  - At Tank T-1401, ensure T-1401 has adequate available volume by reading the level gauge and verifying agreement by manually gauging the tank.
  - At the HMI Screen located at the Main Control Panel in Equipment Enclosure TE-1, from Main Menu Screen, go to Solenoid Control Screen, Set Main Air Supply Solenoid Valve to AUTO. Set Skimmer Solenoid Valve to Auto. Set Skimmer System Timer to desired daily Start/Stop Time.
  - At the Compressed Air Manifold, open the mechanical ball valves in line with the main air supply solenoid valve and at the Skimmer System Solenoid Valve. Adjust Main Air supply regulator to 110 pounds per square inch gauge (PSIG), and Skimmer System Air Supply Regulator to 90 PSIG.
- At the Skimmer Recovery Wells, perform the following steps:
  - Activate 1 or more of the eight (8) Skimmer zones by accessing the respective “A” vaults for each of the desired zones to be operated. At the A vault, turn the compressed air supply valve ON and the zone discharge valve ON. Check the pressure setting of low pressure side of the Compressed Air Regulator with the portable gauge assembly. Adjust the regulator such that the low pressure output is set at 40 to

50 PSIG as an initial setting for the zone. Bleed any air from the product discharge manifolds in the A vaults via the bleed valves.

- At all skimmer recovery wells to be operated in each zone, ensure that the regulated compressed air valves and pump discharge valves are ON. Also check if the pressure and sample taps are CLOSED. Listen for pump cycling, and open pump discharge sample tap to determine if pump cycling and discharging liquid. Determine if pump discharging oil, water, combination or nothing. Readjust pump setting as required to ensure pump skimmer set at correct elevation range in well. Check and record pump discharge pressure with portable gauge assembly. Replace the rigid insulation within the top of the recovery well vault.

- Back at the equipment enclosures:
  - At Enclosure TE-2, check for leaks at piping, hose, joints and connections. Correct as necessary. Check clear section of hose to detect product flow. Open sample tap and pull jar sample and check for water/oil ratio.
  - At Enclosure TE-1, check the compressed air pressure setting are maintained, that solenoid valves have remained open, are functioning properly and that air is flowing. At HMI, check for any alarms, check that.
  - Re-gauge Tank T-1401 and determine if product level has increased and flow into the tanks from the skimmer wells has been confirmed. If necessary, listen for sounds of product flow from the tank withdrawal fitting.

3.2.2 **Total Fluids (TF) System & Groundwater Treatment System Start-up**

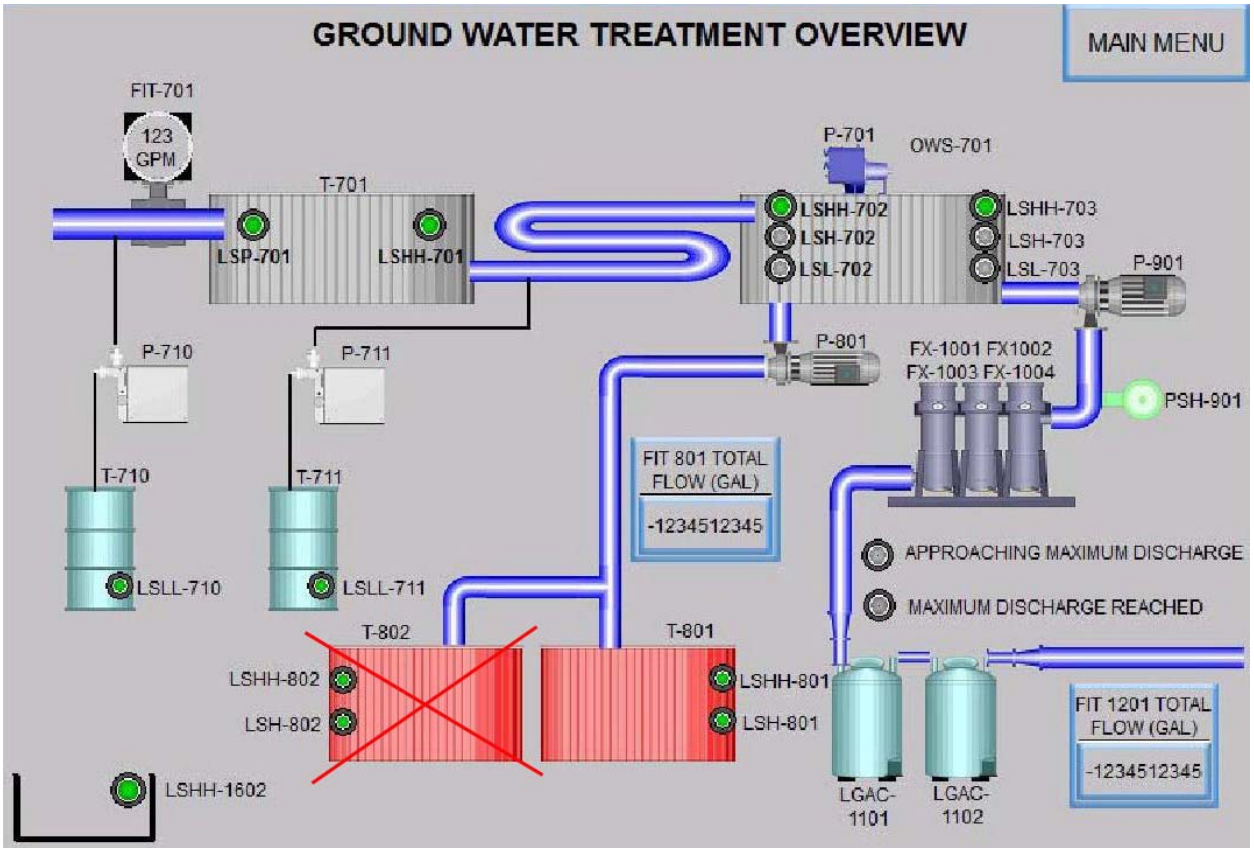


Figure 3-1: Ground Water Treatment Overview

Initial procedures necessary for start-up of the TF recovery system are outlined below:

- At the Treatment System Equipment Trailers, perform the following steps:
  - At Equipment Enclosure TE-1 and TE-2, check the Total Fluids process piping flow path from where the line enters Equipment Enclosure TE-1, across the pipe bridge to where it enters TE-2 (See layout **Figures 2-1 and 2-5**), to where it enters the Pre-Separation Tank T-701. Make sure all isolation valves are OPEN and sample taps are CLOSED as necessary to direct flow to inlet connection of T-701. (Valves for Oil/Water Separator [OWS] System bypass line should be CLOSED).
    - Check the process piping flow path from the Effluent Transfer Pump P-1201 to where it exits TE-2 at the Southwest corner of the enclosure. Make sure all isolation valves are OPEN and sample taps are CLOSED as necessary to direct flow to

the discharge hose exiting the enclosure. Clean the Y-Strainer immediately upstream of Effluent Flow Indicating Totalizer FIT-1201.

- At Tank T-801, ensure T-801 has adequate available volume by reading the level gauge and verifying agreement by manually gauging the tank.
- At the HMI Screen located at the Main Control Panel in Equipment Enclosure TE-1, from Main Menu Screen, go to Solenoid Control Screen, Set Main Air Supply Solenoid Valve to AUTO. Set desired TF-Zone Valves (select 1 or more of 7 TF zones) to AUTO. Set TF Zone Timers to desired daily Start/Stop Times. At the Motor Control Screen, Set the Hand-Off-Autos (HOAs) to AUTO for:
  - P-801 – Product Transfer Pump
  - P-901 – Effluent Transfer Pump
  - Chemical Feed Pumps (2)
  - Belt Skimmer
- At the Compressed Air Manifold, open the mechanical ball valves in line with the main air supply solenoid valve and at the desired TF Solenoid Valve zones to be operated. Adjust Main Air supply regulator to 110 PSIG, and Skimmer System Air Supply Regulator to 90 PSIG.

- At the TF Recovery Wells, perform the following steps:
  - Activate 1 or more of the seven (7) TF zones by accessing the respective a vaults for each of the desired zones to be operated. At the A vault, turn the compressed air supply valve ON and the zone discharge valve ON. Check the pressure setting of low pressure side of the Compressed Air Regulator with the portable gauge assembly. Adjust the regulator such that the low pressure output is set at 50 to 55 PSIG as an initial setting for the zone. Bleed any air from the product discharge manifolds in the A vaults via the bleed valves.
  - At all TF recovery wells to be operated in each zone, ensure that the regulated compressed air valves and pump discharge valves are ON. Also check if the pressure and sample taps are CLOSED. Listen for pump cycling, and open pump discharge sample tap to determine if pump cycling and discharging liquid. Determine if pump discharging oil, water, combination or nothing. Readjust pump

setting as required to ensure pump skimmer set at correct elevation range in well. Check and record pump discharge pressure with portable gauge assembly. Replace the rigid insulation within the top of the recovery well vault.

- At the equipment enclosures:
  - At Enclosures TE-1 and TE-2, check for leaks at piping, hose, joints, Air/Pressure Vents, Vacuum Breaker and connections. Correct as necessary. Check clear section of hose to detect product flow. Open sample tap at OWS System influent and pull a Total Fluids jar sample and check for oil/water ratio, record product thickness and total liquid thickness, calculate oil/water ratio %. Check that P-701 and 801 are operating properly by observing at least 2 pump out cycles. Check that belt skimmer operating and chemical feed pumps are stroking and modulating at frequency proportional to influent flow rate. Check that influent flow meter FIT-701 is indicating flow, and that flow rate is steady. Once flow rate is steady, adjust rotary skimmer in pre-separation tank T-701 to draw off product into day tank, observe that water not being drawn off and readjust as necessary. Check that chemical feed pumps are cycling and suction lines are primed and moving liquid to injection ports.
  - Check bag filter differential pressure (DP) and record. Change bags as necessary to maintain DP < 3 PSI. Record DP after new bags installed.
  - Check and record DP across primary and secondary LGAC Units.
  - Pull jar samples at taps before and after bag filters, at LGAC mid-fluent and effluent taps and visually observe for product sheen, turbidity, evidence of precipitated iron, etc. and record results.
  - Measure product thickness in T-701 to ensure oil/water interface is 3"+ above conductivity sensor (which is set approx. 21" above bottom of tank). Recheck product thickness in 30+ minutes to ensure product thickness is not increasing, but slightly decreasing. Check to ensure quality of water in OWS T-702 Effluent Tank is free of oil sheen and bacteria growth – correct as necessary.
  - At Enclosure TE-1, check the compressed air pressure setting are maintained, that solenoid valves have remained open, are functioning properly and that air is flowing. At HMI, check for any alarms.

- Re-gauge Tank T-801 and determine if product level has increased and flow into the tanks from the skimmer wells has been confirmed. If necessary, listen for sounds of product flow from the tank withdrawal fitting.

3.2.3 **Vacuum Enhanced Recovery (VER) System Start-up**

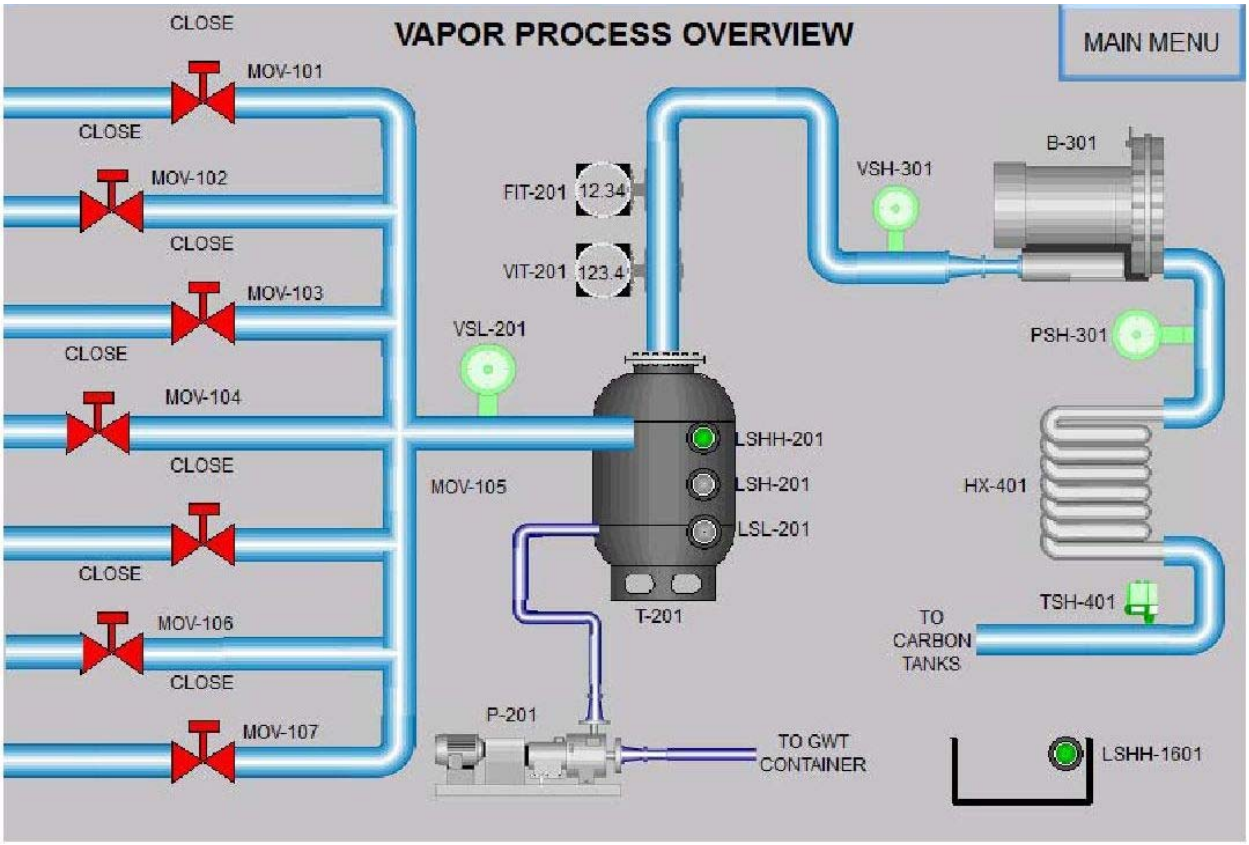


Figure 3-2: Vapor Process Overview

Initial procedures necessary for start-up of the VER system are outlined below:

- At the Treatment System Equipment Trailers, perform the following steps:
  - At Equipment Enclosure TE-1 SVE room, check the VER process piping flow path from where the seven (7) zone lines enter the Equipment Enclosure TE-1 to the SVE blower vacuum manifold, to the Vapor Phase Treatment System. Make sure dilution valve is full open. Open the mechanical butterfly zone valves at one or more of the desired zone valves to be operated. Make sure all isolation valves are OPEN and sample taps are CLOSED as necessary to direct flow to the SVE blower and to the Vapor Phase Treatment System.

- At the HMI Screen located at the Main Control Panel in Equipment Enclosure TE-1 control room, from Main Menu Screen, go to Motorized Valve Control Screen. Set desired TF-Zone Motorized Valves (select 1 or more of 7 TF zones) to AUTO. Set TF Zone Timers to desired daily Start/Stop Times to correspond with TF Pump Zones to be activated.
- Ensure the TF Recovery Pump System has been activated and is properly operating per the above procedures.
- At the vapor phase treatment system, ensure isolation valves are configured to direct flow through two (2) VGAC units in series and bypass the Potassium Permanganate treatment unit (initially). This unit may be put on-line in the event Vinyl Chloride is detected above a minimum acceptable concentration and/or mass flow rate.

- At the TF Recovery Wells, perform the following steps:
  - Open the SVE recovery well isolation valves at each VER/TF well to be operated. Set up portable gauge assembly to be prepared check casing vacuum once VER System activated.
- At the equipment enclosures:
  - At Enclosure TE-1, control room, HMI, go to Motor Control screen and set the following additional HOAs to AUTO for:
  - P-201 – SVE Blower
  - P-201 – Moisture Separator Transfer Pump
  - At Enclosure TE-1, SVE room, check VER/TF zone header vacuum and adjust dilution valve to obtain 2”HG vac. at the active zone headers as a starting point.
  - Check and record total influent flow rate via Pitot tube unit (upstream of dilution line) and total flow rate through SVE blower via Pitot tube unit. Ensure flow rate and back pressure to vapor phase treatment unit is within the VGAC treatment unit capacity rating (1600 CFM and 40 in. w.c.)
- At the TF Recovery Wells:
  - Use portable gauge assembly to check casing vacuum at active VER/TF zones/Recovery wells. Looking for 1” Hg Vac. as a starting point. Adjust dilution valve (in TE-1/SVE room) and/or recovery well isolation valves to balance and obtain approx. 1” Hg Vac.

- At the equipment enclosures:
    - Ensure TF System influent flow rate within the maximum 25 gpm after vacuum enhancement. If not, decrease number of active wells or active zones to decrease influent flow rate.
    - Readjust OWD skimmers as may be necessary to accommodate higher product recovery rates and oil/water ratio.
    - Check product transfer pump P-801 cycle rate, FIT-801 and gauge T-801 to determine impact to product recovery rate as an aide to setting, adjusting active zone configuration and timer settings.
    - Take PID readings at VGAC influent, mid-fluent and effluent. Record values.

3.3 PRODUCT STORAGE TANK OPERATIONS

3.3.1 **Level Monitoring**

3.3.1.1 Automatic

A 90% High Level Alarm (HLA) and 95% High-High Level Alarm (HHLA) is provided for both product storage tanks T-801 and T-1401 along with controls to provide automatic overfill prevention as required by NFPA 30 and New York City Fire Code. The HLA provides a local and remote (email notification) to the operator that the tank is nearing full capacity. If the product recovery systems remain running, the HHLA will automatically shut down the recovery systems in order to prevent the tanks from overfilling and will once again provide a local and remote alarm notification to the operator. The HLA and HHLA are initiated by stainless steel mechanical float switches installed into each storage tank.

3.3.1.2 Manual

A mechanical tank gauge is provided with each storage tank and positioned such that the operator can read the level from ground level. The mechanical tank gauge is composed of a stainless steel float and cable system as well as a visual indicator of product depth in a feet-inch clock dial format. In addition a tank gauging stick is also stored at the site and used to validate the tank gauge accuracies on a monthly basis. Water finding paste is also kept in stock at the site and used along with the gauging stick to determine if water is present and how much is present, such that it can be removed prior to product disposal/recycling tank unloading events.

3.3.2 **Product Tank Loading Procedures**

Once one or more of the product storage tanks have been filled sufficiently to justify a waste oil pick-up for offsite recycling (5000+ gallons), the following tank unloading procedures will be followed:

- Product recovery systems can remain active during tank unloading procedures (if not currently shut-down automatically by automatic overfill prevention system).
- Check for water content in each tank with the gauging stick and water finding paste. If water is detected, pump out with portable product pump or discharge to pre-separation tank (T-701) until liquid stream changes from water back to pure product.
- Gauge the tanks to be unloaded immediately before the product removal process.
- Waste Oil Disposal/Recycling facility must use a vacuum tanker truck or tanker with on-board suction pump (3,000 gallon capacity non-articulated or 5,000 gallon or greater capacity articulated tanker trailer [preferred]) to offload the tanks. Unloading tanker/vacuum tanker trucks shall be equipped with suitable spill containment and clean-up equipment and a driver/operator qualified in spill containment and clean-up in the event it becomes necessary. Tanker Trucks shall be positioned to minimize the length of production suction hose as required for product unloading and wheels chocked prior to offloading operation.
- The drain plug in the nuisance offloading spill pan shall be installed. The nuisance spill pan is located between the east end of the tank secondary containment dike and the base of the tank access stairway further to the east.
- The Operator will also have a qualified representative onsite to oversee tank unloading operations. The operator will also maintain a spill clean-up kit which is stored in the immediate vicinity of the product storage tanks.
- Tanker truck operator shall connect a 2” or larger vacuum rated suction hose to the tank unloading connection (located on the east end of each tank within a spill bucket enclosure) via a 2” camlock connection. The tank offloading connection is equipped with a 2” Male camlock fitting and 2” drop tube routed to 1” from the tank bottom elevation. The tank connection end of the suction hose shall also be equipped with a separate isolation valve and 1” ball valve (located immediately downstream of the 2” camlock) such

that it can be used to bleed or vent the suction line following removal of product from the tank.

- Once the connection is made and cam lock levers wired or secured in the locked position, the operator can begin the vacuum removal process until all product has been evacuated or the tanker truck reaches its maximum safe capacity with freeboard for line purging. Once the product unloading process is completed the suction hose can be purged via the suction drop tube beginning to break suction with product due to removal of product down to the limits of the suction drop tube (preferred) or by closing the 2" isolation valve and opening the 1" bleed valve on the suction hose assembly while the suction hose is still under vacuum. This allows for purging residual product from the line without having to disconnect/break the 2" camlock connection therefore minimizing the chance of a product nuisance or catastrophic release.
- Following the removal process, the operator shall inspect the nuisance spill pan and unloading connection spill bucket for the presence of any spilled product and clean-up with adsorbent pads and/or rags. Such spent pads and rags shall be placed in the 55-gallon DOT shippable regulated petroleum impacted waste accumulation drum.
- Prior to leaving the site, The Operator shall gauge the tank unloaded immediately following unloading activities, calculate the volume removed via the tank gauging chart (posted in the treatment system control room [equipment enclosure TE-1]) and reconcile this volume with the tanker truck operator's volumetric measurements of the outgoing tanker truck. The Operator shall come to agreement with the tanker truck operator's volume accounting and resolve any discrepancies prior to releasing the waste oil recycling vehicle from the site. A discrepancy of no greater than 1% shall be considered acceptable. The Operator, if authorized by the waste generator, shall review and sign the bill of lading or another waste generator representative shall be onsite to review and sign the bill of lading.

3.4 SYSTEM SHUTDOWN PROCEDURES

3.4.1 Emergency Shutdown

In the event of an emergency situation such as a process piping rupture, the product recovery systems and groundwater treatment system can be instantaneously shut down via three (3) Emergency Shut-Down buttons (identified with "Emergency Shutdown" Placards) located as follows:

- Equipment Enclosure TE-1, Control Room, Control Panel
- Equipment Enclosure TE-1, SVE Room interior, north wall immediately to the west of the man-door opening.
- Equipment Enclosure TE-2, Groundwater Treatment Room Interior, north wall immediately to the west of the man-door opening.

The Emergency Stop locations are also identified on the Treatment System Equipment Layout Drawing provided in the equipment manufacturer's O&M Manual located in **Appendix E**. This drawing is also provided on the following page of this document.

3.4.2 **Automatic Shutdown**

The Product Skimmer System, Total Fluids Extraction System, Groundwater Treatment System and VER/SVE System are configured to automatically shut-down all or a portion of the system (pumps, blower, air compressor) in the event of an Alarm Condition which warrants such action to maintain process safety and spill prevention objectives. An Interlock Table is provided in the equipment manufacturer's O&M Manual located in **Appendix E** and clearly identifies all automatic shut-down functions (as it relates the process sensing instrument alarm condition and associated process equipment shut-down action).

3.4.3 **Manual Shutdown**

The Product Skimmer System, Total Fluids Extraction System, Groundwater Treatment System and VER/SVE System can also be manually shut-down locally or remotely by the operator for any reason and at any time (via the cellular modem access system) as follows:

- At the HMI Panel, Motor Control Screen – HAND-OFF-AUTO (HOA) selector buttons are provided for the SVE Blower, Moisture Separator Transfer Pump, Product Removal Pump, Effluent Transfer Pump and Belt Skimmer. In order to turn off any or all of these items, the operator selects the OFF button.
- At the HMI Panel, Chemical Pump Control Screen – HAND-OFF-AUTO (HOA) selector buttons are provided for each of the two (2) chemical feed pumps. In order to turn off either or both of these pumps, the operator selects the OFF button.
- At the HMI Panel, Solenoid Control Screen – OPEN-CLOSED-AUTO (OCA) selector buttons are provided for each of the two (2) chemical feed pumps.

In order to turn off either or both of these pumps, the operator selects the OFF button.

- At the HMI Panel, Motor Operate Valve Control Screen – OPEN-CLOSED-AUTO (OCA) selector buttons are provided for each of the seven (7) TF/VER SVE Motor Operated Zone Valves. In order to CLOSE any of these valves, the operator selects the CLOSED button.
- At the HMI Panel, Motor Operate Valve Control Screen – OPEN-CLOSED-AUTO (OCA) selector buttons are provided for each of the seven (7) TF Compressed Air Supply Solenoid Valves. In order to CLOSE any of these valves, the operator selects the CLOSED button.

4 ROUTINE INSPECTION, MAINTENANCE AND REPORTING

The following section presents the general procedures for routine inspections and maintenance of the LNAPL Extraction and treatment systems. Adherence to these procedures will help ensure safe, effective, and efficient operation. All inspection and maintenance activities will be conducted in accordance with the HASP, the Site Management Plan (SMP), and the Quality Assurance Project Plan (QAPP). A dedicated site log book will be maintained by the VER extraction and groundwater treatment systems operator to document the work conducted on the systems, the hours spent on the site, visitors, samples collected, any unusual conditions, and other observations.

General operational data will be collected on routine inspection and maintenance (RIM) data sheets and any needed adjustments will be made, as well as recorded on the data sheets. The operational data to be collected will consist of groundwater and LNAPL levels, line pressures, equipment run times, flows, pressures, temperatures, well vault measurements, individual treatment units, process flow scenarios, and equipment inspections. Completed OM&M data collection sheets are to be submitted to the OM&M Manager and a copy of the completed collection sheets are to be kept in the LNAPL recovery and groundwater treatment enclosure.

4.1 WEEKLY AND MONTHLY INSPECTION AND MAINTENANCE

4.1.1 **HMI**

The majority of the operational data (such as equipment operation time) to be recorded on the RIM data sheets will be taken from the HMI display.

4.1.2 **Extraction Manifold**

The primary duties for the extraction manifold are as follows:

- Read flow and vacuum from each VER line, and compare flow and vacuum readings to previous readings;
- Observe sight glass for any solid material flowing through the lines;
- Inspect for leaks and vibrations, and;
- Clean flow meters and sight glass as necessary.

4.1.3 Vapor and Groundwater/LNAPL Separator

The primary OM duties for the separator are as follows:

- Read vacuum gauges on the separator unit;
- Inspect the vacuum gauges for proper operation;
- Inspect the influent and effluent piping and other lines for leaks, and;
- Clean filters or replace as necessary.

4.1.4 Pre Separation Tank

The primary OM duties for the pre-separation tank are as follows:

- Inspect the tank and all lines for leaks;
- Check skimmers for proper operation;
- Check LNAPL thickness by manually gauging; and
- Read internal temperature of the equalization tank.

4.1.5 LNAPL/ Groundwater Separator and LNAPL Storage Tank

The primary OM duties for the LNAPL/groundwater separator and LNAPL storage tank during each site visit are as follows:

- Measure the amount of LNAPL in the separator;
- Read LNAPL level gauge in the LNAPL storage tank,
- Check coalescing pac to determine if change out is required;
- Check the condition of the LNAPL surface for buildup of degradation mass;
- Inspect the influent and effluent ends of the separator for potential blockage, and remove as necessary; and;
- Inspect the LNAPL/groundwater separator and storage tank for corrosion and leaks.

4.1.6 Granular Activated Carbon (GAC) Units

The primary OM duties for the GAC units during each site visit are as follows:

- Inspect the units for condensation and drain, if needed;

- Check the level in the condensation effluent tank;
- Read inflow and outflow pressure gauges, compare flow readings to previous readings, check for blockage, if necessary, and;
- For VGAC systems perform air monitoring of the vapor stream.

4.1.7 **Bag Filters**

The primary OM duties for the Bag Filters are:

- Inspect bag filters and clean and replace as necessary;
- Check operating pressure to confirm within operating pressures; and
- Check for flow.

4.1.8 **Pumps**

The primary OM duties for the pumps used throughout the VER extraction and groundwater treatment systems during each site visit are as follows:

- Listen for audible sounds of operation and wear on the pumps;
- Inspect for leaks, and;
- Check for flow.

4.1.9 **Treatment Enclosure**

The primary OM duty for the treatment enclosure during each site visit is to inspect the interior and exterior of the enclosure, including, but not limited to, the following:

- Alarm lights;
- Lighting;
- Gutters;
- Door operation;
- Insulation, and;
- Roof and siding leaks.

4.2 QUARTERLY OM

The quarterly OM operational data will be collected on OM&M data sheets and any needed adjustments will be made. The completed OM&M data collection sheets

will also be submitted to the OM&M Manager. A copy of the completed collection sheets will also be kept at the site.

The primary additional OM duties for quarterly site visits are as follows:

- Open and close all valves in the system to check for proper movement;
- Test the operation of all alarms;
- Check the batteries on the emergency lighting;
- Review the literature on major equipment units and all pump equipment for any additional maintenance requirements;
- Inspect fire extinguishers;
- Check the supply of safety equipment (hearing protection, eye protection, eyewash, first aid supplies, etc.) and replenish as necessary, and;
    - Review spare parts inventory and order parts as necessary.

Table 4-1 summarizes maintenance and inspection tasks and their frequencies, as well as additional system- and equipment- specific tasks. The treatment system Original Equipment Manufacturer (OEM) maintenance manuals and data information are included in the **Appendices**.

Table 4-1: System Routine Operations, Maintenance, and Inspection Summary

Inspection, Maintenance, or Reporting Item	As-Needed	Each Visit	Bi-Weekly	Monthly	Quarterly	Semiannual
Site Inspection		X			X	
Collect Totalizer Information, Hour Meters, Operating Data, Tank Levels		X				
Fill out Daily Log Book		X				
Change Bag Filters	X				X	
Inspect Air Compressor and Drain Valve, Transfer Pumps, OWS, Extraction Manifolds for flow, leaks and operation sounds			X			
Clean Flow Meters, Totalizers and Filters	X		X			
Clean Pre-separation Tank and OWS	X					X
Collect Compliance Permit Samples					X	
Inspect Tanks and Piping Integrity				X		
Check Chemical Metering Pump				X		
Pull, Inspect and Clean TF Pumps	X				X	
Pull, Inspect and Clean Skimmer Pumps	X				X	
Critical Safety Device Check, Maintenance & Motor Lubrication						X
Change KO Tank Inlet Particulate Filter						X
Product Storage Tank Overfill Prevention System Test	X					X
Check Operation of Emergency Lighting, Exit Signs, Fire Extinguishers, Eyewash, Roof, Siding, Doors, Insulation, Heat Trace				X		

4.3 SPARE PARTS AND VENDOR INFORMATION

Table 4-2 provides a list of recommended spare parts that should be either stored onsite or accessible through vendor outlets within 72 hours.

Table 4-2: Recommended Spare Parts and Vendor Information

COMPONENT	TAG	QTY	MANUFACTURER	MODEL	MAINTENANCE ITEM
PROGRESSIVE CAVITY PUMP, 1 HP, 208 VAC, 3PH, TEFC	P-201	1	MOYNO	34401	STATOR / FLEX JOINT
DILUTION FILTER/SILENCER	F-301	1	SOLBERG	FS-235P-400	FILTER ELEMENT
INLINE PARTICULATE FILTER	F-302	1	SOLBERG	CT-275P-600C	FILTER ELEMENT
VAPOR CARBON VESSEL, 4X10 VIRGIN MEDIA	VGAC-501 & VGAC-502	2	TETRASOLV	VF-2000	4X10 VIRGIN MEDIA SERVICE BY CONTRACTOR
6% POTASSIUM PERMANGANATE IMPREGNATED ZEOLITE	VC-501	1	TETRASOLV	VF-1000	6%KMnO4 ZEOLITE SERVICE BY CONTRACTOR
OIL WATER SEPARATOR COAELSCING PACK	OWS-701	1	HYDROQUIP	AG-3SS-150V-IP	12 CUBIC FEET
BELT SKIMMER, .33 HP / 115 VAC, 1 PH, XP	P-701	1	ABENAKI	TOTE IT	BELT
BAG FILTER HOUSING	FX-1001, FX-1002, FX-1003 & FX-1004	4	FILTER TECHNOLOGIES	8-30-2P-1-150-AL-VS-PB	FILTER ELEMENT
LIQUID PHASE CARBON VESSEL, 8x30 VIRGIN MEDIA	LGAC-1101 & LGAC-1102	2	TETRASOLV	AF-1000	8x30 VIRGIN MEDIA SERVICE BY CONTRACTOR
AIR COMPRESSOR, 20 HP, 208 VAC, 3 PH, TEFC	AC-1501	1	KAESER	AIR CENTER SK 20	OIL / BELT / FILTER
PARTICULATE FILTER	PF-1501	1	KAESER	USKPF100BF	FILTER ELEMENT
COALESCING FILTER WITH INDICATOR, 1"	CF-1501	1	KAESER	ANSK20CATKIT	SEPARATOR CARTRIDGE
FLUORESCENT LIGHT		2	NE LIGHTING	VT240EBO-UV	AS NEEDED
LIGHT FIXTURES, CLASS 1 DIVISION 2		4	KILLARK	VUXBGG-2-100X	AS NEEDED
EXTERIOR LIGHT FIXTURES		3	LUMAPRO	4VW95	AS NEEDED
LIGHT FIXTURES, CLASS 1 DIVISION 2		6	KILLARK	VUXBGG-2-100X	AS NEEDED
EXTERIOR LIGHT FIXTURES		3	LUMAPRO	4VW95	AS NEEDED

4.4 EQUIPMENT LUBRICATION

Table 4-3 details items that require maintenance. The air compressor, pump motors, and valves should be checked and cleaned/lubricated/serviced as required by the manufacturer information or the detailed schedule in **Table 4-3** – whichever is more frequent. Appropriate oil and lubrication is stored on site.

Table 4-3: Maintenance Items

COMPONENT	TAG	QTY	MFG.	MODEL	MAINTENANCE ITEM/SCHEDULE
Air Compressor/ Refrigerated Dryer	AC-1501	1	Kaeser	Air Center SK-20	Oil Change – 2,000 hrs 1st, 3,000 hrs subsequent; Change Oil Filter – when indicated on Display; Change oil separator cartridge – when indicated on Display; check Air Filter - </= 1,000 hrs, replace as required; Clean Cooler Filter Mat - </= 1,000 hrs; Clean Control Cabinet Filter Mat - </=1,000 hrs; Clean the cooler & condenser - </= 1,000hrs; Change Air Filter - ;Clean Refrigerant Condenser - ;Change drive belt - < 12,000 hrs; Valve Maintenance <12,000 hrs; Replace drive motor bearings <12,000 hrs; Replace hose lines < 36,000 hrs; Replace control cabinet fan < 36,000 hrs.
SVE Blower & Motor	B-301	1	FPZ Blower Technology w/ 30 HP Baldor Motor	K10 (Blower), CEM41008T (Motor)	Check Inlet Filter 1X / Month – Replace as necessary. Grease motor bearings quarterly w/ Polyrex EM
Motor Operated Valve Actuators	MOV-101 through 107	7	Indelac	M-Series (ML 1,000 In-Lb)	Actuators are permanently lubricated. However, once annually check bushings and if tight or dry, disassemble, clean and lubricate with Lubriplate EMP Grease. Re-calibrate OPEN/CLOSED Position as necessary.

COMPONENT	TAG	QTY	MFG.	MODEL	MAINTENANCE ITEM/SCHEDULE
Belt Skimmer & Motor	P-701	1	Abanaki w/ Leeson Electric Motor	Tote-It 2" (Belt Skimmer), Leeson Electric 0.33HP (Motor)	Monthly – Clean head, wiper blades and trough for build-up. Quarterly – check belt for wear & proper setting, adjust or replace as necessary. Check wiper blades for wear and proper setting, reset adjustable wiper for proper action as necessary. Check bolts for tightness and re-torque as necessary. Motor – Lube bearings every 2 years w/ Shell Dolium R
Moisture Separator Transfer Pump	P-201	1	Moyno	34401	Grease packing's via zerk fittings quarterly. Adjust packing gland quarterly. Lubricate motor bearings every 2 years.
Oil Transfer Pump	P-801	1	Dayton	4KHH8	Disassemble, Clean and Rebuild (Annually). Lubricate motor bearings Annually.
Effluent Transfer Pump	P-901	1	Goulds	NPE 1ST1G5B4	Close Coupled Unit, bearings permanently lubricated, no maintenance required.

4.5 ALARM CONDITIONS AND EMERGENCY RESPONSE

The O&M technicians, technical support, and OM&M manager will be the primary contacts during any emergency response. Contact information for these individuals can be found on the urgent notification poster for the Site.

The system is designed to provide automated notification in the event of a system alarm or system shutdown. In the event of an emergency response, the technicians should respond within 24 hours.

4.6 TROUBLESHOOTING

Troubleshooting of the LNAPL recovery system is complicated and should only be performed by individuals familiar with the system or in the presence of such individuals. The system contains LNAPL liquid and vapor and pressurized lines.

Equipment manuals are available on the Site and troubleshooting guidance is provided in those manuals. Individual troubleshooting forms and solutions should be stored here in the workbook after this section for shared learning.

4.7 MONITORING REQUIREMENTS

Groundwater and LNAPL monitoring is conducted on a monthly, quarterly, and semi-annual basis, with measuring apparent LNAPL thickness and depth to groundwater. Monitoring well LNAPL and groundwater identification information and analytical requirements are described in the Site Management Plan (SMP) which is located on site under separate cover. Monitoring well locations are show in the Record Drawings (**Appendix A)**.

4.8 REPORTING SCHEDULE

Table 4-4 provides a summary of the reporting requirements associated with routine OM&M.

Table 4-4: Reporting Requirements

Deliverables and Documents	Reason for Deliverable	Prepared By	Reviewed By	Due Date and Comments
Monthly Operation Monitoring Report	Contract requirement	OM&M technician	OM&M manager	Report is due to the Project Coordinator by the 5th day of each month.
Quarterly Monitoring	NYCDEP	OM&M technician	OM&M manager	January 31, April 30, July 31, October 31 following each quarter

4.9 PROCEDURES FOR OM&M MANUAL REVISIONS

This OM&M manual was developed to reflect current OM&M conditions. This manual will be reviewed on an annual basis and revised as needed. The document revision summary table located at the beginning of the manual will be populated with the appropriate information for each manual revision. Hardcopies of the Sites' documents will be kept onsite or in secure storage, as required.

4.10 MANAGEMENT OF CHANGE

Changes to OM&M of the treatment system at the Site may be subject to the Management of Change (MOC) process. The MOC procedure is the process by which any permanent or temporary alteration that extends beyond established operating procedures, mechanical systems, or related procedures is controlled. The main requirement of the MOC process is that all modifications of equipment, procedures, raw materials, and processing conditions other than replacement in kind be identified and reviewed by the Site's technical support and OM&M manager.

4.11 ROUTINE SUPPLIERS

This section provides contact information for all routine suppliers of materials, supplies, and services for the Review Avenue Development Site(s) treatment system.

Table 4-5 includes service and equipment supplier contact information.

Table 4-5: Service and Equipment Supplier Information

Supplier	Description	Contact	Phone	E-mail	Address
National Environmental Systems (NES)	Treatment equipment	Randy Bindas	(508) 226-1100	rbindas@nes-inc.biz	84 Dunham Street Attleboro, MA 20703
Kaeser Compressors – D&D Electric Motors & Compressors (Authorized Dealers and Service Techs)	Air compressor equipment.	N/A	(631) 991-3001	info@ddelectricmotors.com	D&D Electric Motors and Compressors, Inc. 127 East Hoffman Ave, Lindenhurst, NY 11757
QED	Skimmers and total fluids pumps	Greg Scarcella	(973) 951-5700	gscarcella@qedenv.com	QED Environmental Systems 2355 Bishop Circle W. Dexter, Michigan 481130

4.12 LNAPL RECOVERY SYSTEM EVALUATION AND ENDPOINTS

During the operation of the LNAPL recovery system, the performance of the system is to be evaluated and adjusted to optimize recovery. Periodically, the performance metrics of the LNAPL recovery system are to be evaluated to determine if the remedial objectives of the system have been achieved or if the system has reached asymptotic conditions (i.e. its practical limits) for sustainable and effective recovery of LNAPL. The performance metrics to be tracked are as follows:

- Vacuum pressures and air flow rates in the VER wells
- Total amount of LNAPL (in gallons) recovered for the skimmer pump systems and for the VER system
- Total of groundwater (gallons) extracted and the rates of extraction
- Recovery ratio of recovered LNAPL to groundwater
- Vapor recovery rates
- Curve analysis of the trend of recovered LNAPL over time
- Trend analysis of recovery ratio of recovered LNAPL to groundwater over time
- Analysis of unit cost per gallon of LNAPL recovered
- Electrical power consumption per gallon of LNAPL recovered
- Levels and properties of the LNAPL obtained from monitoring

It is expected that the LNAPL recovery rates measured during the first months of operation of the VER and skimmer pump systems will decrease during the

progress of the recovery. The decrease in recovery rate is because the most mobile LNAPL will be extracted initially and the less mobile LNAPL will not be extracted as efficiently. An asymptotic extraction rate (the practical limits of the LNAPL recovery system) that will signal the termination of the LNAPL recovery systems may occur after two years, but the actual occurrence of an asymptotic rate of recovery cannot be predicted with any accuracy until the systems have been in operation for some period of time, perhaps several months or a year or more. Therefore, the asymptotic rate will be determined during LNAPL recovery operation. The asymptotic rate will be the rate at which further operation of the LNAPL recovery system will no longer be considered practical and continued operation will be terminated.

A proposal for the approval of the shut-down of the LNAPL recovery system will be made to the New York State Department of Environmental Conservation (NYSDEC) when an asymptotic recovery rate has been achieved. Important factors to determining the shut-down of the LNAPL recovery system is that there is no further migration by LNAPL, there is no exposure of persons to soil gas that may be generated by the remaining LNAPL, and there is no release of LNAPL contaminants that would degrade groundwater quality. Prior to initiation of LNAPL recovery at the Review Avenue Site, it is important to note the following conditions at the Review Avenue Site:

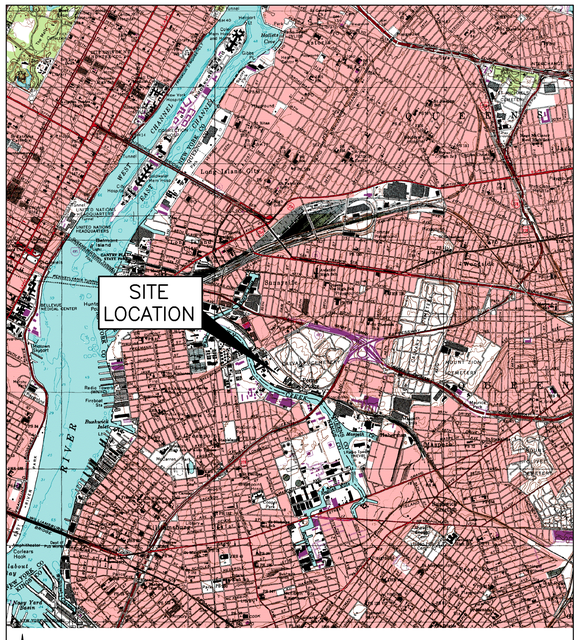
- No offsite migration of soil gas from RAD II was observed. Existing enclosures or new enclosures to be constructed over the LNAPL can be protected, if necessary, by sub slab depressurization methods and/or other barrier methods.
- Impacts to groundwater by the existing LNAPL to a quality worse than the upgradient groundwater were not observed.
- LNAPL evaluation indicated the LNAPL mass was stable and not migrating.

APPENDIX A

Record Drawings

GROUNDWATER REMEDIATION
REVIEW AVENUE DEVELOPMENT SITES
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NEW YORK

RECORD DRAWINGS
DECEMBER 2015



PREPARED FOR:

CRESSWOOD ENVIRONMENTAL CONSULTANTS, LLC
AND ITS DESIGNATED REPRESENTATIVE:

DE MAXIMIS, INC.
1550 POND ROAD, SUITE 120
ALLENTOWN, PA 18104

DRAWING INDEX

PROVIDED BY NES	PROVIDED BY AMEC	SHEET NUMBER	DRAWING TITLE	DISCIPLINE NUMBER
○	●	1	COVER SHEET	G–001
○	●	2	GENERAL NOTES, LEGENDS AND ABBREVIATIONS	G–002
○	●	3	EXISTING SITE PLAN	C–101
○	●	4	SITE, GRADING, EQUIPMENT, AND PIPING PLAN	C–102
○	●	5	GROUNDWATER TREATMENT EQUIPMENT LAYOUT	C–103
○	●	6	EROSION AND SEDIMENT CONTROL PLAN	C–104
○	●	7	PRESTON AVENUE CROSSING DETAILS	C–201
○	●	8	EROSION AND SEDIMENT CONTROL NOTES AND DETAILS	C–501
○	●	9	TOTAL FLUIDS WELL & VER WELL DETAILS AND SCHEDULES	C–502
○	●	10	TANK FOUNDATION AND PIPE SUPPORT DETAILS	C–503
○	●	11	TREATMENT EQUIPMENT FOUNDATION DETAILS	C–504
○	●	12	CROSSING AND HOSE VAULT DETAILS	C–505
○	●	13	PROCESS PIPE TRENCH DETAILS	C–506
○	●	14	CIVIL DETAILS	C–507
●	●	15	PROCESS AND INSTRUMENTATION DIAGRAM: TREATMENT SYSTEM LEGEND	D–600
●	●	16	PROCESS AND INSTRUMENTATION DIAGRAM: TREATMENT SYSTEM 1	D–601
●	○	17	PROCESS AND INSTRUMENTATION DIAGRAM: TREATMENT SYSTEM 2	D–602
○	○	18	PROCESS AND INSTRUMENTATION DIAGRAM: EXTRACTION SYSTEMS	D–603
●	○	19	GROUNDWATER TREATMENT FACILITY ENCLOSURE LAYOUT	M–101
●	○	20	GROUNDWATER TREATMENT FACILITY ENCLOSURE ELEVATIONS 1	M–201
●	○	21	GROUNDWATER TREATMENT FACILITY ENCLOSURE ELEVATIONS 2	M–202
○	●	22	TOTAL FLUIDS WELL & VER WELL VAULT PIPING DETAILS	M–501
○	●	23	SKIMMER WELL VAULT PIPING DETAILS	M–502
○	●	24	WELL VAULT AND PROCESS PIPING ELEVATIONS	M–503
○	●	25	MISCELLANEOUS DETAILS 1	M–504
○	●	26	MISCELLANEOUS DETAILS 2	M–505
●	○	27	ELECTRICAL: MCC AND PANEL ELEVATIONS	E–501
●	○	28	ELECTRICAL: BLOCK DIAGRAM	E–601
●	○	29	ELECTRICAL: SINGLE LINE DIAGRAM	E–602
●	○	30	ELECTRICAL AND INSTRUMENTATION SCHEDULES	E–603
●	○	31	CONTROL LOGIC & INTERLOCK SCHEDULE	E–604

NO.	DATE	REVISION	BY	APVD
2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
1	08/28/15	RECORD DRAWINGS - DRAFT	VMW	BCO

DSGN T. KESSLER DR V. WHELAN CHK T. KESSLER APVD B. O'DELL

BRENT C. O'DELL
NEW YORK, PE NO. 069876

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

GENERAL
COVER SHEET

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG G-001
SHEET 01 OF 31

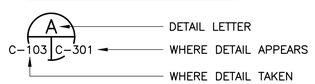
GENERAL NOTES:

1. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE ALL WORK DONE AS PART OF THIS CONTRACT IS DONE TO AND WITHIN ALL APPLICABLE NEW YORK CITY AND STATE OF NEW YORK STANDARDS AND REQUIREMENTS.
2. THE CONTRACTOR SHALL SELECT A CONSTRUCTION SEQUENCE AND METHODOLOGY THAT MINIMIZES IMPACTS TO BUSINESSES AND PUBLIC AREAS IN THE VICINITY OF THE WORK.
3. THE LOCATION OF EXISTING UNDERGROUND UTILITIES AND STRUCTURES SHOULD BE CONSIDERED APPROXIMATE. OTHER UNIDENTIFIED UNDERGROUND FEATURES MAY BE PRESENT. THE CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING UTILITIES OR STRUCTURES WITHIN THE LIMIT OF WORK PRIOR TO THE COMMENCEMENT OF EARTH DISTURBING ACTIVITIES. DIG SAFELY NEW YORK: 811 OR 1-800-962-7962.
4. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EARTH DISTURBING ACTIVITIES, CONSULT THE UTILITY OWNER AND ENGINEER IMMEDIATELY FOR DIRECTIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPAIR OR COORDINATING REPAIR OF CONTRACTOR-DAMAGED UTILITIES TO THE SATISFACTION OF THE UTILITY OWNER, PROPERTY OWNER, AND ENGINEER.
5. DO NOT INTERRUPT EXISTING UTILITIES SERVING OCCUPIED FACILITIES WITHOUT ADVANCED NOTIFICATION TO THE DEPARTMENT AND THE OWNER. PROVIDE COORDINATION AND TIMELY NOTIFICATION TO THE AFFECTED UTILITY OWNER FOR SHUT-OFF AND RE-CONNECTION OF SERVICES FOR TEMPORARY REMOVAL AND REPLACEMENT DURING AND FOLLOWING EARTH DISTURBING ACTIVITIES. THE CONTRACTOR SHALL PROVIDE TEMPORARY FACILITIES DURING CONSTRUCTION.
6. CONTROL DUST GENERATION THROUGHOUT THE DURATION OF THE WORK. DUST MONITORING WILL CONSIST OF CONTINUOUS PARTICULATE/DUST VISUAL OBSERVATION FOR DUST GENERATION DURING EXCAVATION/CONSTRUCTION ACTIVITIES. DURING NON-WORKING HOURS, THE SITE MUST BE LEFT IN A CONDITION THAT WILL PREVENT DUST FROM BEING GENERATED. THE CONTRACTOR SHALL MONITOR WEATHER REPORTS FOR DRY AND/OR WINDY CONDITIONS AND PREPARE THE SITE ACCORDINGLY.
7. SEGREGATE CLEAN MATERIALS, PCB REMEDIATION WASTE (NON-HAZARDOUS), AND TSCA PCB REMEDIATION WASTE (HAZARDOUS) AND STOCKPILE SEPARATELY.
8. EXCAVATED MATERIAL WILL BE RE-USED ON-SITE TO THE MAXIMUM EXTENT POSSIBLE. EXCAVATED MATERIAL WHICH CANNOT BE RE-USED ON-SITE SHALL BE STOCKPILED AND CHARACTERIZED PRIOR TO OFF-SITE DISPOSAL. STOCKPILED MATERIAL SHALL BE COVERED WITH TARPS AND SANDBAGGED DURING NON-WORKING PERIODS.
9. SURFACE WATER ENTERING THE WORK ZONE AND WATER COLLECTED FROM DECONTAMINATION OF VEHICLES AND EQUIPMENT AND EXCAVATION DEWATERING SHALL BE CONTAINERIZED AND CHARACTERIZED FOR PROPER OFF-SITE DISPOSAL.
10. CONTRACTOR WILL PROVIDE APPROPRIATE PROTECTION FOR SITE WORKERS AND TRESPASSERS WHEN THERE IS DANGER OF FALLING INTO AN OPEN EXCAVATION.
11. THE CONTRACTOR MAY NEED TO INSTALL SHEETING AND BRACING FOR SLOPE STABILIZATION PURPOSES DURING EARTH REMOVAL ACTIVITIES.
12. AS REMEDIATION SYSTEM PROCESS PIPING IS NOT ASSOCIATED WITH BUILDING MECHANICAL OR PLUMBING SYSTEMS OR ASSOCIATED WITH REGULATED TANK INSTALLATIONS, THIS PIPING THEREFORE IS NOT SUBJECT TO THE NYC BUILDING MECHANICAL, PLUMBING OR FIRE CODE.

ABBREVIATIONS:

AC.	ACRE
APPROX	APPROXIMATELY
ASPH	ASPHALT
BLDG	BUILDING
BM	BENCHMARK
BOS	BOTTOM OF SKIMMER
BOW	BOTTOM OF WELL
CB	CATCH BASIN
CBFI	CATCH BASIN FIELD INLET
CI	CAST IRON
℄	CENTER LINE
CO	CLEAN OUT
CONC	CONCRETE
CPP	CORRUGATED PLASTIC PIPE
CS	CONDENSATE SUMP
DIA	DIAMETER
DGA	DENSE GRADED AGGREGATE
DW	DRY WELL
E	EASTING, EAST
ELEC	ELECTRIC
ELEV	ELEVATION
'	FEET
FB	FILTER BERM
FM	FORCE MAIN
GP	GEOPROBE
GPM	GALLONS PER MINUTE
GW	GROUNDWATER
HDPE	HIGH DENSITY POLYETHYLENE
HR	HOUR
HSE	HOUSE
ID	IDENTIFICATION, INSIDE DIAMETER
"	INCHES
INV	INVERT
LF	LINEAR FEET
MAX	MAXIMUM
MEAS	MEASURE
MH	MANHOLE
MIN	MINIMUM
MM	MILLIMETER
MSL	MEAN SEA LEVEL
MW	MONITORING WELL
N	NORTHING, NORTH
NES	NATIONAL ENVIRONMENTAL SYSTEMS
NTS	NOT TO SCALE
NYSDEC	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
NYSDOT	NEW YORK STATE DEPARTMENT OF TRANSPORTATION
OD	OUTSIDE DIAMETER
OHU	OVERHEAD ELECTRIC
OT	OVERHEAD TELEPHONE
OZ	OUNCE
PCB	POLYCHLORINATED BIPHENYLS
PSI	POUNDS PER SQUARE INCH
PT	POINT
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
S	SOUTH, SLOPE
SB	SOIL BORING
SC	SITE CONNECTION
SE	SOUTHEAST
SF	SILTATION FENCE
SQ FT	SQUARE FEET
SMH	SEWER MANHOLE
STL	STEEL
SVE	SOIL VAPOR EXTRACTION
TSCA	TOXIC SUBSTANCES CONTROL ACT
TOC	TOP OF CASING
TOS	TOP OF SCREEN
TYP	TYPICAL
UG	UNDERGROUND
WV	WATER VALVE
W	WEST
YR	YEAR

REFERENCE LEGEND:



LEGEND

	EXISTING	PROPOSED
BUILDINGS		
CONTOUR MAJOR	20	20
CONTOUR MINOR	19	19
RAILROAD TRACKS		
PROPERTY LINE		
ADJOINER PROPERTY LINE		
EASEMENT LINE		
CHAIN LINK FENCE		
OVERHEAD WIRES	OHU	
EDGE OF GRAVEL		
FIRE HYDRANT		
UNKNOWN VALVE	U	
LIGHT POLE		
UTILITY POLE		
CATCHBASIN		
ROUND CATCHBASIN	CB	
MONITORING WELL	MW-1	
PROTECTIVE POST		
LARGE TREE		
SMALL TREE		
GAS VALVE	G	
WATER VALVE	W	
WATER BOX	W	
ELECTRIC MANHOLE	E	
SANITARY MANHOLE	S	
WATER MANHOLE	W	
WATER LINE	W	
TELEPHONE MANHOLE	T	
UNKNOWN MANHOLE		
SURVEY MONUMENT		
FORCE MAIN PIPE	FM	FM
CONCRETE MANHOLE		MH
SANITARY SEWER PIPE		SS
SEWER CLEANOUT		CO
COMBINED SEWER MANHOLE		
COMBINED SEWER		
PREVIOUSLY APPROVED APPLICATION #421002603	FM	

BRENT C. O'DELL
NEW YORK, PE NO. 090976

NO.	DATE	DR	REVISION	CHK	APVD
2	12/22/15	VMW	RECORD DRAWINGS - FINAL	BCO	
1	08/28/15	VMW	RECORD DRAWINGS - DRAFT	BCO	
DSGN	C. THERIAULT	DR	V. WHELAN	CHK	T. KESSLER
		BY		APVD	B. O'DELL

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

GENERAL
GENERAL NOTES, LEGENDS AND ABBREVIATIONS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	12/22/15
PROJ NO:	3480140433
DWG	G-002
SHEET	02 OF 31

REVIEW AVENUE

80' R.O.W.

CONC SIDEWALK

CON ED MH

GRATE=21.96'

INV=13.05' (11.43')

RIM=23.13' (21.51')

GRATE=22.09'

INV=14.54' (12.92')

RIM=25.25' (23.63')

CON ED MH GRATE=25.37'

INV=16.45' (14.83')

RIM=27.39' (25.77')

RIM=28.62'

GRATE=25.61'

VENT

GATE

CONC

TRAILER

2 STORY
BRICK BLDG

INV=16.8' (15.2')
RIM=23.5' (21.9')

SS

BM1
MONUMENT
SET BY
GEOD

STEPS

N=206252.493
E=1001705.224
EL=20.01

PARKING

BLOCK 312
LOT 39

RAD I
37–30 REVIEW AVE.

BLOCK 312 LOT 41
AREA = 119,033 SF
(2.733 AC)

PRESTON AVENUE

PRESTON AVENUE CONSTRUCTION
NOT INCLUDED IN SCOPE OF WORK

ELEC EQUIP
ON CONC PAD

RAD II
37–80 REVIEW AVE.
OCCUPANCY – VACANT LOT

BLOCK 312 LOT 69
AREA = 73,865 SF
(1.696 AC)

10.0'

6' C.L.F.

BLOCK 312
LOT 79

5 STORY
BRICK BLDG

DEBRIS

OHU

PILE

STORAGE

LONG ISLAND RAILROAD CO.

BM2
MONUMENT SET
BY GEOD

N=205739.434
E=1001720.737
EL=15.33

SOURCE NOTES:

1. BASE MAP REFERENCE FROM SURVEY DRAWING NAMED "BOUNDARY AND TOPOGRAPHIC PLAN BLOCK 312 LOTS 41 & 69, 37–80 REVIEW AVENUE", BY GEOD CORPORATION, DATED AUGUST 26, 2011.
2. HORIZONTAL DATUM IS NORTH AMERICAN DATUM OF 1983 (NAD83 NEW YORK STATE PLANE COORDINATES, LONG ISLAND ZONE 3104). VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

PROJECT BENCHMARKS			
Description	Northing	Easting	Elevation
BM1	206252.49	1001705.22	20.01
BM2	205736.43	1001720.74	15.33

0 15 30 60
SCALE: 1" = 30'

NO.	DATE	REVISION	CHK	APVD
2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
1	08/28/15	RECORD DRAWINGS - DRAFT	VMW	BCO
DSGN	C. THERIAULT	DR M. STACEY	T. KESSLER	BY B. O'DELL

BRENT C. O'DELL
NEW YORK PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES.
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL
EXISTING SITE PLAN

MACTEC
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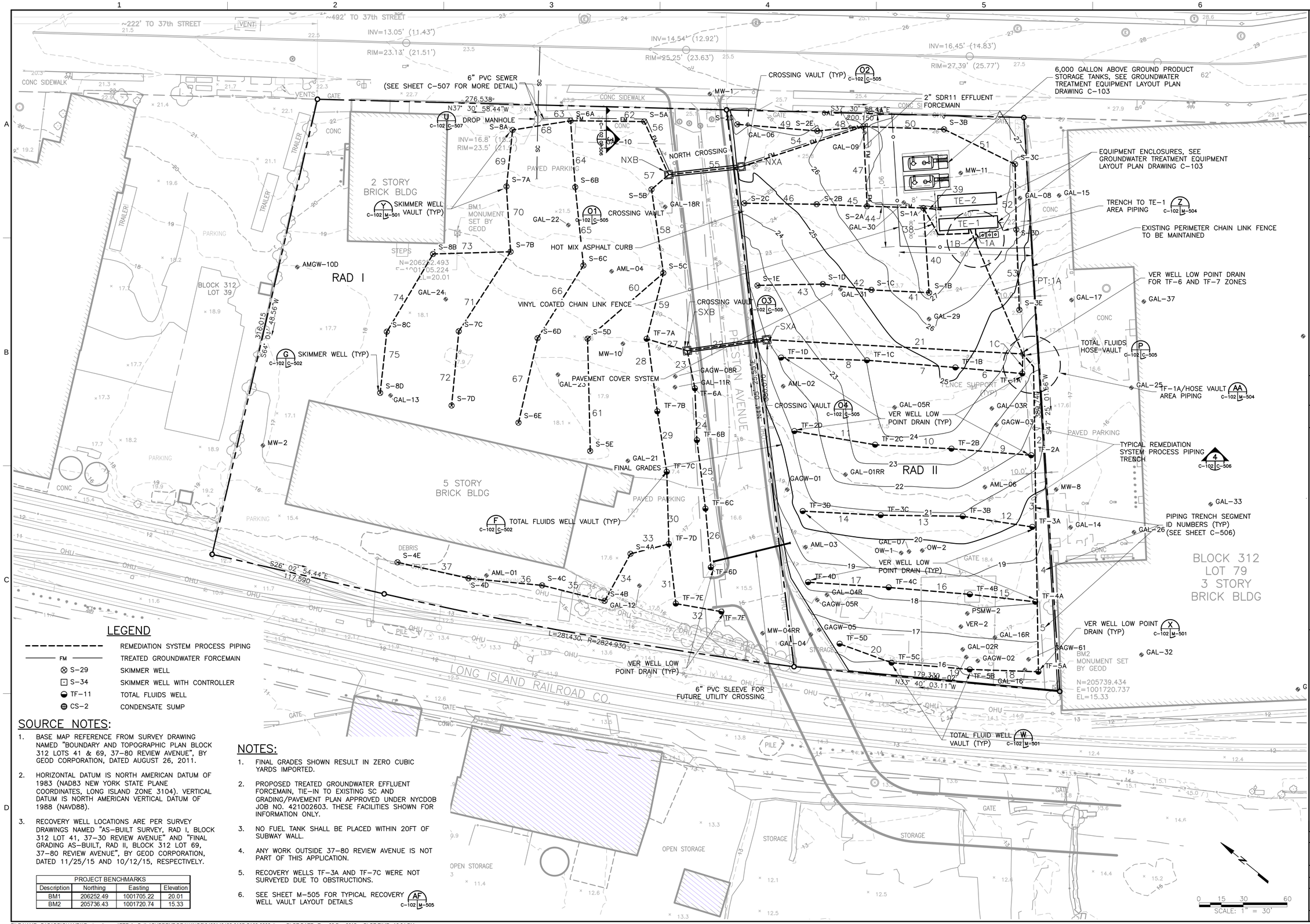
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-101
SHEET 03 OF 31

FILE NAME: P:\CADD\QUANTA\Review Avenue\FER As-Builts\CURRENT DRAWINGS\3480140433-0107-C101-0000.dwg PLOT DATE: Tue, 22 Dec 2015 PLOT TIME: 12:03 PM



LEGEND

----------	REMEDIATION SYSTEM PROCESS PIPING
——— FM ———	TREATED GROUNDWATER FORCEMAIN
⊗ S-29	SKIMMER WELL
⊡ S-34	SKIMMER WELL WITH CONTROLLER
◒ TF-11	TOTAL FLUIDS WELL
⊕ CS-2	CONDENSATE SUMP

SOURCE NOTES:

1. BASE MAP REFERENCE FROM SURVEY DRAWING NAMED "BOUNDARY AND TOPOGRAPHIC PLAN BLOCK 312 LOTS 41 & 69, 37-80 REVIEW AVENUE", BY GEOD CORPORATION, DATED AUGUST 26, 2011.
2. HORIZONTAL DATUM IS NORTH AMERICAN DATUM OF 1983 (NAD83 NEW YORK STATE PLANE COORDINATES, LONG ISLAND ZONE 3104). VERTICAL DATUM IS NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
3. RECOVERY WELL LOCATIONS ARE PER SURVEY DRAWINGS NAMED "AS-BUILT SURVEY, RAD I, BLOCK 312 LOT 41, 37-30 REVIEW AVENUE" AND "FINAL GRADING AS-BUILT, RAD II, BLOCK 312 LOT 69, 37-80 REVIEW AVENUE", BY GEOD CORPORATION, DATED 11/25/15 AND 10/12/15, RESPECTIVELY.

PROJECT BENCHMARKS			
Description	Northing	Easting	Elevation
BM1	206252.49	1001705.22	20.01
BM2	205736.43	1001720.74	15.33

NOTES:

1. FINAL GRADES SHOWN RESULT IN ZERO CUBIC YARDS IMPORTED.
2. PROPOSED TREATED GROUNDWATER EFFLUENT FORCEMAIN, TIE-IN TO EXISTING SC AND GRADING/PAVEMENT PLAN APPROVED UNDER NYCDOB JOB NO. 421002603. THESE FACILITIES SHOWN FOR INFORMATION ONLY.
3. NO FUEL TANK SHALL BE PLACED WITHIN 20FT OF SUBWAY WALL.
4. ANY WORK OUTSIDE 37-80 REVIEW AVENUE IS NOT PART OF THIS APPLICATION.
5. RECOVERY WELLS TF-3A AND TF-7C WERE NOT SURVEYED DUE TO OBSTRUCTIONS.
6. SEE SHEET M-505 FOR TYPICAL RECOVERY WELL VAULT LAYOUT DETAILS AF C-102 M-505

SCALE: 1" = 30'

NO.	DATE	DSGN	DR	CHK	APVD	BY
2	12/22/15	T. KESSLER	S. MAZZA	T. KESSLER	B. O'DELL	VMW BCO
1	08/28/15	RECORD DRAWINGS - DRAFT				VMW BCO
		REVISION				

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL

SITE, GRADING, EQUIPMENT AND PIPING PLAN

MACTEC
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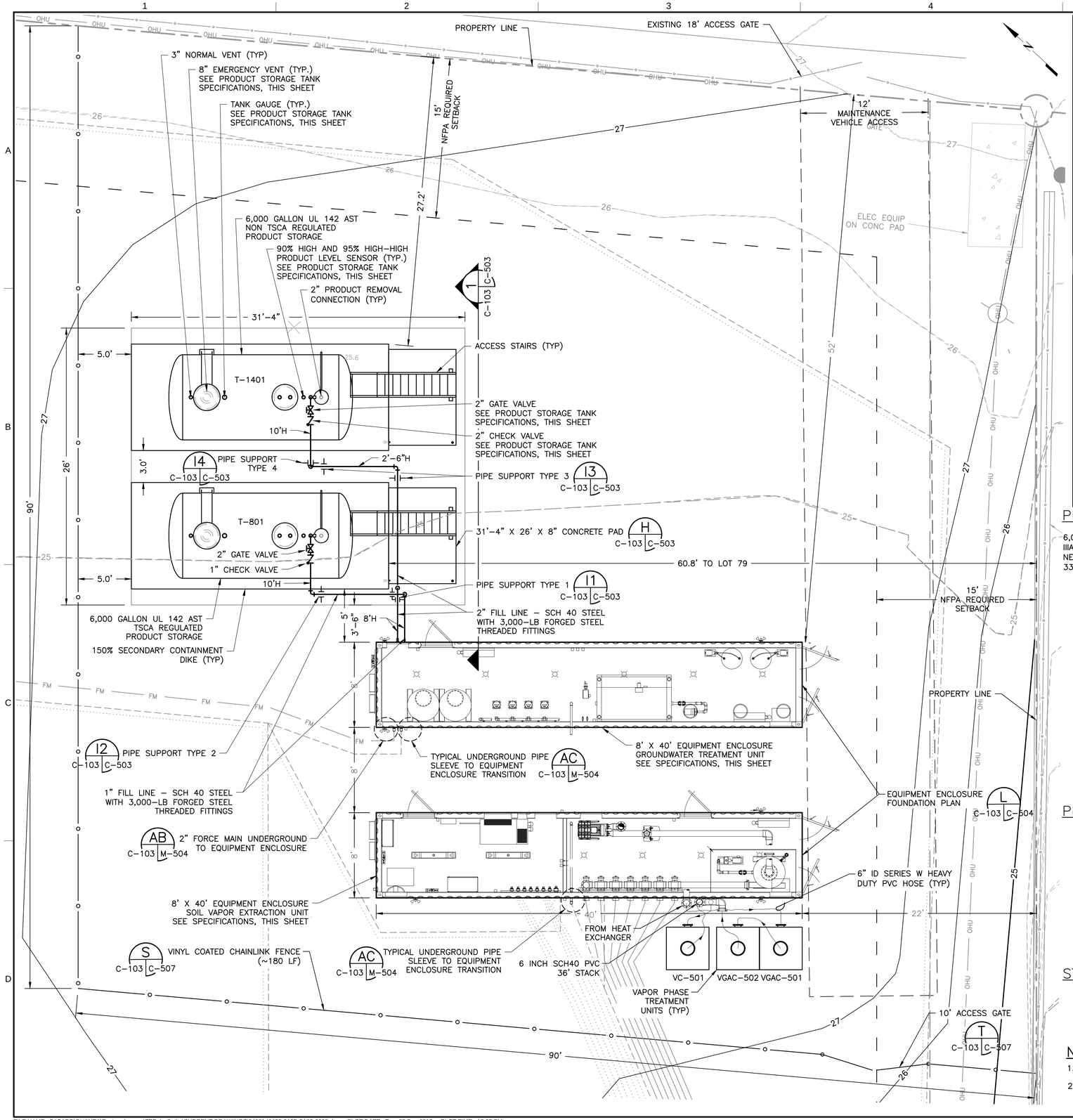
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	12/18/15
PROJ NO:	3480140433
DWG	C-102
SHEET	04 OF 31

FILE NAME: P:\CADD\QUANTA\Review Avenue\FER As-Builts\CURRENT DRAWINGS\3480140433-0107-C102-0002.dwg PLOT DATE: Tue, 22 Dec 2015 PLOT TIME: 12:04 PM



Groundwater Treatment Unit Specifications:

Manufacturer: National Environmental Systems, Attleboro, MA

Component	Quantity	Mfg/Model/Misc.	Performance/Electrical Data
Oil/Water Separator	1	Hydro Quip Model AGM-3SS-150V-1H. API 421, EPA Method 1664 Rev A Separation Chamber. ASTM A240 304SS Construction	40 GPM Capacity, Gravity/Coalescing Plate Separation
Belt Skimmer	1	Abenaki Model TOTE IT 2"	3 GPH, 0.33HP/115VAC/1ph/XP
Effluent Pump	1	Goulds Model 1ST1G5B4	25 GPM @ 100' TDH, 2 HP/208VAC/3ph/XP
Gear Pump	1	Dayton Model 4KHH8	4.8 GPM @ Free Flow, 2.8 GPM @ 100 PSI, 0.5 HP/208VAC/3ph/TEFC
Bag Filter Housings	4	Filter Technologies Model 8-30-2P-1-150-AL-VS-PB	30 GPM nominal capacity
Liquid Phase Carbon	2	Tetrasolv Model AF-1000	1,000 LB Grannular Activated Carbon
Electrical System	N/A	Electrical equipment and wiring inspected for compliance w/ NEC 2011 & NYC Electrical Code at mfg's shop by ICC Certified 3'rd Party Electrical Inspection Service.	All motors are UL Recoginized and UL Listed for hazardous locations where required by NEC.
Unit Heater	2	Dayton Model 2CJF2	3.6KW/208VAC/1ph
Exhaust Fan	1	Dayton Model 10D997 16"	0.25HP/115VAC/1ph
Interior Lighting	6	Killark Model VUXBGG-2-100X	NEC Class 1, Div 2 Hazardous Location compliant
Exterior Lighting	3	Lumapro Model 4VW95	
Equpment Container	1	8 FT W x 40 FT L x 9.5 FT H Steel Intermodal Shipping Container complete with R-13 Insulation, safety signage, exit lighting	

Soil Vapor Extraction Unit Specifications:

Manufacturer: National Environmental Systems, Attleboro, MA

Component	Quantity	Mfg/Model/Misc.	Performance/Electrical Data
Vacuum Blower	1	FPZ Model SCL K10-TS-GOR-C-30-3 Regenerative Vacuum Blower complete w/ Inlet 7 Exhaust Silencers	750 SCFM@54 IN WC VAC, 30HP/460VAC/3ph/TEFC
Moisture Separator	1	NES Model AWT-15T5P	150 Gallon Centrifugal Style
Heat Exchanger	1	NES Custom	Passive finned tube style, no moving parts
Transfer Pump	1	Moyno Model 34401 Progressive Cavity Pump	10 GPM @ 30 PSI, 1 HP/208 VAC/3 ph/TEFC
Electrical System	N/A	Electrical equipment and wiring inspected for compliance w/ NEC 2011 & NYC Electrical Code at mfg's shop by ICC Certified 3'rd Party Electrical Inspection Service.	All motors are UL Recoginized and UL Listed for hazardous locations where required by NEC.
Unit Heater	1	Dayton Model 2HAC6	1.8KW/120VAC/1ph
Unit Heater	1	Dayton Model 2CJF2	3.6KW/208VAC/1ph
Exhaust Fan	1	Dayton Model 10D997 16"	0.25HP/115VAC/1ph/XP
Exhaust Fan	1	Dayton Model 10D964 16"	0.25HP/115VAC/1ph
Interior Lighting	2	NE Lighting Model VT240EBO-UV Flourescent	120VAC/1ph
Interior Lighting	4	Killark Model VUXBGG-2-100X	NEC Class 1, Div 2 Hazardous Location compliant
Exterior Lighting	3	Lumapro Model 4VW95	
Equpment Container	1	8 FT W x 40 FT L x 9.5 FT H Steel Intermodal Shipping Container complete with R-13 Insulation, safety signage, exit lighting	

PRODUCT STORAGE TANK SPECIFICATIONS:

6,000 GALLON UL 142 ABOVE GROUND STORAGE TANK W/ 150% CONTAINMENT DIKE FOR STORAGE OF COMBUSTIBLE CLASS IIIA OR IIIB LIQUID AS DEFINED BY THE NEW YORK CITY FIRE CODE & NFPA 30. TANK SHALL BE MFG. IN ACCORDANCE W/ NEW YORK CITY FUEL STORAGE TANK REQUIREMENTS BY AERO POWER UNITIZED FUELER, INC. OR EQUAL (MEA NUMBER 336-03-E). TANKS WILL BE INSTALLED COMPLETE WITH:

- 3" DIAM. NORMAL VENT PIPE (SCH 40 STEEL) EXTENDING TO 15 FEET ABOVE ADJACENT GROUND LEVEL. NORMAL VENT SHALL BE MORRISON FIGURE 354 3" UPDRAFT STYLE, OR EQUAL
- 8" EMERGENCY VENT - 462,000 CFH CAPACITY @ 2.5 PSI, OPENS @ 8 OZ/SQ IN AS PROVIDED BY AERO POWER UNITIZED FUELER, INC., OR EQUAL
- 150% SECONDARY CONTAINMENT DIKE
- DIKE RAIN SHIELD
- 90% HIGH LEVEL ALARM AND 95% HIGH-HIGH LEVEL AUTOMATIC OVERFILL PREVENTION SYSTEM. LEVEL SENSOR SHALL BE GEMS LS800 S.S. DUAL FLOAT SENSOR, OR EQUAL COMPLETE WITH INTRINSICALLY SAFE BARRIERS. 90% HIGH LEVEL ALARM WILL TRIGGER A LOCAL AND REMOTE ALARM, 95% LEVEL ALARM WILL SHUT DOWN FLOW OF PRODUCT TO TANK FILL LINE AND TRIGGER A LOCAL AND REMOTE ALARM. CONTROL LOGIC VIA PROGRAMMABLE LOGIC CONTROLLER (PLC).
- TANK GAUGE SHALL BE MORRISON FIGURE 818 OR EQUAL.
- FILL LINE DROP TUBE (2") PER NFPA 30 REQUIREMENTS (TERMINATED WITHIN 6" OF THE TANK BOTTOM)
- PRODUCT REMOVAL CONNECTION WITH 2" SUCTION DROP TUBE TERMINATED AT 1" ABOVE TANK BOTTOM.
- OSHA COMPLIANT ACCESS STAIRS, PLATFORM & RAILING
- MILD CARBON STL, ¼" STL TANK SHELL AND DIKE, 5/16" STL DISHED HEADS
- SP-6 BLAST, EPOXY PRIMER AND UV-URETHANE TOPCOAT SYSTEM ON ALL TANK AND DIKE COMPONENTS
- HYDRO TESTED TO 30 PSIG
- NFPA/NYC LABELING
- EACH TANK SHALL BE GROUNDED TO INDIVIDUAL 1/2" DIA. BY 8FT LONG GROUND RODS DRIVEN MIN. OF 10FT INTO GROUND UTILIZING INDIVIDUAL #2AWG MAIN CONDUCTORS. BOND EACH TANK TO EACH OTHER AND TO THE GROUNDWATER AND SOIL VAPOR EXTRACTION TREATMENT SYSTEM ELECTRICAL SYSTEM UTILIZING #6AWG BONDING CONDUCTORS, PER NYC ELECTRICAL CODE.

PRODUCT PIPING SYSTEM SPECIFICATIONS:

- ABOVE GROUND PRODUCT PIPING SHALL BE CONSTRUCTED OF SCH. 40 STEEL WITH 3,000-LB. FORGED STEEL THREADED FITTINGS
- PRODUCT PIPE SUPPORTS SHALL BE CONSTRUCTED OF STEEL AND CONCRETE
- FILL LINES TO BOTH TANKS EQUIPPED WITH CHECK VALVES AND GATE VALVES NEAR TOP ENTRY PIPE CONNECTION AS CLOSE AS POSSIBLE TO THE TANK SHELL. 2" CHECK VALVE SHALL BE MORRISON FIGURE 246ADI (DUCTILE IRON), OR EQUAL. 1" CHECK VALVE SHALL BE MORRISON FIGURE 958 (SS), OR EQUAL. BOTH THE 1" AND 2" FILL LINES WILL BE EQUIPPED WITH 2" GATE VALVES AND SHALL BE MORRISON FIGURE 535DI W/ EXPANSION RELIEF, OR EQUAL
- PRODUCT PIPING SHALL BE HYDROSTATICALLY TESTED TO 150% OF MAX. ANTICIPATED OPERATING PRESSURE OR PNEUMATICALLY TESTED TO 110% OF MAX. ANTICIPATED OPERATING PRESSURE (NOT < 15 PSIG) AT THE HIGHEST POINT IN THE SYSTEM.
- PRODUCT PIPING SHALL BE INSULATED WITH 1" FIBERGLASS (ASTM C547) OR 1" FOAMED ELASTOMER (ASTM C534) INSULATION.
- 3 WATT/FT ELECTRICAL HEAT TRACE SHALL BE APPLIED TO 1" PIPING AND 5 WATT/FT FOR 2" PIPING.

STACK DISTANCE TO PROPERTY LINES:

A = 77'
B = 31'
C = 314'
D = 166'

NOTES:

1. NO FUEL TANK SHALL BE PLACED WITHIN 20FT OF SUBWAY WALL.
2. ANY WORK OUTSIDE OF 37-80 REVIEW AVENUE IS NOT PART OF THIS APPLICATION.

SCALE: 1" = 5'

NO.	DATE	DSGN	DR	CHK	APVD
2	12/22/15	T. KESSLER	S. MAZZA	T. KESSLER	B. O'DELL
1	08/28/15				

REVISION

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT

VMW BCO
VMW BCO

BRENT C. O'DELL
NEW YORK, P.E. NO.: 089876

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL

GROUNDWATER TREATMENT EQUIPMENT LAYOUT

MACTEC

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511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-103
SHEET 05 OF 31

FILE NAME: P:\CADD\QUANTA\Review Avenue\FER As-Builts\CURRENT DRAWINGS\3480140433-0107-C103-0000.dwg PLOT DATE: Tue, 22 Dec 2015 PLOT TIME: 12:05 PM

REVIEW AVENUE

80' R.O.W.

CONC SIDEWALK

INV=14.54' (12.92')

RIM=25.25' (23.63')

INV=13.05' (11.43')

RIM=23.13' (21.51')

INV=16.45' (14.83')

RIM=27.39' (25.77')

SHED

INV=16.8' (15.2')
RIM=23.5' (21.9')

2 STORY BRICK BLDG

5 STORY BRICK BLDG

PAVED PARKING

BM1 MONUMENT SET BY GEOD

N=206252.493
E=1001255.224
EL=19.01

BLOCK 312 LOT 39

BLOCK 312 LOT 79

UtA

UtB

APPROXIMATE LOCATION OF EXISTING 6" CAST IRON WATER LINE

ELEC EQUIP ON CONC PAD

RETAINING WALL

EXISTING PERIMETER CHAIN LINK FENCE TO BE MAINTAINED

REMOVE INACTIVE ELECTRICAL POLES AND OVERHEAD WIRES

REMOVE CONCRETE PAD AND INACTIVE ELECTRICAL EQUIPMENT.

R C-104 C-507 HOT MIX ASPHALT CURB

Q C-104 C-507 PAVEMENT COVER SYSTEM

REGRADED TO FINAL GRADES SHOWN

A C-104 C-501 SILT FENCE (TYP)

PRESTON AVENUE

LONG ISLAND RAILROAD CO.

BM2 MONUMENT SET BY GEOD

N=205739.434
E=1001720.737
EL=15.33

1" PVC (TYP)

ELEC BOX

2" STEEL CONDUIT

4" STEEL CONDUIT

FENCE SUPPORT (TYP)

NOTES:

1. RAD I AND RAD II SITES LOCATED ABOVE FEMA 100-YEAR FLOOD ELEVATION OF 11.0 AS DETERMINED FROM FEMA FIRM MAP NO'S 3604970202G AND 3604970206G WHICH USE A VERTICAL DATUM OF NAVD 88. ALL GROUND SURFACE ELEVATION CONTOURS SHOWN ARE ALSO BASED ON NAVD 88.
2. SITES UNDERLAIN BY URBAN LAND SOIL UNITS UtA and UtB AS SHOWN.
3. FINAL GRADES SHOWN RESULT IN ZERO CUBIC YARDS IMPORTED. (EXCEPT SELECT MATERIALS ON DETAIL A, SHEET C-301.00)

0 15 30 60
SCALE IN FEET

NO.	DATE	DSGN	DR	CHK	APVD
		M. PETERS	M. STACEY	T. KESSLER	B. O'DELL
	12/22/15				
1	08/28/15				

NO.	REVISION	BY
	RECORD DRAWINGS - FINAL	VMW BCO
	RECORD DRAWINGS - DRAFT	VMW BCO

BRENT C. O'DELL
NEW YORK PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL

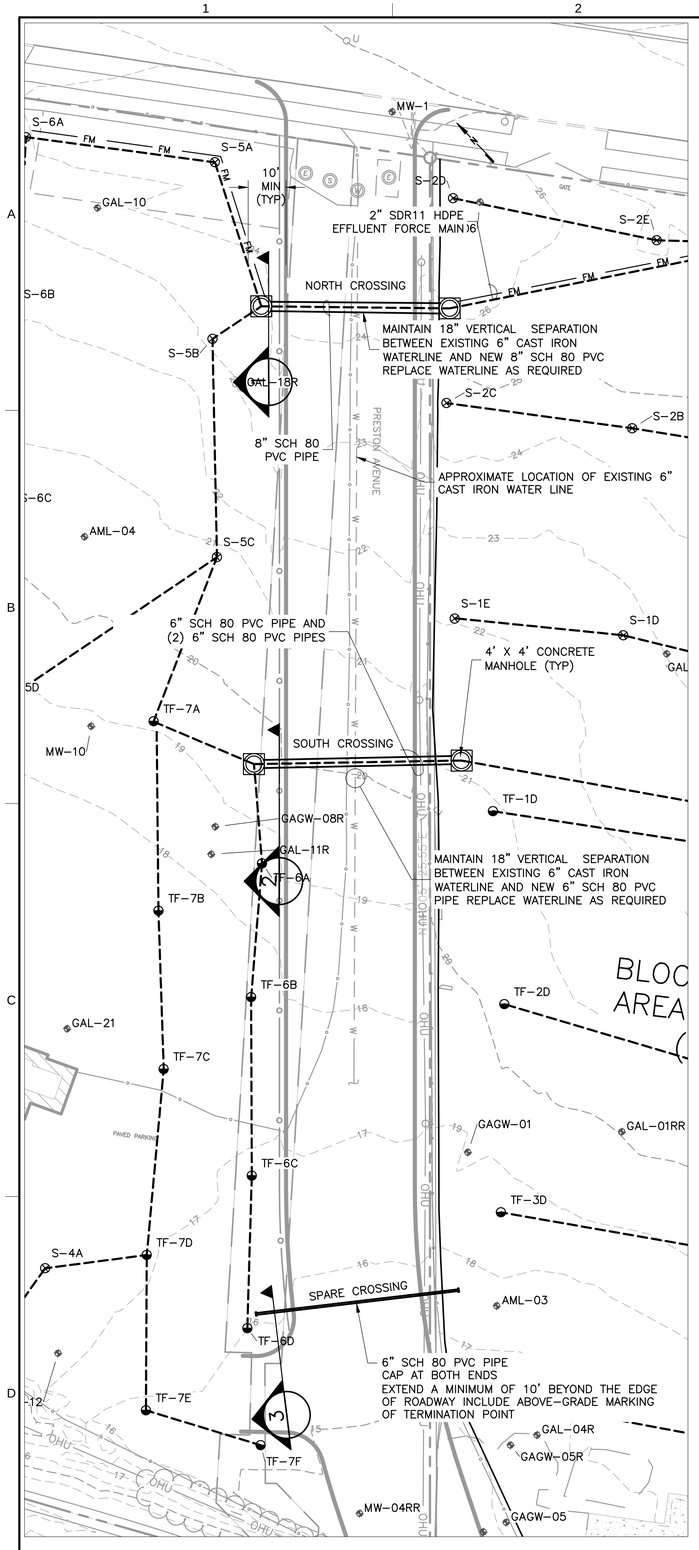
EROSION AND SEDIMENT CONTROL PLAN

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

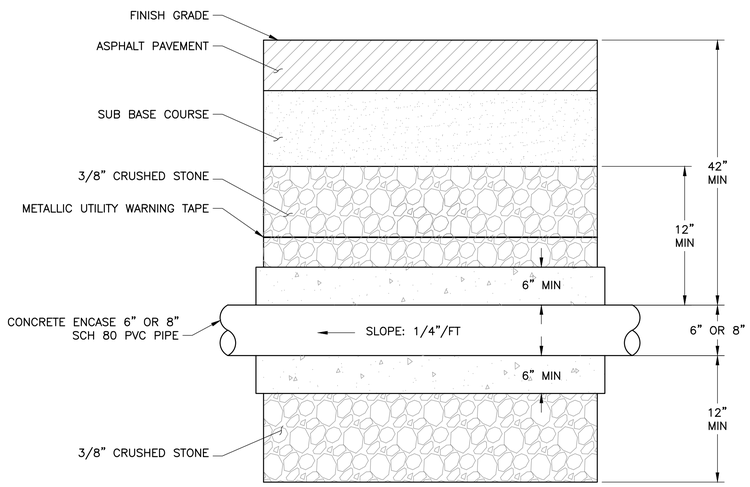
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-104
SHEET 06 OF 31

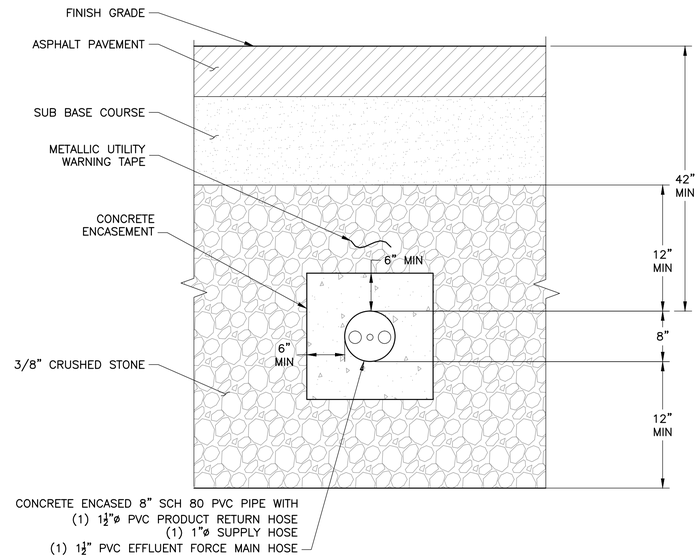
FILE NAME: P:\CADD\QUANTA\Review Avenue\FER As-Builts\CURRENT DRAWINGS\3480140433-0107-C104-0000.dwg PLOT DATE: Tue, 22 Dec 2015 PLOT TIME: 12:06 PM



SITE PLAN
SCALE: 1" = 20'



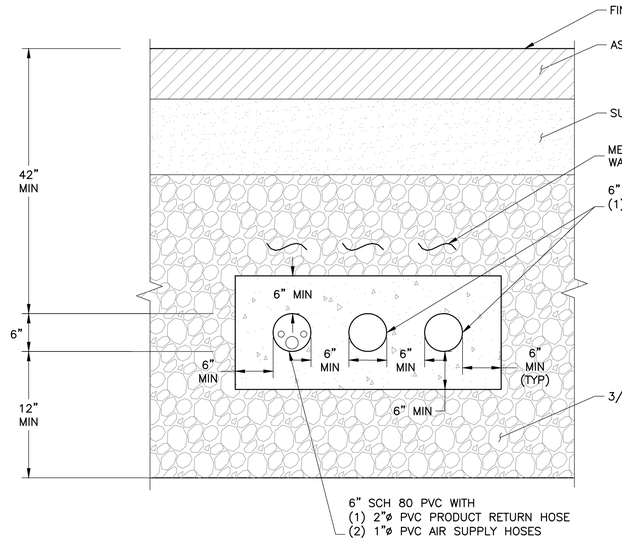
TYPICAL UTILITY TRENCH UNDER PRESTON AVENUE
NTS (NORTH, SOUTH AND SPARE CROSSING)



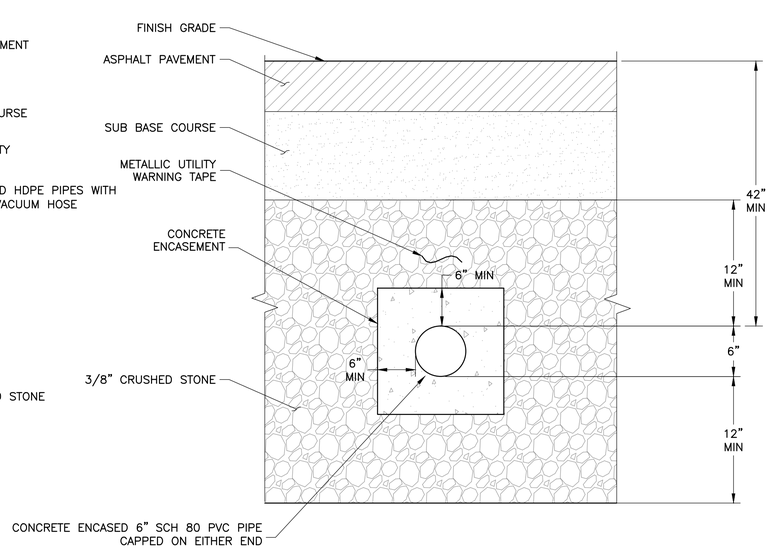
UTILITY TRENCH UNDER PRESTON AVENUE 1
NTS (NORTH CROSSING)

NOTES:

1. PIPES TO BE INSTALLED BY WASTE MANAGEMENT BETWEEN STRUCTURES UNDER PRESTON AVENUE PRIOR TO START OF CONSTRUCTION ON THIS PROJECT.



UTILITY TRENCH UNDER PRESTON AVENUE 2
NTS (SOUTH CROSSING)



UTILITY TRENCH UNDER PRESTON AVENUE 3
NTS (SPARE CROSSING)

NO.	DATE	DR	CHK	APVD	BY
2	12/22/15	M. STACEY	T. KESSLER		VMW
1	08/28/15				VMW
DSGN	C. THERIAULT				B. O'DELL

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT
REVISION
BCO
BCO
APVD

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL
PRESTON AVENUE
NORTH AND SOUTH
CROSSING DETAILS

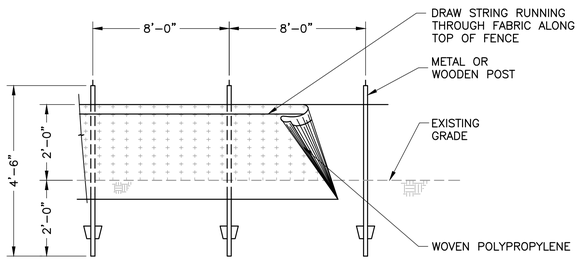
MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

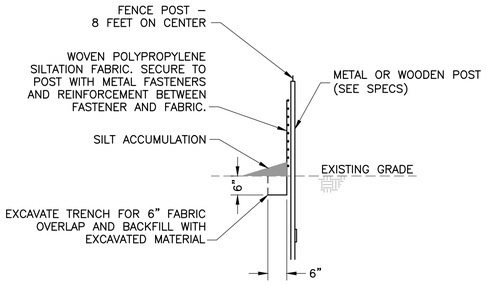
DATE	12/22/15
PROJ NO:	3480140433
DWG	C-201
SHEET	07 OF 31

EROSION AND SEDIMENT CONTROL NOTES:

1. ALL WORK IS TO BE DONE IN ACCORDANCE WITH NEW YORK CITY STANDARDS (NYC STANDARDS) AND NEW YORK STATE STANDARDS (STATE STANDARDS) AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL.
2. ALL EROSION AND SEDIMENT CONTROL PRACTICES ARE TO BE INSTALLED PRIOR TO ANY MAJOR SOIL DISTURBANCE, OR IN THEIR PROPER SEQUENCE, AND MAINTAINED UNTIL PERMANENT PROTECTION IS ESTABLISHED.
3. EROSION AND SEDIMENTATION CONTROLS SHALL BE AUGMENTED OR SUPPLEMENTED IF THE INSTALLED MEASURES DO NOT PROVIDE ADEQUATE PROTECTION OF DOWNSTREAM RESOURCES AS DETERMINED BY THE ENGINEER.
4. ANY DISTURBED AREAS THAT WILL BE LEFT EXPOSED MORE THAN FOURTEEN (14) DAYS, AND NOT SUBJECT TO CONSTRUCTION TRAFFIC, WILL IMMEDIATELY RECEIVE TEMPORARY SEEDING AND MULCHING. IF THE SEASON PREVENTS THE ESTABLISHMENT OF TEMPORARY COVER, THE DISTURBED AREAS WILL BE MULCHED WITH HAY OR STRAW, OR EQUIVALENT MATERIAL, AT A RATE OF 2 TONS PER ACRE, ACCORDING TO CITY AND STATE STANDARDS.
5. IMMEDIATELY FOLLOWING INITIAL DISTURBANCE OR ROUGH GRADING, ALL CRITICAL AREAS SUBJECT TO EROSION (I.E. STEEP SLOPES AND TRIBUTARY/CREEK BANKS) WILL RECEIVE TEMPORARY SEEDING IN COMBINATION WITH HAY OR STRAW MULCH OR A SUITABLE EQUIVALENT, AT A RATE OF 2 TONS PER ACRE, ACCORDING TO CITY AND STATE STANDARDS.
6. THE STANDARD FOR STABILIZED CONSTRUCTION ENTRANCE REQUIRES THE INSTALLATION OF A PAD OF CLEAN CRUSHED STONE AT POINTS WHERE TRAFFIC WILL BE ACCESSING THE CONSTRUCTION SITE.
7. WHERE CONSTRUCTION VEHICLE ACCESS ROUTES INTERSECT PAVED PUBLIC ROADS, PROVISIONS SHALL BE MADE TO MINIMIZE THE TRANSPORT OF SEDIMENT BY VEHICULAR TRACKING ONTO THE PAVED SURFACE. WHERE SEDIMENT IS TRANSPORTED ONTO A PUBLIC ROAD SURFACE, THE ROAD SHALL BE CLEANED THOROUGHLY AT THE END OF EACH DAY. SEDIMENT SHALL BE REMOVED FROM THE ROADS BY SHOVELING OR SWEEPING AND TRANSPORTED TO A SEDIMENT CONTROL DISPOSAL AREA. STREET WASHING SHALL BE ALLOWED ONLY AFTER SEDIMENT IS REMOVED IN THIS MANNER.
8. DEWATERING OPERATIONS SHALL BE UNDERTAKEN IN A MANNER TO MINIMIZE SEDIMENT TRANSFER.
9. SHOULD THE CONTROL OF DUST AT THE SITE BE NECESSARY, THE SITE WILL BE SPRINKLED WITH WATER UNTIL THE SURFACE IS WET. TEMPORARY VEGETATIVE COVER SHALL BE ESTABLISHED OR MULCH SHALL BE APPLIED PER THE CITY AND STATE STANDARDS. CALCIUM CHLORIDE SHALL ONLY BE USED FOR DUST CONTROL DURING FREEZING CONDITIONS.
10. STOCKPILE AND STAGING LOCATIONS ESTABLISHED IN THE FIELD SHALL BE PLACED WITHIN THE LIMIT OF WORK WITH APPROPRIATE PROTECTIVE EROSION AND SEDIMENTATION CONTROLS.
11. THE SUBCONTRACTOR SHALL BE RESPONSIBLE FOR ANY EROSION OR SEDIMENTATION THAT MAY OCCUR DOWNGRADIENT OF STORMWATER OUTFALLS/OUTLETS OR OFFSITE AS A RESULT OF CONSTRUCTION OF THE PROJECT.



PLAN



SECTION

NOTE:

WHERE REQUIRED AT CRITICAL LOCATIONS, SILTATION FENCE REINFORCED WITH HOG OR CHICKEN WIRE OR INTEGRAL PLASTIC MESH REINFORCING MAY BE USED.

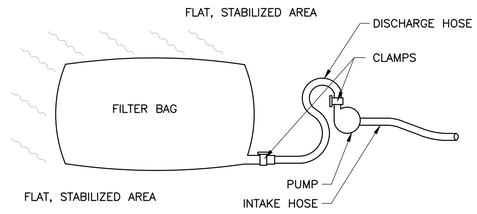
SILT FENCE (A) — NTS — TYP C–501 | C–104

EROSION AND SEDIMENT CONTROL INSPECTION AND MAINTENANCE:

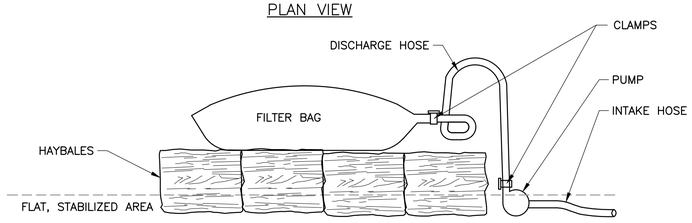
1. STABILIZED CONSTRUCTION ENTRANCE
   - A. STABILIZED CONSTRUCTION ENTRANCES SHALL, AT A MINIMUM, BE INSPECTED WEEKLY AND WITHIN 24 HOURS AFTER EVERY PRECIPITATION EVENT THAT PRODUCES 0.5 INCHES OF RAIN OR MORE DURING A 24–HOUR PERIOD.
   - B. STABILIZED CONSTRUCTION ENTRANCES SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OF SEDIMENT ONTO PAVED SURFACES. CHECK FOR DAMAGE/DETERIORATION/CLOGGING AND IMMEDIATELY REPAIR OR RECONSTRUCT AS NECESSARY.
   - C. THE PERFORMANCE OF STABILIZED CONSTRUCTION ENTRANCES SHALL BE MAINTAINED BY LENGTHENING, SCRAPING, OR TOP–DRESSING WITH ADDITIONAL AGGREGATE.
   - D. STABILIZED CONSTRUCTION ENTRANCES SHALL HAVE A 6–INCH MINIMUM THICKNESS.
   - E. INSPECT ADJACENT IMPERVIOUS SURFACES DAILY (MINIMUM). IMMEDIATELY REMOVE VISIBLE ACCUMULATED SEDIMENT DEPOSITED ON PAVED SURFACES VIA SWEEPING, VACUUMING, OR WASHING. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH AGGREGATE, WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE. PROPERLY DISPOSE OF SEDIMENT.
2. SEDIMENT BARRIERS
   - A. SILTATION FENCE
     - A.1. SILTATION FENCES SHALL, AT A MINIMUM, BE INSPECTED WEEKLY AND WITHIN 24 HOURS AFTER EVERY PRECIPITATION EVENT THAT PRODUCES 0.5 INCHES OF RAIN OR MORE DURING A 24–HOUR PERIOD.
     - A.2. REMOVE THE SEDIMENT DEPOSITS OR INSTALL A SECONDARY BARRIER UPSLOPE FROM THE EXISTING BARRIER WHEN SEDIMENT DEPOSITS REACH ONE HALF THE HEIGHT OF THE FENCE. PROPERLY DISPOSE OF SEDIMENT.
     - A.3. REPLACE OR REPAIR FENCES WITHIN 24 HOURS OF OBSERVED FAILURE (E.G., DAMAGE OR DECOMPOSITION; FENCE MOVED OUT OF POSITION; UNDERCUTTING, OVERTOPPING, OR FLOW CHANNELS AROUND THE END OF FENCES).
     - A.4. MAINTAIN SILTATION FENCES UNTIL THE CONTRIBUTING AREA IS STABILIZED.
3. DUST CONTROL
   - A. THE PROJECT SITE AND ADJACENT RESIDENTIAL AND COMMERCIAL PROPERTIES SHALL, AT A MINIMUM, BE INSPECTED DAILY.
   - B. APPLY DUST CONTROL MEASURES WHEN FUGITIVE DUST BECOMES EVIDENT.
4. ALL TEMPORARY EROSION AND SEDIMENT CONTROLS SHALL BE REMOVED ONCE UPGRADIENT AREAS ARE STABILIZED WITH ESTABLISHED VEGETATION, RIPRAP OR GRAVEL.
5. REFER TO NEW YORK CITY AND NEW YORK STATE REQUIREMENTS.

CONSTRUCTION SEQUENCE:

1. CONDUCT PRE–CONSTRUCTION MEETING WITH THE SUBCONTRACTOR ON SITE.
2. STAKE OUT DISTURBANCE, GRADING, AND DEMOLITION AREA ALONG WITH ANY OTHER PROJECT COMPONENTS.
3. INSTALL SLIT FENCE IN LOCATIONS AS SHOWN IN FIGURE C–102 AND IN ACCORDANCE WITH DETAIL M/C–303.00.
4. CLEAR NECESSARY VEGETATION WITHIN LIMITS OF CONSTRUCTION.
5. DEMOLISH CONCRETE PAD AND REMOVE ELECTRIC EQUIPMENTS FROM BLOCK 312, LOT 69, AS SHOWN IN FIGURE C–102.
6. INSTALL SIXTY EIGHT (68) EXTRACTION WELLS AS SHOWN IN FIGURE C–103.
7. EXCAVATE TRENCHES UP TO 5 FT DEPTH FOR PIPELINE INSTALLATION AND RE–GRADE BLOCK 312, LOT 69 TO ACHIEVE FINAL GRADES AS SHOWN IN FIGURE C–102.
8. INSTALL WELL HEAD AND NETWORK OF PIPELINES FOR CONVEYING VAPOR, GROUNDWATER AND PRODUCT TO TWO (2) TREATMENT EQUIPMENT ENCLOSURES.
9. BACKFILL ALL TRENCHES AND RESTORE WITH ASPHALT PAVEMENT TO PROPOSED GRADES SHOWN IN FIGURE C–102.
10. CONSTRUCT CONCRETE PAD FOR TWO TREATMENT EQUIPMENT ENCLOSURES AND FOUR (4) PRODUCT STORAGE TANKS.
11. REMOVE ALL ESC MEASURES ONCE CONSTRUCTION ACTIVITIES COMPLETED, DISTURBED AREAS ARE RESTORED WITH ASPHALT AND ANY AREAS WHICH HAVE BEEN SEEDED AND MULCHED HAVE BEEN ADEQUATELY ESTABLISHED IN ACCORDANCE WITH NEW YORK STATE AND NEW YORK CITY STANDARDS.



PLAN VIEW

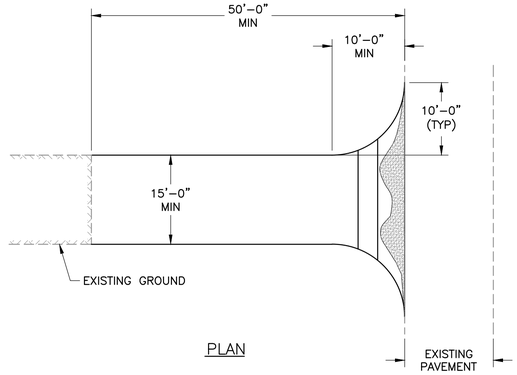


ELEVATION VIEW

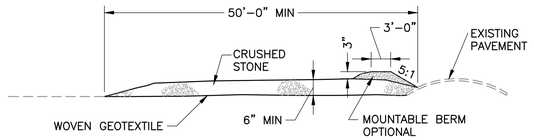
NOTE:

FILTER BAGS MUST BE LOCATED A MIN OF 50' AWAY FROM DRAINAGE FEATURES

DEWATERING FILTER BAG (B) — NTS — TYP C–501



PLAN

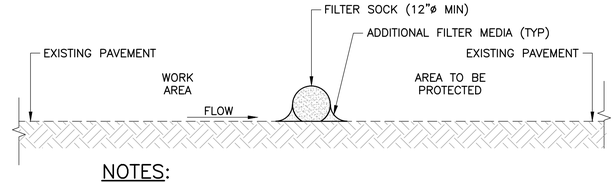


NOTE:

FOR SPECIFICATIONS AND MAINTENANCE, SEE NOTES THIS SHEET.

PROFILE

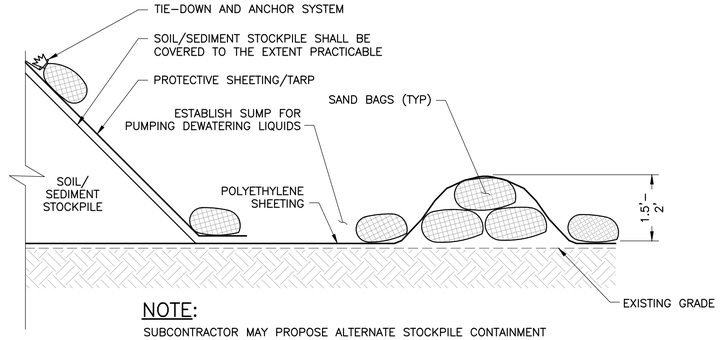
STABILIZED CONSTRUCTION ENTRANCE (C) — NTS — TYP C–501



NOTES:

1. FILTER SOCK SHALL NOT BE INSTALLED WITHIN CONCENTRATED DRAINAGE FLOW PATHS.
2. STABILIZE FILTER SOCK WITH SAND BAGS AS NECESSARY.
3. FILTER MEDIA SHALL BE COMPRISED OF WOOD WASTE COMPOST/BARK.

FILTER SOCK (D) — NTS — TYP C–501



NOTE:

SUBCONTRACTOR MAY PROPOSE ALTERNATE STOCKPILE CONTAINMENT AREA CONFIGURATIONS/DESIGNS FOR APPROVAL BY AMEC.

STOCKPILE CONTAINMENT AREA (E) — NTS — TYP C–501

NO.	DATE	DSGN	DR	CHK	APVD
2	12/22/15	W. MIKULA	M. STACEY	T. KESSLER	B. O'DELL
1	08/28/15				

RECORD DRAWINGS - FINAL — VMW BCO
RECORD DRAWINGS - DRAFT — VMW BCO
REVISION — BY APVD

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL

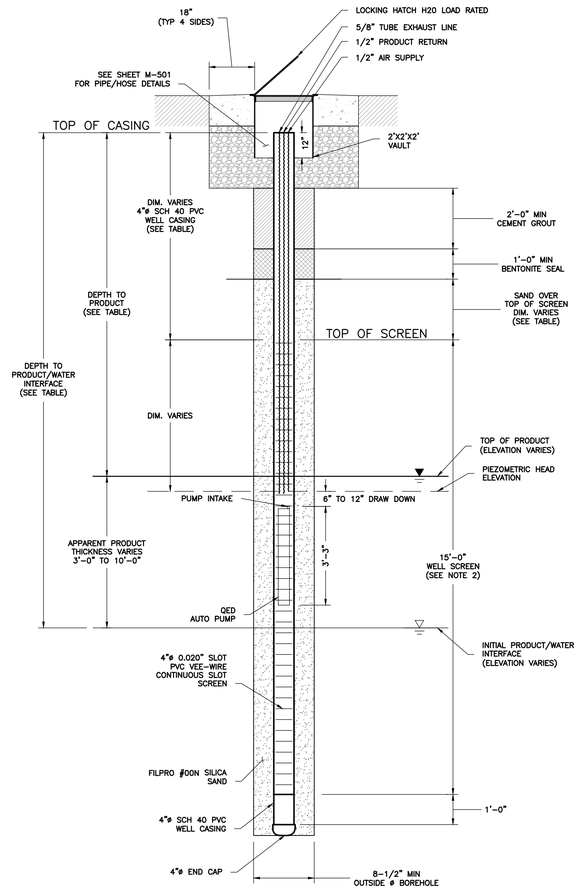
EROSION AND SEDIMENT CONTROL NOTES AND DETAILS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775–5401

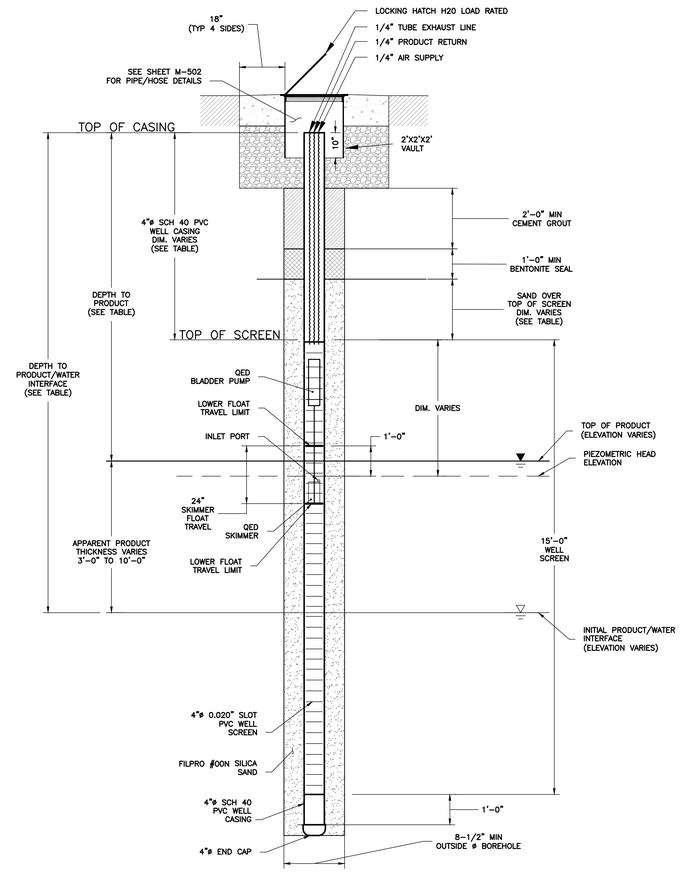
VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING. 0 — 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-501
SHEET 08 OF 31



TOTAL FLUIDS WELL DETAIL F
NTS
C-102 | C-502



SKIMMER WELL DETAIL G
NTS
C-102 | C-502

Well ID	Top of Vault Elev. (msl ft)	Top of Casing Elev. (msl ft)	Bottom of Well Elev. (1' sump) (msl ft)	Depth to Product (ft)	Depth to Product/Water Interface (ft)	Product Thickness (ft)	Approx. Avg Piezometric Head (msl ft)	Avg. Available Liquid Depth in Well (ft)	Top of Screen Elev. (msl ft)	Bottom of Screen Elev. (msl ft)	Top of Sand Pack Elev. (msl ft)	Sand Pack over Top of Screen (ft)
TF-1A	23.41	22.32	-7.48	19.21	21.21	2.00	2.91	10.39	8.52	-6.48	10.52	2.00
TF-1B[1,2]	25.25	24.25	-8.23	21.44	26.49	5.05	2.31	10.54	12.77	-7.23	14.77	2.00
TF-1C[1]	24.02	23.02	-8.24	20.25	25.06	4.81	2.29	10.53	7.76	-7.24	9.76	2.00
TF-1D	22.22	21.23	-6.67	18.02	22.49	4.47	2.76	9.43	9.33	-5.67	11.33	2.00
TF-2A	21.69	20.42	-7.18	17.95	22.51	4.56	2.01	9.19	8.82	-6.18	10.82	2.00
TF-2B[1,2]	23.67	22.67	0.07	20.35	23.26	2.91	2.03	1.96	21.07	1.07	23.07	2.00
TF-2C	23.82	22.65	-9.50	19.65	24.80	5.15	2.49	11.99	6.50	-8.50	8.50	2.00
TF-2D	21.18	19.72	-7.98	16.96	22.24	5.28	2.23	10.21	8.02	-6.98	10.02	2.00
TF-3A	19.8	17.99	-9.01	15.31	20.82	5.51	2.13	11.14	6.99	-8.01	8.99	2.00
TF-3B[1]	20.86	19.86	-5.57	17.28	23.32	6.04	1.98	7.55	10.43	-4.57	12.43	2.00
TF-3C[1]	20.84	19.84	-7.96	17.27	23.08	5.81	1.99	9.95	8.04	-6.96	10.04	2.00
TF-3D	20.53	19.67	-7.53	16.94	23.10	6.16	2.11	9.64	8.47	-6.53	10.47	2.00
TF-4A[1]	18.09	17.09	-7.40	14.86	21.63	6.77	1.55	8.95	8.60	-6.40	10.60	2.00
TF-4B	18.45	17.41	-8.59	14.63	21.33	6.70	2.11	10.70	7.41	-7.59	9.41	2.00
TF-4C	18.39	17.48	-8.22	14.73	21.16	6.43	2.11	10.33	7.78	-7.22	9.78	2.00
TF-4D	18.33	17.32	-10.78	14.46	20.35	5.89	2.27	13.05	5.22	-9.78	7.22	2.00
TF-5A	16.2	15.25	-8.80	12.69	18.89	6.20	1.94	10.74	7.20	-7.80	8.20	1.00
TF-5B	16.2	14.9	-8.80	12.24	18.87	6.63	2.00	10.80	7.20	-7.80	8.20	1.00
TF-5C	15.95	15.02	-8.38	12.47	18.52	6.05	1.95	10.33	7.62	-7.38	8.62	1.00
TF-5D	16.41	15.42	-8.18	12.72	19.39	6.67	2.03	10.21	7.82	-7.18	8.82	1.00
TF-6A	18.68	17.73	-8.47	15.28	17.06	1.78	2.27	10.74	7.53	-7.47	9.53	2.00
TF-6B	17.57	16.34	-8.91	14.07	17.52	3.45	1.93	10.84	7.09	-7.91	9.09	2.00
TF-6C[1]	16.87	15.87	-7.89	13.40	18.44	5.04	1.97	9.86	8.11	-6.89	10.11	2.00
TF-6D	16.09	14.93	-7.97	11.89	17.14	5.25	2.52	10.49	8.03	-6.97	9.03	1.00
TF-7A	19.39	18.30	-8.25	16.30	19.32	3.02	1.70	9.95	7.75	-7.25	9.75	2.00
TF-7B[1]	17.77	16.77	-7.79	14.40	18.37	3.97	1.97	9.76	8.21	-6.79	10.21	2.00
TF-7C[1]	17.52	16.52	-7.33	13.90	18.23	4.33	2.19	9.52	8.67	-6.33	10.67	2.00
TF-7D	17.11	15.93	-7.82	13.40	18.30	4.90	2.04	9.86	8.18	-6.82	10.18	2.00
TF-7E	16.03	15.09	-8.11	12.00	15.10	3.10	2.78	10.89	7.89	-7.11	8.89	1.00
TF-7F	15.40	13.89	-8.71	13.40	15.80	2.40	0.25	8.96	7.29	-7.71	8.29	1.00

ELEVATION SCHEDULE – TOTAL FLUIDS WELLS

NOTES:
1. TOP OF CASING ASSUMED TO BE 12 INCHES BELOW TOP OF VAULT BASED ON AVAILABLE FIELD INFORMATION. ELEVATIONS SUBJECT TO REVISION ONCE VAULTS ARE ACCESSED DURING O&M PERIOD.
2. TF-1B AND TF-2B HAVE 20-FOOT SCREENS.
3. DEPTH TO PRODUCT & WATER BASED ON AUGUST AND OCTOBER 2015 WELL GAUGING DATA

Well ID	Top of Vault Elev. (msl ft)	Top of Casing Elev. (msl ft)	Bottom of Well Elev. (1' sump) (msl ft)	Depth to Product (ft)	Depth to Product/Water Interface (ft)	Product Thickness (ft)	Approx. Avg Piezometric Head (msl ft)	Avg. Available Liquid Depth in Well (ft)	Top of Screen Elev. (msl ft)	Bottom of Screen Elev. (msl ft)	Top of Sand Pack Elev. (msl ft)	Sand Pack over Top of Screen (ft)
S-1A	27.54	26.25	-5.70	23.18	26.89	3.71	2.70	8.40	10.30	-4.70	12.30	2.00
S-1B	27.28	26.15	-6.25	23.02	26.84	3.82	2.75	9.00	9.75	-5.25	11.75	2.00
S-1C	25.37	24.52	-7.13	21.45	25.18	3.73	2.70	9.83	8.87	-6.13	10.87	2.00
S-1D[1]	24.34	23.34	-7.25	21.72	24.17	2.45	1.38	8.63	8.75	-6.25	10.75	2.00
S-1E	22.58	21.31	-7.09	18.07	21.46	3.39	2.90	9.99	8.91	-6.09	10.91	2.00
S-2A	26.91	25.43	-6.07	22.28	25.34	3.06	2.84	8.91	9.93	-5.07	11.93	2.00
S-2B	25.68	23.64	-7.21	20.50	23.35	2.85	2.86	10.07	8.79	-6.21	10.79	2.00
S-2C	25.68	23.42	-3.58	20.34	22.59	2.25	2.86	6.44	12.42	-2.58	14.42	2.00
S-2D	26.19	25.31	-7.69	22.12	24.17	2.05	2.99	10.68	8.31	-6.69	10.31	2.00
S-2E	25.90	24.88	-6.97	21.74	24.05	2.31	2.91	9.88	9.03	-5.97	11.03	2.00
S-3A	26.86	25.46	2.21	22.33	23.15	0.82	3.05	0.84	18.21	3.21	20.21	2.00
S-3B	27.21	25.92	-6.58	22.75	25.76	3.01	2.87	9.45	9.42	-5.58	11.42	2.00
S-3C	26.94	25.5	1.30	22.35	24.20	1.85	2.97	1.67	17.30	2.30	19.30	2.00
S-3D	26.62	24.9	-5.60	21.07	28.59	7.52	3.08	8.68	10.40	-4.60	12.40	2.00
S-3E	24.48	23.49	-7.01	20.52	24.59	4.07	2.56	9.57	8.99	-6.01	10.99	2.00
S-4A[1]	17.55	16.55	-8.85	13.97	18.44	4.47	2.13	10.98	7.15	-7.85	9.15	2.00
S-4B	17.06	16.14	-8.76	13.53	17.31	3.78	2.23	10.99	7.24	-7.76	9.24	2.00
S-4C	15.72	14.24	-7.96	11.68	14.96	3.28	2.23	10.19	8.04	-6.96	9.04	1.00
S-4D	15.67	14.21	-7.59	11.78	12.95	1.17	2.31	9.90	8.41	-6.59	9.41	1.00
S-4E	15.38	13.70	-8.70	11.41	11.41	0.00	2.29	10.99	7.30	-7.70	8.30	1.00
S-5A	24.33	23.40	-8.50	20.67	22.44	1.77	2.55	11.05	7.50	-7.50	9.50	2.00
S-5B	22.52	21.50	-9.45	18.66	20.69	2.03	2.64	12.09	6.55	-8.45	8.55	2.00
S-5C[1]	20.96	19.96	-8.85	17.35	19.61	2.26	2.38	11.23	7.15	-7.85	9.15	2.00
S-5D	18.76	17.76	-8.64	14.91	17.82	2.91	2.56	11.20	7.36	-7.64	9.36	2.00
S-5E[1]	18.23	17.23	-7.85	14.76	18.82	4.06	2.06	9.91	8.15	-6.85	10.15	2.00
S-6A	24.10	23.01	-7.49	20.43	21.38	0.95	2.49	9.98	8.51	-6.49	10.51	2.00
S-6B[1]	22.21	21.21	-9.53	18.66	20.34	1.68	2.38	11.91	6.47	-8.53	8.47	2.00
S-6C	20.51	19.42	-8.58	16.68	18.89	2.21	2.52	11.10	7.42	-7.58	9.42	2.00
S-6D[1]	18.33	17.33	-7.93	14.84	17.45	2.61	2.23	10.16	8.07	-6.93	10.07	2.00
S-6E[1]	18.23	17.23	-7.91	14.70	17.80	3.10	2.22	10.13	8.09	-6.91	10.09	2.00
S-7A[1]	21.65	20.65	-7.94	18.21	19.40	1.19	2.32	10.26	8.06	-6.94	10.06	2.00
S-7B[1]	20.44	19.44	-7.20	17.00	18.76	1.76	2.26	9.46	8.80	-6.20	10.80	2.00
S-7C	18.10	17.24	-8.66	14.42	16.65	2.23	2.60	11.26	7.34	-7.66	9.34	2.00
S-7D	18.09	17.14	-9.36	15.11	16.91	1.80	1.85	11.21	6.64	-8.36	8.64	2.00
S-8A[1]	23.42	22.42	-7.68	19.91	20.83	0.92	2.42	10.09	8.32	-6.68	10.32	2.00
S-8B	18.99	17.99	-8.77	15.44	19.67	4.23	2.13	10.90	7.23	-7.77	9.23	2.00
S-8C	18.08	16.90	-8.30	14.10	16.13	2.03	2.60	10.90	7.70	-7.30	9.70	2.00
S-8D[1]	18.12	17.12	-1.58	14.41	16.82	2.41	2.47	4.05	14.42	-0.58	16.42	2.00

ELEVATION SCHEDULE – SKIMMER WELLS

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
2	12/22/15	T. KESSLER	V. WHELAN	T. KESSLER	B. O'DELL	VMW	BCO
1	08/28/15			REVISION		VMW	BCO

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
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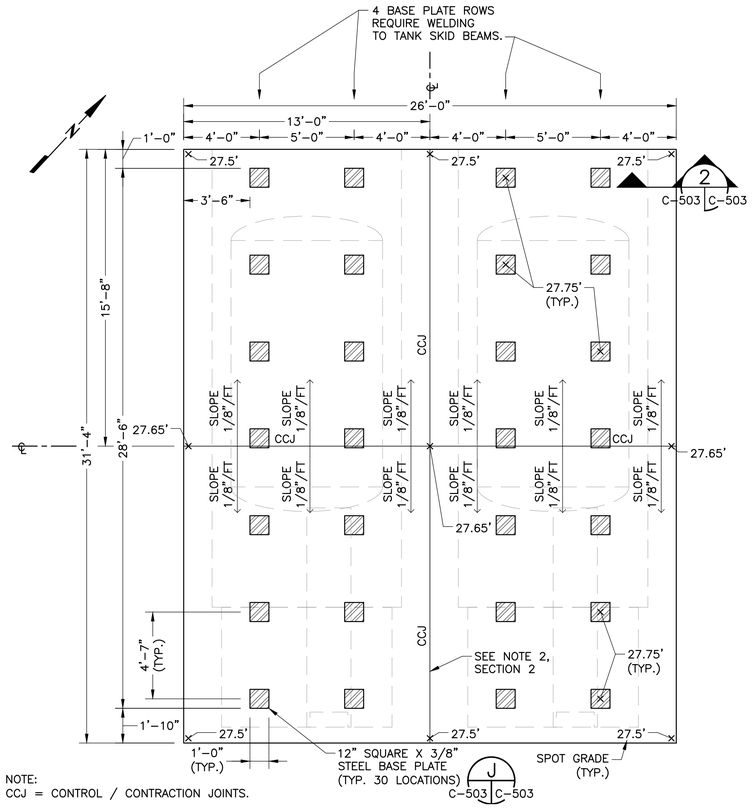
TOTAL FLUIDS WELL & VER WELL
DETAILS AND SCHEDULES

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-502
SHEET 09 OF 31

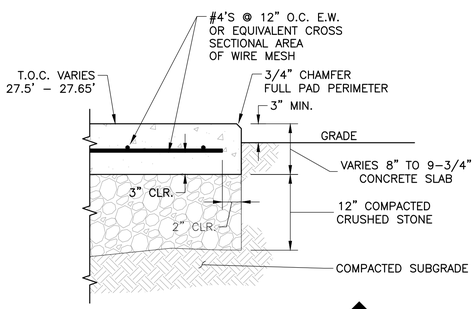


NOTE:
CCJ = CONTROL / CONTRACTION JOINTS.

0 2 4 8
SCALE: 1" = 4'

TANK FOUNDATION CONCRETE PAD H
1" = 4'
C-103 C-503

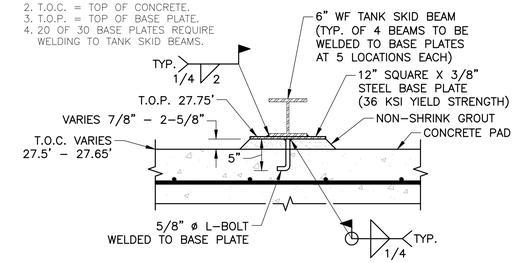
NOTES:
1. CRUSHED STONE SHALL CONSIST OF NYSDOT CRUSHED STONE SIZE DESIGNATION NO. 1 OR 2 PER TABLE 703-4. COMPACT TO MIN. 95% OF MAX. DENSITY PER MODIFIED PROCTOR.
2. CONCRETE MIX: THE CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH (F'C) OF 4000 PSI; AGGREGATE SIZE 467 (2-INCH MINUS); SLUMP RANGE 3 (± 1) INCHES; MAXIMUM WATER/CEMENT RATIO 0.45; AIR-ENTRAINMENT 6 (± 2) PERCENT. AT THE OPTION OF THE CONTRACTOR, THOSE APPLICABLE MATERIAL SECTIONS OF NYSDOT STANDARD SPECIFICATIONS (SS) FOR CLASS E CONCRETE SHALL GOVERN IN LIEU OF THIS SPECIFICATION FOR CONCRETE.
3. CONTROL/CONTRACTION JOINTS (CCJ) SHALL BE INSTALLED VIA SAW-CUTTING ONCE SUFFICIENT CONCRETE STRENGTH HAS DEVELOPED TO PREVENT SAWING WITHOUT EXCESSIVE RAVELING ALONG THE CUT. LATE SAWING CAN CAUSE RANDOM CRACKING AND MUST BE AVOIDED. SEAL JOINTS WITH SILICONE SEALANT. INITIAL SAW-CUT DEPTH SHALL BE 2". SEALANT WIDTH SHALL BE ½" AND EXTEND TO A DEPTH OF ¾". TOP OF SEALANT SHALL BE DEPRESSED 1/8" TO ¼" BELOW TOP OF CONCRETE. ALTERNATE CCJ DETAILS CAN BE UTILIZED UPON ENGINEER'S APPROVAL.
4. STEEL REINFORCEMENT SHALL BE GRADE 60 BARS OR EQUIVALENT WIRE MESH.
5. T.O.C. = TOP OF CONCRETE.



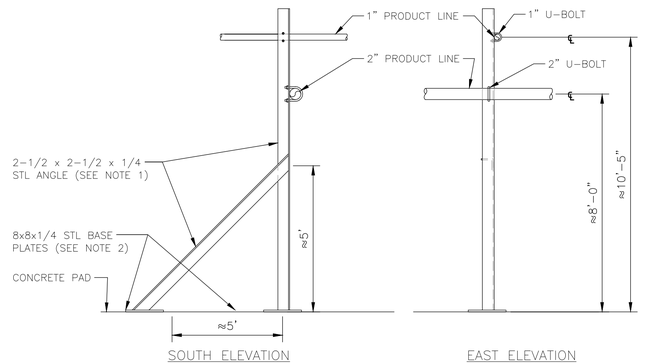
TANK FOUNDATION CONCRETE PAD SECTION 2
1" = 1'
C-503 C-503

0 0.5 1 2
SCALE: 1" = 1'

NOTES:
1. WELDING ELECTRODES SHALL BE E60XX.
2. T.O.C. = TOP OF CONCRETE.
3. T.O.P. = TOP OF BASE PLATE.
4. 20 OF 30 BASE PLATES REQUIRE WELDING TO TANK SKID BEAMS.



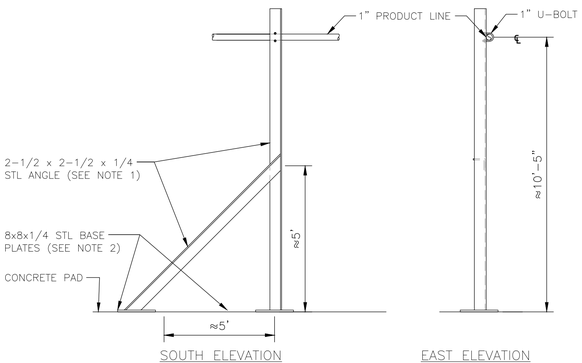
BASE PLATE DETAIL J
1" = 1'
C-503 C-503



SOUTH ELEVATION — EAST ELEVATION

NOTES:
1. CONNECT ANGLE W/ 1/4" FILLET WELDS ALL AROUND.
2. SECURE EACH BASE PLATE TO CONC. PAD W/ FOUR (4) 1/2" ADHESIVE ANCHORS W/ MIN. 4" EMBEDMENT.
3. U-BOLTS SHALL BE 3/8" LIGHT WEIGHT FOR 2" PIPE AND SMALLER.

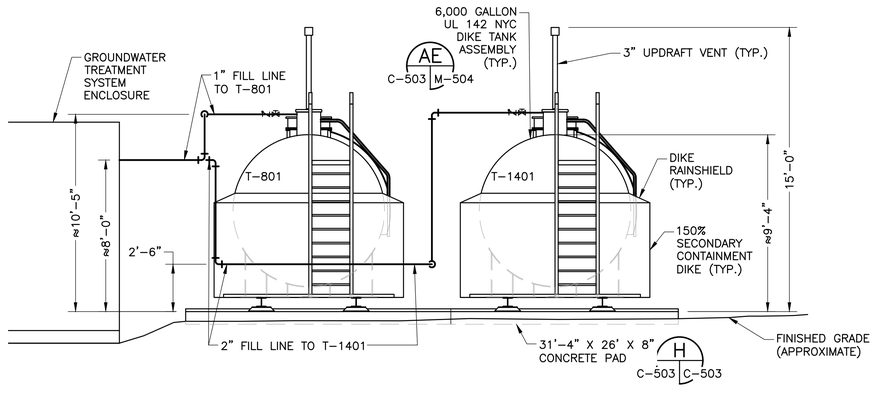
PIPE SUPPORT TYPE 1 I1
NTS
C-103 C-503



SOUTH ELEVATION — EAST ELEVATION

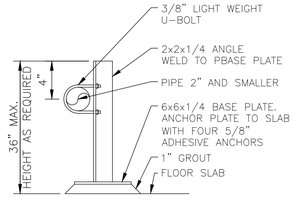
NOTES:
1. CONNECT ANGLE W/ 1/4" FILLET WELDS ALL AROUND.
2. SECURE EACH BASE PLATE TO CONC. PAD W/ FOUR (4) 1/2" ADHESIVE ANCHORS W/ MIN. 4" EMBEDMENT.
3. U-BOLTS SHALL BE 3/8" LIGHT WEIGHT FOR 2" PIPE AND SMALLER.

PIPE SUPPORT TYPE 2 I2
NTS
C-103 C-503



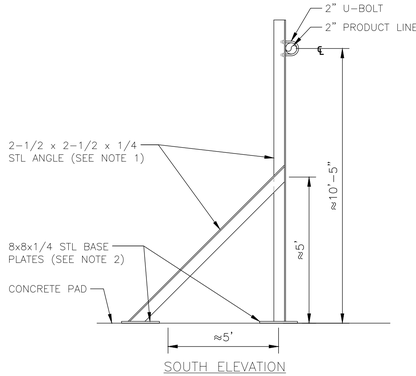
0 2 4 8
SCALE: 1" = 4'

PRODUCT STORAGE TANK SECTION 1
1" = 4'
C-103 C-503



NOTE:
1. MAXIMUM PIPE SUPPORT SPACING: 1" PIPE - 8.5'; 2" PIPE - 11.5'

PIPE SUPPORT TYPE 3 I3
NTS
C-103 C-503



SOUTH ELEVATION

NOTES:
1. CONNECT ANGLE W/ 1/4" FILLET WELDS ALL AROUND.
2. SECURE EACH BASE PLATE TO CONC. PAD W/ FOUR (4) 1/2" ADHESIVE ANCHORS W/ MIN. 4" EMBEDMENT.
3. U-BOLTS SHALL BE 3/8" LIGHT WEIGHT FOR 2" PIPE AND SMALLER.

PIPE SUPPORT TYPE 4 I4
NTS
C-103 C-503

NO.	DATE	DSGN	DR	CHK	APVD	REVISION
2	12/22/15	T. KESSLER	S. MAZZA	T. KESSLER	B. O'DELL	RECORD DRAWINGS - FINAL
1	08/28/15			VMW	BCO	RECORD DRAWINGS - DRAFT

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
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RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

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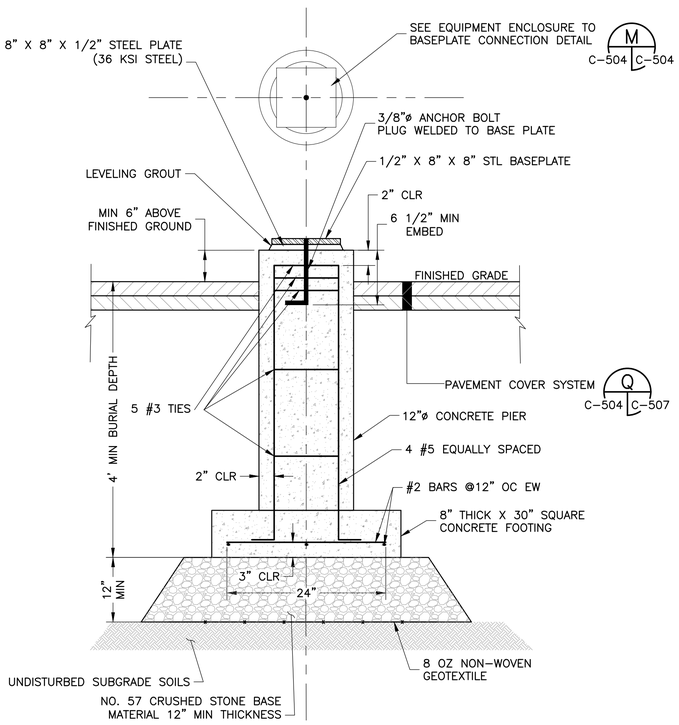
TANK FOUNDATION AND PIPE SUPPORT DETAILS

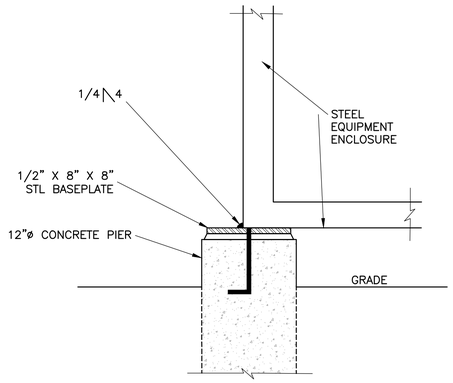
MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

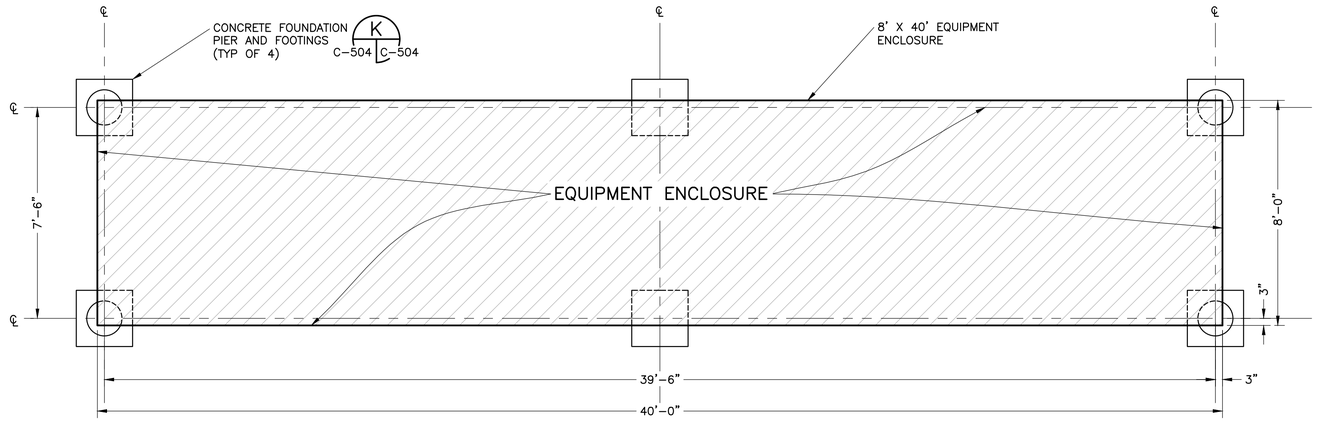
DATE	12/22/15
PROJ NO:	3480140433
DWG	C-503
SHEET	10 OF 31



CONCRETE FOUNDATION PIER AND FOOTING
NTS
K
C-504 C-504



EQUIPMENT ENCLOSURE TO
BASEPLATE CONNECTION DETAIL
NTS
M
C-504 C-504



EQUIPMENT ENCLOSURE PIER AND TIE-DOWN
NTS
L
C-103 C-504

FOUNDATION NOTES:

1. THE CONTRACTOR SHALL VERIFY DIMENSIONS PRIOR TO OBTAINING AND FABRICATING MATERIALS FOR THE WORK.

2. THE CONTRACTOR SHALL VERIFY THE ACTUAL FIELD LOCATION OF ALL UNDERGROUND UTILITIES WITHIN THE WORK LIMITS PRIOR TO CONDUCTING EXCAVATION ACTIVITIES.

CONCRETE WORK:

1. CONCRETE SHALL BE PREPARED, PLACED AND CURED IN ACCORDANCE WITH ACI 318-02 OR LATEST EDITION.

2. ALL SPLICES IN REINFORCEMENT SHALL BE CLASS B SPLICES AS PER ACI 318.

3. CONCRETE MATERIALS:

- CEMENT: ASTM C 150, TYPE I OR II OR ASTM C 595, TYPE IP(MS) OR IS(MS) BLENDED CEMENT.
- AGGREGATES: ASTM C 33. FURNISH AGGREGATES FOR EXPOSED CONCRETE SURFACES FROM ONE SOURCE. AGGREGATES SHALL NOT CONTAIN ANY SUBSTANCE WHICH MAY BE DELETERIOUSLY REACTIVE WITH THE ALKALIES IN THE CEMENT.
- REINFORCING BARS: ACI 301 UNLESS OTHERWISE INDICATED. ASTM A 615 WITH THE BARS MARKED W, GRADE 60.
- NONSHRINK GROUT: ASTM C 1107.
- AIR-ENTRAINING: ASTM C 260.
- HIGH RANGE WATER REDUCER (HRWR) (SUPERPLASTICIZERS): ASTM C 494, TYPE F AND ASTM C 1017.
- EPOXY BONDING COMPOUND: ASTM C 881. PROVIDE TYPE I FOR BONDING HARDENED CONCRETE TO HARDENED CONCRETE; TYPE II FOR BONDING FRESHLY MIXED CONCRETE TO HARDENED CONCRETE. PROVIDE GRADE 1 OR 2 FOR HORIZONTAL SURFACES AND GRADE 3 FOR VERTICAL SURFACES.
- CONCRETE COATING – POLYAMIDE EPOXY COATING SUITABLE FOR OCCASIONAL CONTACT WITH ETHYLENEDIAMINE (EDA) FOR A CONCRETE SECONDARY CONTAINMENT APPLICATION. USE HI-BUILD EPOXOLINE SERIES 66, MANUFACTURED BY TNEMEC COMPANY, INC., OR APPROVED EQUAL. COLOR GRAY. CONCRETE CURING, PREPARATION, AND COATING APPLICATION SHALL BE PER MANUFACTURER INSTRUCTIONS. CONTRACTOR SHALL PRICE COATING AS A SEPARATE OPTION. IF COATING OPTION IS SELECTED, CONTRACTOR SHALL BE PREPARED TO APPLY COATING AFTER INSTALLATION OF THE EDARS SKID.

4. CONCRETE MIX:

- CONTRACTOR-FURNISHED MIX DESIGN: ACI 211.1, ACI 301, AND ACI 318 EXCEPT AS OTHERWISE INDICATED. THE CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH (F'C) OF 4000 PSI; AGGREGATE SIZE 467 (2-INCH MINUS); SLUMP RANGE 3 (± 1) INCHES; MAXIMUM WATER/CEMENT RATIO 0.45; AIR-ENTRAINMENT 6 (± 2) PERCENT.
- CONTRACTOR'S OPTION FOR MATERIAL ONLY: AT THE OPTION OF THE CONTRACTOR, THOSE APPLICABLE MATERIAL SECTIONS OF NJDOT STANDARD SPECIFICATIONS (SS) FOR CLASS B CONCRETE SHALL GOVERN IN LIEU OF THIS SPECIFICATION FOR CONCRETE. DO NOT CHANGE THE SELECTED OPTION DURING THE COURSE OF THE WORK.
- MAXIMUM SLUMP SHOWN ABOVE MAY BE INCREASED ONE INCH FOR METHODS OF CONSOLIDATION OTHER THAN VIBRATION. SLUMP MAY BE INCREASED TO 8 INCHES WHEN SUPERPLASTICIZERS ARE USED. PROVIDE AIR ENTRAINMENT USING AIR-ENTRAINING ADMIXTURE.

5. CONCRETE TESTING:

- SLUMP TESTS: ASTM C 143. TAKE CONCRETE SAMPLES DURING CONCRETE PLACEMENT. THE MAXIMUM SLUMP MAY BE INCREASED AS SPECIFIED WITH THE ADDITION OF AN APPROVED ADMIXTURE PROVIDED THAT THE WATER-CEMENT RATIO IS NOT EXCEEDED. PERFORM TESTS AT COMMENCEMENT OF CONCRETE PLACEMENT, WHEN TEST CYLINDERS ARE MADE, AND FOR EACH BATCH (MINIMUM) OR EVERY 20 CUBIC YARDS (MAXIMUM) OF CONCRETE.
- COMPRESSIVE STRENGTH TESTS: ASTM C 39. MAKE FIVE TEST CYLINDERS FOR BATCH OF CONCRETE IN ACCORDANCE WITH ASTM C 31. TEST TWO CYLINDERS AT 7 DAYS, TWO CYLINDERS AT 28 DAYS, AND HOLD ONE CYLINDER IN RESERVE. SAMPLES FOR STRENGTH TESTS OF EACH MIX DESIGN OF AND FOR CONCRETE PLACED EACH DAY. EACH STRENGTH TEST RESULT SHALL BE THE AVERAGE OF TWO CYLINDERS FROM THE SAME CONCRETE SAMPLE TESTED AT 28 DAYS. IF THE AVERAGE OF ANY THREE CONSECUTIVE STRENGTH TEST RESULTS IS LESS THAN F'C OR IF ANY STRENGTH TEST RESULT FALLS BELOW F'C BY MORE THAN 500 PSI, TAKE A MINIMUM OF THREE ASTM C 42 CORE SAMPLES FROM THE IN-PLACE WORK REPRESENTED BY THE LOW TEST CYLINDER RESULTS AND TEST. CONCRETE REPRESENTED BY CORE TEST SHALL BE CONSIDERED STRUCTURALLY ADEQUATE IF THE AVERAGE OF THREE CORES IS EQUAL TO AT LEAST 85 PERCENT OF F'C AND IF NO SINGLE CORE IS LESS THAN 75 PERCENT OF F'C. LOCATIONS REPRESENTED BY ERRATIC CORE STRENGTHS SHALL BE RETESTED. REMOVE CONCRETE NOT MEETING STRENGTH CRITERIA AND PROVIDE NEW ACCEPTABLE CONCRETE. REPAIR CORE HOLES WITH NONSHRINK GROUT.

EARTHWORK:

1. BASE MATERIAL:

- USE CRUSHED STONE CONSISTING OF COARSE AGGREGATE BASE MATERIAL IN ACCORDANCE WITH AASHTO SIZE NO. 57.
- THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER 1 GRAIN SIZE ANALYSIS FOR EACH SOURCE OF CRUSHED STONE BASE MATERIAL USED.

2. BACKFILL PLACEMENT:

- PRIOR TO BACKFILL PLACEMENT, INSPECT THE SUBGRADE FOR SOFT AREAS AND EXCAVATE UNSATISFACTORY MATERIAL AS DIRECTED BY THE ENGINEER AND BACKFILL WITH CRUSHED STONE BASE MATERIAL. PROOF-ROLL AND COMPACT THE SUBGRADE TO PROVIDE A FIRM UNYIELDING SURFACE.
- PLACE MATERIALS IN LIFTS HAVING A LOOSE THICKNESS SUCH WHEN COMPACTED, THE COMPACTED LIFT SHALL HAVE A NOMINAL THICKNESS OF 10 INCHES OR LESS.
- COMPACT WITH VIBRATION PLATE METHOD.

ANCHOR BOLTS:

- CAST-IN-PLACE THREADED ROD ANCHOR BOLTS OF DIAMETER SHOWN SHALL BE ASTM F 1554, GRADE 36. AND SET TO MINIMUM EMBEDMENT SHOWN. VERIFY LOCATION AND PATTERN OF BOLTS PRIOR TO INSTALLATION AND POURING CONCRETE.

NO.	DATE	DSGN	DR	CHK	APVD	BY
2	12/22/15	T. KESSLER	S. MAZZA	T. KESSLER	APVD	B. O'DELL
1	08/28/15					

REVISION

RECORD DRAWINGS - DRAFT — VMW BCO
RECORD DRAWINGS - FINAL — VMW BCO

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
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MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
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VERIFY SCALE
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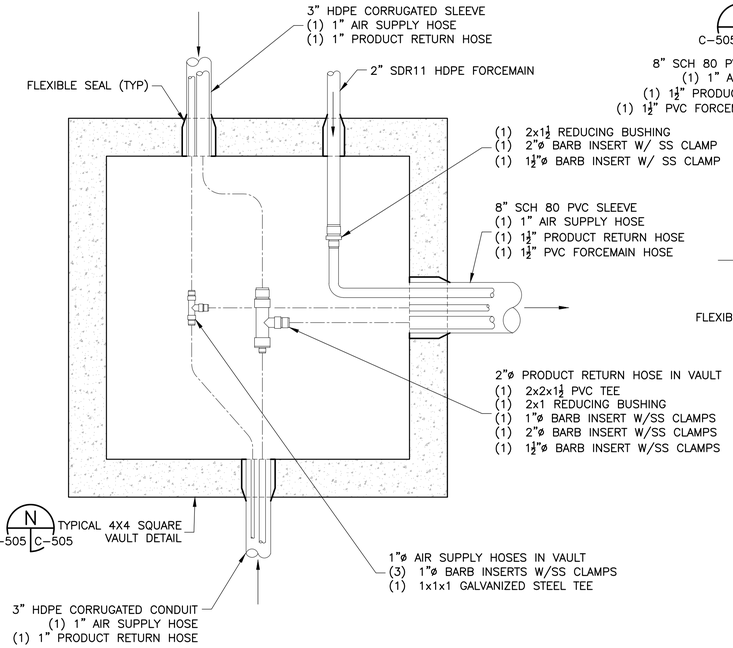
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-504
SHEET 11 OF 31

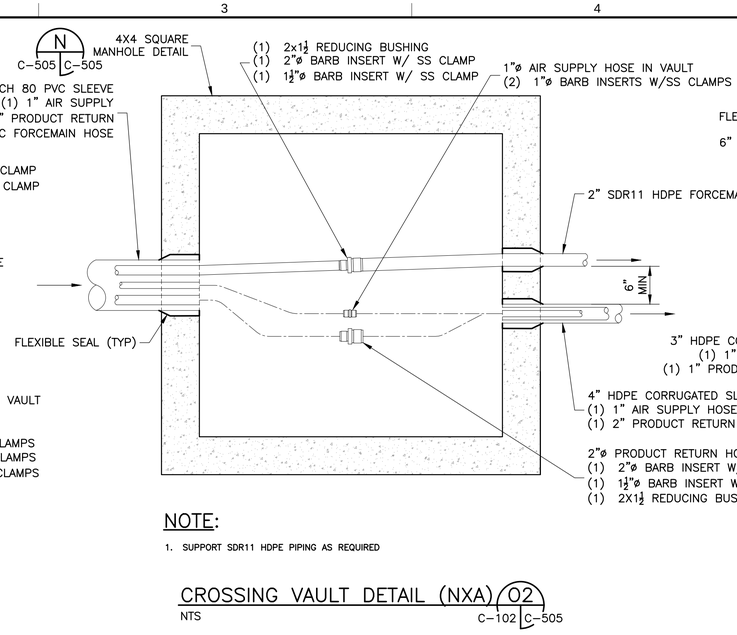


NOTE:

1. SUPPORT SDR11 HDPE PIPING AS REQUIRED

CROSSING VAULT DETAIL (NXB) 01

NTS — C-102 | C-505

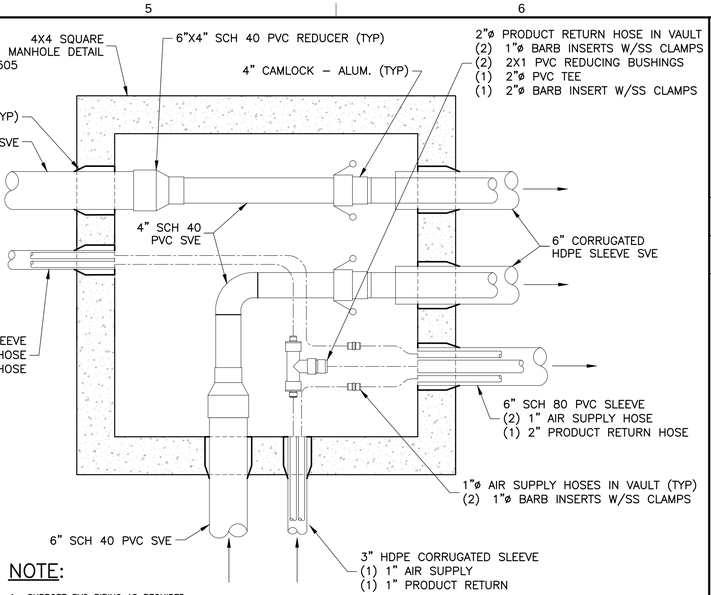


NOTE:

1. SUPPORT SDR11 HDPE PIPING AS REQUIRED

CROSSING VAULT DETAIL (NXA) 02

NTS — C-102 | C-505

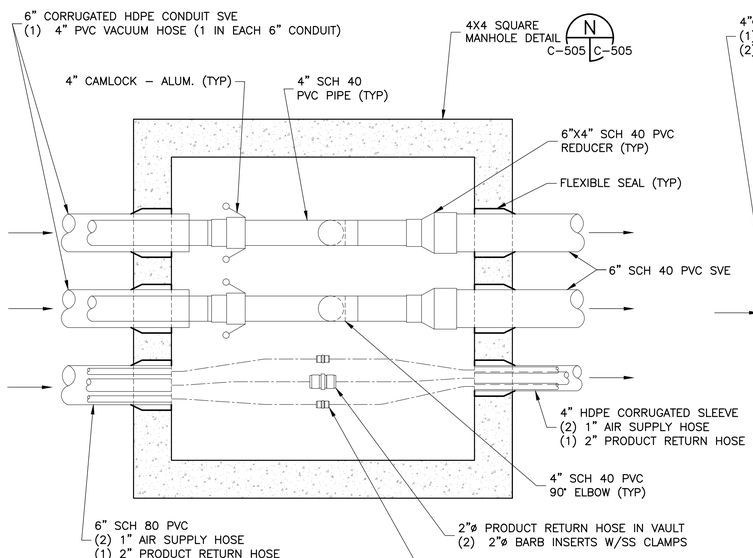


NOTE:

1. SUPPORT PVC PIPING AS REQUIRED

CROSSING VAULT DETAIL (SXB) 03

NTS — C-102 | C-505

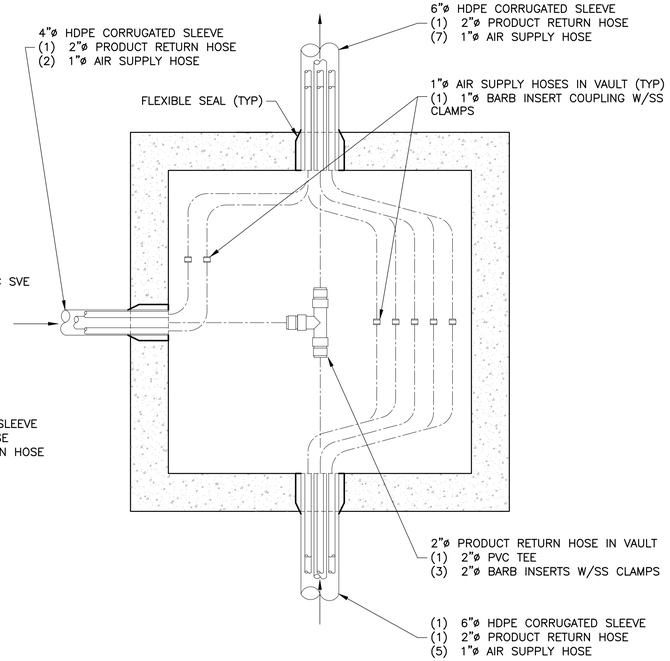


NOTE:

1. SUPPORT PVC PIPING AS REQUIRED

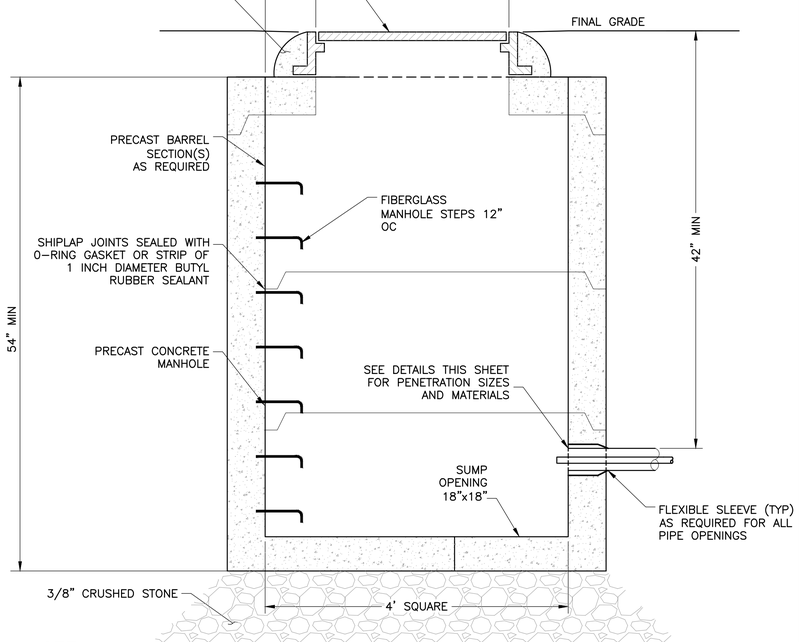
CROSSING VAULT DETAIL (SXA) 04

NTS — C-102 | C-505



TOTAL FLUIDS HOSE VAULT P

NTS — C-102 | C-505



NOTE:

1. FOR MANHOLE SPECIFICATIONS SEE "SEWER DESIGN STANDARDS, (SEPTEMBER 2007) REVISED JANUARY 5, 2009, THE CITY OF NEW YORK BUREAU OF WATER AND SEWER OPERATIONS DEPARTMENT OF ENVIRONMENTAL PROTECTION".
2. INSTALL OPENINGS AS REQUIRED TO INSTALL PIPING.

TYPICAL 4X4 SQUARE VAULT DETAIL N

NTS — C-505 | C-505

NO.	DATE	DSGN	DR	CHK	APVD	BY
2	12/22/15	C. THERIAULT	M. STACEY	T. KESSLER		B. O'DELL
1	08/28/15				VMW	BCO
					VMW	BCO

REVISION

RECORD DRAWINGS - FINAL

RECORD DRAWINGS - DRAFT

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL

CROSSING AND HOSE VAULT DETAILS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

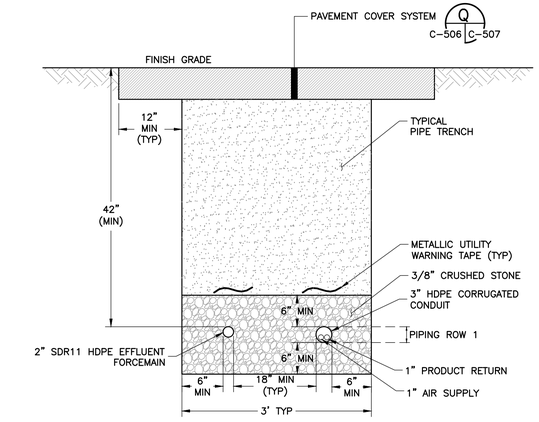
VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

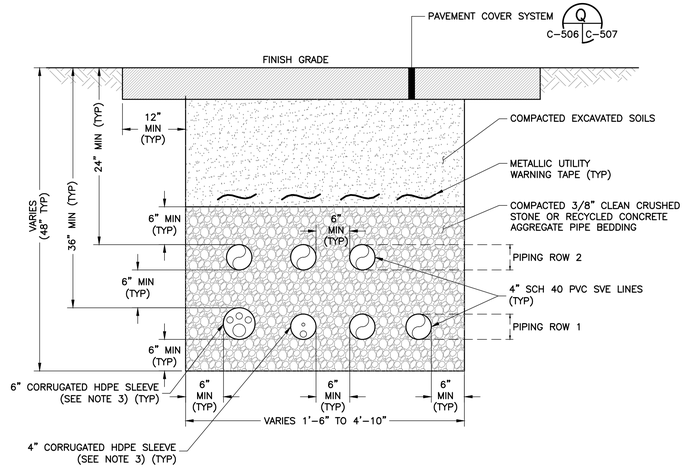
DATE	12/22/15
PROJ NO:	3480140433
DWG	C-505
SHEET	12 OF 31

NOTES:

1. 4" SCH 40 PVC SVE LINES SHALL CONFORM TO ASTM 1785 COMPLETE WITH PRESSURE STYLE FITTINGS..
2. 4" OR 6" CORRUGATED HDPE SLEEVES SHALL BE ADS N-12 ST IB SMOOTH ID PIPE (ASTM F2648) OR ENGINEER APPROVED EQUAL.
3. HDPE SLEEVES SHALL CARRY ½" OR ¾" ID COMPRESSED AIRLINES AND/OR 1" TO 2" ID SKIMMER WELL PRODUCT OR TOTAL FLUIDS WELL PRODUCT/GROUNDWATER TUBING.
4. DEPTHS LISTED IN TABLES ARE APPROXIMATE ONLY. DATA SHOWN IS INTENDED TO DESCRIBE ACTUAL CONFIGURATION OF PIPING WITHIN EACH TRENCH SEGMENT.



TRENCH SECTION 3
NTS C-102 C-506



TYPICAL REMEDIATION SYTEM PROCESS PIPING TRENCH 4
NTS C-102 C-506

Trench Segment ID	From	To	Piping Row 1 (Deep)	Piping Row 2 (Shallow)	Sleeve 1 Contents	Sleeve 2 Contents	Sleeve 3 Contents	Comments
1A	TE1	J1	2 - 4" SVE	5 - 4" SVE	N/A	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 24" below finished grade
1B	TE1	J1	2 - 6" Sleeves	None	1 - 2" Total Fluids	7 - 3/4" Air	N/A	
1	Trench Segment 1A/1B Merger	Hose Vault	2 - 6" Sleeves 2 - 4" SVE	5 - 4" SVE	1 - 2" Total Fluids	7 - 3/4" Air	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 24" below finished grade
1C	Hose Vault	TF1A	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
2	Hose Vault	TF2A	1 - 6" Sleeve 1 - 4" SVE	3 - 4" SVE	1 - 2" Total Fluids 4 - 3/4"" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 24" below finished grade
3	TF2A	TF3A	1 - 6" Sleeve 1 - 4" SVE	2 - 4" SVE	1 - 2" Total Fluids 3 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 24" below finished grade
4	TF3A	TF4A	1 - 4" Sleeve 1 - 4" SVE	1 - 4" SVE	1 - 1.5" Total Fluids 2 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 24" below finished grade
5	TF4A	TF5A	1 - 4" Sleeve	1 - 4" SVE	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 24" below finished grade
6	TF1A	TF1B	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
7	TF1B	TF1C	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
8	TF1C	TF1D	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
9	TF2A	TF2B	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
10	TF2B	TF2C	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
11	TF2C	TF2D	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
12	TF3A	TF3B	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
13	TF3B	TF3C	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
14	TF3C	TF3D	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
15	TF4A	TF4B	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
16	TF4B	TF4C	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
17	TF4C	TF4D	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
18	TF5A	TF5B	1 - 4" Sleeve	1 - 4" SVE	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 approx. 36" below finished grade. ***Maintain SVE Line slope towards TF5A***
19	TF5B	TF5C	1 - 4" Sleeve	1 - 4" SVE	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 approx. 33" below finished grade. ***Maintain SVE Line slope towards TF5B***
20	TF5C	TF5D	1 - 4" Sleeve	1 - 4" SVE	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 approx. 33" below finished grade. ***Maintain SVE Line slope towards TF5C***
21	Hose Vault	SXA	1 - 6" Sleeve	2 - 4" SVE	1 - 2" Total Fluids 2 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade, Row 2 Min. 30" below finished grade. ***Maintain SVE Lines slope towards Crossing Vault SXA***
22	SXA	SXB	3 - 6" Sleeves	None	1 - 2" Total Fluids 2 - 3/4" Air	1 - 4" SVE	1 - 4" SVE	Row 1 is Min. 36" below grade
23	SXB	TF6A	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
24	TF6A	TF6B	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
25	TF6B	TF6C	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
26	TF6C	TF6D	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
27	SXB	TF7A	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
28	TF7A	TF7B	1 - 6" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air (TF Pumps) 1 - 1" Product 1 - 1/2" Air (SKIM Pumps)	N/A	N/A	Row 1 is Min. 36" below finished grade
29	TF7B	TF7C	1 - 6" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air (TF Pumps) 1 - 1" Product 1 - 1/2" Air (SKIM Pumps)	N/A	N/A	Row 1 is Min. 36" below finished grade
30	TF7C	TF7D	1 - 6" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air (TF Pumps) 1 - 1" Product 1 - 1/2" Air (SKIM Pumps)	N/A	N/A	Row 1 is Min. 36" below finished grade
31	TF7D	TF7E	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1.5" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
32	TF7E	TF7F	1 - 4" Sleeve 1 - 4" SVE	None	1 - 1" Total Fluids 1 - 3/4" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
33	TF7D	S4A	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
34	S4A	S4B	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
35	S4B	S4C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
36	S4C	S4D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade

Trench Segment ID	From	To	Piping Row 1 (Deep)	Piping Row 2 (Shallow)	Sleeve 1 Contents	Sleeve 2 Contents	Sleeve 3 Contents	Comments
37	S4D	S4E	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
38	TE1	S1A	1 - 4" Sleeve	None	1 - 1" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
39	TE2	S1A	1 - 2" EFF FM 1 - 6" Sleeve	None	1 - 2" Product	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
40	S1A	S1B	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
41	S1B	S1C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
42	S1C	S1D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
43	S1D	S1E	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
44	S1A	S2A	1 - 2" EFF FM 1 - 6" Sleeve	None	1 - 2" Product 1 - 1" Air	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
45	S2A	S2B	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
46	S2B	S2C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
47	S2A	S3A	1 - 2" EFF FM 1 - 6" Sleeve	None	1 - 2" Product 1 - 1" Air 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
48	S3A	S2E	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
49	S2E	S2D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
50	S3A	S3B	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
51	S3B	S3C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
52	S3C	S3D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
53	S3D	S3E	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
54	S3A	NXA	1 - 2" EFF FM 1 - 6" Sleeve	None	1 - 2" Product 1 - 1" Air	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
55	NXA	NXB	1-8" Sleeve	None	1 - 2" EFF FM 1 - 2" Product 1 - 1" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
56	NXB	S5A	1 - 2" EFF FM 1 - 4" Sleeve	None	1 - 1" Product 1 - 1" Air	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
57	NXB	S5B	1 - 4" Sleeve	None	1 - 1" Product 2 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
58	S5B	S5C	1 - 4" Sleeve	None	1 - 1" Product 2 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
59	S5C	TF7A	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
60	S5C	S5D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
61	S5D	S5E	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
62	S5A	S6A	1 - 2" EFF FM 1 - 4" Sleeve	None	1 - 1" Product 1 - 1" Air	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
63	S6A	Drop Manhole	1 - 2" EFF FM	None	N/A	N/A	N/A	Row 1 is Min. 42" below finished grade due to Plumbing Code
64	S6A	S6B	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
65	S6B	S6C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
66	S6C	S6D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
67	S6D	S6E	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
68	S6A	S8A	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
69	S8A	S7A	1 - 4" Sleeve	None	1 - 1" Product 2 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
70	S7A	S7B	1 - 4" Sleeve	None	1 - 1" Product 2 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
71	S7B	S7C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
72	S7C	S7D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
73	S7B	S8B	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
74	S8B	S8C	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade
75	S8C	S8D	1 - 4" Sleeve	None	1 - 1" Product 1 - 1/2" Air	N/A	N/A	Row 1 is Min. 36" below finished grade

PROCESS PIPING TRENCH SEGMENT SUMMARY TABLES

BRENT C. O'DELL
NEW YORK, PE NO. 090976

NO.	DATE	DSGN	DR	CHK	APVD	BY	APVD
2	12/22/15	T. KESSLER	V. WHELAN	T. KESSLER		VMW	BCO
1	08/28/15					VMW	BCO
				REVISION			B. O'DELL

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT

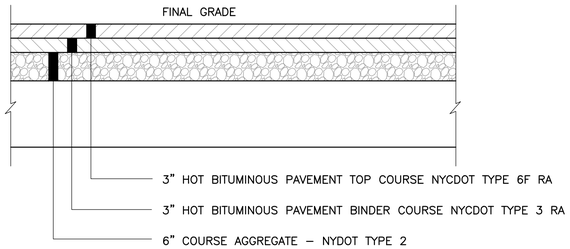
RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES, RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL
PROCESS PIPE TRENCH DETAILS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG C-506
SHEET 13 OF 31



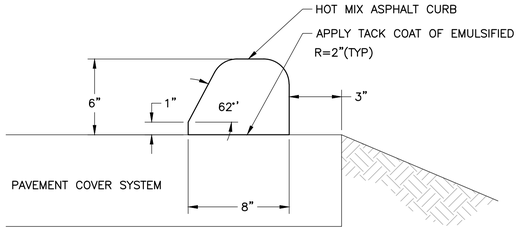
NOTE:

1. ASPHALT PAVEMENT COVER SYSTEM SHALL BE PROVIDED PER THIS DETAIL, HOWEVER, AN ALTERNATE, EQUIVALENT COVER SYSTEM MAY BE UTILIZED BENEATH TREATMENT SYSTEM EQUIPMENT ENCLOSURES UPON ENGINEERS APPROVAL.

PAVEMENT COVER SYSTEM Q

NTS

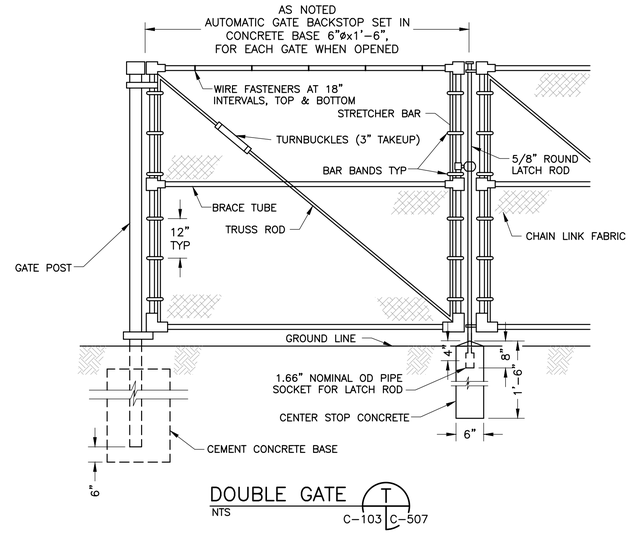
C–104 C–504 C–506 C–507



HOT MIX ASPHALT CURB R

NTS

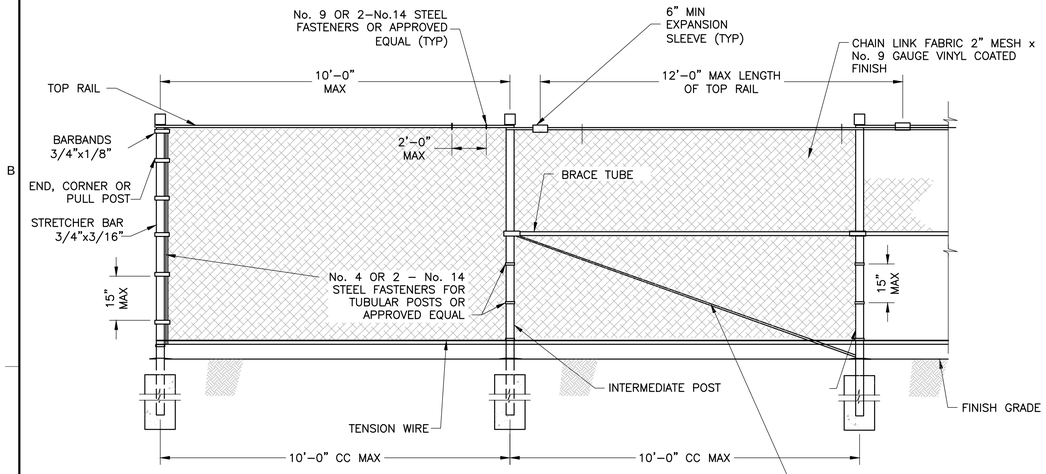
C–104 C–507

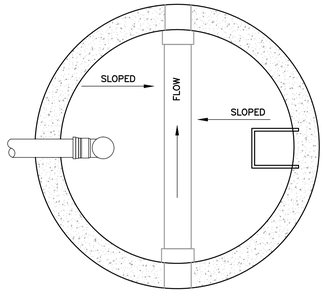


DOUBLE GATE T

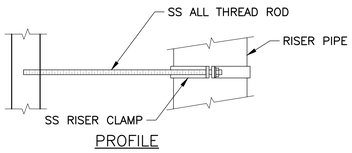
NTS

C–103 C–507

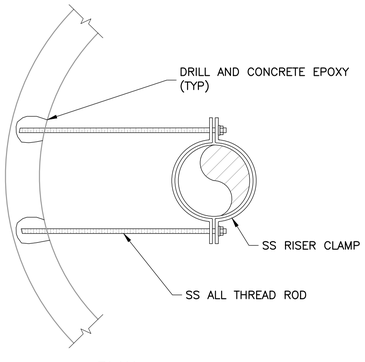




PLAN



PROFILE



PLAN

RISER SUPPORT DETAIL V

NTS

C–507 C–507

DESCRIPTION

END, CORNER AND PULL POSTS FOR FABRIC HEIGHT:

≤6'	ROUND	2.375"ø	3.65#/FT
	SQUARE	2.0"	3.60#/FT
>6'	ROUND	2.875"ø	5.79#/FT
	SQUARE	2.50"	5.70#/FT

INTERMEDIATE POSTS FOR FABRIC HEIGHTS:

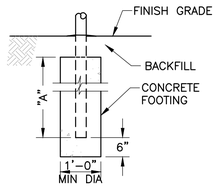
≤6'	ROUND	1.90"	2.72#/FT
	H–SECTION	1.875"x 1.625"x 0.113"	2.70#/FT
>5'	ROUND	2.375"	3.65#/FT
	H–SECTION	2.25"x 1.95"x 1.43"	4.10#/FT

BRACE TUBES:
1.66"OD NOMIMAL, 1.806#/FT GALVANIZED STEEL PIPE

STRETCHER BARS:
LENGTH TO BE 1" LESS THAN FULL HEIGHT OF FABRIC. ONE STRETCHER BAR FOR EACH GATE AND END POST. TWO STRETCHER BARS FOR CORNERS AND BRACING.

TOP RAIL:
1.66"OD NOMIMAL, 1.806#/FT GALVANIZED STEEL PIPE

TENSION WIRE:
7 GA GALVANIZED



FOOTING DETAIL

LINE,GATE AND END POST BASE

"A" 2'–6" FOR FENCE ≤ 6'
3'–0" FOR FENCE > 6'
5'–0" FOR ALL END AND GATE POSTS

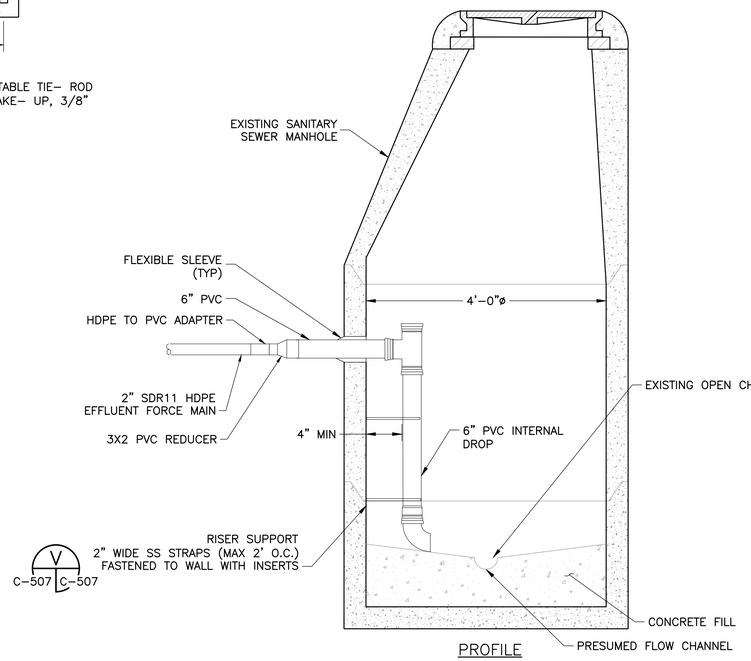
NOTES:

1. POST DIMENSIONS SHOWN ARE OD NOMINAL.
2. GALVANIZED BEFORE WEAVING (GBW) MEETING ASTM A392 AND A817 SPECIFICATIONS,
3. 1.2 OZ. TYPE II, CLASS 4, 9 GAUGE AND 11 GAUGE
4. ALUMINIZED 9 GAUGE, ASTM A491, TYPE 1
5. FUSED AND BONDED 9 GAUGE FINISH (10 GAUGE CORE) VINYL COATED BY THERMALLY FUSED AND BONDED METHOD PER ASTM F668 SPECIFICATIONS, CLASS 2B

VINYL COATED CHAIN LINK FENCE S

NTS

C–103 C–507



PROFILE

DROP MANHOLE U

NTS

C–102 C–507

NO.	DATE	DSGN	DR	CHK	APVD
2	12/22/15	VMW	BCO	T. KESSLER	B. O'DELL
1	08/28/15	VMW	BCO	M. STACEY	

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT
REVISION

BRENT C. O'DELL
NEW YORK, PE NO. 090976

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REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

CIVIL

CIVIL DETAILS

MACTEC
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511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775–5401

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	12/22/15
PROJ NO:	3480140433
DWG	C-507
SHEET	14 OF 31

INSTRUMENT IDENTIFICATION

INSTRUMENT TYPE / INSTRUMENT DESIGNATION (XX / XXX) — LOCALLY MOUNTED INSTRUMENT W / REMOTE DISPLAY

INSTRUMENT TYPE / INSTRUMENT DESIGNATION (XX / XXX) — LOCALLY MOUNTED INSTRUMENT W / DISPLAY

INSTRUMENT TYPE / INSTRUMENT DESIGNATION (XX / XXX) — LOCALLY MOUNTED SWITCH

INSTRUMENTATION ABBREVIATIONS

ADV	AUTOMATIC DRAIN VALVE
CC	CYCLE COUNTER
CF	COALESCING FILTER
DPI	DIFFERENTIAL PRESSURE INDICATOR
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
FE	FLOW ELEMENT
FI	FLOW INDICATOR
FIT	FLOW INDICATING TRANSMITTER
FM	FLOW METER
FP	FLOW PORT
FS	FLOW SWITCH
FSL	FLOW SWITCH LOW
FT	FLOW TOTALIZER
LI	LEVEL INDICATOR
LIT	LEVEL INDICATING TRANSMITTER
LS	LEVEL SWITCH
LSHH	LEVEL SWITCH HIGH-HIGH
LSH	LEVEL SWITCH HIGH
LSL	LEVEL SWITCH LOW
LSLL	LEVEL SWITCH LOW-LOW
LT	LEVEL TRANSMITTER
MOV	MOTOR OPERATED VALVE
OLH	OIL LEVEL HIGH
OLL	OIL LEVEL LOW
PF	PARTICULATE FILTER
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATING TRANSMITTER
PRV	PRESSURE REGULATING VALVE
PS	PRESSURE SWITCH
PSH	PRESSURE SWITCH HIGH
PSL	PRESSURE SWITCH LOW
PSV	PRESSURE SAFETY VALVE
PT	PRESSURE TRANSMITTER
SP	SAMPLE PORT
SV	SOLENOID VALVE
TE	TEMPERATURE ELEMENT
TI	TEMPERATURE INDICATOR
TIT	TEMPERATURE INDICATING TRANSMITTER
TS	TEMPERATURE SWITCH
TSH	TEMPERATURE SWITCH HIGH
TSL	TEMPERATURE SWITCH LOW
VFD	VARIABLE FREQUENCY DRIVE
VI	VACUUM INDICATOR
VIT	VACUUM INDICATING TRANSMITTER
VS	VACUUM SWITCH
VSH	VACUUM SWITCH HIGH
VSL	VACUUM SWITCH LOW
VSV	VACUUM SAFETY VALVE

PIPE DESIGNATION

- AIR LINE
- WATER LINE
- WATER LINE HEAT TRACED AND INSULATED
- CHEMICAL LINE
- PRODUCT LINE
- VENT LINE
- CONTROL LINE
- INTRINSICALLY SAFE LINE
- ANALOG LINE
- BREAK
- FLOW DIRECTION
- PIPE SIZE (X")

SYMBOLS

- ROTAMETER
- FLOW METER (FM XXX)
- ELAPSED TIME METER (ETM)
- AUTO DIALER (AD)
- TIMER (T)
- MOTOR (M)
- AMP METER (A)
- REMOTE TELEMETRY SYSTEM (RTS)
- VARIABLE FREQUENCY DRIVE (VFD)
- STATIC MIXER
- DISCHARGE SILENCER
- DILUTION AIR FILTER
- INLET/INLINE FILTER
- COALESCING FILTER (CF)
- PARTICULATE FILTER (PF)
- AUTOMATIC CONDENSATE DRAIN (CD)
- ALARM DESIGNATION (ALARM)
- WARNING INDICATION (WARN)
- MULTIFUNCTION VALVE
- INJECT NOZZLE
- METERING PUMP INLET CHECK VALVE
- INDUSTRAIL INTERCHANGE COUPLER
- CONDUCTANCE PROBES
- COPPER COIL
- HOSE CONNECTION

SYMBOLS CONTINUED

- FILTER REGULATOR (FR)
- METERING PUMP (MP)
- GLOBE VALVE
- GATE VALVE
- BALL VALVE/ UNION
- BALL VALVE/DRAIN VALVE
- CHECK VALVE
- RAIN CAP
- BUTTERFLY VALVE
- Y-STRAINER
- RELIEF VALVE
- FEMALE CAMLOCK
- MALE CAMLOCK
- SOLENOID VALVE (SV XXX)
- PRESSURE REGULATOR
- SIPHON BREAK
- UNION
- CLEAR PVC
- MECHANICAL FLOAT
- PULSE-DAMPING SNUBBER
- PITOT TUBE
- SIGHT GLASS
- ALARM LIGHT (X / AL)
- RUN LIGHT (R)
- E-STOP (E)
- NEEDLE VALVE
- FLANGED CONNECTION
- REQUIRED FIELD CONNECTION
- FLEX CONNECTOR
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- MOTOR OPERATED BUTTERFLY VALVE (MOV XXX)
- AUTOMATIC DRAIN VALVE (ADV XXX)
- MOTOR OPERATED VALVE (MOV XXX)

SYMBOLS CONTINUED

- LIQUID PHASE CARBON (INLET / OUTLET)
- VAPOR PHASE CARBON (OUTLET / INLET / X")
- RECOVERY PUMPS
- RECOVERY WELL (LSH / LSL / REF)
- SKIMMER PUMP
- ELECTRIC PUMP (XX XXX)
- SUMP PUMP
- ROTARY CLAW BLOWER (X")
- GENERIC BLOWER (X")
- P-XXX OIL SKIMMER PUMP MODEL:
- GEAR PUMP (X")
- DOUBLE DIAPHRAGM (QIT XXX, 1")
- TRANSFER PUMP (SP, PI XXX, X")
- HEAT EXCHANGER (X")
- C-XXX SPARGE COMPRESSOR XX HP / XXX VAC X PHASE / TEFC XXX CFM @ XX PSI MODEL: (INLET FILTER, X")
- PROGRESSIVE CAVITY PUMP (PI XXX, 1")
- PASSIVE HEAT EXCHANGER (X")
- T-XXX MOISTURE SEPARATOR XXX GALLONS (SIGHT GLASS, LSHH / LSH / LSL XXX, X")
- B-XXX SVE BLOWER XX HP / XXX VAC X PHASE / TEFC XXX ACFM @ XX INCHES HgV BLOWER MODEL: MOTOR MODEL: (SILENCER, X")
- T-XXX PRODUCT TANK XXX GALLONS (VENT, LSHH XXX)
- FX-XXX BAG FILTER MODEL: (VENT, X")
- FINE SEPARATOR
- ABSORPTION MEDIA SOCK
- FX-XXX BAG FILTER MODEL: (VENT)
- AC-XXX AIR COMPRESSOR XX HP / XXX VAC X PHASE / TEFC XXX ACFM @ XX PSI MODEL: (INLET FILTER, PSH XXX, PSL XXX, PI)
- AS-XXX TRAY STRIPPER MODEL: (LSHH / LSH / LSL XXX, X")
- OWS-XXX OIL WATER SEPARATOR INTEGRAL INFLUENT SUMP & PRODUCT CHAMBER FLOWRATE: MODEL: (LSHH / LSH / LSL XXX, 2")
- OWS-XXX OIL WATER SEPARATOR MODEL: (VENT, LSHH / LSH / LSL XXX)
- LRP-XXX LIQUID RING PUMP XX HP / XXX VAC X PHASE / TEFC XXX ACFM @ XX INCHES HgV MODEL: (VI XXX, SCAVENGER LINE, TSH XXX, TE XXX, PI XXX, TI XXX, LSH / LSL XXX)

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NEW YORK PE NO. 090976

DSGN	NO.	DATE	BY	REVISION	CHK	APVD
NES	1	08/28/15	VMW	RECORD DRAWINGS - DRAFT	T. KESSLER	B. O'DELL
	2	12/22/15	VMW	RECORD DRAWINGS - FINAL		

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

PROCESS
PROCESS AND INSTRUMENTATION DIAGRAM - TREATMENT SYSTEM
LEGEND

MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-3401

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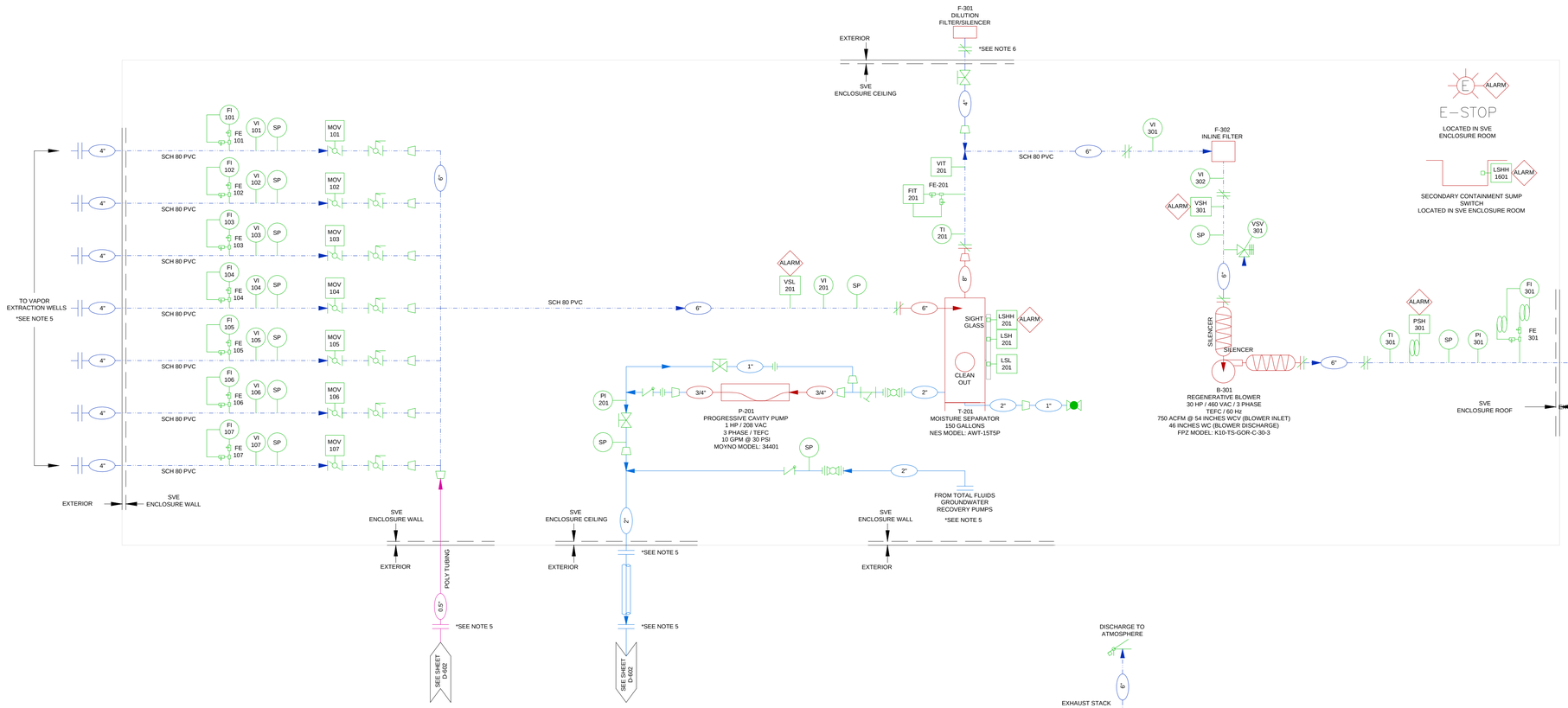
508-226-1100 / / FAX 508-226-1160 (Fax)
WWW.NES-INC.NET

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG D-600
SHEET 15 OF 31

FILE NAME: P:\CADD\QUANTA\Review Avenue\FER As-Builts\CURRENT DRAWINGS\3480140433-0107-D600-0000.dwg PLOT DATE: Tue, 22 Dec 2015 PLOT TIME: 12:09 PM



GENERAL NOTES:

1. PROCESS & INSTRUMENTATION DIAGRAM IS A REPRESENTATIVE DRAWING SHOWING EQUIPMENT SPECIFICATIONS, PROCESS PIPING, VALVES AND INSTRUMENTATION NOT TO BE INTERPRETED AS A LAYOUT DRAWING DEPICTING PLUMBING LOCATION, CONNECTIONS, OR FITTINGS.
2. NEC ELECTRICAL CLASSIFICATION:
   - SVE SYSTEM INTERIOR NEC CLASS I, DIVISION 2 LOCATION
   - CONTROL & AIR COMPRESSOR ROOM NEC NON-CLASSIFIED LOCATION
   - GROUNDWATER TREATMENT INTERIOR NEC CLASS I, DIVISION I LOCATION
   - ENCLOSURE EXTERIORS NEC NON-CLASSIFIED LOCATION
3. REFER TO E-603 FOR INSTRUMENTATION LIST
4. REFER TO E-604 FOR INTERLOCKS
5. FIELD CONNECTION BY AMEC
6. SHIPPED LOOSE FOR FIELD INSTALLATION BY AMEC.
7. FUTURE T-802 & T-1402 PRODUCT TANKS WITH LEVEL SWITCH ASSEMBLIES

NO.	DATE	DR	CHK	REVISION
2	12/22/15	NES	NES	RECORD DRAWINGS - FINAL
1	08/28/15	NES	NES	RECORD DRAWINGS - DRAFT

DSGN	BY	APVD
VMW	BCO	B. O'DELL
VMW	BCO	T. KESSLER

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RECORD DRAWINGS
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PROCESS
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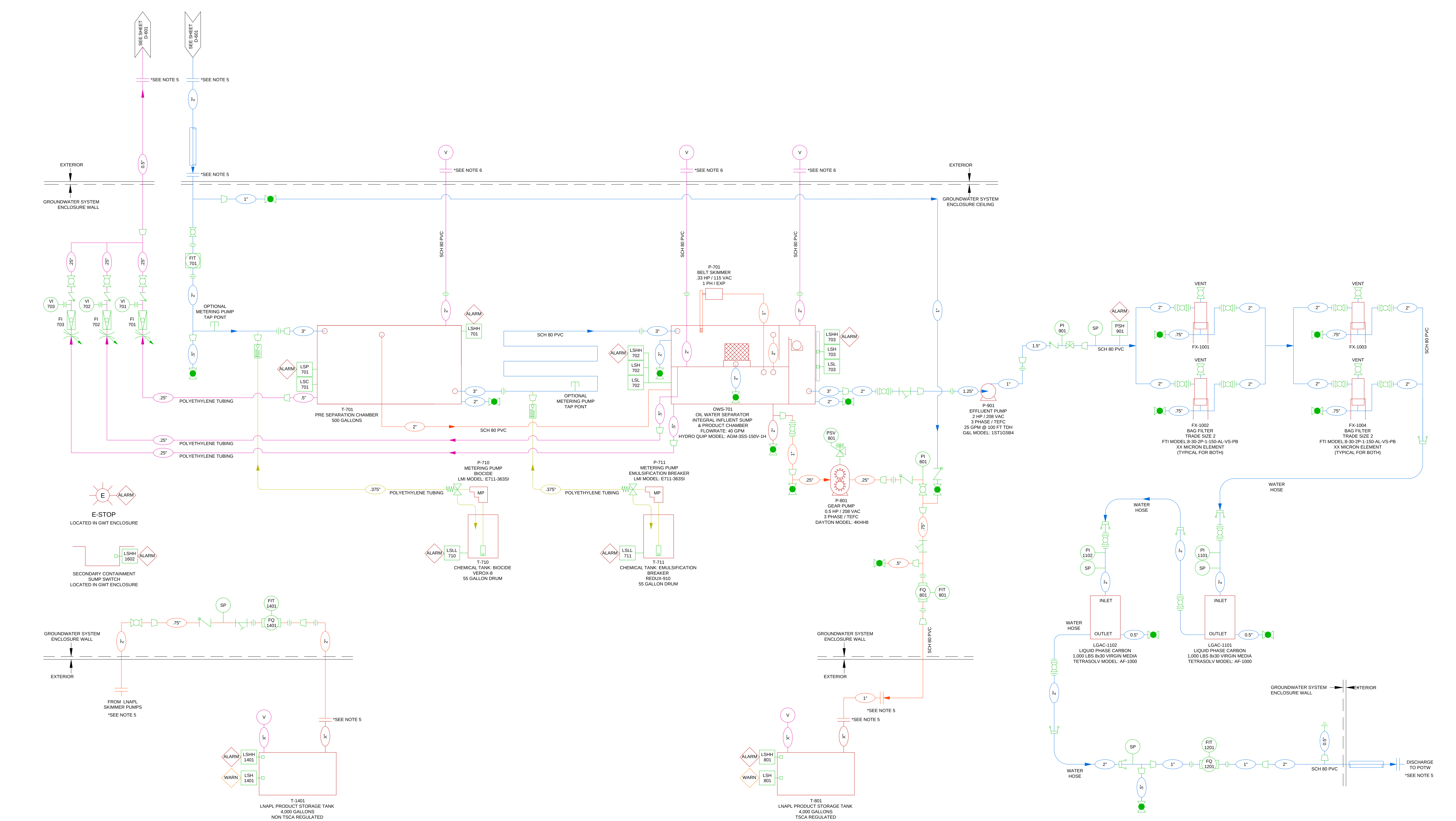

GENERAL NOTES:

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2. NEC ELECTRICAL CLASSIFICATION:
   - SVE SYSTEM INTERIOR NEC CLASS I, DIVISION 2 LOCATION
   - CONTROL & AIR COMPRESSOR ROOM NEC NON-CLASSIFIED LOCATION
   - GROUNDWATER TREATMENT INTERIOR NEC CLASS I, DIVISION I LOCATION
   - ENCLOSURE EXTERIORS NEC NON-CLASSIFIED LOCATION
3. REFER TO E-603 FOR INSTRUMENTATION LIST
4. REFER TO E-604 FOR INTERLOCKS
5. FIELD CONNECTION BY AMEC
6. SHIPPED LOOSE FOR FIELD INSTALLATION BY AMEC.

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2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
1	08/28/15	RECORD DRAWINGS - DRAFT	VMW	BCO

DSGN	DR	CHK	APVD
NES	NES	T. KESSLER	B. O'DELL

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES, RAD I AND RAD II
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PROCESS

PROCESS AND INSTRUMENTATION DIAGRAM - TREATMENT SYSTEM 2

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DATE	12/22/15
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DWG	D-602
SHEET	17 OF 31

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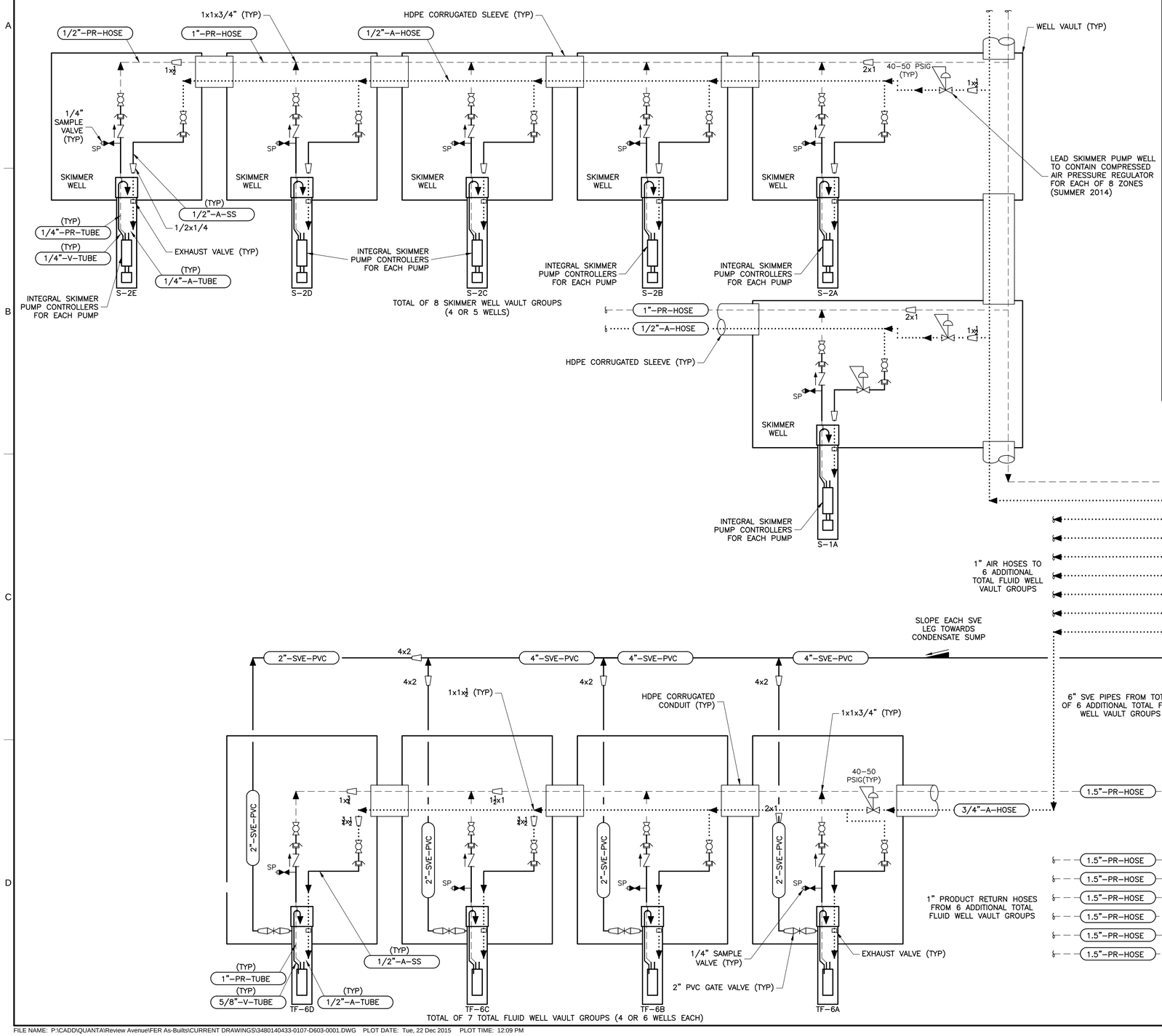

LEGEND
(APPLICABLE FOR D-603 ONLY)

DATA SYMBOLS

X"-XXX-XXXX
- LINE ID
- PIPING MATERIAL
- SERVICE DESIGNATION
- LINE SIZE

VALVE AND ACTUATOR SYMBOLS

	GATE VALVE OR ANY IN-LINE BLOCK VALVE NOT IDENTIFIED BY TYPE		SLIDE GATE VALVE
SP	CHECK VALVE	SP	SAMPLE VALVE
	BALL VALVE		BACK PRESSURE REGULATOR

PIPE SERVICE DESIGNATIONS

A	AIR
D	DRAIN
PR	PRODUCT RETURN
SVE	SOIL VAPOR EXTRACTION
V	VENT

EQUIPMENT SYMBOLS

	SKIMMER WELL PUMP
	TOTAL FLUID WELL PUMP

FITTING SYMBOLS

	REDUCER
	HOSE COUPLING
	QUICK CONNECT HOSE COUPLING

PIPING MATERIALS DESIGNATIONS

PVC	POLYVINYL CHLORIDE
SS	STAINLESS STEEL

PIPING LINE SYMBOLS

- AIR SUPPLY HOSE
- PRODUCT RETURN HOSE
- SVE OR PIPING
- SECONDARY CONTAINMENT
- SLOPE LINE

NO.	DATE	DSGN	DR	CHK	APVD
2	12/22/15	C. THERIAULT	M. STACEY	T. KESSLER	B. O'DELL
1	08/28/15		VMW	BCO	VMW	BCO

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RECORD DRAWINGS - DRAFT

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PROCESS

PROCESS AND INSTRUMENTATION DIAGRAM - EXTRACTION SYSTEMS

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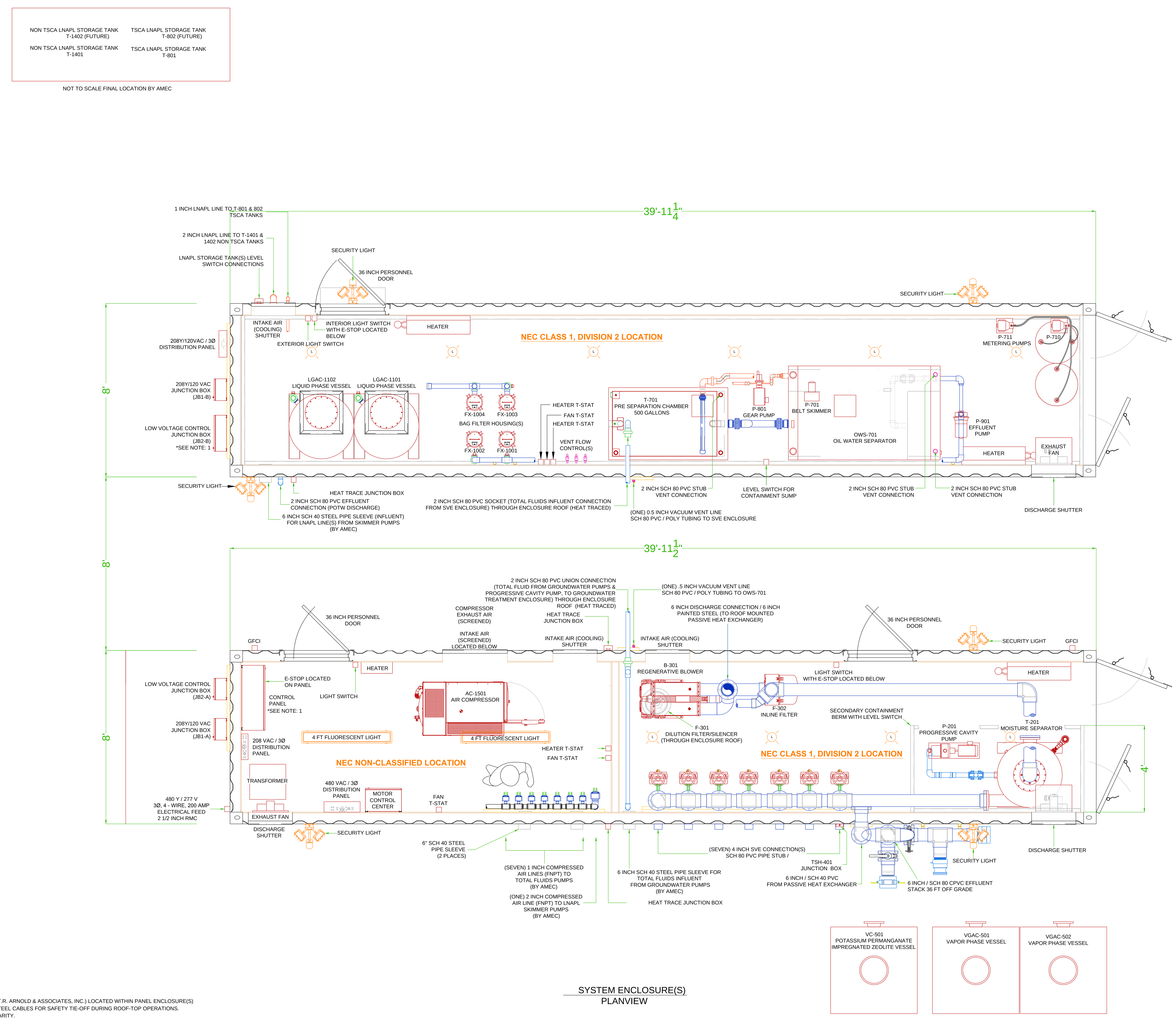

SYSTEM ENCLOSURE(S)
PLANVIEW

GENERAL NOTES:
1. THIRD PARTY NEC INSPECTION STICKER (T.R. ARNOLD & ASSOCIATES, INC.) LOCATED WITHIN PANEL ENCLOSURE(S)
2. ENCLOSURES ROOFS ARE FITTED WITH STEEL CABLES FOR SAFETY TIE-OFF DURING ROOF-TOP OPERATIONS.
3. NOT ALL ITEMS SHOWN FOR DRAWING CLARITY.
4. HX-401, HX-401 EFFLUENT PLUMBING, VAPOR CARBON 6 INCH EFFLUENT STACK PLUMBING, SVE DILUTION FILTER, (T-701) VENT STACK TEES, (OWS-701) VENT STACK TEES, ALL INTAKE/ EXHAUST HOODS, SECURITY LIGHTING FIXTURES, AND GFCI RECEPTACLE COVERS SHIPPED LOOSE FOR SITE RE-INSTALLATION.

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DSGN	DR	CHK	APVD
NES	NES	T. KESSLER	B. O'DELL

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES, RAD I AND RAD II
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MECHANICAL
GROUNDWATER TREATMENT FACILITY ENCLOSURE LAYOUT

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DWG M-101
SHEET 19 OF 31

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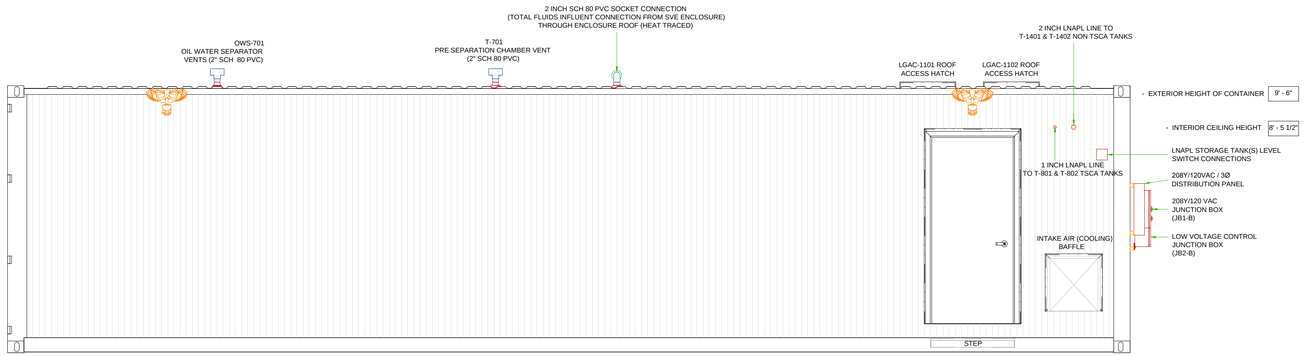
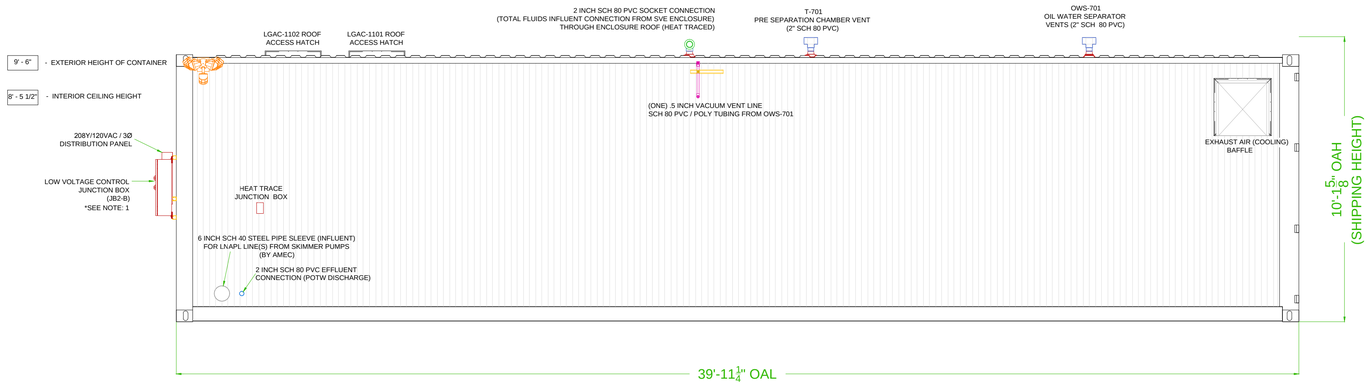
GROUNDWATER TREATMENT SYSTEM ENCLOSURE
NORTH EAST ELEVATIONAL VIEW





GROUNDWATER TREATMENT SYSTEM ENCLOSURE
SOUTH WEST ELEVATIONAL VIEW

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2	12/22/15	NES	NES	RECORD DRAWINGS - FINAL	T. KESSLER	VMW
1	08/28/15			RECORD DRAWINGS - DRAFT		VMW
DSGN						

B. O'DELL APVD BCO
BCO

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MECHANICAL

GROUNDWATER TREATMENT FACILITY ENCLOSURE ELEVATIONS 1

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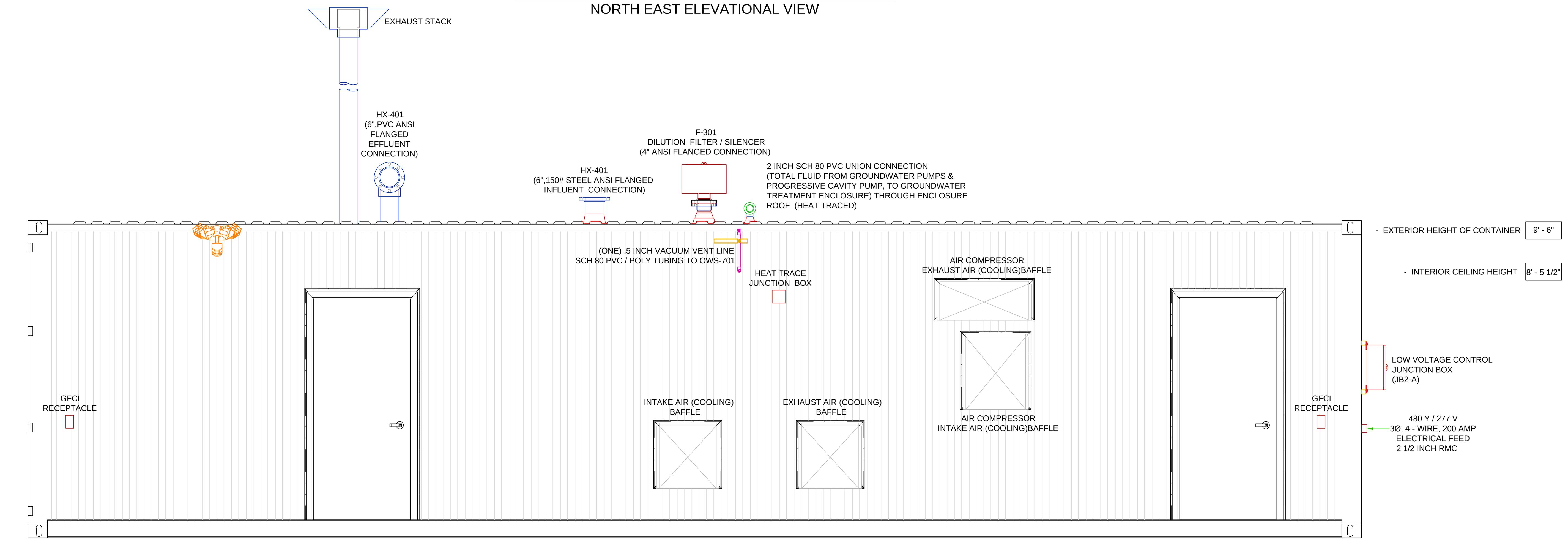
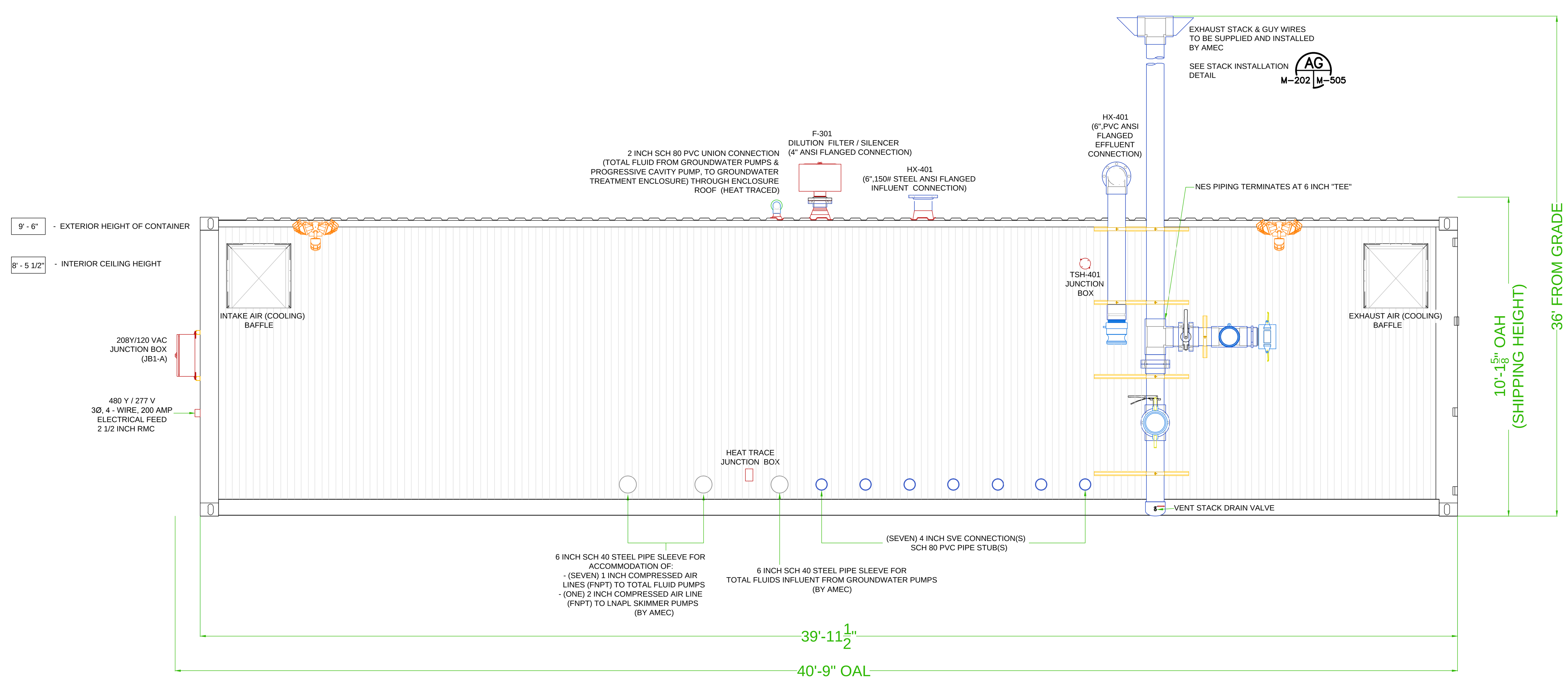
CONTROL & SVE TREATMENT SYSTEM ENCLOSURE
NORTH EAST ELEVATIONAL VIEW





CONTROL & SVE TREATMENT SYSTEM ENCLOSURE
SOUTH WEST ELEVATIONAL VIEW

NO.	DATE	REVISION	BY	APVD
2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
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DSGN NES | DR NES | CHK T. KESSLER | APVD B. O'DELL

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MECHANICAL
GROUNDWATER TREATMENT FACILITY ENCLOSURE
ELEVATIONS 2

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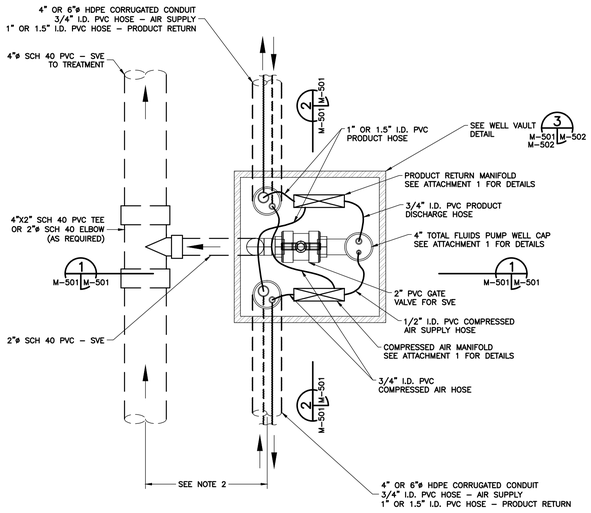
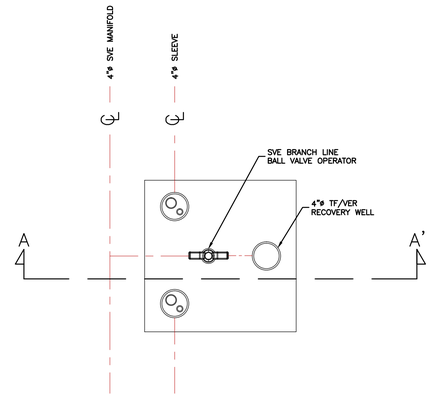


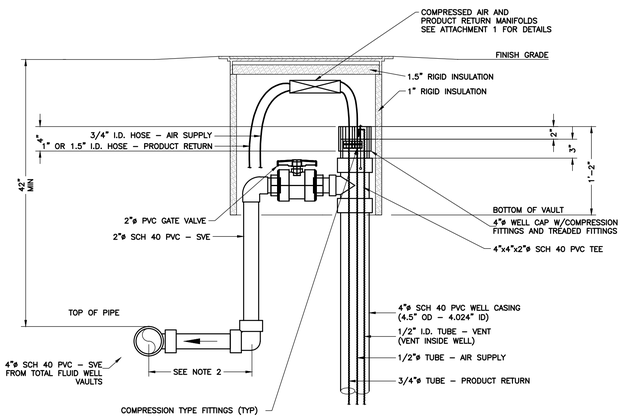
TOTAL FLUID WELL VAULT PLAN W
C–102 M–501

NOTES:

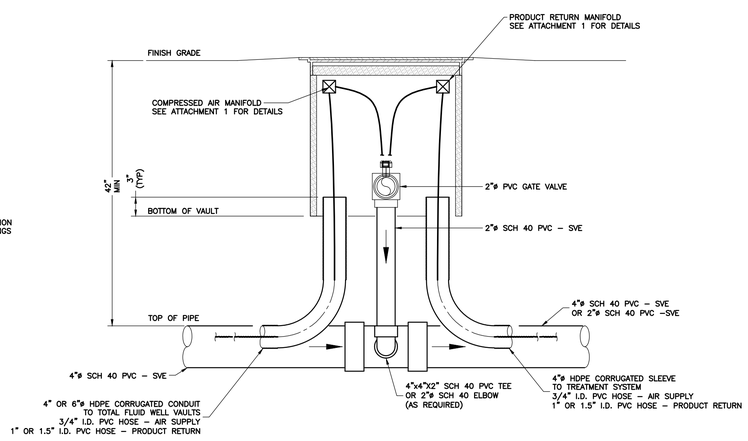
1. FOR PIPE TRENCH AND WELL VAULT DETAILS SEE SHEET C–502, C–505, C–506, AND C–507.
2. SUPPORT ISOLATION VALVES, HOSE, EXHAUST VALVE, AND CONTROLLER FROM STEEL WELL VAULT SIDES.
3. ALL MANIFOLD ASSEMBLIES MOUNTED TO UNISTRUT CHANNEL BOLTED TO VAULT SKIRTS.



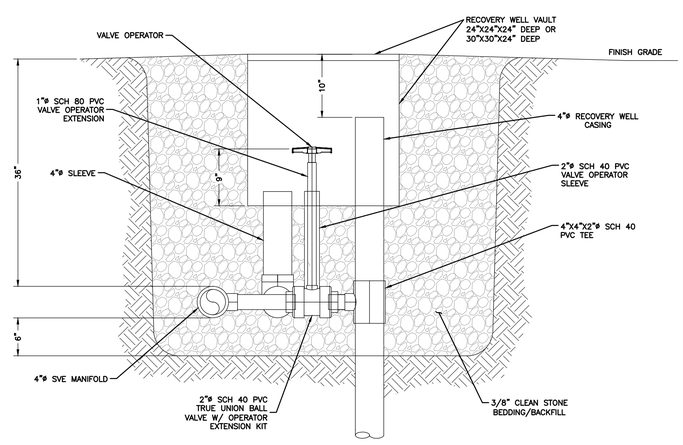
PLAN



SECTION 1
M–501 M–501



SECTION 2
M–501 M–501



SECTION A–A'

LOW POINT DRAIN TF WELL HEAD DETAIL X
C–102 M–501

12 6 0 12
SCALE OF INCHES

NO.	DATE	DSGN	DR	CHK	REVISION	APVD	BY
2	12/22/15	T.KESSLER	V. WHELAN	T. KESSLER	RECORD DRAWINGS - FINAL	APVD	VMW
1	08/28/15				RECORD DRAWINGS - DRAFT	BCO	VMW
						BCO	

B. O'DELL

BRENT C. O'DELL
NEW YORK PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
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MECHANICAL

TOTAL FLUIDS WELL & VER WELL VAULT PIPING DETAILS

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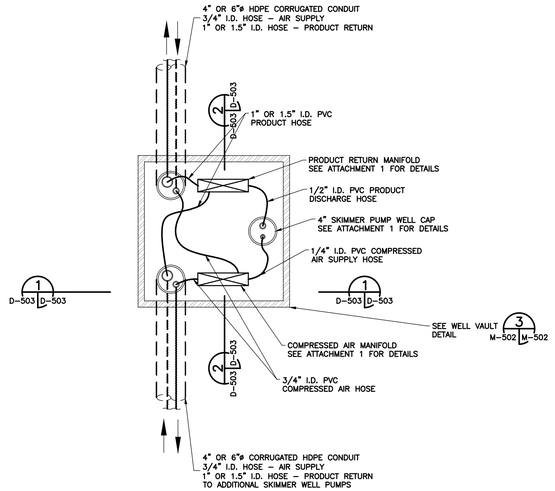
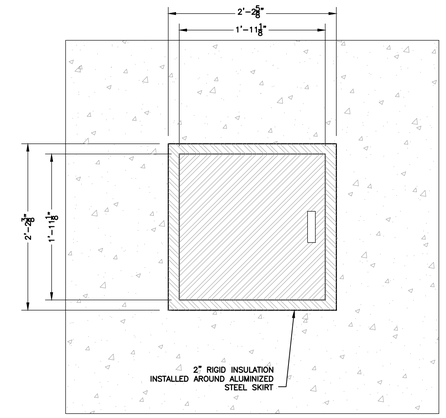
DWG M-501
SHEET 22 OF 31

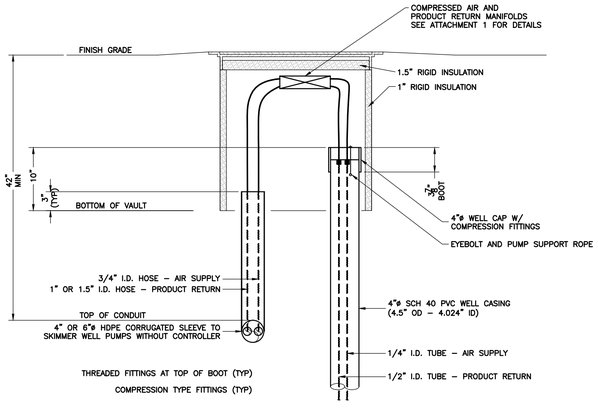


SKIMMER WELL VAULT PLAN Y
C-102 M-502

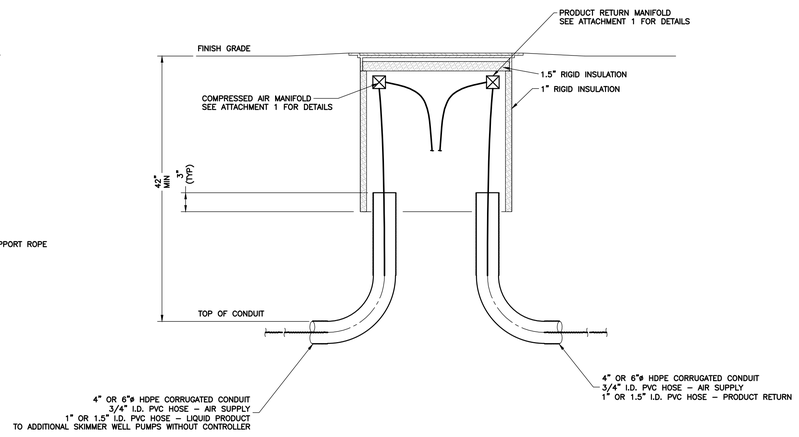
NOTES:

1. FOR PIPE TRENCH AND WELL VAULT DETAILS SEE SHEET C-502, C-505, C-506, AND C-507.
2. SUPPORT ISOLATION VALVES AND HOSE FROM STEEL WELL VAULT SIDES.
3. ALL MANIFOLD ASSEMBLIES MOUNTED TO UNISTRUT CHANNEL BOLTED TO VAULT SKIRTS.

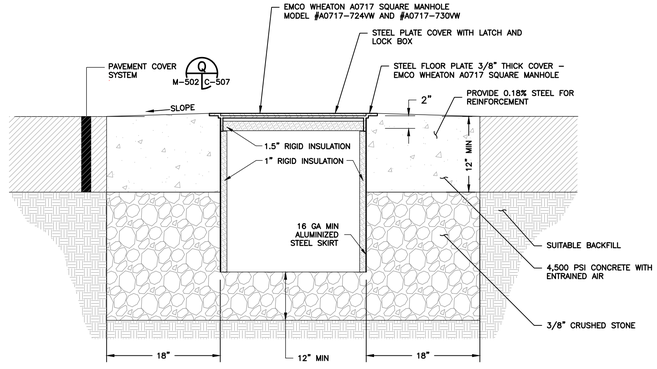




SECTION 1
M-502 M-502



SECTION 2
M-502 M-502



WELL VAULT DETAIL 3
M-501 M-502
M-502

12 6 0 12
SCALE OF INCHES

NO.	DATE	DSGN	DR	CHK	APVD	BY
2	12/22/15	C. THERIAULT	M. STACEY	T. KESSLER	B. O'DELL	VMW BCO
1	08/28/15			REVISION		VMW BCO

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT

BRENT C. O'DELL
NEW YORK P.E. NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

MECHANICAL
SKIMMER WELL VAULT PIPING DETAILS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG M-502
SHEET 23 OF 31

TOTAL FLUIDS WELL VAULT AND PROCESS PIPING TRENCH ELEVATIONS

Well or Location ID	Approx. Existing Grade Elev. (msl ft)	Top of Vault Elev. (msl ft)	Top of Casing Elev. in Vault (msl ft) **(Note 1)**	Approx. Finished Grade Elev (msl ft)	Bottom of Trench Elev (msl ft)	Top of Pipe Elev Row 1 (msl ft)	Top of Pipe Elev Row 2 (msl ft)	Vault Size (")	SVE Low Point Drain?	Grade Change (Existing to Finished - ft)
TE1 Trench Termination Point	24.70	N/A	N/A	27.25	23.21	24.25	25.13	N/A		2.55
Pt. 1A	23.70	N/A	N/A	25.50	21.46	22.50	23.38	N/A		1.80
TE2 Trench Termination Point	24.80	N/A	N/A	27.25	22.71	23.75	N/A	N/A		2.45
HOSE VAULT	22.00	23.26	N/A	23.16	19.12	20.16	21.04	30" x 30" x 24" D		1.16
Pt. 21A	23.00	N/A	N/A	25.40	18.65	19.69	20.57	N/A		2.40
Pt. 21B	22.70	N/A	N/A	24.10	18.11	19.15	20.03	N/A		1.40
SXA	21.00	21.60	N/A	21.50	17.50	18.54	19.42	N/A		0.50
TF-1A	22.00	23.41	22.32	23.41	19.54	20.41	N/A	24" x 24" x 24" D	Y	1.41
TF-1B	22.75	25.25	24.25*	25.25	21.38	22.25	N/A	24" x 24" x 24" D		2.50
TF-1C	22.50	24.02	23.02*	24.02	20.15	21.02	N/A	24" x 24" x 24" D		1.52
TF-1D	21.00	22.22	21.23	22.22	18.35	19.22	N/A	30" x 30" x 24" D	Y	1.22
TF-2A	20.50	21.69	20.42	21.69	17.82	18.69	N/A	30" x 30" x 24" D	Y	1.19
TF-2B	21.00	23.67	22.67*	23.67	19.80	20.67	N/A	24" x 24" x 24" D		2.67
TF-2C	21.20	23.82	22.65	23.82	19.95	20.82	N/A	24" x 24" x 24" D		2.62
TF-2D	20.00	21.18	19.72	21.18	17.31	18.18	N/A	24" x 24" x 24" D	Y	1.18
TF-3A	18.40	19.80	17.99	19.79	15.92	16.79	N/A	30" x 30" x 24" D	Y	1.39
TF-3B	19.30	20.86	19.86*	20.86	16.99	17.86	N/A	24" x 24" x 24" D		1.56
TF-3C	19.20	20.84	19.84*	20.84	16.97	17.84	N/A	24" x 24" x 24" D		1.64
TF-3D	18.50	20.53	19.67	20.53	16.66	17.53	N/A	30" x 30" x 24" D	Y	2.03
TF-4A	17.00	18.09	17.09*	18.09	14.05	14.92	N/A	30" x 30" x 24" D	Y	1.09
TF-4B	17.50	18.45	17.41	18.45	14.58	15.45	N/A	24" x 24" x 24" D		0.95
TF-4C	17.50	18.39	17.48	18.39	14.52	15.39	N/A	24" x 24" x 24" D		0.89
TF-4D	16.50	18.33	17.32	18.33	14.29	15.16	N/A	30" x 30" x 24" D	Y	1.83
TF-5A	15.30	16.20	15.25	16.20	12.33	13.20	13.20	30" x 30" x 24" D	Y	0.90
TF-5B	15.60	16.20	14.90	16.20	12.33	13.20	13.45	24" x 24" x 24" D		0.60
TF-5C	16.00	15.95	15.02	15.95	12.08	12.95	13.20	30" x 30" x 24" D		-0.05
TF-5D	16.00	16.41	15.42	16.41	12.54	13.41	13.91	24" x 24" x 24" D		0.41
TF-6A	19.00	18.68	17.73	18.56	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.44
TF-6B	17.63	17.57	16.34	17.73	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.10
TF-6C	16.92	16.87	15.87*	16.84	12.97	13.84	N/A	24" x 24" x 24" D		-0.08
TF-6D	15.98	16.09	14.93	15.86	11.99	12.86	N/A	24" x 24" x 24" D	Y	-0.12
TF-7A	19.05	19.39	18.30	19.41	6" Bedding Below Pipe	36" Min. Burrial	N/A	30" x 30" x 24" D		0.36
TF-7B	17.66	17.77	16.77*	17.73	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.07
TF-7C	17.58	17.52	16.52*	17.55	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.03
TF-7D	17.13	17.11	15.93	17.14	6" Bedding Below Pipe	36" Min. Burrial	N/A	30" x 30" x 24" D		0.01
TF-7E	15.56	16.03	15.09	16.10	12.23	13.10	N/A	24" x 24" x 24" D		0.54
TF-7F	15.00	15.40	13.89	15.40	11.53	12.40	N/A	24" x 24" x 24" D	Y	0.40

SKIMMER WELL VAULT AND PROCESS PIPING TRENCH ELEVATIONS

Well or Location ID	Approx. Existing Grade Elev. (msl ft)	Top of Vault Elev. (msl ft)	Top of Casing Elev. in Vault (msl ft) **(Note 1)**	Approx. Finished Grade Elev (msl ft)	Bottom of Trench Elev (msl ft)	Top of Pipe Elev Row 1 (msl ft)	Top of Pipe Elev Row 2 (msl ft)	Vault Size (")	SVE Low Point Drain?	Grade Change (Existing to Finished - ft)
S-1A	24.75	27.54	26.25	27.54	23.33	24.37	N/A	30" x 30" x 24" D		2.79
S-1B	24.00	27.28	26.15	27.28	23.41	24.28	N/A	24" x 24" x 24" D		3.28
S-1C	23.50	25.37	24.52	25.37	21.50	22.37	N/A	24" x 24" x 24" D		1.87
S-1D	22.80	24.34	23.34*	24.34	20.47	21.34	N/A	24" x 24" x 24" D		1.54
S-1E	22.20	22.58	21.31	22.58	18.71	19.58	N/A	24" x 24" x 24" D		0.38
S-2A	24.75	26.91	25.43	26.91	22.70	23.74	N/A	30" x 30" x 24" D		2.16
S-2B	24.50	25.68	23.64	25.68	21.81	22.68	N/A	24" x 24" x 24" D		1.18
S-2C	24.50	25.68	23.42	25.68	21.81	22.68	N/A	24" x 24" x 24" D		1.18
S-2D	26.50	26.19	25.31	26.19	22.32	23.19	N/A	24" x 24" x 24" D		-0.31
S-2E	25.90	25.90	24.88	25.90	22.03	22.90	N/A	24" x 24" x 24" D		0.00
S-3A	25.90	26.86	25.46	26.86	22.65	23.69	N/A	30" x 30" x 24" D		0.96
S-3B	26.00	27.21	25.92	27.21	23.34	24.21	N/A	24" x 24" x 24" D		1.21
S-3C	25.70	26.94	25.50	26.94	23.07	23.94	N/A	24" x 24" x 24" D		1.24
S-3D	24.40	26.62	24.90	26.62	22.75	23.62	N/A	24" x 24" x 24" D		2.22
S-3E	23.50	24.48	23.49	24.48	20.61	21.48	N/A	24" x 24" x 24" D		0.98
S-4A	17.60	17.55	16.55*	17.57	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.03
S-4B	16.20	17.06	16.14	16.94	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.74
S-4C	14.70	15.72	14.24	15.84	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		1.14
S-4D	14.85	15.67	14.21	15.72	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.87
S-4E	14.80	15.38	13.70	15.45	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.65
S-5A	24.30	24.33	23.40	24.35	6" Bedding Below Pipe	42" Min. Burrial	N/A	24" x 24" x 24" D		0.05
S-5B	22.30	22.52	21.50	22.58	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.28
S-5C	20.80	20.96	19.96*	20.97	6" Bedding Below Pipe	36" Min. Burrial	N/A	30" x 30" x 24" D		0.17
S-5D	18.70	18.76	17.76	18.38	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.32
S-5E	18.10	18.23	17.23*	18.22	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.12
S-6A	24.00	24.10	23.01	24.15	6" Bedding Below Pipe	42" Min. Burrial	N/A	30" x 30" x 24" D		0.15
S-6B	21.95	22.21	21.21*	22.20	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.25
S-6C	20.40	20.51	19.42	20.54	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.14
S-6D	18.40	18.33	17.33*	18.40	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.00
S-6E	18.20	18.23	17.23*	18.47	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.27
S-7A	21.65	21.65	20.65*	21.62	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.03
S-7B	20.20	20.44	19.44*	20.40	6" Bedding Below Pipe	36" Min. Burrial	N/A	30" x 30" x 24" D		0.20
S-7C	18.10	18.10	17.24	18.05	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.05
S-7D	18.20	18.09	17.14	18.12	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.08
S-8A	23.15	23.42	22.42*	23.38	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.23
S-8B	18.95	18.99	17.99*	19.00	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.05
S-8C	18.05	18.08	16.90	18.09	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		0.04
S-8D	18.20	18.12	17.12*	18.10	6" Bedding Below Pipe	36" Min. Burrial	N/A	24" x 24" x 24" D		-0.10

Notes:
1) Top of Casing of wells noted with an asterisk (*) assumed to be approximately 12" below top of vault based on available field information. Elevations subject to revision once vaults are accessed during O&M period.
2) Piping at all other piping locations not mentioned in the table default to standard minimum burrial depths as indicated on the typical trench section details.

NO.	DATE	DSGN	DR	CHK	APVD	REVISION
2	12/22/15	T. KESSLER	V. WHELAN	T. KESSLER	B. O'DELL	RECORD DRAWINGS - FINAL
1	08/28/15					RECORD DRAWINGS - DRAFT

BY	APVD
VMW	BCO
VMW	BCO

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

MECHANICAL

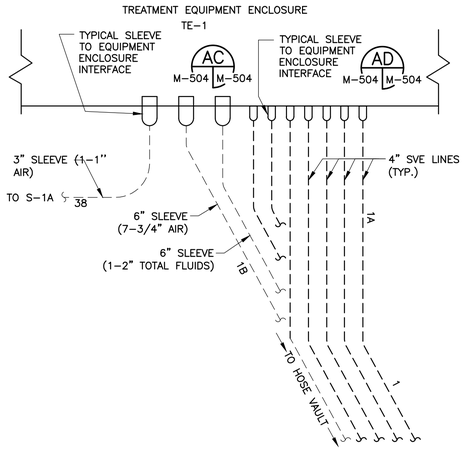
WELL VAULT AND PROCESS PIPING ELEVATIONS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

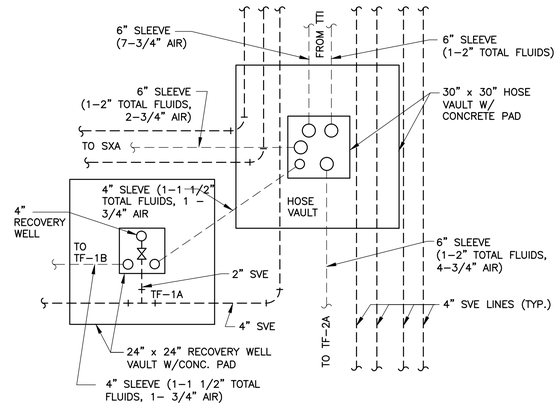
VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

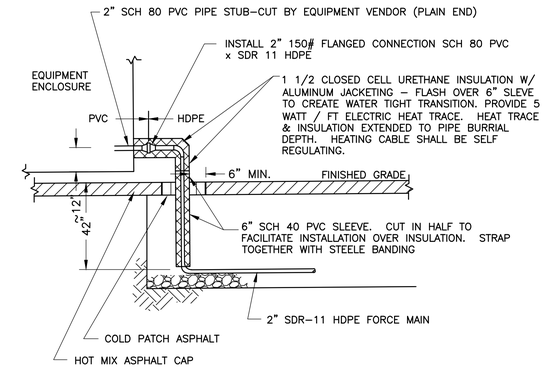
DATE	12/22/15
PROJ NO:	3480140433
DWG	M-503
SHEET	24 OF 31



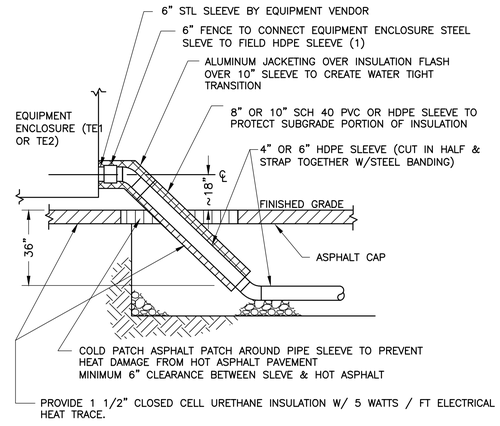
TRENCH TO TE-1 AREA PIPING Z
N.T.S. C-102 M-504



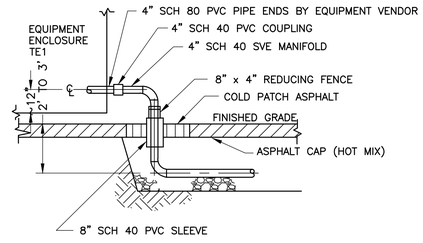
TF-1A / HOSE VAULT AREA PIPING AA
N.T.S. C-102 M-504



2" FORCE MAIN UNDERGROUND TO EQUIPMENT ENCLOSURE DETAIL AB
N.T.S. C-103 M-504



TYPICAL UNDERGROUND PIPE SLEEVE TO EQUIPMENT ENCLOSIRE TRANSITION DETAIL AC
N.T.S. C-103 M-504 M-504

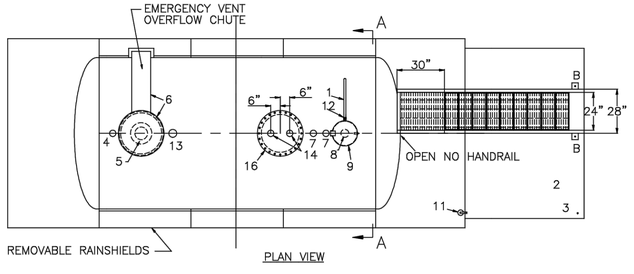


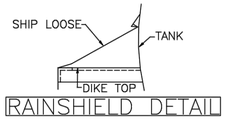
TYPICAL UNDERGROUND SVE MANIFOLD TO EQUIPMENT ENCLOSURE TRANSITION DETAIL AD
N.T.S. M-504 M-504

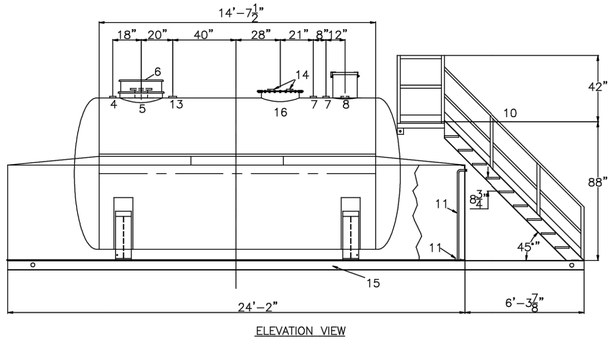
NOTES
1. PRIMARY TANK:
SHELL - 1/4" HEAD - 5/16"
CONTAINMENT: 1/4"
CONTAINMENT CAPACITY: 150%
2. MATERIAL - MILD CARBON STEEL
3. TEST AT 30 PSIG HYDRO.
4. ENTIRE UNIT UL LISTED. NYC LABEL REQUIRED. NYC MEA No. 336-03-E
5. EXTERIOR FINISH - SP-6 BLAST, EPOXY PRIMER & UV-URETHANE TOPCOAT ON TANK EXTERIOR AND ALL COMPONENTS
6. INTERIOR LINING - NONE
7. ALL DIMENSIONS APPROXIMATE.

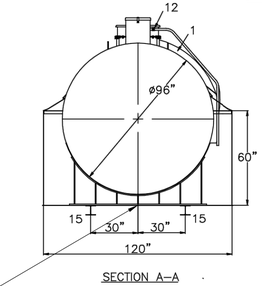
FITTING LEGEND

1	1" OVERFLOW PIPE - SHIPPED LOOSE
2	DRIP PAN PLATFORM WITH 2" LIP
3	1/2" DRAIN FITTING WITH PLUG
4	3" NORMAL VENT FITTING
5	8" FLANGED EMERGENCY VENT w/ ≥ 462,000 CFH CAPACITY @2.5 PSI - SHIP LOOSE
6	VENT DEFLECTOR ASSEMBLY - SHIPPED LOOSE
7	3" FULL COUPLING
8	3" FULL COUPLING
9	FILL CONTAINMENT CHAMBER
10	STAIRS AND PLATFORM - SHIP LOOSE
11	3/4" PUMP OUT PIPE & 3" PIPE CAP SUMP
12	1" PIPE UNION
13	4" FITTING
14	(2) 3" FITTING w/ PIPE PLUGS
15	W6 x 15# I-BEAM
16	24" X 3/8" THK ACCESS MANWAY









NOTE: TANK MANUFACTURER INSTALLED AN EXTRA I-BEAM AT CENTER IN ERROR. STL SHIMS WERE INSTALLED BELOW THIS I-BEAM AT EACH TANK SADDLE LOCATION AND ONE AT CENTER OF EACH SADDLE TO CARRY DEAD WEIGHT OF I-BEAM AS DIRECTED BY JOSH LEMINGER OF HIGHLAND TANK ON 7/9/15.

TANK MANUFACTURER'S SHOP DRAWING AE
1" = 4' C-503 M-504

AREO-POWER: –

1	MODIFY LEGEND "4", "5", "8", "14" AND EXTERIOR FINISH NOTES. REQ'D NYC MEA LABEL	03/17/15	008

AREO-POWER®
PATENT NUMBER 5346093

6,000 GAL 96"ø CYL. NYC FUELER
PATENT: 5,695,089 PATENT: 5,809,650

CUSTOMER: AREO-POWER
PROJECT: HAMILTON, NJ
QUOTE NO: 355261 CHK'D BY:

SCALE:	DATE:	DWG. BY:	DWG. NO.:
1/4"=1'-0"	02/27/15	008	92730

NO.	DATE	DSGN	DR	CHK	APVD
2	12/22/15	T. KESSLER	S. RUDKIN	T. KESSLER	B. O'DELL
1	08/28/15	REVISION			

RECORD DRAWINGS - FINAL — VMW BCO
RECORD DRAWINGS - DRAFT — VMW BCO

BRENT C. O'DELL
NEW YORK, PE NO. 090976

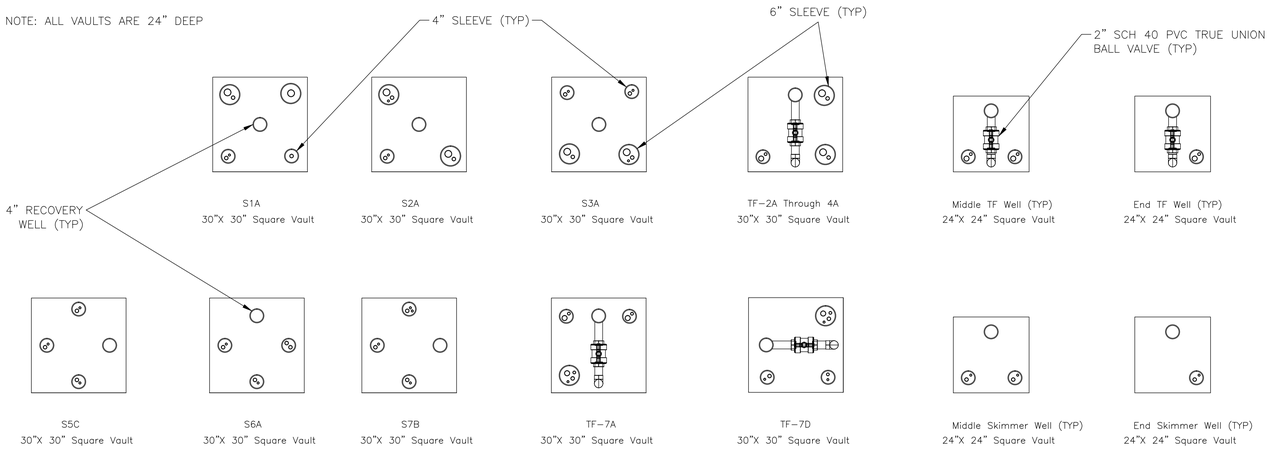
RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES, RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

MECHANICAL
MISCELLANEOUS DETAILS

MACTEC
MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG M-504
SHEET 25 OF 31

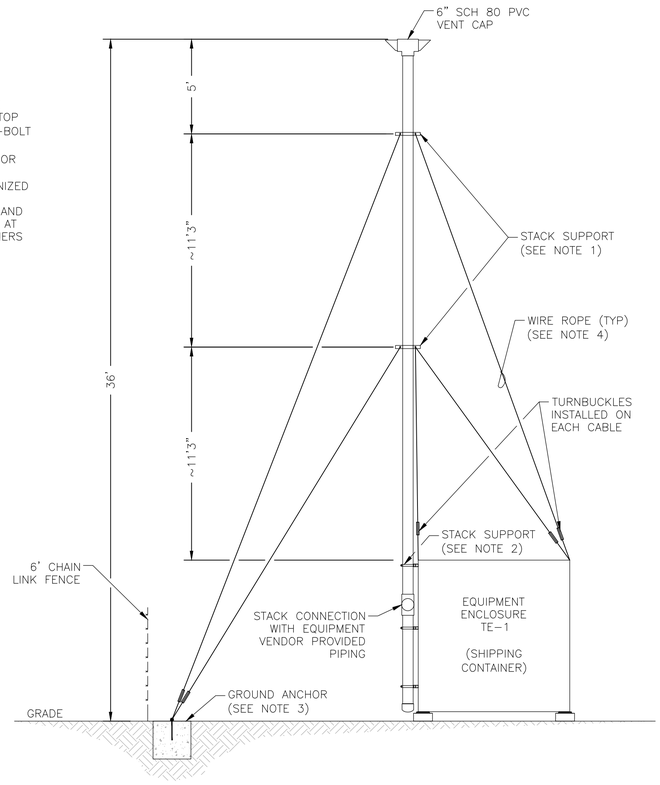


TYPICAL RECOVERY WELL VAULT LAYOUT DETAIL (AF)

1" = 2'

C-102 | M-505

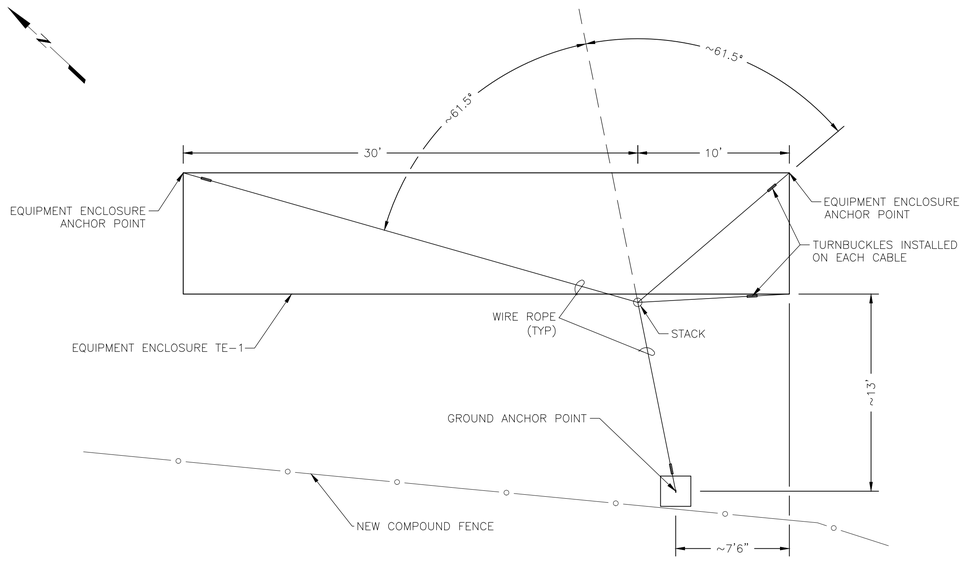
NOTES:
1. 6" STEEL RISER CLAMPS
2. 2-1/2" X 2-1/2" X 1/4" ANGLE WELDED TO SHIPPING CONTAINER TOP SUPPORT (STEEL TUBE) W/ 6" U-BOLT
3. 2'X2'X2' CONCRETE POURED INTO EXCAVATION W/ 1/2" X 12" ANCHOR BOLT COMPLETE WITH CABLE EYE
4. 3/16" 7X19 STRAND CORE GALVANIZED STEEL WIRE PIPE
5. CABLE ANCHOR POINTS PROVIDED AND INSTALLED BY EQUIPMENT VENDOR AT NORTHEAST AND NORTHWEST CORNERS OF ENCLOSURE (2 PROVIDED)



STACK INSTALLATION DETAIL (AG)

1" = 4'

M-202 | M-505



STACK INSTALLATION PLAN VIEW

1" = 5'

NO.	DATE	DSGN	DR	CHK	APVD	BY
2	12/22/15	T. KESSLER	V. WHELAN	T. KESSLER	B. O'DELL	VMW BCO
1	08/28/15					VMW BCO

RECORD DRAWINGS - FINAL
RECORD DRAWINGS - DRAFT
REVISION

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

MECHANICAL
MISCELLANEOUS DETAILS 2

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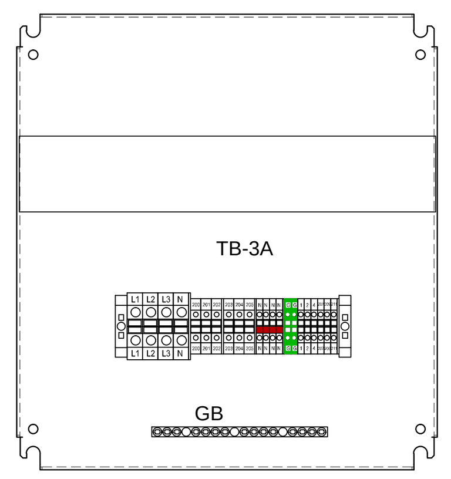
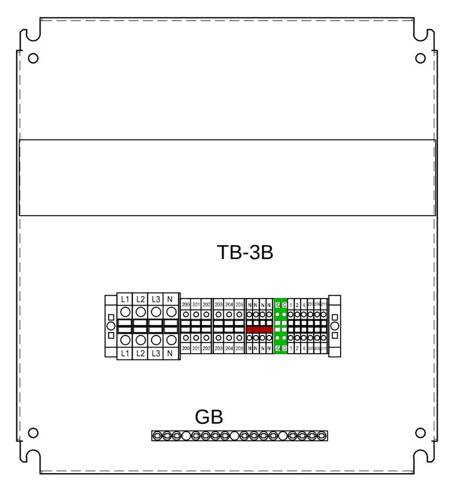
Portland, Maine 04112
(207) 775-5401

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

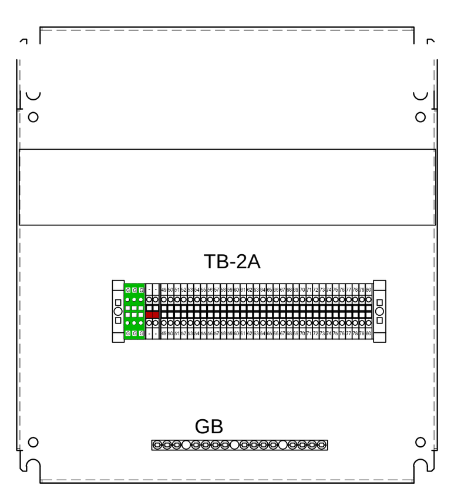
DATE 12/22/15
PROJ NO: 3480140433
DWG M-505
SHEET 26 OF 31



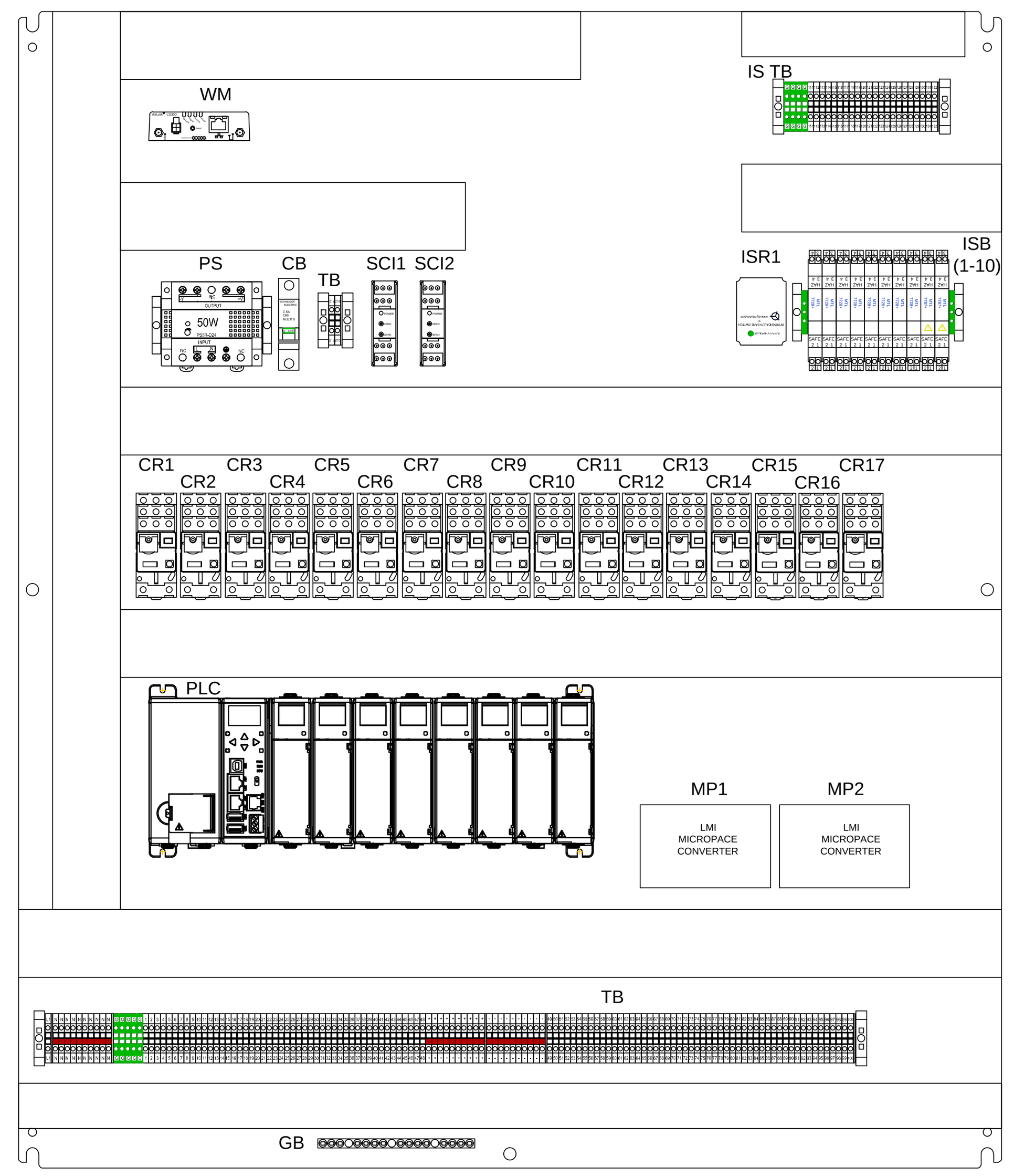
JUNCTION BOX (JB1-A) INTERIOR - SVE
EXTERNAL DIMENSIONS: 16"L X 12"W X 6"D
*SEE NOTE:3



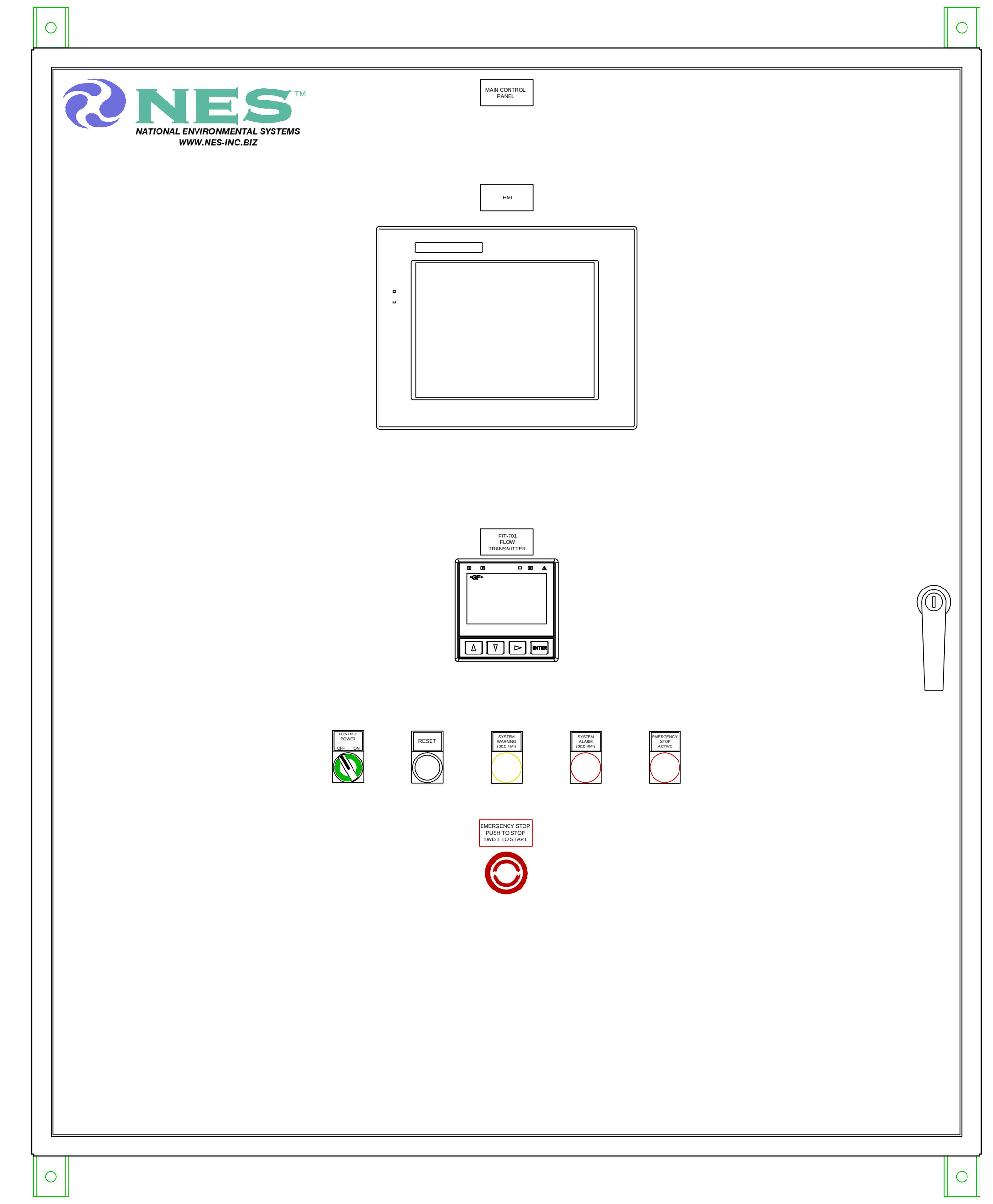
JUNCTION BOX (JB1-B) INTERIOR - GWT
EXTERNAL DIMENSIONS: 16"L X 12"W X 6"D
*SEE NOTE:3



JUNCTION BOX (JB2-A) INTERIOR - SVE
EXTERNAL DIMENSIONS: 16"L X 12"W X 6"D
*SEE NOTE:3

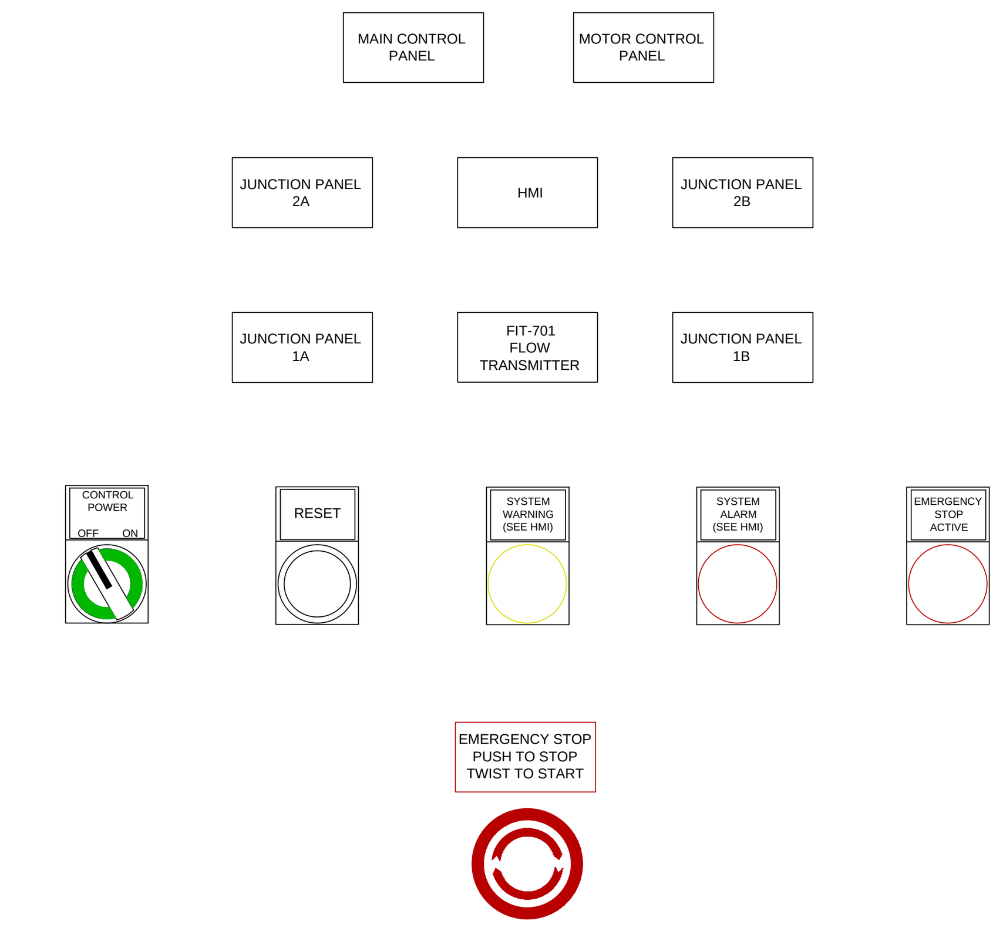


PANEL INTERIOR

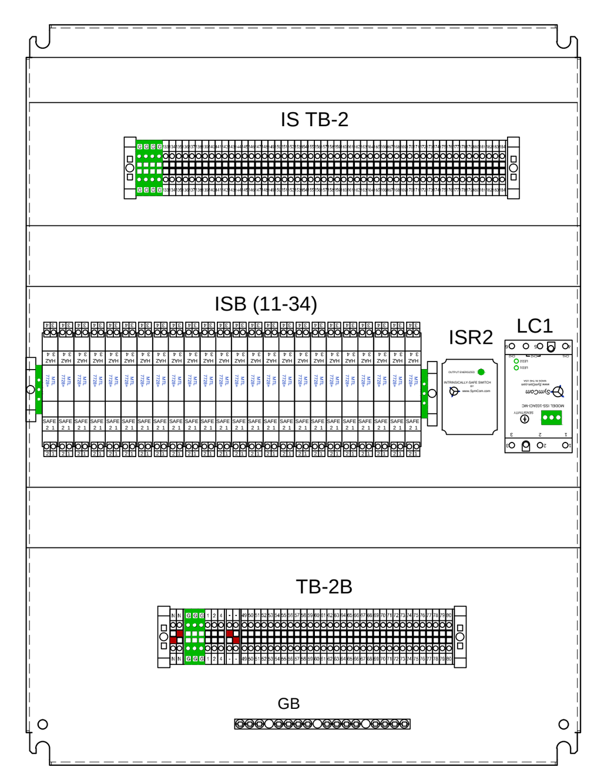


PANEL EXTERIOR

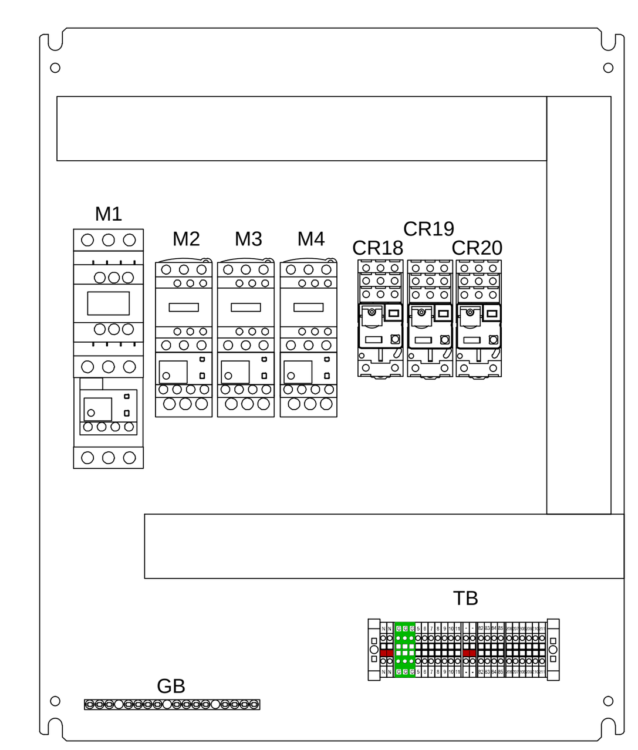
ENCLOSURE EXTERNAL DIMENSIONS: 42"L X 36"W X 8"D
*SEE NOTES: 1, 4 & 5



OPERATOR DETAILS



JUNCTION BOX (JB2-B) INTERIOR - GWT
EXTERNAL DIMENSIONS: 24"L X 20"W X 6"D
*SEE NOTES: 2 & 4



MOTOR CONTROL PANEL
EXTERNAL DIMENSIONS: 24"L X 20"W X 8"D
*SEE NOTE:3

LEGEND

- CB - CONTROLS CIRCUIT BREAKER
- CR - CONTROL RELAY
- GB - GROUND BAR
- HMI - HUMAN MACHINE INTERFACE
- ISB - INTRINSICALLY SAFE BARRIER
- ISR - INTRINSICALLY SAFE RELAY
- IS TB - INTRINSICALLY SAFE TERMINAL BLOCKS
- LC - LEVEL CONTROLLER
- M - MOTOR STARTER
- MP - MICROPACE ANALOG TO DIGITAL CONVERTER
- PLC - PROGRAMMABLE LOGIC CONTROLLER
- PS - POWER SUPPLY
- SCI - SIGNAL CONVERTER / ISOLATOR
- TB - TERMINAL BLOCK (SET)
- WM - WIRELESS MODEM

GENERAL NOTES:

1. THIRD PARTY CERTIFICATION STICKER (T.R. ARNOLD & ASSOCIATES, INC.) LOCATED WITHIN PANEL ENCLOSURE. PANEL LOCATION: CONTROL & SVE TREATMENT SYSTEM ENCLOSURE INTERIOR.
2. THIRD PARTY CERTIFICATION STICKER (T.R. ARNOLD & ASSOCIATES, INC.) LOCATED WITHIN PANEL ENCLOSURE. PANEL LOCATION: GROUND WATER TREATMENT SYSTEM ENCLOSURE EXTERIOR.
3. CONTROL PANEL ASSEMBLY IS UL 508A LISTED
4. CONTROL PANEL ASSEMBLY IS UL 698A LISTED
5. H/O/A'S CONTROLLED BY HMI SCREEN
6. GROUND IN ACCORDANCE WITH N.E.C. ARTICLE 250.122 & LOCAL AUTHORITY HAVING JURISDICTION
7. REFER TO SHEET E-603 FOR BILL OF MATERIALS

NO.	DATE	REVISION	BY	APVD
2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
1	08/28/15	RECORD DRAWINGS - DRAFT	VMW	BCO

DSGN NES | DR NES | CHK T. KESSLER | APVD B. O'DELL

BRENT C. O'DELL NEW YORK, PE NO. 069876

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

ELECTRICAL
MCC AND PANEL ELEVATIONS

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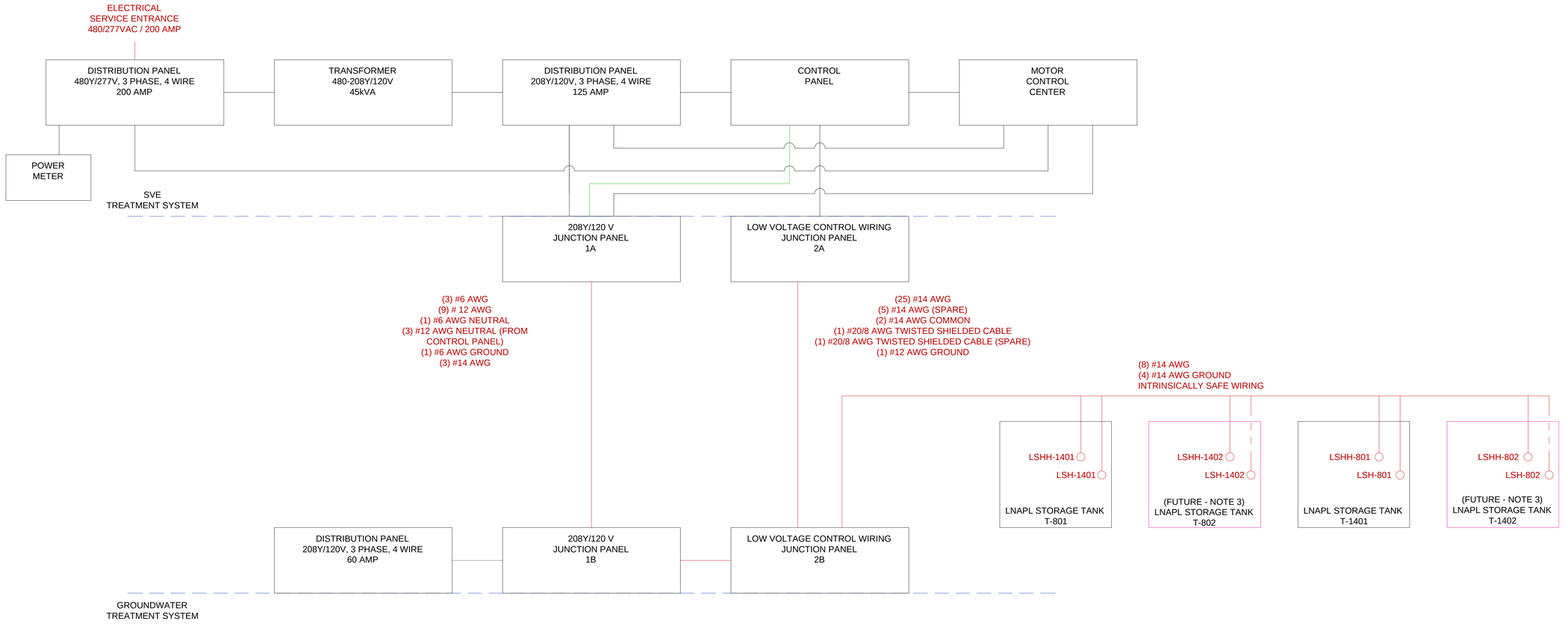
Portland, Maine 04112
(207) 775-5401

NES NATIONAL ENVIRONMENTAL SYSTEMS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG E-501
SHEET 27 OF 31



NOTES:

1. ALL FIELD INSTALLED CONDUCTORS TO BE SIZED FOR APPROPRIATE DISTANCES BY OTHERS.
2. GROUND CONDUCTORS NOT SHOWN. INSTALL ALL GROUNDS PER NEC ARTICLES 250.66, 250.122 , LOCAL ELECTRICAL CODES, AND PER THE AUTHORITY HAVING JURISDICTION.
3. TERMINALS FOR T-802 & T-1402 PRESENT FOR FUTURE CONNECTION

LEGEND	
ABBREV.	DESCRIPTION
AWG	AMERICAN WIRE GAUGE
	FACTORY WIRING
	FIELD WIRING
	ENCLOSURE LIMIT

NO.	DATE	BY	REVISION	CHK	APVD
DSGN					
DR					
NES	12/22/15	VMW	RECORD DRAWINGS - FINAL	T. KESSLER	B. O'DELL
2	08/28/15	VMW	RECORD DRAWINGS - DRAFT	BCO	BCO
1					

BRENT C. O'DELL
NEW YORK PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

ELECTRICAL
BLOCK DIAGRAM

MACTEC Engineering and Consulting, P.C.
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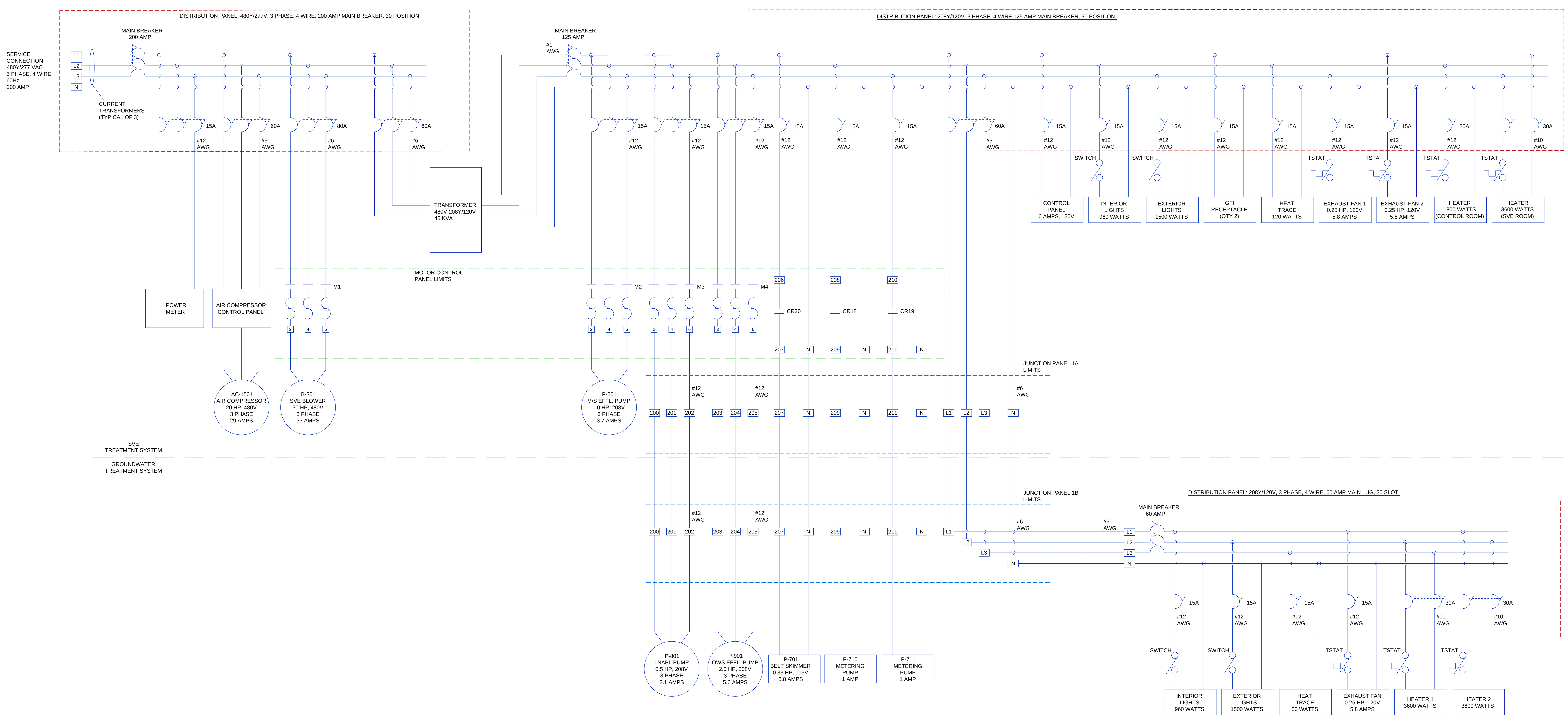
MACTEC

NES™
NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG E-601
SHEET 28 OF 31



NOTES:

1. CONTROL PANEL SHALL BE UL 698A LISTED.
2. GROUND CONDUCTORS NOT SHOWN. INSTALL ALL GROUNDS PER LOCAL CODE.

LEGEND

ABBREV.	DESCRIPTION
M	MOTOR STARTER
CB	CIRCUIT BREAKER
CR	CONTROL RELAY
TSTAT	THERMOSTAT
AWG	AMERICAN WIRE GAUGE
- - -	DISTRIBUTION PANEL LIMIT
— —	MOTOR CONTROL CENTER LIMIT
- - -	JUNCTION BOX LIMIT

NO.	DATE	REVISION	BY	APVD
2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
1	08/28/15	RECORD DRAWINGS - DRAFT	VMW	BCO

DSGN NES | DR NES | CHK T. KESSLER | APVD B. O'DELL

BRENT C. O'DELL NEW YORK, PE NO. 069876

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES, RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

ELECTRICAL
SINGLE LINE DIAGRAM

MACTEC
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511 Congress Street, Suite 200
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NES NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG E-602
SHEET 29 OF 31

ITEM	TAG	QTY	MANUFACTURER	MODEL
MASTER CONTROL PANEL ENCLOSURE	MCP	1	HAMMOND	EN4SD42368GY
BACK PANEL	MCP	1	HAMMOND	EP4236
MOUNTING FEET	MCP	1	HAMMOND	EZPMFHD
PLC CABLE	PLC	1	AUTOMATION DIRECT	EA-2CBL
RACK 8 SLOT	PLC	1	AUTOMATION DIRECT	P3-08B
RACK POWER SUPPLY	PLC	1	AUTOMATION DIRECT	P3-01AC
P3000 CPU	PLC	1	AUTOMATION DIRECT	P3-550
16 POINT DC INPUT CARD	PLC	4	AUTOMATION DIRECT	P3-16ND3
ANALOG COMBO CARD (8 IN 4 OUT)	PLC	1	AUTOMATION DIRECT	P3-8AD4DA-1
16 POINT RELAY OUTPUT CARD	PLC	2	AUTOMATION DIRECT	P3-16TR
FILL CARD	PLC	1	AUTOMATION DIRECT	P3-FILL
IO CARD CONNECTOR	PLC	7	AUTOMATION DIRECT	P3-RTB
TOUCH SCREEN 8 INCH COLOR	HMI	1	AUTOMATION DIRECT	EA9-T8C
POWER SUPPLY FOR TOUCH SCREEN	HMI	1	AUTOMATION DIRECT	EA-AC
CELLULAR 3G GATEWAY - STATIC IP HMI - AT&T	CM	1	SIERRA WIRELESS	LS300 / 1101489
MODEM BRACKET	CM	1	SIERRA WIRELESS	6000558
MODEM ANTENNA	CM	1	WILSON	301125
SIGNAL CONVERTER / ISOLATOR	SCI 1, 2	2	DYWER	SC4380
24VDC POWER SUPPLY	PS	1	IDEC	PS5R-D24
INTRINSIC SAFETY BARRIERS DIGITAL	ISB	8	MTL	7728+
INTRINSIC SAFTY BARRIER ANALOG	ISB	2	MTL	7787+
INTRINSIC SAFTY BARRIER STAND	ISB	2	MTL	ISP-7000
INTRINSIC SAFETY RELAY	ISR	1	SYMCOM	ISS-101
6 AMP BREAKER	CB	1	SQUARE D	MG24430
3 POLE RELAY 120VAC	CR1	1	SQUARE D	RUMF3AB2F7
2 POLE RELAY 120VAC	CR2-17	16	SQUARE D	RUMF2AB2F7
2 / 3 POLE RELAY BASE	CR1-17	17	SQUARE D	RUZSFEM
CONVERTER (PULSE TO 4-20mA)	MPC1,2	2	LMI	MP100
FLOW METER DISPLAY/TRANSMITTER	FIT-701	1	SIGNET	9900
GROUND BAR	GB	1	SQUARE D	PKA15GTA
TERMINAL BLOCKS	TB	125	SQUARE D	NSYTRV22
GROUNDING TERMINAL BLOCKS	TB	15	SQUARE D	NSYTRV22PE
END ANCHORS	TB	10	SQUARE D	NSYTRAABV35
END BARRIERS	TB	10	SQUARE D	NSYTRAC22
TERMINAL BLOCKS, BLUE	IS TB	20	SQUARE D	NSTRV22BL
END BARRIERS, BLUE	IS TB	10	SQUARE D	NSYTRAC22BL
SELECTOR SWITCH 2 WAY		1	SQUARE D	ZB5AK1233
PUSH BUTTON		1	SQUARE D	ZB5AA2
RED PILOT LIGHT		2	SQUARE D	ZB5AV043
YELLOW PILOT LIGHT		1	SQUARE D	ZB5AVO53
E-STOP BUTTON		3	SQUARE D	ZB5AS844
E-STOP BOX		2	SQUARE D	XALD01H7
MOUNTING LATCH		2	SQUARE D	ZB5AZ009
GREEN LED LIGHT 120VAC		1	SQUARE D	ZB5AVG3
RED LED LIGHT 120VAC		2	SQUARE D	ZB5AVG4
YELLOW LED LIGHT 120VAC		1	SQUARE D	ZB5AVG5
NORMALLY OPEN CONTACTS		2	SQUARE D	ZBE101
NORMALLY CLOSED CONTACT		3	SQUARE D	ZBE102

CONTROL PANEL BILL OF MATERIALS

ITEM	TAG	QTY	MANUFACTURER	MODEL
MOTOR CONTROL CENTER ENCLOSURE	MCC	1	HAMMOND	EN4SD24208GY
BACK PANEL	MCC	1	HAMMOND	EP2420
MOUNTING FEET	MCC	1	HAMMOND	EZPMFHD
LOCKING HANDLE	MCC	1	SCE	SCE-PLWKB
2 POLE RELAY	CR17-20	3	SQUARE D	RUMF2AB2F7
2 POLE RELAY BASE	CR17-20	3	SQUARE D	RUZSF3M
GROUND BAR	GB	1	SQUARE D	PKA15GTA
GROUNDING TERMINALS	TB	5	SQUARE D	NSYTRV22PE
TERMINAL BLOCKS	TB	25	SQUARE D	NSYTRV22
END ANCHORS	TB	4	SQUARE D	NSYTRAABV35
END BARRIERS	TB	10	SQUARE D	NSYTRAC22
MOTOR STARTER (CONTACTOR)	M1	1	SQUARE D	LC1D65AG7
MOTOR STARTER (OVERLOAD) 37-50A	M1	1	SQUARE D	LRD350L
MOTOR STARTER (CONTACTOR)	M2,M3,M4	3	SQUARE D	LC1D09G7
MOTOR STARTER (OVERLOAD) 1.6-2.5A	M2	1	SQUARE D	LRD07
MOTOR STARTER (OVERLOAD) 7-10A	M3	1	SQUARE D	LRD14
MOTOR STARTER (OVERLOAD) 2.5-4 A	M4	1	SQUARE D	LRD08

MOTOR CONTROL BILL OF MATERIALS

ITEM	TAG	QTY	MANUFACTURER	MODEL
JUNCTION BOXES	JB1-A,JB1-B,JB2-A	3	HAMMOND	EN4SD16126GY
BACK PANEL	JB-2B	3	HAMMOND	EP1612
JUNCTION BOXES	JB2-B	1	HAMMOND	EN4SD24206GY
BACK PANEL	JB2-B	1	HAMMOND	EP2420
MOUNTING FEET	ALL JB	4	HAMMOND	EZPMFHD
LOCKING HANDLE	ALL JB	4	SCE	SCE-PLWKB
TERMINAL BLOCKS 50 AMP MAX	TB	20	SQUARE D	NSYTRV62
TERMINAL BLOCKS	TB	100	SQUARE D	NSYTRV22
INTRINSIC SAFETY BARRIERS DIGITAL	ISB	22	MTL	7728+
TERMINAL BLOCKS, BLUE	IS TB	50	SQUARE D	NSTRV22BL
END BARRIERS, BLUE	IS TB	10	SQUARE D	NSYTRAC22BL
INTRINSIC SAFTY BARRIER STAND	ISB	4	MTL	ISP-7000
INTRINSIC SAFETY RELAY	ISR	1	SYMCOM	ISS-101
INTRINSIC SAFETY LEVEL CONTROL	LC	1	SYMCOM	ISS-102-ACI

JUNCTION BOX BILL OF MATERIALS

ITEM	TAG	QTY	MANUFACTURER	MODEL
DISTRIBUTION PANEL 480Y/277V, 3 PHASE, 4 WIRE, 200 AMP MAIN		1	SQUARE D	NF430L2C
TRANSFORMER, 480-208Y/120V, 45kVA		1	SQUARE D	EE45T3H
DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 125 AMP MAIN		1	SQUARE D	QO330MQ125
DISTRIBUTION PANEL COVER		1	SQUARE D	QOC342MQS
DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 60 AMP MAIN		1	SQUARE D	QO320L125GRB
CIRCUIT BREAKER, 3 POLE , 60 AMP		2	SQUARE D	QO360
CIRCUIT BREAKER, 3 POLE , 15 AMP		3	SQUARE D	QO315
CIRCUIT BREAKER, 2 POLE , 30 AMP		3	SQUARE D	QO230
CIRCUIT BREAKER, 1 POLE , 20 AMP		1	SQUARE D	QO120
CIRCUIT BREAKER, 1 POLE , 15 AMP		15	SQUARE D	QO115
POWER MONITOR TRANSMITTER	PMX-100	1	LEVITON	3500 / 3KUMT-02M

POWER DISTRIBUTION BILL OF MATERIALS

NO.	DATE	REVISION	BY	APVD
2	12/22/15	RECORD DRAWINGS - FINAL	VMW	BCO
1	08/28/15	RECORD DRAWINGS - DRAFT	VMW	BCO

DSGN NES | DR NES | CHK T. KESSLER | APVD B. O'DELL

BRENT C. O'DELL NEW YORK, PE NO. 069876

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES, RAD I AND RAD II
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VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE 12/22/15
PROJ NO: 3480140433
DWG E-603
SHEET 30 OF 31

Interlock	Interlock ID	Interlock Description	MOV-101, SVE MOTOR OPERATED VALVE	MOV-102, SVE MOTOR OPERATED VALVE	MOV-103, SVE MOTOR OPERATED VALVE	MOV-104, SVE MOTOR OPERATED VALVE	MOV-105, SVE MOTOR OPERATED VALVE	MOV-106, SVE MOTOR OPERATED VALVE	MOV-107, SVE MOTOR OPERATED VALVE	P-201, MS TRANSFER PUMP	B-301, SVE BLOWER	SV-601, TOTAL FLUIDS PUMP AIR SUPPLY	SV-602, TOTAL FLUIDS PUMP AIR SUPPLY	SV-603, TOTAL FLUIDS PUMP AIR SUPPLY	SV-604, TOTAL FLUIDS PUMP AIR SUPPLY	SV-605, TOTAL FLUIDS PUMP AIR SUPPLY	SV-606, TOTAL FLUIDS PUMP AIR SUPPLY	SV-607, TOTAL FLUIDS PUMP AIR SUPPLY	P-701, PRODUCT BELT T SKIMMER	P-710, BIOCIDE METERING PUMP	P-711, EMULS. BREAKER METERING PUMP	P-801, PRODUCT TRANSFER PUMP	P-901, OWS EFFLUENT PUMP	SV-1401, SKIMMER PUMP AIR SUPPLY (NORMALLY CLOSED)	SV-1402, SKIMMER PUMP AIR SUPPLY (NORMALLY OPEN)	SV-1501, AIR COMPRESSOR SUPPLY (NORMALLY CLOSED)	SV-1502, AIR COMPRESSOR SUPPLY (NORMALLY CLOSED)	OPERATOR INTERFACE	Adjustable Set Point (HMI Screen Display)	Warning Notification (HMI Screen Display)	Alarm Notification (HMI Screen Display)	Warning Notification (HMI Screen Display)	Alarm Notification (Local Panel Display)	Manual Reset (Warning / Alarm)	Remote Warning Notification	Remote Alarm Notification	Event Log	Alarm Log	Data Log (10 Minutes)	INSTRUMENT TYPE
1		Emergency Stop	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O														D
2		HMI SVE MOV Programmable Timer	I/O	I/O	I/O	I/O	I/O	I/O	I/O																					Y											L
3		HMI Total Fluids SV Programmable Timer										I/O	I/O	I/O	I/O	I/O	I/O	I/O												Y											L
4		HMI Skimmer Pump SV Programmable Timer																					I/O	I/O																	
5	VSL-201	SVE Manifold Header Vacuum Switch - Low	O	O	O	O	O	O	O		O																				Y		Y	Y		Y		Y		D
6	LSHH-201	MS Level Switch - High/High	O	O	O	O	O	O	O	O	O																				Y		Y	Y		Y		Y		D
7	LSH-201	MS Level Switch - High								I																											Y			D
8	LSL-201	MS Level Switch - Low								O																											Y			D
9	FIT-201	SVE Air Flow																																					Y	A
10	VIT-201	SVE Vacuum																																					Y	A
11	VSH-301	SVE Blower Inlet Vacuum Switch - High	O	O	O	O	O	O	O		O																				Y		Y	Y		Y		Y		D
12	PSH-301	SVE Blower Discharge Pressure Switch - High	O	O	O	O	O	O	O		O																				Y		Y	Y		Y		Y		D
13	TSH-401	Heat Exchanger Discharge Temperature Switch - High	O	O	O	O	O	O	O		O																				Y		Y	Y		Y		Y		D
14	FIT-701	MS Transfer Pump Flow Indicating Transmitter																		P	P																		Y	A
15	LSP-701	Non-Conductive Liquid Detected in Separator (Product)							O		O	O	O	O	O	O	O			O	O										Y		Y	Y		Y		Y		D
16	LSHH-701	Pre-Separator Level Switch High/High							O		O	O	O	O	O	O	O			O	O										Y		Y	Y		Y		Y		D
17	LSHH-702	OWS Level Switch (Product) - High/High							O		O	O	O	O	O	O	O	O	O	O	O	O									Y		Y	Y		Y		Y		D
18	LSH-702	OWS Level Switch (Product) High																				I															Y			D
19	LSL-702	OWS Level Switch (Product) - Low																				O															Y			D
20	LSHH-703	OWS Level Switch (Water) - High/High							O		O	O	O	O	O	O	O			O	O										Y		Y	Y		Y		Y		D
21	LSH-703	OWS Level Switch (Water) - High																				I															Y			D
22	LSL-703	OWS Level Switch (Water) - Low																				O															Y			D
23	LSLL-710	Chemical Tank Level Switch (Biocide) - Low																			O										Y		Y	Y		Y		Y		D
24	LSLL-711	Chemical Tank Level Switch (Emuls. Breaker) - Low																				O									Y		Y	Y		Y		Y		D
25	FIT-801	Flow Total Pulse from OWS Product Effl. Pump																																					Y	D
26	LSHH-801	LNAPL Tank, T-801 Level Switch (TSCA) - High / High							O		O	O	O	O	O	O	O	O	O	O	O	O									Y		Y	Y		Y		Y		D
27	LSH-801	LNAPL Tank, T-801 Level Switch (TSCA) - High									O	O	O	O	O	O	O														Y		Y		Y	Y		Y		D
28	LSHH-802	LNAPL Tank, T-802 Level Switch (TSCA) - High / High							O		O	O	O	O	O	O	O	O	O	O	O	O									Y		Y	Y		Y		Y		D
29	LSH-802	LNAPL Tank, T-802 Level Switch (TSCA) - High									O	O	O	O	O	O	O														Y		Y		Y	Y		Y		D
30	PSH-901	Bag Filter Inlet Pressure Switch - High							O		O	O	O	O	O	O	O			O	O		O								Y		Y	Y		Y		Y		D
31	FIT-1201	Flow Total Pulse from System Effluent																																					Y	D
32	FTH-1201	High Total Flow Discharge Warning																													Y		Y		Y		Y			L
33	FTHH-1201	High Total Flow Discharge Alarm	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O		O								Y		Y			Y		Y		L
34	FIT-1401	Flow Total Pulse from Product Skimmer Pumps																																					Y	D
35	LSHH-1401	LNAPL Tank, T-1401 Level Switch (NON TSCA) - High / High																							O	O							Y		Y	Y		Y		Y		D
36	LSH-1401	LNAPL Tank, T-1401 Level Switch (NON TSCA) - High																													Y		Y		Y	Y		Y		D
37	LSHH-1402	LNAPL Tank, T-1402 Level Switch (NON TSCA) - High / High																							O	O							Y		Y	Y		Y		Y		D
38	LSH-1402	LNAPL Tank, T-1402 Level Switch (NON TSCA) - High																													Y		Y		Y	Y		Y		D
39	PSL-1501	Air Compressor Pressure Switch - Low									O	O	O	O	O	O	O			O	O										Y		Y	Y		Y		Y		D
40	LSHH-1601	Secondary Containment Level Switch (SVE Enclosure) - High	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O			Y		Y	Y		Y		Y		D
41	LSHH-1602	Secondary Containment Level Switch (GWT Enclosure) - High	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O			Y		Y	Y		Y		Y		D
42	PM	Power meter pulse for Watt Hours (total energy usage)																																					Y	A
43	MOV CLOSED	All MOV's Closed								O																					Y		Y					Y		L

Notes:

HMI – Human/Machine Interface

O – Off
I – On
I/O – On/Off Control
P – Propositional Control

Y – Yes

A – Analog
D – Digital
L – Internal Logic

LSH/LSHH–802 and LSH/LSHH–1402 not to be used / interlocks present – inputs jumped

NO.	DATE	DSGN	DR	CHK	REVISION
2	12/22/15	NES	NES	T. KESSLER	RECORD DRAWINGS - FINAL
1	08/28/15	VMW	BCO	APVD	RECORD DRAWINGS - DRAFT
		VMW	BCO	B. O'DELL	

BRENT C. O'DELL
NEW YORK, PE NO. 090976

RECORD DRAWINGS
REVIEW AVENUE DEVELOPMENT SITES,
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101

ELECTRICAL

CONTROL LOGIC & INTERLOCK SCHEDULE

MACTEC Engineering and Consulting, P.C.
511 Congress Street, Suite 200
Portland, Maine 04112
(207) 775-3401

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 / FAX 508-226-1160 (Fax)
WWW.NES-INC.NET

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	12/22/15
PROJ NO:	3480140433
DWG	E-604
SHEET	31 OF 31

Review Avenue Development Sites

RAD I and RAD II
Long Island City, Queens

Record Drawings - Final

December 2015

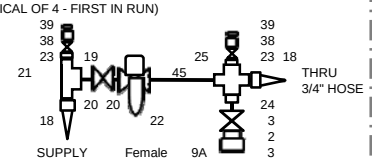
Attachment 1

Manifold Assemblies, Well Cap and Hose Assembly Details and Schedules

TOTAL FLUIDS WELL PIPE ASSEMBLY DETAILS - FINAL

AIR SUPPLY PIPING TF-A

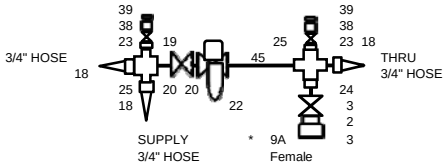
TOTAL FLUIDS WELL VAULT - A
(TYPICAL OF 4 - FIRST IN RUN)



ASSEMBLY 9 TF1A, TF5A, TF6A, TF7A

AIR SUPPLY PIPING TF-A

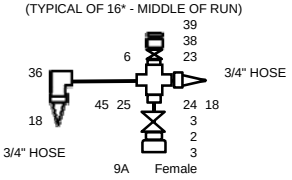
TOTAL FLUIDS WELL VAULT - A
(TYPICAL OF 3 - FIRST IN RUN WITH PASS THROUGH CONNECTION)



ASSEMBLY 9A TF2A, TF 3A & TF4A

AIR SUPPLY PIPING TF-BC

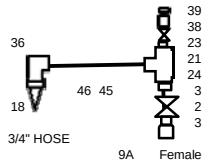
TOTAL FLUIDS WELL VAULT - B,C TF-7D&E
(TYPICAL OF 16* - MIDDLE OF RUN)



ASSEMBLY 10

AIR SUPPLY PIPING TF-D& 7F

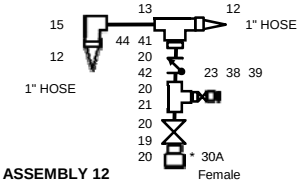
TOTAL FLUIDS WELL VAULT - D & 7F
(TYPICAL OF 7 - END OF RUN)



ASSEMBLY 11

PRODUCT RETURN PIPING

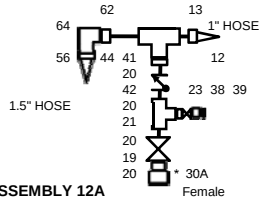
TOTAL FLUIDS WELL VAULT - D*
(FIRST IN RUN WITH PASS-THRU)



ASSEMBLY 12

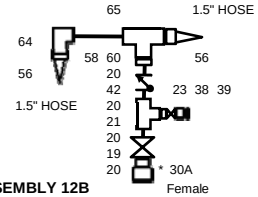
PRODUCT RETURN PIPING

TOTAL FLUIDS WELL VAULT - D*
(FIRST IN RUN WITH PASS-THRU)



ASSEMBLY 12A

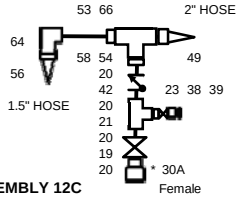
PRODUCT RETURN PIPING



ASSEMBLY 12B

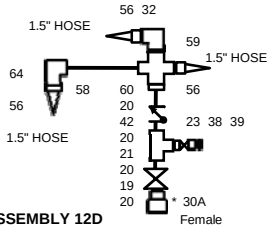
TF5B, TF7A,

PRODUCT RETURN PIPING



ASSEMBLY 12C

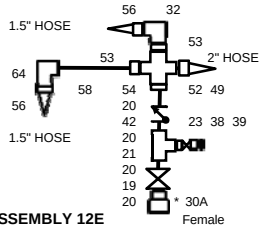
PRODUCT RETURN PIPING



ASSEMBLY 12D

TF4A

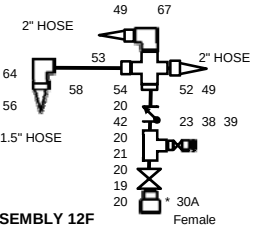
PRODUCT RETURN PIPING



ASSEMBLY 12E

TF3A

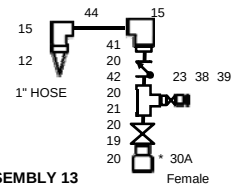
PRODUCT RETURN PIPING



ASSEMBLY 12F

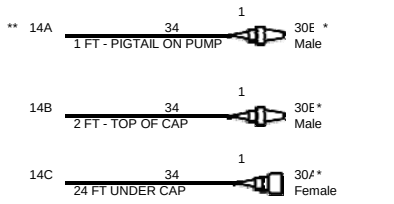
PRODUCT RETURN PIPING

TOTAL FLUIDS WELL VAULT - D & E
(TYPICAL OF 7 - END OF RUN)



ASSEMBLY 13

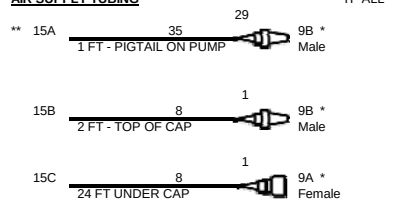
TF-ALL



NOTE: 3/4" ID NITRILE HOSES: 1' LONG (MALE) PUMP PIGTAIL; 2' LONG (MALE) TOP OF CAP; 24' LONG (FEMALE) UNDER CAP

ASSEMBLY 14 *PRODUCT DISCHARGE HOSE SET*

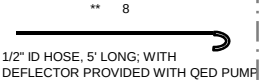
AIR SUPPLY TUBING TF-ALL



NOTE: 1/2" ID FLEXIBLE HOSES: 1' LONG (MALE) PUMP PIGTAIL; 2' LONG (MALE) TOP OF CAP; 24' LONG (FEMALE) UNDER CAP

ASSEMBLY 15 *AIR SUPPLY HOSE SET*

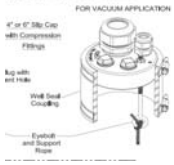
VENT TUBE TF-ALL



1/2" ID HOSE, 5' LONG; WITH
DEFLECTOR PROVIDED WITH QED PUMP

ASSEMBLY 16 *VENT HOSE*

FIGURE TO BE REVISED: 4" PVC CAP HAS BARB FITTINGS TOP & BOTTOM FOR AIR AND PRODUCT HOSE CONNECTIONS, EYE BOLT IN BOTTOM FOR TETHER LINE, 30' NYLON ROPE, PLUGGED HOLE FOR LEVEL MEASUREMENT, ITEM 38 & 39 FOR VACUUM GAUGE CONNECTION, FERNCO BOOT SEAL (ITEM 26), ASSEMBLED WITH ALL HOSES; TOP AND BOTTOM.
REF: ASSYS 14 & 15

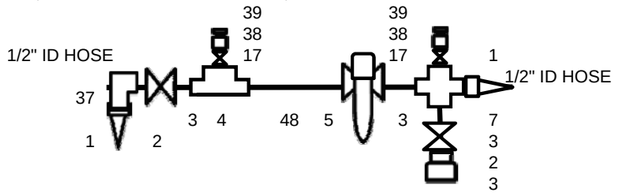


ASSEMBLY 17 *TOTAL FLUIDS SVE WELL CAP W/ HOSES* ALL TF WELLS

SKIMMER WELL PIPE ASSEMBLY DETAILS - FINAL

AIR SUPPLY PIPING S-A

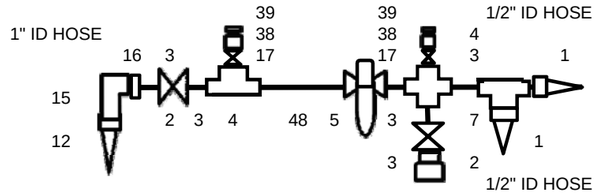
SKIMMER WELL VAULT - A
(TYPICAL OF 8 - FIRST IN RUN)



ASSEMBLY 1 9A Female

AIR SUPPLY PIPING S2A ONLY

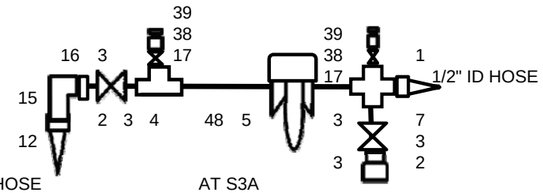
SKIMMER WELL VAULT - A



ASSEMBLY 1A -1X0.5X0.5" PASS THRU 9A Female

AIR SUPPLY PIPING

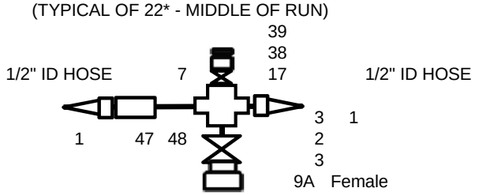
SKIMMER WELL VAULT - A



ASSEMBLY 1B - 1X0.5" PASS THROUGH 9A Female

AIR SUPPLY PIPING S-BCD

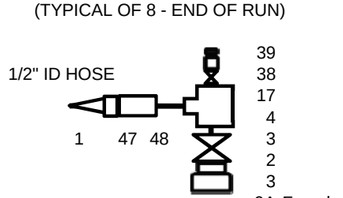
SKIMMER WELL VAULT - B, C & D*
(TYPICAL OF 22* - MIDDLE OF RUN)



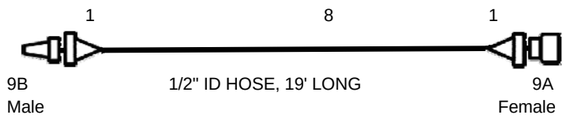
ASSEMBLY 2

AIR SUPPLY PIPING S-E

SKIMMER WELL VAULT - D & E*
(TYPICAL OF 8 - END OF RUN)

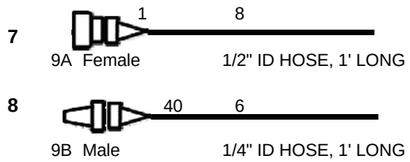


ASSEMBLY 3



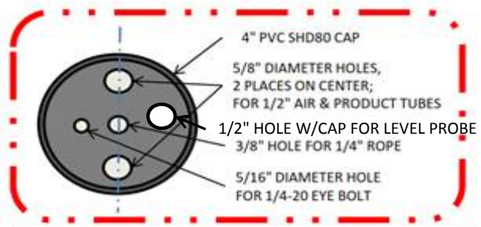
NOTE: ASSEMBLE TWO (2) HOSES THROUGH CAP (ITEM 10) ; 1 MALE AND 1 FEMALE EACH END

ASSEMBLY 6 - CAP WITH (2) HOSES



NOTE: ONE EACH 1/2" ID PIGTAILS PER PUMP

ASSEMBLY 7 & 8

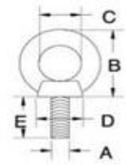


ALTERNATE PRODUCT RECOVERY WELL CAP

NOTES:
1. Assemble 316ss eye bolt on top of cap with flat washer and nylon insert hex nut tightened from below
2. Tie loop in end of 1/4" Nylon rope to prevent dropping into well.
3. Mark skimmer pump setting level on rope with electric tape or ty wrap.
4. Wrap loose end of rope around eye bolt 2X, pull loop through eye bolt and hitch 2X to tight end (to pump) to secure.

1/4" x 9/16" Machine Eye Bolt Stainless Steel Type 316
US Cargo Control PN MSSEB14X916

Specifications
Working Load Limit: 400 LBS
"A" = 1/4" **"B"** = 1""**C"** = 5/8" **"D"** = 1/2""**E"** = 9/16"

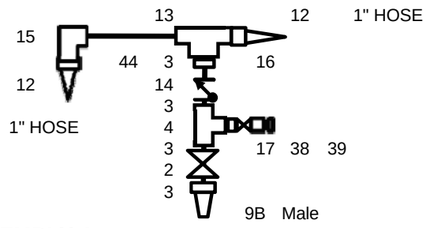


BoltDepot.com PN 16008
1/4"-20 HexLock Nut Nylon Insert, 316ss
BoltDepot.com PN 16020
5/16" Flat Washer, 316ss

ASSEMBLY 6A SKIMMER WELL CAP ASSEMBLY W/30' NYLON ROPE & FERNCO

PRODUCT RETURN PIPING S-ABCD

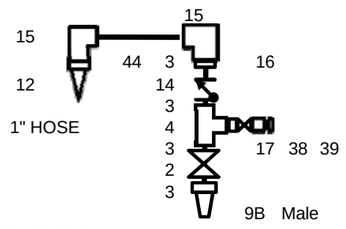
SKIMMER WELL VAULT - A, B, C, D*
(TYPICAL OF 30 - ALL EXCEPT LAST IN RUN)



ASSEMBLY 4

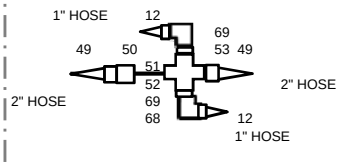
PRODUCT RETURN PIPING S-E

SKIMMER WELL VAULT - D & E*
(TYPICAL OF 8 - END OF RUN)

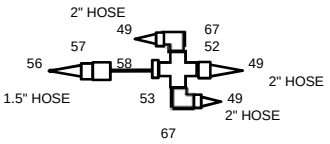


ASSEMBLY 5

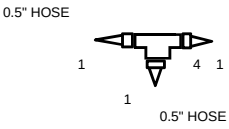
SPLICE CONNECTION PIPE ASSEMBLY DETAILS - FINAL



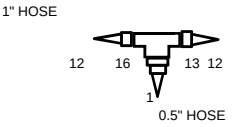
ASSEMBLY 18 - PVC
2x2x1x1 HOSE SPLICE CONNECTOR



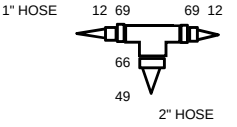
ASSEMBLY 18A - PVC
2x2x2x1.5 HOSE SPLICE CONNECTOR



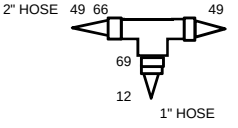
ASSEMBLY 19 - GALV/BRASS
0.5" x 0.5 " x 0.5" HOSE SPLICE CONNECTOR



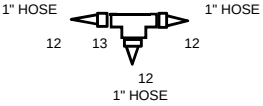
ASSEMBLY 20 - GALV/BRASS
1" x 1" x 0.5" HOSE SPLICE CONNECTOR



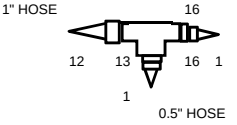
ASSEMBLY 21 - PVC
2" x 1 " x 1" HOSE SPLICE CONNECTOR



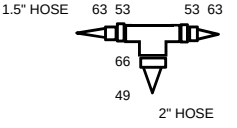
ASSEMBLY 22 - PVC
2" x 2 " x 1" HOSE SPLICE CONNECTOR



ASSEMBLY 23 - PVC
1" x 1 " x 1" HOSE SPLICE CONNECTOR



ASSEMBLY 24 - GALV/BRASS
1" x 0.5 " x 0.5" HOSE SPLICE CONNECTOR

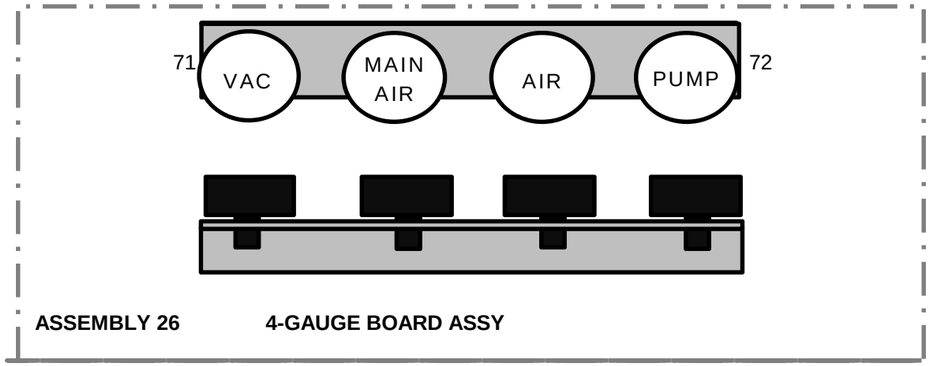


ASSEMBLY 25 - PVC
2" x 1.5" x 1.5" HOSE SPLICE CONNECTOR

LOOSE HOSE SPLICE CONNECTORS

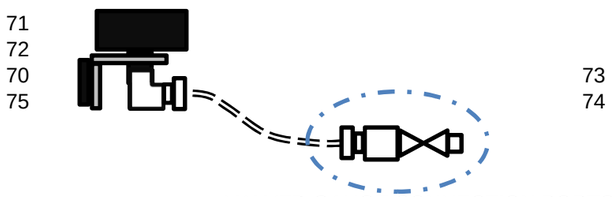
ASSY:	DESCRIPTION
27	2x2" HOSE SPLICE, PVC
28	1.5X1.5" HOSE SPLICE, PVC
29	1X1" HOSE SPLICE, PVC
29A	1X1" HOSE SPLICE, BRASS
30	0.75X0.75" HOSE SPLICE, PVC
30A	0.75X0.75" HOSE SPLICE, BRASS
31	0.5X0.5" HOSE SPLICE, PVC
31A	0.5X0.5" HOSE SPLICE, BRASS

GAUGE BOARD DETAIL AND BOM



ASSEMBLY 26 4-GAUGE BOARD ASSY

GAUGE BOARD - TYPICAL DETAIL



VALVED GAUGE CONNECTION PORTS

	QTY OF ASSEMBLIES:	4
ITEM	**DESCRIPTION**	**Assy 31**
70	4-GAUGE BRACKET; 3/16" AL, (2) 1/8" MOUNTING HOLES	1
71	2.5" GAUGE, 1/4" FNPT, REAR MOUNT - PRESSURE [0-160PSI	3
72	2.5" GAUGE, 1/4" FNPT, REAR MOUNT - VACUUM	1
73	1/4" OD TUBE x 1/4" NPTF EL QUICK CONNECT, BRASS	4
74	1/4" OD NYLON TUBE X 2' LONG	4
75	MAGNETIC MOUNT 10-LB PULL	2

* NOTE: MAGNETIC ATTACHMENT TO ANGLE IRON UNDER VAULT LID

ITEM	COMPONENT DESCRIPTION / ASSEMBLY ID	1	1A	1B	2	3	4	5	6 & 6A	7	8	9	9A	10	11	12	12A	12B	12C	12D	12E	12F	13	14	15	16	17	18	18A	19	20	21	22	23	24	25	26	27	28	29	29A	30	30A	31	31A
		6	1	1	21	9	29	9	38	38	38	4	3	16	7	0	7	16	1	1	1	0	7	30	30	30	30	3	1	1	2	1	2	5	1	2	4	6	6	8	8	8	8	8	8
1	1/2" HOSE BARB X 1/2' MNPT	0	2	1	2	1	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	2	0	0	3	1	0	0	0	2	0	0	0	0	0	0	0	0	0
2	1/2" BALL VALVE, BRONZE	2	2	2	1	1	1	1				1	1	1	1																														
3	1/2" X CLOSE NIPPLE	4	6	5	2	2	4	4				2	2	2	2																														
4	1/2" TEE,	1	2	1		1	1	1																						1													
5	1/2" FILTER REGULATOR, PN	1	1	1																																								
6	1/4" ID FLEXIBLE HOSE (FT)										1																																	
7	1/2" CROSS,	1	1	1	1																																							
8	1/2" ID FLEXIBLE HOSE (FT)								30	1															27	26																			
*9A	1/2" QUICK-CONNECT SHUT-OFF, FNPT X FEMALE, BRASS	1	1	1	1	1			2	1		1	1	1	1										1																			
*9B	1/2" QUICK-CONNECT SHUT-OFF, FNPT X MALE, BRASS						1	1	2		1														2																			
10	4" SKIMMER WELL CAP - NES								1																																			
11	1/4" NYLON ROPE (FT)								30																		30																		
12	1" HOSE BARB X 1" MNPT,		1	1			2	1								2	1						1				2			2	2	1	3	1									
13	1" TEE,						1									1	1													1			1	1										
14	1/2" CHECK VALVE, SPRING LOADED, BRASS						1	1																																			
15	1" ELBOW,		1	1			1	2								1							2																				
16	1" x 1/2" REDUCING BUSHING		1	1			1	1																						1				2								
17	1/2" x 1/4" REDUCING BUSHING,	2	2	2	1	1	1	1																																			
18	3/4" BARB X 3/4' MNPT											2	3	2	1												2																
19	3/4" BALL VALVE, BRASS											1	1			1	1	1	1	1	1	1	1																				
20	3/4" X CLOSE NIPPLE											2	2			4	4	4	4	4	4	4	4																				
21	3/4" TEE,											1			1	1	1	1	1	1	1	1	1																				
22	3/4" AIR FILTER REGULATOR, HIGH FLOW											1	1																														
23	3/4" x 1/4" REDUCING BUSHING,											2	2	1	1	1	1	1	1	1	1	1	1																				
24	3/4" x 1/2" REDUCING BUSHING,											1	1	1	1																												
25	3/4" CROSS,											1	2	1																													
26	4" FERNCO COUPLING (PART OF ASSY 17)																										1																
27	1" x 1/4" REDUCING BUSHING,																																										
28	4" TF VACUUM WELL CAP, AP4 W/ GAUGING PLUG - NES																										1																
29	3/8" HOSE BARB X 1/2" MNPT,																									1																	
30A	3/4" QUICK-CONNECT SHUT-OFF, FNPT X FEMALE, BRASS															1	1	1	1	1	1	1	1	1																				
30B	3/4" QUICK-CONNECT SHUT-OFF, FNPT X MALE, BRASS																								2																			
31	EYE BOLT ASSY, SS (PART OF CAP ASSY)								1																		1																
32	1.5" STREET EL																				1																						
33	1" CROSS,																																										
34	3/4" ID FLEXIBLE HOSE (FT)																								27																		
**35	3/8" ID FLEXIBLE HOSE (FT)																									1	5																
36	3/4"ELBOW													1	1																												
37	1/2" STREET ELBOW,	1																																								
38	1/4" BALL VALVE, MXFNPT, BRONZE	2	2	2	1	1	1	1				2	2	1	1	1	1	1	1	1	1	1	1				1																
39	1/4" OD TUBE X MNPT, PUSH TO CONNECT FITTING	2	2	2	1	1	1	1				2	2	1	1	1	1	1	1	1	1	1	1				1																
40	1/4" HOSE BARB X 1/2"MNPT										1																																
41	1" x 3/4" REDUCING BUSHING,															1	1						1																				
42	3/4" CHECK VALVE, SPRING LOADED, BRASS															1	1	1	1	1	1	1	1																				
43	1" COUPLING, NOT USED																																										
44	1" X 4" NIPPLE,						1	1								1	1						1																				
45	3/4" X 4" NIPPLE,											1	1	1	1																												
46	3/4" COUPLING, NOT USED																																										
47	1/2" COUPLING,				1																																					
48	1/2" X 4" NIPPLE,	1	1	1	1	1																																				
49	2" HOSE BARB X 2' NPTM																		1		1	2						2	3			1	2			1							
50	2" COUPLING																											1	1														
51	2" X 4" NIPPLE																											1	1														
52	2" CROSS																				1	1						1	1														
53	2" X 1.5" RED BUSHING																				2	1							1							2							
54	2" X 3/4" RED BUSHING																			1		1																					
55	2" X 1/4" RED BUSHING																																										
56	1.5" HOSE BARB X 1.5" NPTM																1	2	1	3	2	1							1													
57	1.5" COUPLING																												1													
58	1.5" X 4" NIPPLE																	1	1	1	1	1							1													
59	1.5" CROSS																				1																					
60	1.5" X 3/4" RED BUSHING																	1			1																					
61	1.5" X 1/4" RED BUSHING																																									
62	1.5" X 1" RED BUSH																1																									
63	1.5" HOSE BARB X 1.5" NPTM																																			2							
64	1.5" ELBOW																1	1	1	1	1	1																				
65	1.5" TEE																	1																									
66	2" TEE																		1																	1							
67	2" STREET EL																					1							2			1										
68	1" STREET EL																											2														
69	2" X 1" RED BUSHING																											2				2	1									
70	4-GAUGE BRACKET; 3/16" AL																																				1						
71	2.5" GAUGE, 1/4" FNPT, REAR MOUNT - PRESSURE [0-160PSI																																				3						
72	2.5" GAUGE, 1/4" FNPT, REAR MOUNT - VACUUM																																				1						
73	1/4" OD TUBE x 1/4" NPTF EL QUICK CONNECT, BRASS																																				4						
74	1/4" OD NYLON TUBE X 2' LONG																																				4						
75	MAGNETIC MOUNT 10-LB PULL																																				2						
76	2x2" HOSE SPLICE, PVC																																					1					
77	1.5X1.5" HOSE SPLICE, PVC																																						1				
78	1X1" HOSE SPLICE, PVC																																							1			
79	1X1" HOSE SPLICE, BRASS																																								1		
80	0.75X0.75" HOSE SPLICE, PVC																																									1		
81	0.75X0.75" HOSE SPLICE, BRASS																																										1	
82	0.5X0.5" HOSE SPLICE, PVC																																											1
83	0.5X0.5" HOSE SPLICE, BRASS																																											1

ASSY #	QTY	DESCRIPTION	USED IN VAULTS						WELL VAULT NUMBERS																																						SUBTOTALS
SKIMMER WELL SUBASSEMBLIES			A	B	C	D	E	F	S1A	S1B	S1C	S1D	S1E	S2A	S2B	S2C	S2D	S2E	S3A	S3B	S3C	S3D	S3E	S4A	S4B	S4C	S4D	S4E	S5A	S5B	S5C	S5D	S5E	S6A	S6B	S6C	S6D	S6E	S7A	S7B	S7C	S7D	S8A	S8B	S8C	S8D	
A	**38**	QED 24" GENIE CONTROLLERLESS BALDDER PUMP #301807	X	X	X	X	X	X*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**38**
B	**38**	QED SPG4 SKIMMER ASSY, 24" TRAVEL, COILED TUBE, #301226	X						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**38**
1	**6**	SKIM AIR SUPPLY ASSY W/REGULATOR - 0.5X0.5" 1ST RUN	X						1															1					1					1					1				1				**6**
1A	**1**	SKIM AIR SUPPLY ASSY W/REGULATOR - 0.5X1X1" TEE DISCHARGE	X											1																																	**1**
1B	**1**	SKIM AIR SUPPLY ASSY W/REGULATOR - 1X0.5" TEE DISCHARGE	X																1																												**1**
2	**21**	SKIM AIR SUPPLY ASSY - MID RUN		X	X	X*				1	1	1			1			1		1	1	1			1	1	1			1	1	1			1	1	1			1	1			1	1		**21**
3	**9**	SKIM AIR SUPPLY ASSY - END				X*	X						1			1	1						1					1					1					1				1				1	**9**
4	**29**	SKIM PRODUCT PIPE ASSY - ALL EXCEPT END	X	X	X	X	X*		1	1	1	1		1	1			1	1	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1		1	1	1		1	1	1		**29**
5	**9**	SKIM PRODUCT PIPE ASSY - END				X*	X*						1			1	1						1					1					1					1				1				1	**9**
6	**38**	SKIM AIR SUPPLY HOSE	X	X	X	X*	X*		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**38**
7	**38**	SKIM PRODUCT RETURN HOSE	X	X	X	X*	X*		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**38**
8	**38**	SKIM WELL CAP ASSEMBLY	X	X	X	X*	X*		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**38**
TF WELL SUBASSEMBLIES									TF1A	TF1B	TF1C	TF1D	TF2A	TF2B	TF2C	TF2D	TF3A	TF3B	TF3C	TF3D	TF4A	TF4B	TF4C	TF4D	TF5A	TF5B	TF5C	TF5D	TF6A	TF6B	TF6C	TF6D	TF7A	TF7B	TF7C	TF7D	TF7E	TF7F									
C	**30**	QED SHORT AP4+ TOP LOAD PUMP #301006P	X	X	X	X	X	X*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									**30**
9	**4**	TF AIR SUPPLY ASSY W/REGULATOR - 0.75X0.75"	X						1																1				1				1														**4**
9A	**3**	TF AIR SUPPLY ASSY W/REGULATOR - 0.75X0.75X0.75"	X										1				1				1																										**3**
10	**16**	TF AIR SUPPLY - MID RUN		X	X	X	X*			1	1			1	1			1	1			1	1			1	1			1	1			1	1	1	1										**16**
11	**7**	TF AIR SUPPLY - END RUN					X*	X*				1				1				1				1				1				1						1									**7**
12	**0**	TOTAL FLUIDS PIPE ASSY - 1X1"	X	X	X	X	X*																																								**0**
12A	**7**	TOTAL FLUIDS PIPE ASSY - 1.5X1"			X						1				1				1				1				1				1						1										**7**
12B	**16**	TOTAL FLUIDS PIPE ASSY - 1.5X1.5"	X	X	X	X	X*		1	1	1			1	1			1			1	1			1	1			1	1			1	1	1	1											**16**
12C	**1**	TOTAL FLUIDS PIPE ASSY - 1.5X2"	X	X	X	X	X*						1																																		**1**
12D	**1**	TOTAL FLUIDS PIPE ASSY - 1.5X1.5X1.5"	X	X	X	X	X*														1																										**1**
12E	**1**	TOTAL FLUIDS PIPE ASSY - 1.5X1.5X2"	X	X	X	X	X*										1																														**1**
12F	**0**	TOTAL FLUIDS PIPE ASSY - 1.5X2X2"	X	X	X	X	X*																																								**0**
13	**7**	TOTAL FLUIDS PIPE ASSY- 1" END OF RUN				X		X*				1				1				1				1				1				1						1									**7**
14	**30**	TOTAL FLUIDS HOSE ASSY FEMALE	X	X	X	X	X	X*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									**30**
15	**30**	TF AIR HOSE ASSY MALE	X	X	X	X	X	X*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									**30**
16	**30**	TF VENT TUBE	X	X	X	X	X	X*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									**30**
17	**30**	TF SVE WELL CAP ASSY	X	X	X	X	X		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1									**30**
HOSE SPLICE ASSEMBLIES [PARTIAL COUNT]									S1A	S1B	S1C	S1D	S1E	S2A	S2B	S2C	S2D	S2E	S3A	S3B	S3C	S3D	S3E	S4A	S4B	S4C	S4D	S4E	S5A	S5B	S5C	S5D	S5E	S6A	S6B	S6C	S6D	S6E	S7A	S7B	S7C	S7D	S8A	S8B	S8C	S8D	
18	**1**	2x2x1x1" HOSE SPLICE CROSS CONNECTOR, PVC																	1																												**1**
18A	**0**	2x2x1.5x1.5" HOSE SPLICE CROSS CONNECTOR, PVC																																													**0**
19	**1**	0.5X0.5X0.5" HOSE SPLICE TEE CONNECTOR, Galv/Brass																																									1				**1**
20	**1**	1X1X0.5" HOSE SPLICE TEE CONNECTOR, Galv/Brass																											1																		**1**
21	**0**	1X1X2" HOSE SPLICE TEE CONNECTOR, PVC																																													**0**
22	**2**	2X2X1" HOSE SPLICE TEE CONNECTOR, PVC							1					1																																	**2**
23	**5**	1X1X1" HOSE SPLICE TEE CONNECTOR, PVC																						1							1			1					1	1							**5**
24	**1**	1X0.5X0.5" HOSE SPLICE TEE CONNECTOR, Galv/Brass																																1													**1**
25	**0**	2X1.5X1.5" HOSE SPLICE TEE CONNECTOR, PVC																																													**0**
HOSE SPLICE ASSEMBLIES [PARTIAL COUNT]									TF1A	TF1B	TF1C	TF1D	TF2A	TF2B	TF2C	TF2D	TF3A	TF3B	TF3C	TF3D	TF4A	TF4B	TF4C	TF4D	TF5A	TF5B	TF5C	TF5D	TF6A	TF6B	TF6C	TF6D	TF7A	TF7B	TF7C	TF7D	TF7E	TF7F	NXA	NXB	SXA	SXB	HVLT				
18	**2**	2x2x1x1" HOSE SPLICE CROSS CONNECTOR, PVC															1		1																												**2**
18A	**1**	2x2x1.5x1.5" HOSE SPLICE CROSS CONNECTOR, PVC																																									1				**1**
19	**0**	0.5X0.5X0.5" HOSE SPLICE TEE CONNECTOR, Galv/Brass																																													**0**
20	**1**	1X1X0.5" HOSE SPLICE TEE CONNECTOR, Galv/Brass																																						1							**1**
21	**1**	1X1X2" HOSE SPLICE TEE CONNECTOR, PVC																																						1							**1**
22	**0**	2X2X1" HOSE SPLICE TEE CONNECTOR, PVC																																													**0**
23	**0**	1X1X1" HOSE SPLICE TEE CONNECTOR, PVC																																													**0**
24	**0**	1X0.5X0.5" HOSE SPLICE TEE CONNECTOR, Galv/Brass																																													**0**
25	**2**	2X1.5X1.5" HOSE SPLICE TEE CONNECTOR, PVC																															1									1					**2**
GAUGE BOARD ASSEMBLY																																															
26	**4**	4-GAUGE BOARD ASSY, PORTABLE TOOL																																													**4**
HOSE SPLICE CONNECTORS																																															
27	**6**	2x2" HOSE SPLICE, PVC																																													**6**
28	**6**	1.5X1.5" HOSE SPLICE, PVC																																													**6**
29	**8**	1X1" HOSE SPLICE, PVC																																													**8**
29A	**8**	1X1" HOSE SPLICE, Brass																																													**8**
30	**8**	0.75X0.75" HOSE SPLICE, PVC																																													**8**
30A	**8**	0.75X0.75" HOSE SPLICE, Brass																																													**8**
31	**8**	0.5X0.5" HOSE SPLICE, PVC																																													**8**
31A	**8**	0.5X0.5" HOSE SPLICE, Brass																																													**8**

APPENDIX B

Activity Hazard Analyses (AHAs)

AHA - Mobilization/Demobilization and Site Preparation

Activity/Work Task:	Mobilization/Demobilization and Site Preparation		
Project Location:	Long Island City, Queens, NY		
Contract Number:			
Date Prepared:	9/8/2014	**Date Accepted:**	**9/8/2014**
Prepared by (Name/Title):	Andrew Shust, Sr Associate Scientist		
Reviewed by (Name/Title):			

Overall Risk Assessment Code (RAC) (Use highest code): **M**

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)

This AHA involves the following:

- Establishing site specific measures
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This AHA is not an exhaustive summary of all hazards associated with the Site. Refer to the site HASP for additional requirements. Contractor to follow general site safety controls for Slips Trips and Falls, Biological hazards, cuts lacerations and pinch points, and emergency procedures.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
1. Prepare for Site Visit	1A) N/A	Prior to leaving for site: ▪ Obtain and review HASP prior to site visit, if possible ▪ Determine PPE needs – bring required PPE to the site, if not otherwise being provided at the site (e.g., steel toed boots) ▪ Determine training and medical monitoring needs and ensure all required Health and Safety training and medical monitoring has been received and is current ▪ Ensure all workers are fit for duty (alert, well rested, and mentally and physically fit to perform work assignment) ▪ If respiratory protection is required/potentially required, ensure that training and fit-testing has occurred within the past year. ▪ Familiarize yourself with route to the site	**L**
	1b) Vehicle defects	Inspect company owned/leased vehicle for defects such as: ▪ Flat tires ▪ Windshield wipers worn or torn ▪ Oil puddles under vehicle ▪ Headlights, brake lights, turn signals not working	**L**

AHA - Mobilization/Demobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	1c) Insufficient emergency equipment, unsecured loads	Insufficient emergency equipment, unsecured loads: ▪ Ensure vehicle has first aid kit and that all medications are current (if first aid kits are not provided at the site) ▪ Ensure vehicle is equipped with warning flashers and/or flares and that the warning flashers work ▪ Cell phones are recommended to call for help in the event of an emergency ▪ Vehicles carrying tools must have a safety cage in place. All tools must be properly secured ▪ Vehicles must be equipped with chocks if the vehicle is to be left running, unattended. ▪ Ensure sufficient gasoline is in the tank	**M**
2. Operating vehicles	2a) Collisions, unsafe driving conditions	Drive Defensively!: ▪ Seat belts must be used at all times when operating any vehicle on company business. ▪ Drive at safe speed for road conditions ▪ Maintain adequate following distance ▪ Pull over and stop if you have to look at a map ▪ Try to park so that you don't have to back up to leave. ▪ If backing in required, walk around vehicle to identify any hazards (especially low level hazards that may be difficult to see when in the vehicle) that might be present. Use a spotter if necessary	**M**
3. Driving to the jobsite (mobilization)	3a) Dusty, winding, narrow roads	Dusty, winding, narrow roads ▪ Drive confidently and defensively at all times. ▪ Go slow around corners, occasionally clearing the windshield**.**	**M**
	3b) Rocky or one-lane roads	Rocky or one-lane roads: ▪ Stay clear of gullies and trenches, drive slowly over rocks. ▪ Yield right-of-way to oncoming vehicles---find a safe place to pull over.	**M**
	3c) Stormy weather, near confused tourists	Stormy weather, near confused tourists: ▪ Inquire about conditions before leaving the office. ▪ Be aware of oncoming storms. ▪ Drive to avoid accident situations created by the mistakes of others.	**M**
	3d) When angry or irritated	When angry or irritated: ▪ Attitude adjustment; change the subject or work out the problem before driving the vehicle. Let someone else drive.	**M**
	3e) Turning around on narrow roads	Turning around on narrow roads: ▪ Safely turn out with as much room as possible. ▪ Know what is ahead and behind the vehicle. ▪ Use a backer if available.	**M**

AHA - Mobilization/Demobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
	3f) Sick or medicated	Sick or medicated: ▪ Let others on the crew know you do not feel well. ▪ Let someone else drive.	**M**
	3g) On wet or slimy roads	On wet or slimy roads ▪ Drive slow and safe, wear seatbelts. ▪	**M**
	3h) Animals on road	Animals on road ▪ Drive slowly, watch for other animals nearby. ▪ Be alert for animals darting out of wooded areas	**M**
4. Gain permission to enter site	4a) Hostile landowner, livestock, pets	Hostile landowner, livestock, pets ▪ Talk to land owner, be courteous and diplomatic ▪ Ensure all animals have been secured away from work area	**M**
5. Mobilization/ Demobilization of Equipment and Supplies	5a) Struck by Heavy Equipment/Vehicles	Struck by heavy equipment: ▪ Be aware of heavy equipment operations. ▪ Keep out of the swing radius of heavy equipment. ▪ Ground personnel in the vicinity of heavy equipment operations will be within the view of the operator at all times ▪ Employees shall wear a high visibility vest or T-shirt (reflective vest required if working at night). ▪ Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. ▪ Ground personnel will not stand directly behind heavy equipment when it is in operation.	**M**
	5b) Struck by Equipment/Supplies	Struck by Equipment/Supplies: ▪ Workers will maintain proper space around their work area, if someone enters it, stop work. ▪ When entering another worker's work space, give a verbal warning so they know you are there.	**M**
	5c) Overexertion Unloading/Loading Supplies	Overexertion Unloading/Loading Supplies: ▪ Train workers on proper body mechanics, do not bend or twist at the waist while exerting force or lifting. ▪ Tightly secure all loads to the truck bed to avoid load shifting while in transit.	**M**
	5d) Overexertion Unloading/Loading Supplies	Caught in/on/between: ▪ Do not place yourself between two vehicles or between a vehicle and a fixed object.	**M**
	5e) Slip/Trip/Fall	Slip/Trip/Fall: ▪ Mark all holes and low spots in area with banner tape. Instruct personnel to avoid these areas.	**M**

AHA - Mobilization/Demobilization and Site Preparation

Job Steps	Hazards	Controls	RAC
		▪ Drivers will maintain 3 point contact when mounting/dismounting vehicles/equipment. ▪ Drivers will check surface before stepping, not jumping down.	
	5f) Vehicle accident	Vehicle accident: ▪ Employees should follow Amec Foster Wheeler vehicle operation policy and be aware of all stationary and mobile vehicles.	**M**
6. Site Preparation	6a) Slip/Trip/Fall	Slip/Trip/Fall: ▪ Mark all holes and low spots in area with banner tape. Instruct personnel to avoid these areas	**M**
7. Installation of soil erosion and sediment controls	7a) Overexertion	Overexertion: ▪ Workers will be trained in the proper method of placing erosion controls. ▪ Do not bend and twist at the waist while lifting or exerting force.	**M**
	7b) Struck by Equipment/Supplies	Struck by Equipment/Supplies: ▪ Workers will maintain proper space around their work area, if someone enters it, stop work. ▪ When entering another worker's work space, give a verbal warning so they know you are there.	**M**
8. Driving back from the jobsite	7c) See hazards listed under item #3	**See safe work practices under item #3**	**M**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
PPE (, Hard Hat, safety glasses, gloves, steel toe work boots, high visibility safety vest, hearing protection) Note: When initially entering the site the following PPE must be donned: • Work Uniform or Work Clothes • Hard Hat • Safety Glasses • Steel Toe Boots • Reflective Vests	**Competent / Qualified Personnel:** Name – Position/Employer **Training requirements:** List specific certification (as applicable) Site Specific HASP Orientation Toolbox safety meeting Task kick-off meeting	Daily inspection of equipment per manufacturer's instructions. Tag tools that are defective and remove from service. Inspect power cord sets prior to use. Inspect all PPE prior to use

AHA – Field Work - General

Activity/Work Task:	Field Work General		
Project Location:	Long Island City, Queens NY		
Contract Number:			
Date Prepared:	8-15-12	**Date Accepted:**	8-15-12
Prepared by (Name/Title):	Kendra Bavor		
Reviewed by (Name/Title):	Kendra Bavor, CSP		

Notes: (Field Notes, Review Comments, etc.)

This AHA involves the following:

- Establishing site specific measures
-

This AHA is not an exhaustive summary of all hazards associated with the Site. Refer to the site HASP for additional requirements. Contractor to follow general site safety controls for Slips Trips and Falls, Biological hazards, cuts lacerations and pinch points, and emergency procedures.

Overall Risk Assessment Code (RAC) (Use highest code) **L**

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
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Job Steps	Hazards	Controls	RAC
1. Mobilization/ See Mobilization/Demobilization and Site Preparation JHA Demobilization and Site Preparation	1A) See Mobilization/Demobilization and Site Preparation JHA	See Mobilization/Demobilization and Site Preparation JHA	**L**
2. Communication	2A) Safety, crew unity	Talk to each other. ▪ Let other crewmembers know when you see a hazard. ▪ Avoid working near known hazard trees (trees that are rotten, dead, damaged, etc.). ▪ Always know the wherabouts of fellow crewmembers. ▪ Carry a radio and spare batteries or cell phone. ▪ Review Emergency Evacuation Procedures (see below).	**L**

AHA – Field Work - General

Job Steps	Hazards	Controls	RAC
3. Walking and working in the field	3A) Falling down, twisted ankles and knees, poor footing	Always watch your footing. ▪ Slow down and use extra caution around logs, rocks, and animal holes. ▪ Extremely steep slopes (>50%) can be hazardous under wet or dry conditions; consider an alternate route. ▪ Wear laced boots with a minimum 8" high upper and non-skid Vibram-type soles for ankle support and traction.	**L**
	3B) Falling objects	Protect head agains falling objects. ▪ Wear your hardhat for protection from falling limbs and pinecones, and from tools and equipment carried by other crewmembers. ▪ Stay out of the woods during extremely high winds.	**L**
	3C) Damage to eyes	Protect eyes: ▪ Watch where you walk, ecpecially around trees and brush with limbs sticking out. ▪ Exercise caution when clearing limbs from tree trunks. Advise wearing eye protection. ▪ Ultraviolet light from the sun can be damaging to the eyes; look for sunglasses that specify significant protection from UV-A and UV-B radiation. If safety glasses require, use one's with tinted lenses	**L**
	3D) Bee and wasp stings	See JHA for Insect Stings and Bites	**L**
	3E) Ticks and infected mosquitos	See JHA for Insect Stings and Bites	**L**
	3A) Lifting Injuries (e.g., Back Injuries)	Lifting Injuries (e.g., Back Injuries) ▪ Site personnel will be instructed on proper lifting techniques. ▪ Perform warm-up excercises before starting work. ▪ **DO NOT EXCEED THE AMEC FOSTER WHEELER LIFTING LIMIT OF 50 POUNDS.** ▪ Use two people to lift, lower, or carry equipment or materials heavier than 50 pounds. ▪ Mechanical devices should be used to reduce manual handling of materials. ▪ Drive the field vehicle as close to the point that the heavy equipment/material will be used as long as the area is safe to drive into and you do not create hazards to you, your co-worker, or the vehicle.	**L**
	3F) Slips/Trips/Falls	Slips/Trips/Falls ▪ Maintain work areas safe and orderly; unloading areas should be on even terrain; mark or repair possible tripping hazards. ▪ Site SHSO inspect the entire work area to identify and mark hazards. ▪ Be aware of work area conditions that can cause slip hazards such as ponding of water on concrete surfaces. Ponding of water on smooth surfaces, such as concrete, coupled with the warm or freezing weather conditions has the potential to cause slippery condiitons such as growth of scum or ice, as applicable. Adding	**L**

AHA – Field Work - General

Job Steps	Hazards	Controls	RAC
		a layer of clean fill to the surface may prevent the growth of scum, and/or create a non-slippery walking surface.	
	3G) Vehicular Traffic	Vehicular Traffic ▪ Spotters will be used when backing up trucks and heavy equipment and when moving equipment. ▪ High visibility vests will be worn when workers are exposed to vehicular traffic at the site or on public roads.	**L**
	3H) Overhead Hazards	Overhead Hazards ▪ Personnel will be required to wear hard hats that meet ANSI Standard Z89.1. ▪ All ground personnel will stay clear of suspended loads. ▪ All equipment will be provided with guards, canopies or grills to protect the operator from falling or flying objects. ▪ All overhead hazards will be identified prior to commencing work operations.	**L**
	3I) Dropped Objects	Dropped Objects ▪ Safety toed boots meeting ANSI Standard Z41 will be worn.	**L**
	3J) Noise	Noise ▪ Hearing protection will be worn with a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs); all equipment will be equipped with manufacturer's required mufflers. Hearing protection shall be worn by all personnel working in or near heavy equipment.	**L**
	3K) Eye Injuries	Eye Injuries ▪ Safety glasses meeting ANSI Standard Z87 will be worn.	**L**
	3L) Heavy Equipment (overhead hazards, spills, struck by or against)	Heavy Equipment ▪ Equipment will have seat belts. ▪ Operators will wear seat belts when operating equipment. ▪ Do not operate equipment on grades that exceed manufacturer's recommendations. ▪ Equipment will have guards, canopies or grills to protect from flying objects. ▪ Ground personnel will stay clear of all suspended loads. ▪ Ground personnel will wear high visibility vests ▪ Spill and absorbent materials will be readily available. ▪ Drip pans, polyethylene sheeting or other means will be used for secondary containment. ▪ Ground personnel will stay out of the swing radius of excavators. ▪ Eye contact with operators will be made before approaching equipment. ▪ Operator will acknowledge eye contact by removing his hands from the controls. ▪ Equipment will not be approached on blind sides.	**L**

AHA – Field Work - General

Job Steps	Hazards	Controls	RAC
		▪ All equipment will be equipped with backup alarms and use spotters when significant physical movement of equipment occurs on-site, (i.e., other than in place excavation or truck loading).	
	3M) Struck by vehicle/equipment	Struck by vehicle/equipment ▪ Be aware of heavy equipment operations. ▪ Keep out of the swing radius of heavy equipment. ▪ Ground personnel in the vicinity of heavy equipment operations will be within the view of the operator at all times and will wear high visibility vests. ▪ Ground personnel will be aware of the counterweight swing and maintain an adequate buffer zone. ▪ Ground personnel will not stand directly behind heavy equipment when it is in operation. ▪ Drivers will keep workers on foot in their vision at all times, if you lose sight of someone, Stop!	**L**
	3N) Struck/cut by tools	Struck/cut by tools ▪ Cut resistant work gloves will be worn when dealing with sharp objects. ▪ All hand and power tools will be maintained in safe condition. ▪ Guards will be kept in place while using hand and power tools.	**L**
	3O) Caught in/on/between	Caught in/on/between ▪ Workers will not position themselves between equipment and a stationary object. ▪ Workers will not wear long hair down (place in pony-tail and tuck into shirt) or jewelry if working with tools/machinery.	**L**
	3P) Contact with Electricity/Lightning	Contact with Electricity/Lighting ▪ All electrical tools and equipment will be equipped with GFCI. ▪ Electrical extension cords will be of the “Hard” or “Extra Hard” service type. ▪ All extension cords shall have a three-blade grounding plug. ▪ Personnel shall not use extension cords with damaged outer covers, exposed inner wires, or splices. ▪ Electrical cords shall not be laid across roads where vehicular traffic may damage the cord without appropriate guarding. ▪ All electrical work will be conducted by a licensed electrician. ▪ All utilities will be marked prior to excavation activities. ▪ All equipment will stay a minimum of 10 feet from overhead energized electrical lines (50 kV). This distance will increase by 4 inches for each 10 kV above 50 kV. Rule of Thumb: Stay 10 feet away from all overhead powerlines known to be 50 kV or less and 35 feet from all others.) ▪ The SHSO shall halt outdoor site operations whenever lightning is visible, outdoor work will not resume until 30 minutes after the last sighting of lightning.	**L**

AHA – Field Work - General

Job Steps	Hazards	Controls	RAC
	3Q) Equipment failure	Equipment failure ▪ All equipment will be inspected before use. If any safety problems are noted, the equipment should be tagged and removed from service until repaired or replaced.	L
	3R) Hand & power tool usage, cuts, burns, etc.	Hand & power tool usage ▪ Inspect the tool daily. ▪ Remove broken or damaged tools from service. ▪ Use the tool for its intended purpose. ▪ Use in accordance with manufacturers instructions.	L
	3S) Burns and Exposure to Exhaust from Portable Propane Torch Use	Portable propane torch usage ▪ Read the manual to become familiar with the propane torch and follow all safety precautions. Don PPE (safety glasses, heavy leather gloves) before using the torch. ▪ Inspect the propane cylinder and the torch tip to ensure there are no defects, damage, etc. ▪ Assemble the torch kit per instruction manual. The torch is designed to be used with the small propane cylinder, do not attempt to attach the torch to any other gas cylinder. ▪ Do not use the torch in areas where gasoline or other liquids having flammable vapors are stored or used. ▪ Do not smoke while igniting or operating the propane torch. ▪ Have an ABC type fire extinguisher readily accessible to the work area. ▪ Be sure the torch tip has a tight seal to the cylinder. If you smell gas, do not try to light the torch. Check the seal between the cylinder and torch. Do not attempt to light the torch until the seal is secure and no gas is leaking. ▪ To ignite the torch flame, first position the point of the torch tip away from you. ▪ If the unit requires a striker to ignite the torch, only use the striker provided with the unit. Never use a match or lighter to ignite torch. Do not place hand or any part of your body in the path of the flame while lighting or operating the propane torch. ▪ Never leave an ignited torch unattended while in operation. When not in use, the torch tip must be removed from the propane cylinder. ▪ Be aware of the weather conditions. On bright sunny days, the torch flame may be barely visible. On windy days, the wind may carry the torch's heat back towards you. ▪ The torch can produce combustion products such as carbon monoxide. Do not breathe in the exhaust. Propane vapors are heavier than air and can accumulate in low or confined areas. Use the torch only in a well ventilated area. ▪ Heating a surface may cause heat to be conducted to adjoining surfaces that may be combustible or become pressurized when heated. Always check to make sure no unintended parts or materials are being heated.	L

Job Steps	Hazards	Controls	RAC
		▪ Torch will be extremely hot, allow the torch to cool before touching it to remove it from the cylinder. ▪ Never store a torch that is still hot. ▪ When cooled, disconnect the torch from the cylinder for storage, and store them in a safe manner to prevent damage.	
4. Environmental health considerations	4A) HEAT Stress	Take precautions to prevent heat stress ▪ Remain constantly aware of the four basic factors that determine the degree of heat stress (air temperature, humidity, air movement, and heat radiation) relative to the surrounding work environmental heat load. ▪ Know the signs and symptoms of heat exhaustion, heat cramps, and heat stroke. Heat stroke is a true medical emergency requiring immediate emergency response action. NOTE: The severity of the effects of a given environmental heat stress is decreased by reducing the work load, increasing the frequency and/or duration of rest periods, and by introducing measures which will protect employees from hot environments. ▪ Maintain adequate water intake by drinking water periodically in small amounts throughout the day (flavoring water with citrus flavors or extracts enhances palatability). ▪ Allow approximately 2 weeks with progressive degrees of heat exposure and physical exertion for substantial acclimatization. ▪ Acclimatization is necessary regardless of an employee's physical condition (the better one's physical condition, the quicker the acclimatization). Tailor the work schedule to fit the climate, the physical condition of employees, and mission requirements. ▪ A reduction of work load markedly decreases total heat stress. ▪ Lessen work load and/or duration of physical exertion the first days of heat exposure to allow gradual acclimatization. ▪ Alternate work and rest periods. More severe conditions may require longer rest periods and electrolyte fluid replacement.	**L**
	4B) Wet Bulb Globe Temperature (WBGT) Index	WBGT ▪ Curtail or suspend physical work when conditions are extremely severe (see attached Heat Stress Index). ▪ Compute a Wet Bulb Globe Temperature Index to determine the level of physical activity (take WBGT index measurements in a location that is similar or closely approximates the environment to which employees will be exposed).	**L**
		WBGT THRESHOLD VALUES FOR INSTITUTING PREVENTIVE MEASURES 80-90 degrees F — Fatigue possible with prolonged exposure and physical activity. 90-105 degrees F — Heat exhaustion and heat stroke possible with prolonged exposure and physical activity.	.

AHA – Field Work - General

Job Steps	Hazards	Controls	RAC
		105-130 degrees F Heat exhaustion and heat stroke are likely with prolonged heat exposure and physical activity.	
	4C) Cold Extremes	Take precautions to prevent cold stress injuries ▪ Cover all exposed skin and be aware of frostbite. While cold air will not freeze the tissues of the lungs, slow down and use a mask or scarf to minimize the effect of cold air on air passages. ▪ Dress in layers with wicking garments (those that carry moisture away from the body – e.g., cotton) and a weatherproof slicker. A wool outer garment is recommended. ▪ Take layers off as you heat up; put them on as you cool down. ▪ Wear head protection that provides adequate insulation and protects the ears. ▪ Maintain your energy level. Avoid exhaustion and over-exertion which causes sweating, dampens clothing, and accelerates loss of body heat and increases the potential for hypothermia. ▪ Acclimate to the cold climate to minimize discomfort. ▪ Maintain adequate water/fluid intake to avoid dehydration.	**L**
	4D) Wind	Effects of the wind ▪ Wind chill greatly affects heat loss (see attached Wind Chill Index). ▪ Avoid marking in old, defective timber, especially hardwoods, during periods of high winds due to snag hazards.	**L**
	4E) Thunderstorms	Thunderstorms ▪ Monitor weather channels to determine if electrical storms are forcased. ▪ Plan ahead and identify safe locations to be in the event of a storm. (e.g., sturdy building, vehicle, etc.) ▪ Suspend all field work at the first sound of thurnder. You should be in a safe place when the time between the lightning and thunder is less than 30 seconds. ▪ Only return to work 30 minutes after the after the last strike or sound of thunder	**L**
5. Check and calibrate industrial hygiene and other field instruments and equipment as required and as recommended by the manufacturer	5A) Exposure to Calibration Gases/Chemicals due to: • Use of damaged instruments.	Verify proper operation of the instrument prior to calibration. Calibrate instruments in an area with adequate ventilation and follow the manufacturer's recommendations. ▪ Wear appropriate PPE to conduct calibrations as specified in the instrument manual.	**L**
	5B) Exposure to Site contaminants due to: • Improper instrument calibration; • Misinterpretation of calibration results;	5A) Calibrate the instrument in accordance with the manufacturer's recommendations (see instrument manual) using the applicable calibration standard and calibration procedure. ▪ Perform calibrations at a frequency recommended by the manufacturer. Be aware of the instrument's limitations (e.g., detection limit, maximum sensitivity) and the conditions (e.g., humidity) that may affect correct operation or accuracy of that	**L**

AHA – Field Work - General

Job Steps	Hazards	Controls	RAC
	• Improper instrument repair; • Improper use of instrument due to lack of training.	equipment. Possible sources of error that may affect the correct calibration of the instrument. ▪ Use only calibration materials recommended by the manufacturer for calibration. Do not use substitutions. ▪ Confirm that the connections between the instrument and the calibration gas/material is leak-free. ▪ Record all instrument calibrations in the field logbook. Include the instrument ID (type/manufacture/serial number/lamp eV, etc.), calibration gas used (chemical and concentration), and instrument result. ▪ Do not attempt to repair instrument. Return to the vendor for replacement. Report any damaged or malfunctioning instrument to the vendor. ▪ All personnel must be familiar with operation of the instrument and understand: - Theroy of its operation including any alarms and their setpoints - Materials the instrument can and cannot detect, - Instrument's limitations - The expected responses to calibration gases/materials - Interfering gases/chemicals and their affects on the instrument readings - When re-zeroing is appropriate.	

AHA – Field Work - General

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
PPE (1/2 face respirator with P-100 cartridge (upgrade), Hard Hat, safety glasses, gloves (per HASP), steel toed work boots, high visibility safety vest, hearing protection)	**Competent / Qualified Personnel:** Names provided in HASP (Position/Employer) **Training requirements:** Site Specific HASP Orientation Toolbox safety meeting Task kick-off meeting	Daily inspection of equipment per manufacturer's instructions. Tag tools that are defective and remove from service. Inspect power cord sets prior to use. Inspect all PPE prior to use

NOAA's National Weather Service

Heat Index

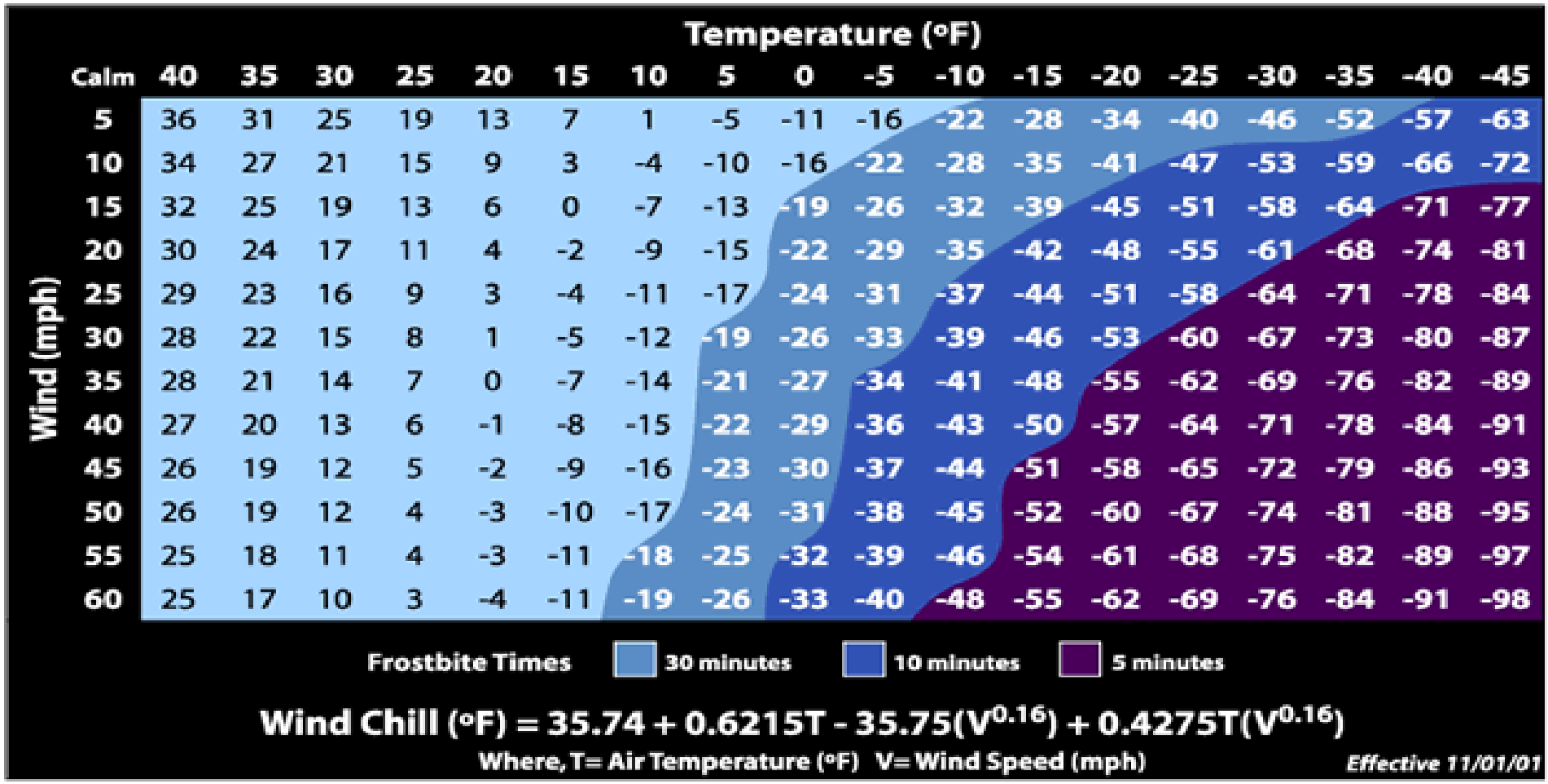
Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution | Extreme Caution | Danger | Extreme Danger

Wind Chill Chart



AHA – Treatment System Inspection/Maintenance

Activity/Work Task:	**Treatment System General Inspection and Maintenance**			Overall Risk Assessment Code (RAC) (Use highest code)	**M**
Project Location:	**Review Ave., Long Island City, NY**			**Risk Assessment Code (RAC) Matrix**	
Contract Number:					
Date Prepared:	**11/27/2014**	**Date Accepted:**	**11/27/2014**		
Prepared by (Name/Title):	Laurie Gneiding Associate Toxicologist				
Reviewed by (Name/Title):	Chad Barnes, Mtn. Group Safety Manager				

	Frequent	Likely	Occasional	Seldom	Unlikely
		E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)

This AHA involves the following:

- Establishing general inspection and maintenance measures for treatment system operations.

This AHA is not an exhaustive summary of all hazards associated with the Site. Refer to the site HASP for additional requirements. Contractor to follow general site safety controls for Slips Trips and Falls, Biological hazards, cuts lacerations and pinch points, and emergency procedures.

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

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Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Hard Hat, safety glasses, gloves, safety work boots, high visibility safety vest, hearing protection.	**Competent / Qualified Personnel:** Dennis Young – Amec Foster Wheeler SHSO/Lead Operator Dan Berkowitz – alternate operator **Training requirements:** 40-Hr HAZWOPER Hazard Communications Site-Specific HASP Orientation Toolbox safety meeting Task kick-off meeting	Daily inspection of equipment per manufacturer's instructions. Tag tools that are defective and remove from service. Inspect power cord sets prior to use. Inspect all PPE prior to use.

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
1. Prepare For Site Visit	**N/A**	▪ Obtain and review HASP prior to site visit. ▪ Determine PPE needs – bring required PPE to the site, if not otherwise being provided at the site (e.g., safety boots). ▪ Determine training and medical monitoring needs and ensure all required Health and Safety training and medical monitoring has been received and is current. ▪ Complete site specific/ client required training. ▪ Ensure all workers are fit for duty (alert, well rested, and mentally and physically fit to perform work assignment). ▪ First aid kits and fire extinguishers shall be available at the work site and on each transport vehicle. ▪ Familiarize yourself with route to the site. ▪ Check weather forecast. Pack appropriate clothing for anticipated weather conditions. ▪ Verify that subsurface utilities have been identified.	**NA**
2. Traveling To The Site By Vehicle		See AHA - Mobilization, Demobilization and Site Preparation	**L**
3. Open Access Cover Or Hatch And Allow Well To Ventilate.	3A) Chemical Hazards	3A) Chemical Hazards ▪ See HASP for appropriate level of PPE. ▪ Use monitoring equipment, as outlined in HASP, to monitor breathing zone. ▪ Read chemical hazard summaries within HASP and SDSs for all chemicals brought to the site. ▪ Ensure that all containers are properly labelled in accordance with GHS ▪ Have spill kit available. ▪ Decon thoroughly prior to consumption of food, beverage or tobacco.	**L**
	3B) Hand Injury	3B) Hand Injury ▪ Cut resistant work gloves will be worn when dealing with sharp objects or glass bottles.	**L**
	3C) Insect/Animal Bites and Stings	3C) Insect and Animal Bites and Stings See AHA - Noxious Insects and Animals.	**L**
	3D) Lifting	▪ 3D) Good lifting techniques (lift with legs not back). ▪ Mechanical devices (e.g., hand truck, cart, forklift, etc.) should be used to reduce manual handling of materials and drums. ▪ Team lifting should be utilized if mechanical devices are not available. (mandatory for items over 50 lbs).	**M**

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
		▪ Split heavy loads in to smaller loads. ▪ Make sure that path is clear prior to lift. ▪ Redesign work area to avoid low lifts. ▪ Stretch prior to lifting.	
4. Working Around Blowers and Other Process Equipment	**4A) Noise**	4A) Noise ▪ Hearing protection will be worn with a noise reduction rating (NRR) >30 or capable of maintaining personal exposure below 85 dBA (ear muffs or plugs) or when workers need to shout when standing two feet away from each other. ▪ All equipment will be equipped with manufacturer's required mufflers. ▪ Segregate noisy equipment from the operators if possible. ▪ Use sound dampening around noisy equipment if possible.	**L**
	4B) Exhaust	4B) Exhaust ▪ Only work in properly vented work areas. ▪ If fumes are present, leave work area and allow fumes to dissipate prior to return.	**L**
	4C) Slips / Trips / Falls	4C) Slips / Trips / Falls ▪ Site SHSO will inspect the entire work area to identify and mark hazards. ▪ Clear area of trip hazards; mark or barricade those that cannot be moved. ▪ Horseplay is strictly prohibited. ▪ Wear slip resistant footwear preferably laced boots with a minimum 8" high upper for ankle support and traction. ▪ Pay attention to where you place your feet. Be aware of surroundings. Avoid wet areas if possible.	**L**
	4D) Head Injury	4D) Head Injury ▪ Where process piping or other overhead obstructions are present, don hard hat.	
5. Process Sampling	5A) Chemical Hazards	5A) Chemical Hazards See Section 3A above.	**L**

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
	5B) Back Injury	5B) Back Injury ▪ Good lifting techniques (lift with legs not back). ▪ Mechanical devices (e.g., hand truck, cart, forklift, etc.) should be used to reduce manual handling of materials and drums. ▪ Team lifting should be utilized if mechanical devices are not available. (mandatory for items over 50 lbs). ▪ Split heavy loads in to smaller loads. ▪ Make sure that path is clear prior to lift. ▪ Redesign work area to avoid low lifts. ▪ Stretch prior to lifting. ▪ Maintain a healthy life style and level of physical fitness.	**L**
	5C) Hand Injury from Use of Hand Tools	5C) Hand Injury from Use of Hand Tools ▪ Cut resistant work gloves will be worn when working with sharp objects. ▪ All hand and power tools will be maintained in safe condition. ▪ Do not drop or throw tools. Tools shall be placed on the ground or work surface or handed to another employee in a safe manner. ▪ Ensure guards are in place and are in good condition. ▪ Daily inspections will be performed. ▪ Remove broken or damaged tools from service and tag out as defective. ▪ Tampering with electrical equipment is not allowed (e.g., splicing cords, cutting the grounding prong off plug, etc.). ▪ Use tool in accordance with manufacturers instructions and for its intended purpose. Ensure all workers are trained in proper use of the tool. ▪ Remove broken or damaged tools from service.	**L**
	5D) Personnel Decontamination	5D) Personnel Decontamination See AHA - Decontamination.	**L**
	5E) Contact With Electricity	5E) Contact With Electricity ▪ All electrical tools and equipment will be equipped with GFCI. ▪ All electrical equipment will be UL-listed ▪ Electrical extension cords will be of the “Hard” or “Extra Hard” service type. ▪ All extension cords shall have a three-blade grounding plug.	**M**

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
		▪ Personnel shall not use extension cords with damaged outer covers, exposed inner wires, or splices. ▪ Electrical cords shall not be laid across roads where vehicular traffic may damage the cord without appropriate guarding. ▪ All electrical work will be conducted by a licensed electrician. ▪ All equipment will be locked out and tagged out and rendered in a zero energy state prior to commencing any operation that may exposed workers to energy (electrical, mechanical, hydraulic, etc.) hazards. ▪ All utilities will be marked prior to excavation activities. ▪ All equipment will stay a minimum of 10 feet from overhead energized electrical lines (50 kV). This distance will increase by 4 inches for each 10 kV above 50 kV. Rule of Thumb: Stay 10 feet away from all overhead powerlines known to be 50 kV or less and a minimum of 35 feet from all others.).	
	5F) Equipment Failure	5F) Equipment Failure ▪ All equipment will be inspected before use to ensure proper working order. ▪ If equipment is in disrepair, tag and remove from service until repaired or replaced.	**L**
	5G) Fire Protection	5G) Fire Protection ▪ Ensure that adequate number and type of fire extinguishers are present at the site. ▪ Inspect fire extinguishers on a monthly basis – document tag on each extinguisher. ▪ All employees who are expected to use fire exinguishers will have received training on an annual basis. ▪ Obey no-smoking policy. ▪ Open fires are prohibited. ▪ Maintain good housekeeping. Keep rubbish and combustibles to a minimum.	**L**
	5H) Confined Space Entry	5H) Confined Space Entry **Confined Space Entry is not a scheduled activity for this project. Contact Cynthia Sundquist before entering any confined space**.	**L**

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
	5I) Injury from Heavy Equipment or Vehicles	5I) Injury from Heavy Equipment or Vehicles See Section 4I of AHA - Field Work Oversight.	L
	5J) Personnel Decontamination	5J) Personnel Decontamination See AHA - Decontamination.	L
6. Typical Daily / Routine Tasks	**6A) Operations Conducted At An Active Facility**	▪ Stay well clear of operations being conducted at the facility ▪ Keep alert for moving materials, equipment or vehicles. ▪ Determine client specific PPE needs prior to arriving at the site. ▪ Determine client specific emergency response procedures and follow as appropriate. ▪ Participate in client required safety training. ▪ Get copies of Client/Subcontractor SDSs for any chemicals that Amec Foster Wheeler may be exposed to. ▪ Provide SDSs to client for all chemicals brought to the site.	L
	6B) Remote Locations or Working Alone	6B) Remote Locations or Working Alone ▪ Carry a two-way radio or cell phone with clear signal ▪ Make sure your project manager knows your whereabouts and when you are expected back in the office or at home. ▪ Carry a first aid kit.	L
	6C) Slips, Trips, Falls	6C) Slips, Trips, Falls See Section 4C above.	L
	6D) Chemical Hazards	6D) Chemical Hazards See Section 3A above.	L
7. Environmental Health Considerations	7A) Insect, Spider and Animal Bites and Stings	7A) Insect, Spider and Animal Bites and Stings See - AHA Noxious Insects and Animals.	L

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
	7B) Poisonous Plants	7B) Poisonous Plants See Section 3C of AHA - Field Work Oversight.	L
	7C) Heat related or cold related injuries, Weather related hazards	7C) Heat related or cold related injuries, Weather related hazards See Section 7 of AHA - Field Work Oversight.	L
8. Inspection of Various Equipment a. Air compressors b. Drain valves c. Transfer pumps d. OWS e. Extraction manifolds f. Tanks/piping integrity	8A) Chemical Hazards	See 3A above	L
	8B) Pressurized Liquids	Wear safety glasses/goggles	
	8C) Hot equipment	Wear long sleeves and leather work gloves to prevent thermal burns if necessary to touch equipment	
9. Changing Bag Filters	9A) Chemical Hazards	See 3A above	L
	9B) Inhalation of Dusts	See 3A above. Wear N95/N100 dust mask during removal.	M
	9C) Hand Injury for using hand tools	See 5C above	L
	9D) Head injury	See 4D above	L
	9E) slips, trips, falls	See 4C above	L
	9F) exposure to electricity	See 5E above	

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
	9G) falls from ladders	Use a fiberglass ladder. Use three points of contact when going up/down Do not place ladder in water or other slippery material. If using an "A" frame ladder: • Do not stand on top two steps. • Ensure braces are locked in place • If using an extension ladder: • Ensure ladder is placed correctly with 1:4 ratio	**L**
	9H) cuts/abrasions/lacerations	Wear leather work gloves over chemical resistant gloves.	
10. Cleaning flow meters, totalizers/filters	10A) chemical hazards	See 3A above.	**L**
	10B) Hand Injury for using hand tools	See 5C above	**L**
	10C) head injury	See 4D above	**L**
	10D) slips, trips, falls	See 4C above	**L**
	10E) exposure to electricity	See 5E above	**L**
	10F) falls from ladders	Use a fiberglass ladder. Use three points of contact when going up/down	**L**

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
		Do not place ladder in water or other slippery material. If using an "A" frame ladder: • Do not stand on top two steps. • Ensure braces are locked in place • If using an extension ladder: • Ensure ladder is placed correctly with 1:4 ratio	
	10G) cuts/abrasions/lacerations	Wear leather work gloves over chemical resistant gloves.	
11. Cleaning equipment a. pre-separation tanks/OWS b. TF pumps c. Skimmer pumps	11A) Chemical Hazards	See 3A above	**L**
	11B) pinch points	Ensure lock-out/tag out procedures are in place prior to opening equipment and re-energizing.	**H**
	11C) injury	See 4D above	**L**
	11D) slips, trips, falls	See 4C above	
	11E) Back injury	See 3D above	**M**
	11F) exposure to electricity	See 5E above	**L**
	11G) falls from ladders	Use a fiberglass ladder. Use three points of contact when going up/down Do not place ladder in water or other slippery material.	**L**

AHA – Treatment System Inspection/Maintenance

Job Steps	Hazards	Controls	RAC
		If using an “A” frame ladder: • Do not stand on top two steps. • Ensure braces are locked in place • If using an extension ladder: • Ensure ladder is placed correctly with 1:4 ratio	
	11H) cuts/abrasions/lacerations	Wear leather work gloves over chemical resistant gloves.	**L**
12. Inspection of emergency lighting, exit signs, fire extinguishers, eyewash, roof, siding, doors, insulation, heat trace	12A) slips, trips, falls	See 4C above	**L**
13. Return to office/home		**See AHA - Mobilization/ Demobilization and Site Preparation.**	**L**

AHA – Decontamination

Activity/Work Task:	Decontamination		
Project Location:	Long Island City, Queens, NY		
Contract Number:			
Date Prepared:	8-15-12	**Date Accepted:**	8-15-12
Prepared by (Name/Title):	Kendra Bavor		
Reviewed by (Name/Title):	Kendra Bavor, CSP		

Notes: (Field Notes, Review Comments, etc.)

This AHA involves the following:

- Establishing site specific measures
-

This AHA is not an exhaustive summary of all hazards associated with the Site. Refer to the site HASP for additional requirements. Contractor to follow general site safety controls for Slips Trips and Falls, Biological hazards, cuts lacerations and pinch points, and emergency procedures.

Overall Risk Assessment Code (RAC) (Use highest code) **M**

Risk Assessment Code (RAC) Matrix

Severity	Probability				
	Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
1. Establish Decontamination Station	1A) Materials Handling	1A) Materials Handling ▪ Use proper lifting techniques ▪ Use mechanical aids, if available, to move heavy items.	L
2. Decontamination / Steam cleaning.	2A) Struck by steam/hot water/pressure washing	2A) Struck by steam/hot water ▪ Workers not directly engaged in steam cleaning operations must stay clear. ▪ Workers using steam cleaning equipment must be trained on operation and safety devices/procedures using the owners/operators manual. ▪ Use face shield **and** safety glasses or goggles, if steam cleaning. ▪ Stay out of the splash/steam radius. ▪ Pressure washer must have dead man switch. ▪ Do not direct steam at anyone. ▪ Do not hold objects with your feet or hands. ▪ Ensure that direction of spray minimizes spread of contaminants of concern. ▪ Use shielding as necessary.	M

AHA – Decontamination

Job Steps	Hazards	Controls	RAC
	2B) Exposure to contaminants	2B) Exposure to contaminants ▪ Conduct air monitoring (see HASP). ▪ Wear proper PPE (see HASP). ▪ See MSDSs for hazards associated with the decon solutions used (if other than water alone us used).	**L**
	2C) Slips/Trips/Falls	2C) Slips/Trips/Falls ▪ Be cautious as ground/plastic can become slippery ▪ Use boots or boot covers with good traction	**L**
3. Vehicle Decontamination	3A) Vehicle traffic in and out of the CRZ	3A) Large Vehicle Traffic ▪ Always wear a hard hat, steel toe boots, and a high visibility vest (unless Tyveks are used and are high visibility). ▪ Vehicle drivers are not to exit the vehicle in the CRZ. ▪ Identify an individual to communicate with vehicle drivers and maintain order ▪ Trucks will be lined with plastic and kept out of direct contact with any contaminated materials during loading. Wear PPE when removing plastic lining from truck beds. ▪ If not in the vehicle, obtain eye contact with the driver, so he is aware of your presence and location in the CRZ. ▪ If you are driving the vehicle, be aware of personnel in the CRZ and maintain communication with the identified personnel.	**L**
	3B) Exposure to contaminants	3B) Exposure to contaminants ▪ Use safety glasses or goggles, Polycoated Tyvek (if level of contamination poses dermal hazard or to keep work clothes dry), high visibility vest (if high visibility Tyveks are not used) hard hats, steel toe boots, and gloves while cleaning contaminated materials. ▪ Do not doff PPE until decontamination of the vehicle is complete and a decontamination certificate has been issued by the HSO. ▪ Conduct air monitoring (see HASP). ▪ See MSDSs for hazards associated with the decon solutions (if other than water alone is used).	**L**
	3C) Slips/Trips/Falls	3C) Slips/Trips/Falls ▪ Be cautious as ground/plastic can become slippery ▪ Use boots or boot covers with good traction	**L**
4. Equipment and Sample Decontamination	4A) Chemical exposure when handling contaminated sample jars and equipment	4A) Chemical exposure ▪ Wear PPE as outlined in the HASP. ▪ Refer to MSDS for specific hazards associated with decon solutions ▪ Monitor breathing zone for contaminants	**M**

AHA – Decontamination

Job Steps	Hazards	Controls	RAC
		▪ Monitor breathing zone for decon solutions (e.g., methanol, hexane, etc.) if appropriate (see HASP)	
	4B) Materials Handling related injuries	4B) Materials Handling related injuries ▪ Use proper lifting techniques when lifting heavy equipment ▪ Use two person lift for heavy coolers	**L**
5. Personal Decontamination	4C) Exposure to contaminants	4C) Exposure to contaminants ▪ Avoid bringing contaminated materials via shoes and clothing into the CRZ by examining such prior to exiting the EZ. ▪ Removal of PPE will be performed by the following tasks in the listed order: ▪ Gross boot wash and rinse and removal ▪ Outer glove removal ▪ Suit removal ▪ Respirator removal (if worn). ▪ Inner glove removal ▪ Contaminated PPE is to be placed in the appropriate, provided receptacles. ▪ Respirators will be removed and decontaminated at a specified location within the CRZ by a designated technician, then placed in storage bag. ▪ Employees will wash hands, face, and any other exposed areas with soap and water. ▪ Portable eyewash stations and showers will be available should employees come into direct contact with contaminated materials. ▪ See MSDSs for hazards associated with the decontamination solutions used. ▪ Decon solutions will be disposed of according to the work plan.	**M**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
PPE (Safety glasses, gloves (HASP), steel toe work boots, high visibility safety vest, hearing protection.)	**Competent / Qualified Personnel:** See HASP - Name – Position/Employer **Training requirements:** Site Specific HASP Orientation Toolbox safety meeting Task kick-off meeting	Daily inspection of equipment per manufacturer's instructions. Tag tools that are defective and remove from service. Inspect power cord sets prior to use. Inspect all PPE prior to use

APPENDIX C

Standard Operating Procedures (SOPs)

Review Avenue LNAPL Recovery and Groundwater Treatment System Operation, Maintenance & Monitoring

Standard Operating Procedures
Bag Filter Change-Out

To change out individual bag filters, it is not necessary to shut down the LNAPL Recovery and Groundwater Treatment System. Because the bag filter units run in series-parallel, it is possible to bypass individual units to allow the system to run during bag filter change-out.

Appropriate PPE:

- Nitrile gloves
- Clear safety glasses or goggles
- Tyvek suit

Bag Filter Change-out:

1. Isolate the individual bag filter housing unit by closing the influent valve and effluent valve on the unit to be bypassed.
2. Open the air vent on the top of the bag filter housing unit to depressurize **CAUTION: Do not loosen the eyebolts on the cover or attempt to open the unit without completely depressurizing it first.**
3. If not already in place, install a ¾" hose barb on the drain valve located at the bottom of the bag filter housing unit. Attach tubing to the hose barb, open the valve, and drain the contents of the unit to an appropriate vessel.
4. Loosen the eyebolts and open the cover of the housing unit.
5. Lift the used filter bag by grasping the loop on the bag and lifting upward slowly, allowing any residual liquid in the bag to continue draining as you pull it out. If necessary, squeeze the bag to remove as much liquid as possible.
6. Once the bag is removed and drained appropriately, place the used bag filter in a trash bag or other temporary container prior to disposal.
7. Close the drain valve at the bottom of the housing unit, remove the tubing, and discard the drained liquid into the Pre-Separation Tank (T-701).
8. Place a new appropriately-sized bag filter into the housing unit, ensuring that it is secure and spread out inside the unit.
9. Close the cover of the housing unit and tighten the eyebolts.
10. De-isolate the unit by opening the influent and effluent valves on the unit.
11. When the Oil/Water Separator Effluent Pump (P-901) turns on, monitor the air vent to ensure that the unit pressurizes: close the vent after water is observed coming through.
12. Repeat Steps 1 through 11 for each bag filter unit that needs a replacement.
13. When all necessary bag filter replacements are complete, discard the used bag filters into the appropriate spent waste drum (labeled as "spent bag filters, PPE, rags" or similar) located between the treatment enclosures.

Review Avenue LNAPL Recovery and Groundwater Treatment System Operation, Maintenance & Monitoring

Standard Operating Procedures
Oil/Water Separator (OWS) Cleaning

The oil/water separator will be cleaned by an outside subcontractor. The following SOP details the procedures required to be performed before and after the vessels are cleaned.

Appropriate PPE:

- Tyvek suit
- Nitrile gloves
- Clear safety glasses or goggles

1. Shut down the Total Fluids Recovery and Groundwater Treatment System.
    a. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Solenoid Valves Controls menu. Make a note of which solenoid valves are set to **AUTO**, then set **SV-601 through SV-607** to **CLOSE**.
    b. Return to the Main Menu, then to the Motor Controls menu and set **P-901 OWS Effluent Pump** to **OFF**.
2. Allow the OWS Belt Skimmer (P-701) to run in AUTO for as long as possible prior to subcontractor arrival.
    a. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Motor Controls menu and set **P-701 Belt Skimmer** to **AUTO**.
3. Adjust the rotary skimmer in the OWS to recover as much LNAPL as possible.
4. When the subcontractor arrives onsite, use the OWS Product Transfer Pump (P-801) to transfer LNAPL in the OWS Product Day Tank to the LNAPL Storage Tank (T-801), the shut the pump off.
    a. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Motor Controls menu and operate **P-801 Product Transfer Pump** in **HAND** until no more LNAPL remains in the day tank.
    b. When complete, set **P-801 Product Transfer Pump** to **OFF**.
5. Shut off the Belt Skimmer.
    a. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Motor Controls menu and set **P-701 Belt Skimmer** to **OFF**.
6. Close the valves at the influent of the Pre-Separation Tank (T-701) and the effluent of the OWS.
7. Allow the subcontractor to clean the Pre-Separation Tank and OWS. Cleaning tasks should include but are not limited to vacuuming out the remaining water in the tanks, pressure washing the coalescing packs, pressure washing the inside of the tanks, hand cleaning float switches, rods, and probes.

8. Once the subcontractor has finished cleaning the Pre-Separation Tank and OWS, open the valves at the influent of the Pre-Separation Tank and the effluent of the OWS.
9. Follow steps outlined in **Section 3.0** of the **OM&M Manual** to restart the Total Fluids Recovery and Groundwater Treatment System.
10. Adjust the rotary skimmer as necessary to skim off the appropriate amount of product.

Review Avenue LNAPL Recovery and Groundwater Treatment System
Operation, Maintenance & Monitoring

Standard Operating Procedures
Transfer of New Carbon to Liquid-Phase Granular Activated Carbon (LGAC) Units

LGAC carbon change-outs will be performed by the carbon vendor/subcontractor. The following SOP details the procedures required to be performed before and after the vessels are refilled.

Appropriate PPE:

- Nitrile gloves
- Clear safety glasses or goggles

Preparatory Procedure:

1. Allow Total Fluids Recovery and Groundwater Treatment System to run in **AUTO** until the Oil/Water Separator (OWS) effluent tank is near capacity.
2. Shut down the Total Fluids Recovery and Groundwater Treatment System.
    a. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Solenoid Valves Controls menu. Make a note of which solenoid valves are set to **AUTO**, then set **SV-601 through SV-607** to **CLOSE**.
    b. Return to the Main Menu, then to the Motor Controls menu and set **P-901 OWS Effluent Pump** to **OFF**.
3. Remove the vacuum break (siphon break) located downstream of the Effluent Flow Meter (FIT/FQ-1201) in the Groundwater Treatment enclosure and replace with a ½" PVC pipe plug.
4. Operate **P-901 OWS Effluent Pump** in **HAND** until flow is observed.
    a. Ensure that the P-901 pump timer is set to an appropriate manual run time from the Advance Settings menu on the HMI screen (security code 13214).
    b. When flow is observed, set **P-901 OWS Effluent Pump** to **OFF**.
5. Close the OWS Effluent Pump discharge valve located downstream of the OWS Effluent Pressure valve.
6. Open the vent valves on the two secondary bag filter units.
    a. Ensure that air is being drawn through the vents to allow the carbon vessels to siphon drain to the sewer.
7. After approximately 10 minutes, disconnect the camlock fitting at the inlet of the lead LGAC vessel to allow additional siphon draining to occur.
8. After approximately 15 minutes, open the drain valves on the bottom of the LGAC vessels to ensure they are drained completely. Drain residual water as necessary from the LGAC vessels into an appropriate container and transfer to the Pre-Separation Tank (T-701). Ensure that the drain valves are closed.

Review Avenue LNAPL Recovery and Groundwater Treatment System
Operation, Maintenance & Monitoring

Standard Operating Procedures
Transfer of New Carbon to Liquid-Phase Granular Activated Carbon (LGAC) Units

The LGAC units are now ready for carbon change-out (to be performed by vendor). Once the tanks have been refilled, the following post-change-out procedure must be followed.

Post-Change-Out Procedure:

1. Remove the ½" PVC plug and reinstall the vacuum breaker that was removed prior to carbon change-out.
2. Close the two vents on the secondary bag filters and reattach the camlock fitting at the inlet of the lead LGAC vessel.
3. Open the OWS Effluent Pump discharge valve.
4. Restart Total Fluids Recovery and Groundwater Treatment System.
    a. Follow steps outlined in **Section 3.0** of the **OM&M Manual.**
        i. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Solenoid Valves Controls menu. Set the solenoid valves noted prior to change-out back to **AUTO**.
        ii. Return to the Main Menu, then to the Motor Controls menu and set **P-901 OWS Effluent Pump** to **AUTO**.
5. Open the secondary bag filter air vents while the system is running and P-901 is pumping until the units are re-pressurized (water is observed), then close them.
6. While the system is running and P-901 is pumping, open the air vents on the top of each LGAC vessel and at the air pressure vent located at the high point of the effluent discharge line. Close each valve once water is observed from it.
7. When water has been observed from each of the air vents, shut down the Total Fluids Recovery and Groundwater Treatment System.
    a. On the HMI screen on the control panel located in TE-1, navigate from the Main Menu to the Solenoid Valves Controls menu. Make a note of which solenoid valves are set to **AUTO**, then set **SV-601 through SV-607** to **CLOSE**.
    b. Return to the Main Menu, then to the Motor Controls menu and set **P-901 OWS Effluent Pump** to **OFF**.
8. Open the air vents on the top each of the LGAC units and leave the system off for at least 24 hours before commencing Treatment System operations.
9. Prior to restarting the system, close the air vents on the top of each LGAC vessel.
10. Follow steps outlined in **Section 3.0** of the **OM&M Manual** to restart the Total Fluids Recovery and Groundwater Treatment System.

Review Avenue LNAPL Recovery and Groundwater Treatment System
Operation, Maintenance & Monitoring

Standard Operating Procedures
2,000 LB VGAC Vessel Load-Out

Appropriate PPE:

- Clear safety glasses or goggles

LNAPL Storage Tank Load-Out:

1. Before going to the site, verify that you have written permission to sign the bill of lading on behalf of the generator. Also verify that you have a copy of the waste approval documentation.
2. Shut down SVE system and isolate SVE influent, midfluent and effluent lines from VGAC vessels using inlet/outlet connection butterfly valves
3. Hook-up chemical transfer pump and transfer water from VGAC vessel drains to pre-separation tank T-701 located in equipment enclosure T-2.
4. Ensure the driver of the carbon replenishment vehicle has chocked the wheels of the truck.
5. Turn over spent carbon removal and re-filling operation to carbon vendor technicians.
6. Confirm correct replacement carbon is being provided.
7. Verify that all spent carbon has been removed from each vessel to be replenished.
8. Once new carbon is placed, verify that 2,000 LBs has been provided.
9. Verify that carbon vendor technicians have properly re-secured the manways.
10. Open isolation valves and re-start SVE system.
11. Verify that quantity to be disposed of matches approximately 2,000 lbs per vessel emptied/replenished, then sign the bill of lading.
12. Ensure driver/operator has purged the vacuum/suction/transfer lines, cleaned up any minor waste or virgin carbon prior to releasing the driver/operator from the site.

Review Avenue LNAPL Recovery and Groundwater Treatment System Operation, Maintenance & Monitoring

Standard Operating Procedures
LNAPL Storage Tank Load-Out

To load out either of the LNAPL Storage Tanks (T-801 Total Fluids System or T-1401 Skimmer system), it is not necessary to shut down the LNAPL Recovery and Groundwater Treatment System. The Skimmer and Total Fluids systems will automatically shut down at Tank 95% High-High and Tank 90% High-High Levels respectively, as such, tank load out can proceed while LNAPL recovery is active and without manual system shut-down.

Appropriate PPE:

- Nitrile gloves
- Clear safety glasses or goggles
- Tyvek suit

LNAPL Storage Tank Load-Out:

1. Before going to the site, verify that you have written permission to sign the bill of lading on behalf of the generator. Also verify that you have a copy of the waste approval documentation.
2. Verify that the spill clean-up kit is on-site and stocked with spill clean-up materials.
3. Stick the tank to be offloaded and record total volume in tank prior to tanker load-out. Compare the stick reading to the tank gauge reading and note any discrepancy (schedule tank gauge calibration if a discrepancy of more than ½" is identified). Use the tank gauging chart (posted on wall of control room in Enclosure TE-1) and convert stick reading (inches) to Gallons.
4. Check for water content using water finding paste or the oil/water interface probe. If more than 2" of water is detected, transfer water from the tank to the system Pre-Separation Tank (T-701) using the fuel transfer pump system assembly.
5. Familiarize the waste oil disposal company driver/operator with the tank system and to the location of the product removal/load out connection.
6. Ensure tanker the truck has a minimum capacity of 5,000 gallons and has the ability to vacuum offload or offload under suction with an on-board transfer pump.
7. Ensure the driver has chocked the wheels of the tanker truck.
8. Turn-over the tank and waste oil removal process to the tanker truck operator/driver.
9. Operator will hook-up suction line to the 2" load-out connection (2" male cam-lock fitting) located in the spill bucket immediately adjacent to the tank access stairway platform. Operator can also choose to use 1-1/2" stinger wand and insert within the 2" load-out connection.
10. Once operator has removed all product possible (tank empty or tanker truck full), stick tank again gauge tank again, convert to gallons (using tank gauging chart) and record. Subtract volume from initial volume to calculate volume removed and compare to tanker

truck operator's volume. If a discrepancy of more than 25 gallons is detected, re-check readings and conversion to gallons and resolve with operator prior to signing the bill of lading. Contact project manager if not resolved. If project manager not available, note on bill of lading that a discrepancy has been identified and Amec Foster Wheeler was not able to reconcile the discrepancy.

11. Once the outgoing volume has been agreed too with the operator, sign the bill of lading. Ensure that the shipping name matches the waste approval documentation.
12. Ensure driver/operator has purged the vacuum/suction/transfer lines, secured all tank fittings, cleaned up any minor waste oil drips or spillage prior to releasing the driver/operator from the site.

Review Avenue LNAPL Recovery and Groundwater Treatment System
Operation, Maintenance & Monitoring

Standard Operating Procedures
Chemical Drum Re-Filling

Chemcials:

- Redux 910 – Emulsification Breaker – Stored in 55-Gallon Poly Drum - MSDS Attached
- Verox-8 – Biocide - Stored in 55-Gallon Poly Drum - MSDS Attached

Appropriate PPE:

- Nitrile gloves
- Splash shield and Clear safety glasses or goggles
- Tyvek suit

Chemical Drum Re-Filling:

1. Verify that the spill clean-up kit is on-site and stocked with spill clean-up materials.
2. Coordinate chemical drum deliveries such that AMEC FW personnel are on-site to receive the drums. Ensure that the delivery truck has a lift gate or means of offloading the drums from the truck.
3. Using the Amec FW drum dolly, stage the drums near the double doors on the east end of Equipment Enclosure TE-2. Also stage the spill clean-up kit to the same location.
4. Open the double doors and set-up the chemical transfer pump system such that the suction line will draw from the desired replenishment chemical drum and the discharge line will direct flow to the identical fixed chemical drum to be replenished.
5. Shut down the groundwater treatment system and Total Fluids pumping system.
6. Remove the low level alarm float switch assembly from the fixed chemical drum to be replenished.
7. Open the bung on the replenishment drum and insert the suction line into the new chemical drum staged just outside the double doors and insert the discharge line into the fixed chemical drum to be replenished. Secure the lines to the bungs via bung wedges or other means. Check that the receiving drum can accommodate the full volume of the new chemical drum. If not measure the freeboard in the receiving drum and mark this level on the new drum with tape. Measure up 2” and re-tape the line – which will serve as the maximum withdraw line.
8. Initiate operation of the transfer pump in manual mode (using dead-man trigger) while being in visual range of both the new drum and receiving drums.
9. Once the new drum is nearing full, stop the transfer operation. Withdraw the suction line and purge by operating transfer pump until purged.
10. Stage empty drum in waste disposal staging area.
11. Re-start the groundwater treatment and Total Fluids Pumping Systems.

REDUX TECHNOLOGY®

Division of Azure water Services, LLC

Material Safety Data Sheet

Product Name: Redux 910
MSDS #: 42

Effective date: 9/15/2009

Section 1 – Chemical Product and Company Information

PRODUCT NAME: Redux 910
SYNONYMS: Biodispersant, Emulsion Breaker
SUPPLIER: Redux Technology
ADDRESS: 280 Callegari Drive, West Haven, Ct 06516
Office Phone: 802-365-7200
24 hour Emergency Phone (Chemtrec): 800-424-9300

NFPA Rating		HMIS Rating	
HEALTH:	2	HEALTH:	2
FLAMMABILITY:	1	FLAMMABILITY:	1
REACTIVITY:	0	REACTIVITY:	0

EMERGENCY OVERVIEW

Clear to slightly hazy, colorless to yellow liquid with mild odor. May cause skin, eye and respiratory irritation.

Section 2 - Composition Information

INGREDIENTS	CAS NO.	% WT/WT	PEL	TLV
Trade Secret Ingredients		~10	*15 mg/m^3 (TD)	
(SOLUBLE SALTS:			*5 mg/m^3 (RF)	*2 mg/m^3 (TWA))
Ethoxylated Alcohol		~10	240 mg/m^3, 50 ppm	20 ppm

*Aluminum metal, (as Al)

LISTED AS CARCINOGEN BY:

IARC: NO NTP: NO
OSHA: NO ACGIH: NO

PEL:	OSHA Permissible Exposure Limit	TWA:	Time Weighted Average, 8-hr	TD:	Total dust
STEL:	Short Term Exposure Limit	TLV:	ACGIH Threshold Limit	ND:	Nuisance dust
HI:	Hazardous Ingredient	C.LIM:	Ceiling Limit	INP:	Inhalable Particulate
OM:	Oil mist	WF:	Wax fume	RF:	Respirable fraction
ST:	Skin TWA				

Section 3 - Hazards Identification

ROUTES OF EXPOSURE

INHALATION: Inhalation of mist or spray may irritate respiratory tract.

SKIN CONTACT: May cause skin irritation, especially on prolonged contact.

SKIN ABSORBTION: No Data

EYE CONTACT: Direct eye contact may cause irritation, redness, and swelling. Prolonged exposure to Aluminum salts may cause conjunctivitis.

INGESTION: May cause gastrointestinal irritation, nausea, vomiting and diarrhea.

EFFECTS OF OVEREXPOSURE

ACUTE OVEREXPOSURE: Possible eye, skin and respiratory tract irritation.

CHRONIC OVEREXPOSURE: May aggravate existing skin, eye, and lung conditions. Persons with kidney disorders have an increased risk from exposure based on general information found on aluminum salts.

Section 4 - First Aid Measures

EYES: Immediately flush with plenty of water for at least 15 minutes, holding eyelids apart to ensure flushing of the entire surface. Washing within one minute is essential to achieve maximum effectiveness. Seek medical attention.

SKIN: Wash thoroughly with soap and water, remove contaminated clothing and footwear. Wash clothing before reuse. Get medical attention if irritation should develop.

INHALATION: Remove to fresh air.

INGESTION: Seek medical attention immediately. Give large amounts of water to drink. If vomiting should occur spontaneously, keep airway clear. Never give anything by mouth to an unconscious person.

NOTES TO PHYSICIAN: Aluminum soluble salts may cause gastroenteritis if ingested. Treatment includes the use of demulcents. Note: Consideration should be given to the possibility that overexposure to materials other an this product may have occurred.

Section 5 - Fire Fighting Measures

FLASHPOINT: NAPL

AUTOIGNITION TEMPERATURE: NAPL

FLAMMABLE LIMITS IN AIR, % BY VOLUME:

LOWER FLAMMABILITY LIMIT: NAPL

UPPER FLAMMABILITY LIMIT: NAPL

EXTINGUISHING MEDIA: Water Spray, Carbon Dioxide, Foam, Dry Chemical.

FIRE OR EXPLOSION HAZARDS: May produce hazardous fumes or hazardous decomposition products.

FIRE FIGHTING PROCEDURES: Product is a water solution and nonflammable. In a fire, this product may build up pressure and rupture a sealed container; cool exposed containers with water spray. Use self-contained breathing apparatus in confined areas; avoid breathing vapors or dust.

Section 6 - Accidental Release Measures

Stop leaks. Clean up spill immediately. Build dikes as necessary to contain flow of large spills. Do not allow liquid to enter stream or waterways. For small spills, use soda ash or lime to neutralize, an inert material to absorb, or wash product to a chemical sewer. Place contaminated materials into containers and store in a safe place to await proper disposal. Wear adequate personal protective clothing and equipment. Caution use of soda ash or lime may generate carbon dioxide gas. Provide adequate ventilation to spill area. Approved breathing apparatus may be necessary.

Section 7 - Handling and Storage

PRECAUTIONARY STATEMENTS:

CAUTION!
MAY CAUSE IRRITATION.
Avoid contact with eyes, skin, and clothing.
Avoid breathing mist or spray.
Wear chemical splash goggles, gloves, and protective clothing when handling.
Use with adequate ventilation and employ respiratory protection where mist or spray may be generated.
Wash thoroughly after handling.
May be harmful if swallowed or inhaled.
Keep away from heat and open flame.
Keep container closed when not in use.
FOR INDUSTRIAL USE ONLY.

HANDLING/STORAGE REQUIREMENTS:

Store in a cool, dry place away from direct heat. Keep container tightly closed when not in use. Do not store in unlined metal containers. Product may slowly corrode iron, brass, copper, aluminum and mild steel.

Section 8 - Exposure Controls/Personal Protection

VENTILATION REQUIREMENTS:	Local exhaust ventilation recommended.
EYE PROTECTION:	Chemical splash goggles and/or face shield.
SKIN PROTECTION:	Chemical resistant gloves.
RESPIRATORY PROTECTION:	When exposures exceed the PEL, use NIOSH/MSHA approved respirator in accordance with OSHA Respiratory Protection Requirements under 29 CFR 1910.134.
OTHER REQUIRED EQUIPMENT:	Standard work clothing and work shoes. Safety shower and eye wash located in immediate area.

Section 9 - Physical and Chemical Properties

APPEARANCE:	Clear to slightly hazy, colorless to yellow liquid		
ODOR:	mild odor		
SOLUBILITY IN WATER:	Soluble	pH:	3.5 (AS IS)
SPECIFIC GRAVITY (WATER=1):	1.02	DENSITY @ 25°C:	8.51 lb/gal
BOILING POINT:	~230°F	MELTING POINT:	NAV
FREEZING POINT:	~19°F	EVAPORATION RATE:	NAV
VAPOR PRESSURE:	NAV	VAPOR DENSITY (AIR=1):	NAV
VISCOSITY:	<50 cps	VOLATILES BY WEIGHT:	NAV

Section 10 - Stability and Reactivity

STABLE: YES HAZARDOUS POLYMERIZATION: NO

CONDITIONS TO AVOID:	NONE
IINCOMPATIBLE MATERIALS:	Product is incompatible with strong acids or bases, and strong oxidizers.
DECOMPOSITION PRODUCTS:	Thermal decomposition may release toxic and/or hazardous gases such as aluminum, Cl2, and HCl.

Section 11 Toxicological Information

Ingestion:	LD50 Rat: 4700 – 30,000 mg/kg
Skin Absorption	LD50 Rat: 22,700 mg/kg
	LD50 Rabbit: 990 – 6,100 mg/kg
Inhalation	LC50 7hr Vapor Rat: 7,000ppm

Section 12 - Ecological Information

Aquatic Toxicity:

Ceridaphnia dubia	LC 50 (48 hour, static)	2,200 mg/L
	NOEC	1,000 mg/l
Pimephales promelas	LC 50 (96 hour, static)	5,300 mg/l
	NOEC	2,000 mg/l

Section 13 - Disposal Considerations

Dispose of in accordance with all applicable federal, state and local regulations.

Section 14 - Transportation Information

DOT Proper Shipping Name:
NOT APPLICABLE, NOT RESTRICTED

Section 15 - Regulatory Information

This product contains the following ingredients subject to the reporting requirements of SARA Title III, Section 313 (40 CFR Part 372):

Ethylene glycol monobutyl ether CAS # 111-76-2

SARA Section 311/312: Acute Health Hazard.

TSCA: Components found in TSCA Inventory.

REDUX TECHNOLOGY®
Division of Azure Water Services, LLC

MATERIAL SAFETY DATA SHEET

(Prepared According to 29 CFR 1910.1200)

PRODUCT NAME: **VEROX-8**

Stabilized Chlorine Dioxide

SECTION I - GENERAL INFORMATION

Manufacturer/Supplier Name:

The Verox Group, LLC
1220 Market Street, Suite 606
Wilmington, DE 19801

Phone: 302-655-5015

Emergency: 603-773-5685

Fax 302-655-5016

Date prepared: 7/6/06

SECTION II - COMPONENT INFORMATION

Chemical Name	CAS REG. NO.	PERCENT	LD_{50}	LC_{50}
Sodium Chlorite	7758-19-2	8%	N/E	N/E

SECTION III - PHYSICAL PROPERTIES

FREEZE POINT (ºC): -3
pH (25°C): 11.8
SPECIFIC GRAVITY(25ºC):1.056 min.
EVAPORATION RATE (BuAC=1): 1
VAPOR PRESSURE (mmHg) @ 25ºC: 0.03
SOLUBILITY IN WATER: Complete
APPEARANCE & ODOR: Liquid, Pale Yellow, Odorless

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (COC): None when diluted.
FLAMMABLE LIMITS: LOWER: N/E UPPER: N/E
EXTINGUISHING MEDIA: Foam, CO_2.
SPECIAL FIREFIGHTING PROCEDURES: Wear a self-contained breathing apparatus with personal protective equipment.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Contamination with other materials such as acids, toxic chlorine, organic chemicals, etc. may cause a chemical reaction.

SECTION V - REACTIVITY DATA

STABILITY: Stable.
INCOMPATIBILITY: Strong acids.
HAZARDOUS DECOMPOSITION PRODUCTS: Contamination with other materials may cause a chemical reaction.

SECTION VI - HEALTH HAZARDS

ROUTE (S) OF ENTRY:EYE: ✓ INHALATION: ✓ SKIN: ✓ INGESTION: ✓

EYE:	Irritant to the eyes, causes burns.
INHALATION:	Can cause headache, nausea.
SKIN:	Slight irritant when overexposure occurs.
INGESTION:	Causes severe burns to the lungs.

SECTION VII - EMERGENCY AND FIRST AID PROCEDURES

EYE:	Flush with plenty of water for at least 15 minutes. Call a physician.
INHALATION:	Move victim to fresh air.
SKIN:	Wash affected areas with soap and water for at least 15 minutes. If irritation persists, call a physician. Wash clothing before re-use.
INGESTION:	DO NOT INDUCE VOMITING. Promptly drink a large quantity of water. Call a physician.

SECTION VIII - SPECIAL PROTECTION

RESPIRATORY PROTECTION:	None required under normal use conditions.
VENTILATION REQUIREMENTS:	Adequate local exhaust. Specific needs should be addressed by supervisory or health/safety personnel.
PROTECTIVE GLOVES:	Neoprene.
EYE PROTECTION:	Safety glasses, chemical splash goggles, face shield.
OTHER PROTECTIVE CLOTHING:	Apron, coveralls, foot coverings as needed.

280 Callegari Drive, West Haven, Connecticut 06516
Phone: 203-933-9071 Fax: 203-933-1751 www.reduxtech.com

SECTION IX - SPILL OR LEAK HANDLING PROCEDURES

STEPS TO BE TAKEN IF RELEASED OR SPILLED: Dilute with a large quantity of water. Do not allow liquid to dry because this could present a fire hazard. In case of contamination, do not reseal container. Isolate in an open, well-ventilated area.

WASTE DISPOSAL METHODS: Dispose of in an approved waste facility according to Federal, State and Local regulations.

SECTION X - HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:
OXIDIZER! CORROSIVE! Handle with care. Store in closed container in well-ventilated area.

SECTION XI - TRANSPORTATION INFORMATION

Hazard Class or Division: 8
Identification: UN-1908
Label Codes: 8

The health hazards given on the Material Safety Data Sheet apply to this product in its concentrated form (as supplied) and may differ significantly at use dilution. The signs and symptoms of overexposure apply only to negligence in handling or misuse of the concentrated product and not to the routine exposure to the diluted product under conditions of ordinary use.

280 Callegari Drive, West Haven, Connecticut 06516
Phone: 203-933-9071 Fax: 203-933-1751 www.reduxtech.com

APPENDIX D

Permits and Sampling Requirements

ORDER TYPE POMSC PO-BLDG PRPS MS PAGE 1 OF 1
ACCOUNT 0001051539001 NAME AMEC FOSTER WHEELER PHONE 000-000-0000
ADD NM BORO 1 BLK 99999 LOT 9999 SEC 99 COMM BRD 199
ADDR MDSE ONLY SPCL PREM INS
NEW YORK NY 10002
SPCL READ INSTR
BUILDING CLASS Z0 PLUMBER
CROSS STREETS NOT AVAILABLE NOT AVAILABLE
UMS VARIANCE CODE
NON UMS VARIANCE CODE

ASGN TO 0000 STATUS A PEND/INITIATED REAS A NORMAL ISS DATE 11/05/15
CONTRACT 0000 BATCH 00000 PLACED BY EXPEDITOR PH #
WANTED BY DATE 12/04/15 TIME 0000 CREATED BY MO DATE 11/04/15
CONTRACT ITEM CODES
SPCL INST PO-BLDG PRPS MS AMEC FOSTER WHEELER, DEWATERING @ 37-80 REVIEW AVE,
CASE #C-5652, DISCHARGE 5,400,000 GALLONS OF WATER, 11/2015 - 2/2016.

POMSC - PO-BLDG PRPS MS PERMIT NUMBER 743197
SVC SIZE 000 SVC SIZE DESC TAP SIZE 000 TAP SIZE DESC
FEE 43,748.66 NO DAYS USAGE 000 START/END DATE 00/00/00 00/00/00
APPLICATION DATE 00/00/00 EXPIRE DATE 00/00/00 START/END TIME 0000 0000
PLUMBER LICENSE NO 0000000 EXPIRE DATE 00/00/00 STATUS
ADDRESS

ADDITIONAL ORDER INFORMATION
-

COMPLETION DATE _____ WO STATUS _____
COMPLETED BY (ID) _____ WO STATUS REASON _____
COMPLETION TIME IN _____ COMPLETION TIME OUT _____

COMMENTS _____

_____

_____

_____

NYC Environmental Protection

Emily Lloyd
Commissioner

Vincent Sapienza, P.E.
Deputy Commissioner

Bureau of Wastewater Treatment
96-05 Horace Harding Expressway – 2nd Floor
Corona, NY 11368

Tel. (718) 595-4906
Fax (718) 595-6950
vsapienza@dep.nyc.gov

October 8, 2014

AMEC Environment & Infrastructure, Inc.
200 American Metro Boulevard, Suite 113
Hamilton, NJ 08619
Attn: Brent C. O'Dell, P.E.

Re: Groundwater Discharge, Review Avenue Development Sites, Queens, File # C-5652

Dear Mr. O'Dell:

This is in response to the June 28, 2012 and May 17, June 24, July 1, and September 24, 2014 submissions requesting permission to discharge up to **36,000 gallons per day (gpd)** of groundwater generated during the remediation located at 37-30 and 37-80 Review Avenue in Queens, NY 11101 (New York State Department of Environmental Conservation Brownfield Cleanup Program Site Nos. C241089 and C241005, respectively). The groundwater will be treated through one 500 gallon pre-separation/eq chamber (with the addition of biocide before chamber and emulsification breaker after chamber), one 40 gpm oil/water separator, two 50-micron bag filter units, two 10-micron bag filter units, and two 1,000 lb carbon units, per provided schematic and information, before discharging to a 6" site connection. The site connection leads to the 12" combined sewer located at Review Avenue between 37th Street and Railroad Avenue in Queens, NY.

Based upon the information, schematic and analytical data submitted, you are hereby conditionally authorized, to discharge up to 36,000 gpd of the groundwater, treated through the above system, per provided schematic and information, as specified in your submissions, **for a period of one year**, to the combined sewer at the above mentioned location. **This Letter of Approval shall expire at midnight on October 7, 2015.**

This conditional approval, however, is subject to your obtaining a groundwater discharge Approval, specifying allowable flow rates, from the Chief of Permitting and Compliance, Bureau of Water and Sewer Operations. You are also required to follow manufacturer specifications for the operation and maintenance of the selected equipment. **This Letter of Approval is contingent upon the permittee's compliance with any other Federal, State or Local laws applicable to the permitted activity.**

Under no circumstances shall muddy groundwater be discharged into the public sewer.

Payment shall be made to and permit obtained from the Bureau of Customer

Service for groundwater discharge into the New York City Wastewater System in accordance with the Water and Wastewater Rate Schedule established by the New York City Water Board.

You must notify this section in writing prior to the commencement of discharge. In addition, you are required to hold the groundwater to the maximum extent practicable during heavy wet weather events. Refer to File # C-5652 in any correspondence to this office.

The permittee must collect samples of the groundwater after the pretreatment system in each quarter of the calendar year. The samples must be analyzed for the parameter(s) included in the attached chart by a New York State Department of Health certified laboratory. The results must be submitted to this office within 21 days after each sampling date. If the sampling results, or any other sampling results, exceed the DEP limits, the discharge must cease and the Bureau of Wastewater Treatment must be notified immediately by phone at (718) 595-4715 and by fax at (718) 595-4771.

You are prohibited from discharging any groundwater that exceeds the attached discharge limit(s), as well as those contained in Title 15 Rules of the City of New York Chapter 19.

This Letter of Approval is an Order of the Commissioner of the Department of Environmental Protection. Please be advised that failure to comply with this Letter of Approval may result in the issuance of Notices of Violation (returnable to the New York City Environmental Control Board) and/or revocation of the Letter of Approval. Notices of Violation carry penalties of up to $10,000 a day, per violation.

If you have any questions concerning this matter, please contact Sean Hulbert, Assistant Chemical Engineer, at (718) 595-4715.

Sincerely,

Frances Leung

Frances Leung, P.E., Chief
Industrial Inspections and
Permitting Section

enc: Sampling Requirements and Limitations

SAMPLING REQUIREMENTS AND LIMITATIONS

Parameter[1]	Daily Limit	Units	Sample Type	Monthly Limit
Non-polar material[2]	50	mg/l	Instantaneous	---
pH	5-12	SU's	Instantaneous	---
Temperature	< 150	Degree F	Instantaneous	---
Flash Point	> 140	Degree F	Instantaneous	---
Cadmium	2 0.69	mg/l mg/l	Instantaneous Composite	--- ---
Chromium (VI)	5	mg/l	Instantaneous	---
Copper	5	mg/l	Instantaneous	---
Lead	2	mg/l	Instantaneous	---
Mercury	0.05	mg/l	Instantaneous	---
Nickel	3	mg/l	Instantaneous	---
Zinc	5	mg/l	Instantaneous	---
Benzene	134	ppb	Instantaneous	57
Carbontetrachloride	---	---	Composite	---
Chloroform	---	---	Composite	---
1,4 Dichlorobenzene	---	---	Composite	---
Ethylbenzene	380	ppb	Instantaneous	142
MTBE (Methyl-Tert-Butyl-Ether)	50	ppb	Instantaneous	---
Naphthalene	47	ppb	Composite	19
Phenol	---	---	Composite	---
Tetrachloroethylene (Perc)	20	ppb	Instantaneous	---
Toluene	74	ppb	Instantaneous	28
1,2,4 Trichlorobenzene	---	---	Composite	---
1,1,1 Trichloroethane	---	---	Composite	---
Xylenes (Total)	74	ppb	Instantaneous	28
PCB's (Total)[3]	1	ppb	Composite	---
Total Suspended Solids (TSS)	350	mg/l	Instantaneous	---
CBOD	---	---	Composite	---
Chloride	---	---	Instantaneous	---
Total Nitrogen[4]	---	---	Composite	---
Total Solids	---	---	Instantaneous	---
Other				

1 All handling and preservation of collected samples and laboratory analyses of samples shall be performed in accordance with 40 C.F.R. pt. 136. If 40 C.F.R. pt. 136 does not cover the pollutant in question, the handling, preservation, and analysis must be performed in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater." All analyses shall be performed using a detection level less than the lowest applicable regulatory discharge limit. If a parameter does not have a limit, then the detection level is defined as the least of the Practical Quantitation Limits identified in NYSDEC's Analytical Detectability and Quantitation Guidelines for Selected Environmental Parameters, December 1988.

2 Non-Polar Material shall mean that portion of the oil and grease that is not eliminated from a solution containing N-Hexane, or any other extraction solvent the EPA shall prescribe, by silica gel absorption.

3 Analysis for PCB's must be done by EPA method 608 with MDL=<65 ppt. PCB's (total) is the sum of PCB-1242 (Aroclor 1242), PCB-1254 (Aroclor 1254), PCB-1221 (Aroclor 1221), PCB-1232 (Aroclor 1232), PCB-1248 (Aroclor 1248), PCB-1260 (Aroclor 1260) and PCB-1016 (Aroclor 1016).

4 Total Nitrogen = Total Kjeldahl Nitrogen (TKN) + Nitrite (NO_2) + Nitrate (NO_3).

NYC Environmental Protection

Emily Lloyd
Commissioner

John G. Petito, P.E.
Acting
Deputy Commissioner

Bureau of Wastewater Treatment
96-05 Horace Harding Expressway – 2nd Floor
Corona, NY 11368

Tel. (718) 595-5046
Fax (718) 595-6950

November 2, 2015

Amec Foster Wheeler Environment &
Infrastructure, Inc.
200 American Metro Boulevard, Suite 113
Hamilton, NJ 08619
Attn: William J. Mikula, P.E.

Re: Groundwater Discharge, Review Avenue Development Sites, Queens, File # C-5652

Dear Mr. Mikula:

This Letter of Approval is a renewal of the Letter of Approval issued on October 8, 2014.

This is in response to the October 22, 2015 submission requesting permission to discharge up to **36,000 gallons per day (gpd)** of groundwater generated during the remediation located at 37-30 and 37-80 Review Avenue in Queens, NY 11101 (New York State Department of Environmental Conservation Brownfield Cleanup Program Site Nos. C241089 and C241005, respectively). The groundwater will be treated through one 500 gallon pre-separation/eq chamber (with the addition of biocide before chamber and emulsification breaker after chamber), one 40 gpm oil/water separator, two 50-micron bag filter units, two 10-micron bag filter units, and two 1,000 lb carbon units, per provided schematic and information, before discharging to a 6" site connection. The site connection leads to the 12" combined sewer located at Review Avenue between 37th Street and Railroad Avenue in Queens, NY.

Based upon the information, schematic and analytical data submitted, you are hereby conditionally authorized, to discharge up to 36,000 gpd of the groundwater, treated through the above system, per provided schematic and information, as specified in your submissions, **for a period of one year**, to the combined sewer at the above mentioned location. **This Letter of Approval shall expire at midnight on November 1, 2016.**

This conditional approval, however, is subject to your obtaining a groundwater discharge Approval, specifying allowable flow rates, from the Chief of Permitting and Compliance, Bureau of Water and Sewer Operations. You are also required to follow manufacturer specifications for the operation and maintenance of the selected equipment. **This Letter of Approval is contingent upon the permittee's compliance with any other Federal, State or Local laws applicable to the permitted activity.**

Under no circumstances shall muddy groundwater be discharged into the

public sewer.

Payment shall be made to and permit obtained from the Bureau of Customer Service for groundwater discharge into the New York City Wastewater System in accordance with the Water and Wastewater Rate Schedule established by the New York City Water Board.

You must notify this section in writing prior to the commencement of discharge. In addition, you are required to hold the groundwater to the maximum extent practicable during heavy wet weather events. Refer to File # C-5652 in any correspondence to this office.

The permittee must collect samples of the groundwater after the pretreatment system in each quarter of the calendar year. The samples must be analyzed for the parameter(s) included in the attached chart by a New York State Department of Health certified laboratory. The results must be submitted to this office within 21 days after each sampling date. If the sampling results, or any other sampling results, exceed the DEP limits, the discharge must cease and the Bureau of Wastewater Treatment must be notified immediately by phone at (718) 595-4715 and by fax at (718) 595-4771.

You are prohibited from discharging any groundwater that exceeds the attached discharge limit(s), as well as those contained in Title 15 Rules of the City of New York Chapter 19.

This Letter of Approval is an Order of the Commissioner of the Department of Environmental Protection. Please be advised that failure to comply with this Letter of Approval may result in the issuance of Notices of Violation (returnable to the New York City Environmental Control Board) and/or revocation of the Letter of Approval. Notices of Violation carry penalties of up to $10,000 a day, per violation.

If you have any questions concerning this matter, please contact Sean Hulbert, Assistant Chemical Engineer, at (718) 595-4715.

Sincerely,

Frances Leung, P.E., Chief
Industrial Inspections and
Permitting Section

enc: Sampling Requirements and Limitations

SAMPLING REQUIREMENTS AND LIMITATIONS

Parameter[1]	**Daily Limit**	**Units**	**Sample Type**	**Monthly Limit**
Non-polar material[2]	50	mg/l	Instantaneous	---
pH	5-12	SU's	Instantaneous	---
Temperature	< 150	Degree F	Instantaneous	---
Flash Point	> 140	Degree F	Instantaneous	---
Cadmium	2 0.69	mg/l mg/l	Instantaneous Composite	--- ---
Chromium (VI)	5	mg/l	Instantaneous	---
Copper	5	mg/l	Instantaneous	---
Lead	2	mg/l	Instantaneous	---
Mercury	0.05	mg/l	Instantaneous	---
Nickel	3	mg/l	Instantaneous	---
Zinc	5	mg/l	Instantaneous	---
Benzene	134	ppb	Instantaneous	57
Carbontetrachloride	---	---	Composite	---
Chloroform	---	---	Composite	---
1,4 Dichlorobenzene	---	---	Composite	---
Ethylbenzene	380	ppb	Instantaneous	142
MTBE (Methyl-Tert-Butyl-Ether)	50	ppb	Instantaneous	---
Naphthalene	47	ppb	Composite	19
Phenol	---	---	Composite	---
Tetrachloroethylene (Perc)	20	ppb	Instantaneous	---
Toluene	74	ppb	Instantaneous	28
1,2,4 Trichlorobenzene	---	---	Composite	---
1,1,1 Trichloroethane	---	---	Composite	---
Xylenes (Total)	74	ppb	Instantaneous	28
PCB's (Total)[3]	1	ppb	Composite	---
Total Suspended Solids (TSS)	350	mg/l	Instantaneous	---
CBOD	---	---	Composite	---
Chloride	---	---	Instantaneous	---
Total Nitrogen[4]	---	---	Composite	---
Total Solids	---	---	Instantaneous	---
Other				

1 All handling and preservation of collected samples and laboratory analyses of samples shall be performed in accordance with 40 C.F.R. pt. 136. If 40 C.F.R. pt. 136 does not cover the pollutant in question, the handling, preservation, and analysis must be performed in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater." All analyses shall be performed using a detection level less than the lowest applicable regulatory discharge limit. If a parameter does not have a limit, then the detection level is defined as the least of the Practical Quantitation Limits identified in NYSDEC's Analytical Detectability and Quantitation Guidelines for Selected Environmental Parameters, December 1988.

2 Non-Polar Material shall mean that portion of the oil and grease that is not eliminated from a solution containing N–Hexane, or any other extraction solvent the EPA shall prescribe, by silica gel absorption.

3 Analysis for PCB's must be done by EPA method 608 with MDL=<65 ppt. PCB's (total) is the sum of PCB-1242 (Aroclor 1242), PCB-1254 (Aroclor 1254), PCB-1221 (Aroclor 1221), PCB-1232 (Aroclor 1232), PCB-1248 (Aroclor 1248), PCB-1260 (Aroclor 1260) and PCB-1016 (Aroclor 1016).

4 Total Nitrogen = Total Kjeldahl Nitrogen (TKN) + Nitrite (NO_2) + Nitrate (NO_3).

NYC Environmental Protection

Emily Lloyd
Commissioner

James J. Roberts, P.E.
Deputy Commissioner
Bureau of Water and
Sewer Operations

59-17 Junction Boulevard
Flushing, NY 11373

December 14, 2015

Brent Curtis O-Dell, P.E.
AMEC Environmental & Infrastructure, Inc.
200 American Metro Blvd, Suite 113
Hamilton, NY 08619

RE: Dewatering at 37-30 & 37-80 REVIEW AVENUE
Block #312. Lot #s 41 & 69,
Borough of Queens

Dear Dr. Adib:

We are in receipt of your dewatering submission dated December 9, 2015, requesting permission to continue to temporarily discharge up to 36, 000 gallons per day (gpd) of groundwater, continuously for a period of one year, during construction through an existing 6" diameter (dia.) connection to the 12"dia. combined sewer in Review Avenue between 37th Street and Railroad Avenue in the Borough of Queens.

Based upon the information, schematic and analytical data submitted, you are hereby authorized to obtain a DEP Permit to continue to temporarily discharge, during construction up to 36,000 gallons per day (gpd) of groundwater at the rate not to exceed 0.06 cubic feet per second (cfs) for a period of one year as specified in your submission to the combined sewer at the above-mentioned location The Industrial Inspections and Permitting Section have given you approval for this dewatering discharge (C-5652) by the letter dated November 2, 2015.

The discharger shall indemnify and hold the City harmless for any damage or liability incurred by the City due to the dewatering and in the event that the discharge results in overloading the capacity of the discharge sewer. See the copy of the revised Special Indemnity Agreement attached, to be signed and filed with the discharge permit application.

Please note that no dewatering permit will be issued until the payment is made to the Bureau of Customer Service for a groundwater discharge into the New York City Wastewater System in accordance with the Water Rate Schedule established by the New York City Water Board.

This approval is an extension of the previous approval dated December 15, 2014.

If you have any further questions concerning this matter, please contact Mr. Suresh Kumar at (718) 595-5205.

Very truly yours,

Guo Zhan Wu, P.E., Acting Chief
Site Connections, Green Infrastructure
And Plan Review

Special Indemnity Agreement
For temporary groundwater discharge in the City sewer sytem

(Present Date)

Commissioner
Department of Environmental Protection
59-17 Junction Boulevard
Corona, NY 11368

Location: 37-30 Review Avenue
Long Island City
Queens, NYC

Re: **Dewatering Permit**

Dear Commissioner:

(Property Owner) hereby agrees to indemnify and to save harmless, to the fullest extent permitted by law, the City of New York, the New York City Department of Environmental Protection (hereinafter referred to as the "City") and their respective offices, representatives, agencies, contractors, servants, and employees from and against any and all claims, suits, actions, proceedings, and losses that may arise after the date of this agreement from the construction, maintenance, operation, or use of any sewer connection (direct or indirect) to the City Sewer System for the purpose of dewatering.

In addition it is noted that the City is held harmless due to any harmful side effects of lowering the Water Table such as but not limited to impact of drawdown on the perimeter of the site, salt water intrusion, movement of contaminated groundwater, backflow due to surcharge of outlet sewer and effect on any wetlands.

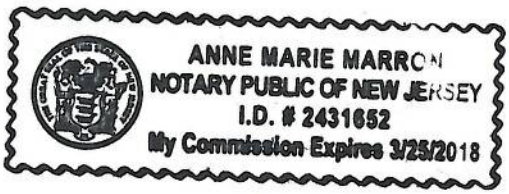
6/22/15

Professional Engineer, STAMP & Signature

Very truly yours,

(Property Owner's Signature)
Name (print)
Address

To Be Notarized



Anne Marron
7/1/15

Rev. February 2004

NEW YORK STATE

PBS Number
2-612454

New York State Department of Environmental Conservation
PETROLEUM BULK STORAGE CERTIFICATE

625 Broadway, 11th Floor, Albany, NY 12233-7020 Phone: 518-402-9553

Region 2 NYSDEC - PBS Unit
47-40 21st Street, 1st Floor
Long Island City, NY 11101-5407
(718) 482-6454

TANK NUMBER	TANK LOCATION	DATE INSTALLED	TANK TYPE	PRODUCT STORED	CAPACITY (GALLONS)	DATE LAST TESTED	TESTING DUE DATE
T-0001	Aboveground - No Contact (on saddles, legs, rack, cradle, etc.)	08/25/2015	Steel/Carbon Steel/Iron	waste oil/used oil	6,000		*
T-002	Aboveground - No Contact (on saddles, legs, rack, cradle, etc.)	08/25/2015	Steel/Carbon Steel/Iron	waste oil/used oil	6,000		*

*** Aboveground tanks require monthly visual inspections and may need documented internal inspections as described in 6 NYCRR Part 613**

SITE:
REVIEW AVENUE DEVELOPMENT SITES
37-80 REVIEW AVENUE
LONG ISLAND CITY, NY 11101

FACILITY OWNER:
37-80 REVIEW REALTY LLC
80 LEXINGTON AVENUE
NEW YORK, NY 10168

Tank Owner Name:
REVIEW AVENUE SYSTEM LLC

Class B (Daily On-Site) Operator: AMEC FW
Class A (Primary) Operator: REVIEW AVENUE SYSTEM LLC
Emergency Contact Name: BRENT O'DELL
Emergency Contact Phone Number: (908) 285-1769

Facility Phone Number
(917) 832-6303

MAILING CORRESPONDENCE:

CRAIG COSLETT
REVIEW AVENUE SYSTEM LLC
% DE MAXIMIS INC
1550 POND ROAD, SUITE 120
ALLENTOWN, PA 18104

ISSUED BY: Acting Commissioner
Marc Gerstman
PBS NUMBER: **2-612454**
DATE ISSUED: 08/27/2015
EXPIRATION DATE: 08/27/2020
FEE PAID: $0.00

As an authorized representative of the above named facility, I affirm under penalty of perjury that the information displayed on this form is correct to the best of my knowledge. Additionally, I recognize that I am responsible for assuring that this facility is in compliance with all sections of 6 NYCRR Parts 612, 613 and 614, and applicable sections of 6 NYCRR Subpart 374-2 (used oil tanks only), not just those cited below:
-- The facility must be re-registered if there is a transfer of ownership.
-- The Department must be notified within 30 days prior to adding, replacing, reconditioning, or permanently closing a stationary tank.
-- The facility must be operated in accordance with the code for storing petroleum, 6NYCRR Part 613.
-- Any new facility or substantially modified facility must comply with 6NYCRR Part 614.
-- This certificate must be signed and posted on the premises at all times. Posting must be at the tank, at the entrance of the facility, or the main office where the storage tanks are located.
-- Any person with knowledge of a spill, leak or discharge must report the incident to DEC within two hours **(1-800-457-7362)**.

Signature of Representative/ Owner — Date: 10/16/2015

for and on behalf of Review Ave Systems LLC
Name and Title of Authorized Representative/Owner (Please Print)

Print Date: 8/27/2015

THIS REGISTRATION CERTIFICATE IS NON-TRANSFERABLE

PBS # : **2-612454**

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Petroleum Bulk Storage Program
Facility Information Report

Printed : 8/27/2015

Site Information

REVIEW AVENUE DEVELOPMENT SITE
37-80 REVIEW AVENUE
LONG ISLAND CITY, NY 11101

Site Phone: (917) 832-6303

Town: New York City County: Queens

Class B (On-Site) Operator: AMEC FW

Class A (Primary) Operator: REVIEW AVENUE SYSTEM LLC

Emergency Contact: BRENT O'DELL

Tax Map Information

Borough/Section:
Block:
Lot:

Site Owner Information

37-80 REVIEW REALTY LLC
80 LEXINGTON AVENUE
NEW YORK, NY 10168

(212) 661-0858

Owner Type : Corporate/Commercial/Other

Authorized Representative:

Emergency Phone: (908) 285-1769

Mail Correspondent Information

REVIEW AVENUE SYSTEM LLC
% DE MAXIMIS INC
1550 POND ROAD, SUITE 120
ALLENTOWN, PA 18104

ATTN: CRAIG COSLETT

(610) 435-1151

Site Status : Active
Site Type: Other

Reg Expires : 08/27/2020 Cert Printed:
Cert Issued: 08/27/2015

Total Active Tanks : 2
Total Active Capacity : 12,000

Last Inspected:
Inspected By:

(2) Tank No	(3) Tank Loc	(4) Status	(5) Date Instal	(5) Date Closed	(6) Capacity (gals)	(7) Product	(8) Tank Type	(9) Tank IP	(10) Tank EP	(11) Tank SC	(12) Tank LD	(13) Tank OP	(14) Tank SP	(15) Tank Disp	(16) Pipe Loc	(17) Pipe Type	(18) Pipe EP	(19) Pipe SC	(20) Pipe LD	(21) UDC	Last Test Date	Next Test Date	Tank Owner
T-0001	3	1	08/25/2015		6,000	0022	01	00	09	01	99	02	03	00	00	01	01	09	00	99				REVIEW AVENUE
T-002	3	1	08/25/2015		6,000	0022	01	00	09	01	99	02	03	00	00	01	01	09	00	99				REVIEW AVENUE

(See Reverse Side or Last Page for Code Keys)

PETROLEUM BULK STORAGE APLICATION - SECTION B - TANK INFORMATION - CODE KEYS

Action (1)

1. Initial Listing
2. Add Tank
3. Close/Remove Tank
4. Information Correction
5. Recondition/Repair/Reline Tank

Tank Location (3)

1. Aboveground-contact w/soil
2. Aboveground-contact w/ impervious barrier
3. Aboveground on saddles, leggs, stilts, rack or cradle
4. Aboveground with 10% or more below ground
5. Underground
6. Aboveground in Subterranean Vault w/access for inspections

Status (4)

1. In-service
2. Temporarily out-of-service
3. Closed-Removed
4. Closed- In Place
5. Tank converted to Non-Regulated use

Products Stored (7)

Heating Oils: On-Site Consumption

0001. #2 Fuel Oil
0002. #4 Fuel Oil
0259. #5 Fuel Oil
0003. #6 Fuel Oil
0012. Kerosene
0591. Clarified Oil
2711. Biodiesel (Heating)
2642. Used Oil (Heating)

Heating Oils: Resale/ Redistribution

2718. #2 Fuel Oil
2719. #4 Fuel Oil
2720. #5 Fuel Oil
2721. #6 Fuel Oil
2722. Kerosene
2723. Clarified Oil
2724. Biodiesel (Heating)

Motor Fuels

0009. Gasoline
2712. Gasoline/Ethanol
0008. Diesel
2710. Biodiesel
0011. Jet Fuel
1044. Jer Fuel (Biofuel)
2641. Aviation Gasoline

Lubricating/Cutting Oils

0013. Lube Oil
0015. Motor Oil
1045. Gear/Spindle Oil
0010. Hydraulic Oil
0007. Cutting Oil
0021. Transmission Fluid
1836. Turbine Oil
0308. Refrigerator Oil

Oils Used as Building Materials

2626. Asphaltic Emulsions
0748. Form Oil

Petroleum Spirits

0014. White/Mineral Spirits
1731. Naptha

Mineral/Insulating Oils

0020. Insulating Oil (e.g., Transformer, Cable Oil)
2630. Mineral Oil

Waste/Used/Other Oils

0022 Waste/Used Oil
9999. Other-Please list:*

Crude Oil

0006. Crude Oil
0701. Crude Oil Fractions

Tank Type (8)

01. Steel/Carbon Steel/Iron
02. Galvanized Steel Alloy
03. Stainless Steel Alloy
04. Fiberglass Coated Steel
05. Steel Tank in Concrete
06. Fiberglass Reinforced Plastic (FRP)
07. Plastic
08. Equivalent Technology
09. Concrete
10. Urethane Clad Steel
99. Other-Please list:*

Internal Protection (9)

00. None
01 Epoxy Liner
02. Rubber Liner
03. Fiberglass Liner (FRP)
04. Glass Liner
99. Other-Please list:*

External Protection (10/18)

00. None
01. Painted/Asphalt Coating
02. Original Sacrificial Anode
03. Original Impressed Current
04. Fiberglass
05. Jacketed
06. Wrapped (Piping)
07 Retrofitted Sacrificial Anode
08. Retrofitted Impressed Current
09. Urethane
99. Other-Please list:*

Tank Secondary Containment (11)

00. None
01. Diking (Aboveground Only)
02. Vault (w/access)
03. Vault (w/o access)
04. Double-Walled (Underground Only)
05. Synthetic Liner
06. Remote Impounding Area
07. Excavation Liner
09. Modified Double-Walled (Aboveground Only)
10. Impervious Underlayment (Aboveground Only)**
11. Double Bottom (Aboveground Only)**
12. Double-Walled (Aboveground

Tank Leak Detection (12)

00. None
01. Interstitial Electronic Monitoring
02. Interstitial Manual Monitoring
03. Vapor Well
04. Groundwater Well
05. In-Tank System (Auto Tank Gauge)
06. Impervious Barrier/Concrete Pad (Aboveground Only)

Overfill Protection (13)

00. None
01. Float Vent Valve
02. High Level Alarm
03. Automatic Shut-Off
04. Product Level Gauge (Aboveground Only)
05. Vent Whistle
99. Other-Please list:*

Spill Prevention (14)

00. None
01. Catch Basin
99. Other-Please list:*

Pumping/Dispensing Method (15)

00. None
01. Presurized Dispenser
02. Suction Dispenser
03. Gravity
04. On-Site Heating System (Suction)
05. On-Site Heating System (Supply/Return)
06. Tank-Mounted Dispenser
07. Loading Rack/Transfer Pump

Piping Location (16)

00. No Piping
01. Aboveground
02. Underground/On-ground
03. Aboveground/Underground Combination

Piping Type (17)

00. None
01. Steel/Carbon Steel/Iron
02. Galvanized Steel
03. Stainless Steel Alloy
04. Fiberglass Coated Steel
05. Steel Encased in Concrete
06. Fiberglass Reinforced Plastic (FRP)
07. Plastic
08. Equivalent Technology
09. Concrete
10. Copper
11. Flexible Piping
99. Other-Please list:*

Piping Secondary Containment (19)

00. None
01. Diking (Aboveground Only)
02. Vault (w/access)
04. Double-Walled (Underground Only)
06. Remote Impounding Area
07. Trench Liner
12. Double-Walled (Aboveground Only)

Pipe Leak Detection (20)

00. None
01. Interstitial Electronic Monitoring
02. Insterstitial Manual Monitoring
03. Vapor Well
04. Groundwater Well
07. Pressurized Piping Leak Detector
09. Exempt Suction Piping
99. Other-Please list:*

Under Dispenser Containment (UDC) (21)

Check Box if Present

- -

* If other, please list on a separate sheet including tank number

** Each of these codes must be combined with code 01 or 06 to meet compliance requirements

APPENDIX E

National Environmental Systems (NES) Operation & Maintenance Manual

Operation & Maintenance Manual

NES PROJECT NUMBER: 13-214, January 2015
PROJECT NAME: Vacuum Enhanced Recovery System – Dual Cargo Boxes
Review Ave Development
Brownfield Cleanup Program
Sites: C241005 & C241089
Queens County, New York

Prepared for:

AMEC Environment & Infrastructure
200 American Metro Boulevard, Suite 113
Hamilton, NJ 08619

Sales: (508)226-1100 Option 2
Technical Support: (508)226-1100 Option 3

Phone (508) 226-1100 Fax (508) 226-1180 84 Dunham Street Attleboro, MA 02703
www.nes-inc.biz

NES Project: 13-214
Vacuum Enhanced Recovery & Treatment System
AMEC – Review Ave Development - Queens, NY

Operation & Maintenance Manual

E-2, ELECTRICAL BLOCK DIAGRAM

E-3, POWER DISTRIBUTION PANEL LAYOUT(S)

SECTION 4 - 100 SERIES PROCESS EQUIPMENT - SVE INLET MANIFOLD

MOTOR OPERATED VALVE, 4" - JOMAR MODEL 600-04DSPL

MOTOR OPERATED VALVE ACTUATOR - INDELAC MODEL ML4X/7BF07-152SMP-1

FLOW INDICATOR (MAGNEHELIC) - DWYER MODEL 2005

FLOW ELEMENT PITOT TUBE - DWYER MODEL DS-300-4

VACUUM INDICATOR - DWYER MODEL LPG4-D7722N

SECTION 5 - 200 SERIES PROCESS EQUIPMENT - MOISTURE SEPARATOR & TRANSFER PUMP

VACUUM INDICATOR - DWYER MODEL LPG4-D7722N

VACUUM SWITCH - DWYER MODEL 1950-20-2F

MOISTURE SEPARATOR, 150 GAL - NES MODEL 150 GAL

LEVEL SWITCH - MULTI-POSITION - FPI SENSORS MODEL LS-500-3 POS

FLOW INDICATOR - DWYER MODEL ISDP-006

FLOW ELEMENT - DWYER MODEL DS-300-6

VACUUM TRANSMITTER - DWYER MODEL ISDP-010

PROGRESSIVE CAVITY PUMP - MOYNO MODEL 34401

PROGRESSIVE CAVITY MOTOR, 1 HP, 208 VAC, 3PH, TEFC - BALDOR MODEL M3546

PRESSURE INDICATOR - DWYER MODEL SGY-D10522N

TEMPERATURE INDICATOR - AV MODEL 1NFY8

SECTION 6 - 300 SERIES PROCESS EQUIPMENT - SVE BLOWER

VACUUM INDICATOR - DWYER MODEL LPG4-D7722N

DILUTION FILTER/SILENCER - SOLBERG MODEL FS-235P-400

INLINE PARTICULATE FILTER - SOLBERG MODEL CT-275P-600C

VACUUM SWITCH - DWYER MODEL 1950P-8-2F

VACUUM RELIEF VALVE - FPZ MODEL VRL9

REGENERATIVE BLOWER, 30 HP, 460 VAC, 3PH, TEFC - FPZ MODEL SCL K10-TS-GOR-C-30-3

REGENERATIVE BLOWER MOTOR - BALDOR MODEL 0107485397-000010

PRESSURE INDICATOR - DWYER MODEL LPG4-D8622N

PRESSURE SWITCH - DWYER MODEL 1950P-2-2F

TEMPERATURE INDICATOR - AV MODEL 1NFY4

FLOW INDICATOR (MAGNEHELIC) - DWYER MODEL 2005

FLOW ELEMENT PITOT TUBE - DWYER MODEL DS-300-6

SECTION 7 - 400 SERIES PROCESS EQUIPMENT - SVE DISCHARGE HEAT EXCHANGER

PRESSURE INDICATOR - DWYER MODEL LPG4-D8422N

TEMPERATURE INDICATOR - AV MODEL 1NFY4

TEMPERATURE SWITCH - UNITED ELECTRIC MODEL B400-120

SECTION 8 - 500 SERIES PROCESS EQUIPMENT - VAPOR TREATMENT

VAPOR CARBON VESSEL, 4X10 VIRGIN MEDIA - TETRASOLV MODEL VF-2000

6% POTASSIUM PERMANGANATE IMPREGNATED ZEOLITE - TETRASOLV MODEL VF-1000

PRESSURE INDICATOR - DWYER MODEL LPG4-D8422N

PRESSURE INDICATOR - DWYER MODEL LPG4-D8322N

PRESSURE INDICATOR - DWYER MODEL LPG4-D8222N

SECTION 9 - 600 SERIES PROCESS EQUIPMENT - PUMP AIR SUPPLY MANIFOLD

SOLENOID VALVE, 1", N.C - ASCO MODEL 8210G054

PRESSURE INDICATOR - AV MODEL 4FLZ8

SECTION 10 - 700 SERIES PROCESS EQUIPMENT - LIQUID SEPARATION

VACUUM INDICATOR - DWYER MODEL LPG4-D7322N

FLOW INDICATOR - OMEGA MODEL FL-4216-V

FLOW INDICATOR SENSOR - GF SIGNET MODEL P51530-P0

PRE-SEPARATION CHAMBER - HYDROQUIP MODEL 500 GLN CUSTOM

LEVEL SWITCH - CONDUCTIVITY INSTALL FITTING - GEMS MODEL 3E2C

LEVEL SWITCH - CONDUCTIVITY - GEMS MODEL 3R2C5

LEVEL SWITCH - FPI SENSORS MODEL LS-500-1 POS

OIL WATER SEPARATOR - HYDROQUIP MODEL AG-3SS-150V-IP

BELT SKIMMER - ABENAKI MODEL TOTE IT / ST2CR

BELT SKIMMER MOTOR, 0.33 HP / 115 VAC, 1 PH, XP - LEESON MODEL A617EC2ON

LEVEL SWITCH - MULTI-POSITION - FPI SENSORS MODEL LS-500-3 POS

LEVEL SWITCH - MULTI-POSITION - FPI SENSORS MODEL LS-500-3 POS

METERING PUMP (BIOCIDE) 115 VAC, 1 PH, EXP - LMI MODEL E711-363SI

METERING PUMP (EMULSIFICATION BREAKER) 115 VAC, 1 PH, EXP - LMI MODEL E711-363SI

LEVEL SENSOR (BIOCIDE) - DWYER MODEL F7-SS2

LEVEL SENSOR (EMULSIFICATION BREAKER) - DWYER MODEL F7-SS2

SECTION 11 - 800 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - OIL

GEAR PUMP - DAYTON MODEL 4KHH8

GEAR PUMP MOTOR, 1/2 HP, 208 VAC, 3PH, TEFC - BALDOR MODEL M7006A / A-16690852

PRESSURE INDICATOR - DWYER MODEL SGY-D10422N

FLOW METER - OMEGA MODEL FTB-32P

FLOW TOTALIZER - OMEGA MODEL M0505/0300

LEVEL SENSOR (WARNING / ALARM) - FPI SENSORS MODEL LS-500-2 POS

SECTION 12 - 900 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - AQUEOUS

EFFLUENT PUMP, CENTRIFUGAL - GOULDS MODEL 1ST1G5B4

PRESSURE INDICATOR - DWYER MODEL SGY-D10522N

PRESSURE SWITCH - DWYER MODEL CS-150

SECTION 13 - 1000 SERIES PROCESS EQUIPMENT - BAG FILTERS

BAG FILTER HOUSING - FILTER TECHNOLOGIES MODEL 8-30-2P-1-150-AL-VS-PB

SECTION 14 - 1100 SERIES PROCESS EQUIPMENT - LGAC

LIQUID PHASE CARBON VESSEL, 8x30 VIRGIN MEDIA - TETRASOLV MODEL AF-1000

PRESSURE INDICATOR - DWYER MODEL SGY-D10422N

SECTION 15 - 1200 SERIES PROCESS EQUIPMENT - LGAC DISCHARGE FLOWMETER

FLOW METER - NEPTUNE MODEL T10-1

FLOW TOTALIZER - NEPTUNE MODEL TRICON / S REGISTER

SECTION 16 - 1400 SERIES PROCESS EQUIPMENT - LNAPL PUMPS

SOLENOID VALVE, 2", N.C. - ASCO MODEL 8215B080

SOLENOID VALVE, 1/2", N.O. - ASCO MODEL 8210G034

FLOW METER - OMEGA MODEL FTB-32P

FLOW TOTALIZER - OMEGA MODEL M0505/0300

LEVEL SENSOR (WARNING / ALARM) - FPI SENSORS MODEL LS-500-2 POS

SECTION 17 - 1500 SERIES PROCESS EQUIPMENT - AIR COMPRESSOR

AIR COMPRESSOR, 20 HP, 460 VAC, 3 PH, TEFC - KAESER MODEL AIR CENTER SK 20

PARTICULATE FILTER - KAESER MODEL USKPF100BF

COALESCING FILTER WITH INDICATOR, 1" - KAESER MODEL USKOR100

PRESSURE REGULATOR WITH GAUGE, 1" - KAESER MODEL ANR119-08C

PRESSURE INDICATOR - DWYER MODEL SGY-D10722N

AUTOMATIC DRAIN VALVE - KAESER MODEL ECO DRAIN 30

PRESSURE SWITCH - ASHCROFT MODEL B424V

SOLENOID VALVE, 2", N.C. - ASCO MODEL 8215B080

SOLENOID VALVE, 1/2", N.O. - ASCO MODEL 8210G034

SECTION 18 - 1600 SERIES PROCESS EQUIPMENT - ENCLOSURE SUMP

LEVEL SENSOR (SVE ENCLOSURE) - DWYER MODEL F7-SB

LEVEL SENSOR (GWT ENCLOSURE) - DWYER MODEL F7-SB

SECTION 19 - POWER DISTRIBUTION EQUIPMENT

DISTRIBUTION PANEL 480Y/277V, 3 PHASE, 4 WIRE, 200 AMP MAIN - SQUARE D MODEL NF430L2C

TRANSFORMER, 480-208Y/120V, 45kVA - SQUARE D MODEL EE45T3H

DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 125 AMP MAIN - SQUARE D MODEL QO330MQ125

DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 60 AMP MAIN - SQUARE D MODEL QO320L125GRB

JUNCTION BOX - HAMMOND MODEL EN4SD16126GY

JUNCTION BOX - HAMMOND MODEL EN4SD24206GY

POWER MONITOR TRANSMITTER - LEVITON MODEL 3500 / 3KUMT-02M

E-STOPS (3) - SQUARE D MODEL ZB5AS844

SECTION 20 - MOTOR CONTROL CENTER PANEL EQUIPMENT

MOTOR CONTROL CENTER ENCLOSURE - HAMMOND MODEL EN4SD24208GY

SECTION 21 - MASTER CONTROL PANEL EQUIPMENT

MASTER CONTROL PANEL ENCLOSURE - HAMMOND MODEL EN4SD42368

P3000 CPU - AUTOMATION DIRECT MODEL P3-550

16 POINT DC INPUT CARD - AUTOMATION DIRECT MODEL P3-16ND3

ANALOG COMBO CARD (8 IN 4 OUT) - AUTOMATION DIRECT MODEL P3-8AD4DA-1

16 POINT RELAY OUTPUT CARD - AUTOMATION DIRECT MODEL P3-16TR

TOUCH SCREEN 8 INCH COLOR - AUTOMATION DIRECT MODEL EA9-T8CL

CELLULAR 3G GATEWAY - STATIC IP HMI - AT&T - SIERRA WIRELESS MODEL LS300 / 1101489

MODEM ANTENNA - WILSON MODEL 301125

24VDC POWER SUPPLY - IDEC MODEL PS5R-D24

INTRINSIC SAFETY BARRIERS DIGITAL - MTL MODEL 7728+

INTRINSIC SAFETY BARRIERS ANALOG - MTL MODEL 7787+

INTRINSIC SAFETY RELAY - SYMCOM MODEL ISS-101

INTRINSIC SAFETY LEVEL CONTROL - SYMCOM MODEL ISS-102-ACI-MC

CONVERTER (PULSE TO 4-20mA) - LMI MODEL MP100

FLOW METER DISPLAY/TRANSMITTER - SIGNET MODEL 3-9900-1P

SIGNAL CONVERTER / ISOLATOR - DWYER MODEL SC4380

SECTION 22 - ENCLOSURE EQUIPMENT - SVE COMP / CONTROL ROOM (NEC NON-CLASSIFIED)

HEATER, 1.8 KW, 120 VAC, 1 PH W/ T-STAT - DAYTON MODEL 2HAD8

EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH - DAYTON MODEL 10D964

FAN THERMOSTAT - HONEYWELL MODEL T6031A1136

FLUORESCENT LIGHT - COLUMBIA LIGHTING MODEL XEM4-232-RA-EU

SECTION 23 - ENCLOSURE EQUIPMENT - SVE PROCESS ROOM (NEC CLASS 1, DIVISION 2)

HEATER, 3.6 KW, 208 VAC, 1 PH - DAYTON MODEL 2CJF2

HEATER THERMOSTAT - WHITE ROGERS MODEL 1687-9

EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH - DAYTON MODEL 10D997

FAN THERMOSTAT - HONEYWELL MODEL T6031A1136

LIGHT FIXTURES, CLASS 1 DIVISION 2 - KILLARK MODEL VUXBGG-2-100X

EXTERIOR LIGHT FIXTURES - LUMAPRO MODEL 4VW95

SECTION 24 - ENCLOSURE EQUIPMENT - GW ENCLOSURE (NEC CLASS 1, DIVISION 2)

HEATER, 3.6 KW, 208 VAC, 1 PH - DAYTON MODEL 2CJF2

HEATER THERMOSTAT - COLUMBUS ELECTRIC MODEL EPETD8DJ

EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH - DAYTON MODEL 10D997

EXHAUST FAN THERMOSTAT - COLUMBUS ELECTRIC MODEL EPETD8DJ

LIGHT FIXTURES, CLASS 1 DIVISION 2 - KILLARK MODEL VUXBGG-2-100X

EXTERIOR LIGHT FIXTURES - LUMAPRO MODEL 4VW95

NES Project: 13-214
Vacuum Enhanced Recovery & Treatment System
AMEC – Review Ave Development - Queens, NY

SECTION 1 - PROJECT SUMMARY

MAJOR EQUIPMENT SUMMARY

NES PROJECT WARRANTY

Phone (508) 226-1100 Fax (508) 226-1180 84 Dunham Street Attleboro, MA 02703
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National Environmental Systems
84 Dunham Street
Attleboro, MA 02703

MAJOR COMPONENT SUMMARY

PROJECT NUMBER: **13-214 (REVISION B OCTOBER 2015)**

CLIENT PROJECT REFERENCE: AMEC - VACUUM ENHANCED RECOVERY SYSTEM / REVIEW AVE DEVELOPMENT - QUEENS COUNTY, NY

COMPONENT	TAG	QTY	MANUFACTURER	MODEL	SERIAL NUMBERS
100 SERIES PROCESS EQUIPMENT - SVE INLET MANIFOLD					
MOTOR OPERATED VALVE, 4"	MOV-101 / MOV-107	7	JOMAR	600-04DSPL	N/A
MOTOR OPERATED VALVE ACTUATOR	MOV-101 / MOV-107	7	INDELAC	ML4X/7BF07-152SMP-1	442590004 / 442590003 / 442590001 / 44250007 / 442590005 / 442590006 / 442590002
FLOW INDICATOR (MAGNEHELIC)	FI-101 / FI-107	7	DWYER	2005	W39Z SE / W39Z KS / W39Z KS / W39Z SE / W39Z KS / W39Z SE / W39Z KS
FLOW ELEMENT PITOT TUBE	FE-101 / FE-107	7	DWYER	DS-300-4	N/A
VACUUM INDICATOR	VI-101 / VI-107	7	DWYER	LPG4-D7722N	N/A
200 SERIES PROCESS EQUIPMENT - MOISTURE SEPARATOR & TRANSFER PUMP					
VACUUM INDICATOR	VI-201	1	DWYER	LPG4-D7722N	N/A
VACUUM SWITCH	VSL-201	1	DWYER	1950-20-2F	N/A
MOISTURE SEPARATOR, 150 GAL	T-201	1	NES	150 GAL	N/A
LEVEL SWITCH - MULTI-POSITION	LSHH-201, LSH-201 & LSL-201	1	FPI SENSORS	LS-500-3 POS	N/A
FLOW INDICATOR	FIT-201	1	DWYER	ISDP-006	A36Z
FLOW ELEMENT	FE-201	1	DWYER	DS-300-6	N/A
VACUUM TRANSMITTER	VIT-201	1	DWYER	ISDP-010	A524
PROGRESSIVE CAVITY PUMP	P-201	1	MOYNO	34401	1045777
PROGRESSIVE CAVITY MOTOR, 1 HP, 208 VAC, 3PH, TEFC	P-201	1	BALDOR	M3546	W1409031068
PRESSURE INDICATOR	PI-201	1	DWYER	SGY-D10522N	KC-H14
TEMPERATURE INDICATOR	TI-201	1	AV	1NFY8	N/A
300 SERIES PROCESS EQUIPMENT - SVE BLOWER					
VACUUM INDICATOR	VI-301 & VI-302	2	DWYER	LPG4-D7722N	N/A
DILUTION FILTER/SILENCER	F-301	1	SOLBERG	FS-235P-400	N/A
INLINE PARTICULATE FILTER	F-302	1	SOLBERG	CT-275P-600C	N/A
VACUUM SWITCH	VSH-301	1	DWYER	1950P-8-2F	N/A
VACUUM RELIEF VALVE	VSV-301	1	FPZ	VRL9	N/A
REGENERATIVE BLOWER, 30 HP, 460 VAC, 3PH, TEFC	B-301	1	FPZ	SCL K10-TS-GOR-C-30-3	V1101-2014
REGENERATIVE BLOWER MOTOR	B-301	1	BALDOR	0107485397-000010	1410300001
PRESSURE INDICATOR	PI-301	1	DWYER	LPG4-D8622N	N/A
PRESSURE SWITCH	PSH-301	1	DWYER	1950P-2-2F	N/A
TEMPERATURE INDICATOR	TI-301	1	AV	1NFY4	N/A
FLOW INDICATOR (MAGNEHELIC)	FI-301	1	DWYER	2005	W39Z KS
FLOW ELEMENT PITOT TUBE	FE-301	1	DWYER	DS-300-6	N/A
400 SERIES PROCESS EQUIPMENT - SVE DISCHARGE HEAT EXCHANGER					
HEAT EXCHANGER (PASSIVE)	HX-401	1	NES	CUSTOM	N/A
PRESSURE INDICATOR	PI-401	1	DWYER	LPG4-D8422N	N/A
TEMPERATURE INDICATOR	TI-401	1	AV	1NFY4	N/A
TEMPERATURE SWITCH	TSH-401	1	UNITED ELECTRIC	B400-120	K2067938
500 SERIES PROCESS EQUIPMENT - VAPOR TREATMENT					
VAPOR CARBON VESSEL, 4X10 VIRGIN MEDIA	VGAC-501 & VGAC-502	2	TETRASOLV	VF-2000	AA764 / AA165
6% POTASSIUM PERMANGANATE IMPREGNATED ZEOLITE	VC-501	1	TETRASOLV	VF-1000	AA766
VAPOR VESSEL HOSE, 6"		1	KURITEC / TIGERFLEX	W600	N/A
PRESSURE INDICATOR	PI-501	1	DWYER	LPG4-D8422N	N/A
PRESSURE INDICATOR	PI-502	1	DWYER	LPG4-D8322N	N/A
PRESSURE INDICATOR	PI-503	1	DWYER	LPG4-D8222N	N/A
600 SERIES PROCESS EQUIPMENT - PUMP AIR SUPPLY MANIFOLD					
SOLENOID VALVE, 1", N.C	SV-601 / SV-607	7	ASCO	8210G054	T943897 / T943897 / T943897 / T943897 / T887288 / T943897 / T943897
PRESSURE INDICATOR	PI-601 / PI-607	7	AV	4FLZ8	N/A
700 SERIES PROCESS EQUIPMENT - LIQUID SEPARATION					
VACUUM INDICATOR	VI-701,VI-702 & VI-703	3	DWYER	LPG4-D7322N	N/A
FLOW INDICATOR	FI-701,FI-702 & FI-703	3	OMEGA	FL-4216-V	28690314005 / 28690314004 / 28690314002
REV B. FLOW INDICATOR SENSOR	FIT-701	1	GF SIGNET	3-2536-P0	61505180649
REV B. FLOW INDICATOR SENSOR INSTALL "T"	FIT-701	1	GF SIGNET	MPV8T007	61312060244
FLOW INDICATOR TRANSMITTER (SEE MCP INSTALLATION)	FIT-701	1	GF SIGNET	3-9900-1P	61410240625
PRE-SEPARATION CHAMBER	T-701	1	HYDROQUIP	500 GLN CUSTOM	N/A

National Environmental Systems
84 Dunham Street
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MAJOR COMPONENT SUMMARY

PROJECT NUMBER: **13-214 (REVISION B OCTOBER 2015)**

CLIENT PROJECT REFERENCE: AMEC - VACUUM ENHANCED RECOVERY SYSTEM / REVIEW AVE DEVELOPMENT - QUEENS COUNTY, NY

COMPONENT	TAG	QTY	MANUFACTURER	MODEL	SERIAL NUMBERS
LEVEL SWITCH - CONDUCTIVITY INSTALL FITTING	LSP-701 & LSC-701	2	GEMS	3E2C	N/A
LEVEL SWITCH - CONDUCTIVITY	LSP-701 & LSC-701	4	GEMS	3R2C5	N/A
LEVEL SWITCH	LSHH-701	1	FPI SENSORS	LS-500-1 POS	N/A
OIL WATER SEPARATOR	OWS-701	1	HYDROQUIP	AG-3SS-150V-IP	N/A
BELT SKIMMER	P-701	1	ABENAKI	TOTE IT / ST2CR	32410-0101
BELT SKIMMER MOTOR, 0.33 HP / 115 VAC, 1 PH, XP	P-701	1	LEESON	A617EC2ON	N/A
LEVEL SWITCH - MULTI-POSITION	LSHH-702, LSH-702 & LSL-702	1	FPI SENSORS	LS-500-3 POS	N/A
LEVEL SWITCH - MULTI-POSITION	LSHH-703, LSH-703 & LSL-703	1	FPI SENSORS	LS-500-3 POS	N/A
METERING PUMP (BIOCIDE) 115 VAC, 1 PH, EXP	P-710	1	LMI	E711-363SI	14113906092-2
METERING PUMP (EMULSIFICATION BREAKER) 115 VAC, 1 PH, EXP	P-711	1	LMI	E711-363SI	141239125586-1
LEVEL SENSOR (BIOCIDE)	LSLL-710	1	DWYER	F7-SS2	N/A
LEVEL SENSOR (EMULSIFICATION BREAKER)	LSLL-711	1	DWYER	F7-SS2	N/A
800 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - OIL					
GEAR PUMP	P-801	1	DAYTON	4KHH8	3647
GEAR PUMP MOTOR, 1/2 HP, 208 VAC, 3PH, TEFC	P-801	1	BALDOR	M7006A / A-16690852	W1409034250
PRESSURE INDICATOR	PI-801	1	DWYER	SGY-D10422N	KC-F14
FLOW METER	FQ-801	1	OMEGA	FTB-32P	4436209
FLOW TOTALIZER	FIT-801	1	OMEGA	M0505/0300	4436210
LEVEL SENSOR (ALARM / WARNING)	LSH / LSHH-801	1	FPI SENSORS	L500-2 POSITION	N/A
900 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - AQUEOUS					
EFFLUENT PUMP, CENTRIFUGAL	P-901	1	GOULDS	1ST1G5B4	G1325252
EFFLUENT PUMP MOTOR, 2 HP, 208 VAC, 3 PH, TEFC	P-901	1	BLUFFTON	1313381107	1305240077
PRESSURE INDICATOR	PI-901	1	DWYER	SGY-D10522N	KC-L13
PRESSURE SWITCH	PSH-901	1	DWYER	CS-150	M03104-T40Z
1000 SERIES PROCESS EQUIPMENT - BAG FILTERS					
BAG FILTER HOUSING	FX-1001, FX-1002, FX-1003 & FX-1004	4	FILTER TECHNOLOGIES	8-30-2P-1-150-AL-VS-PB	101514-13C / 101514-13B / 101514-13A / 101514-13D
1100 SERIES PROCESS EQUIPMENT - LGAC					
LIQUID PHASE CARBON VESSEL, 8x30 VIRGIN MEDIA	LGAC-1101 & LGAC-1102	2	TETRASOLV	AF-1000	AA376 / AA737
PRESSURE INDICATOR	PI-1101 & PI-1102	2	DWYER	SGY-D10422N	KC-F14 / KC-F14
1200 SERIES PROCESS EQUIPMENT - LGAC DISCHARGE FLOWMETER					
FLOW METER	FQ-1201	1	NEPTUNE	T10-1	53192354
FLOW TOTALIZER	FIT-1201	1	NEPTUNE	TRICON / S REGISTER	N/A
1400 SERIES PROCESS EQUIPMENT - LNAPL PUMPS					
SOLENOID VALVE, 2", N.C.	SV-1401	1	ASCO	8215B080	A601722
SOLENOID VALVE, 1/2", N.O.	SV-1402	1	ASCO	8210G034	T985324
FLOW METER	FQ-1401	1	OMEGA	FTB-32P	4908999
FLOW TOTALIZER	FIT-1401	1	OMEGA	M0505/0300	4908999
LEVEL SENSOR (ALARM / WARNING)	LSH / LSHH-1401	1	FPI SENSORS	L500-2 POSITION	N/A
1500 SERIES PROCESS EQUIPMENT - AIR COMPRESSOR					
AIR COMPRESSOR, 20 HP, 460 VAC, 3 PH, TEFC	AC-1501	1	KAESER	AIR CENTER SK 20	2835
PARTICULATE FILTER	PF-1501	1	KAESER	USKPF100BF	1409
COALESCING FILTER WITH INDICATOR, 1"	CF-1501	1	KAESER	USKOR100	N/A
PRESSURE REGULATOR WITH GAUGE, 1"	PRV-1501	1	KAESER	ANR119-08C	4214
PRESSURE INDICATOR	PI-1502	1	DWYER	SGY-D10722N	KC-G14
AUTOMATIC DRAIN VALVE	ADV-1501	1	KAESER	ECO DRAIN 30	40239111-12832132
PRESSURE SWITCH	PSL-1501	1	ASHCROFT	B424V	F4041810
SOLENOID VALVE, 2", N.C.	SV-1501	1	ASCO	8215B080	A601722
SOLENOID VALVE, 1/2", N.O.	SV-1502	1	ASCO	8210G034	T920302
1600 SERIES PROCESS EQUIPMENT - ENCLOSURE SUMP					
LEVEL SENSOR (SVE ENCLOSURE)	LSHH-1601	1	DWYER	F7-SB	N/A
LEVEL SENSOR (GWT ENCLOSURE)	LSHH-1602	1	DWYER	F7-SB	N/A
POWER DISTRIBUTION EQUIPMENT					
DISTRIBUTION PANEL 480Y/277V, 3 PHASE, 4 WIRE, 200 AMP MAIN	SVE ENCLOSURE	1	SQUARE D	NF430L2C	N/A
TRANSFORMER, 480-208Y/120V, 45kVA	SVE ENCLOSURE	1	SQUARE D	EE45T3H	1050114035

National Environmental Systems
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MAJOR COMPONENT SUMMARY

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CLIENT PROJECT REFERENCE: AMEC - VACUUM ENHANCED RECOVERY SYSTEM / REVIEW AVE DEVELOPMENT - QUEENS COUNTY, NY

COMPONENT	TAG	QTY	MANUFACTURER	MODEL	SERIAL NUMBERS
DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 125 AMP MAIN	SVE ENCLOSURE	1	SQUARE D	QO330MQ125	N/A
DISTRIBUTION PANEL COVER	SVE ENCLOSURE	1	SQUARE D	QOC342MQS	N/A
DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 60 AMP MAIN	GWT ENCLOSURE	1	SQUARE D	QO320L125GRB	N/A
CIRCUIT BREAKER, 3 POLE , 60 AMP		2	SQUARE D	QO360	N/A
CIRCUIT BREAKER, 3 POLE , 15 AMP		3	SQUARE D	QO315	N/A
CIRCUIT BREAKER, 2 POLE , 30 AMP		3	SQUARE D	QO230	N/A
CIRCUIT BREAKER, 1 POLE , 20 AMP		1	SQUARE D	QO120	N/A
CIRCUIT BREAKER, 1 POLE , 15 AMP		15	SQUARE D	QO115	N/A
JUNCTION BOX	JB1-A,JB1-B,JB2-A	3	HAMMOND	EN4SD16126GY	A-11975113, A-11975114, A-11975112
JUNCTION BOX	JB2-B	1	HAMMOND	EN4SD24206GY	VCL-445596
POWER MONITOR TRANSMITTER	PMX-100	1	LEVITON	3500 / 3KUMT-02M	14304C9919R
E-STOPS (3)	ESTOP	3	SQUARE D	ZB5AS844	N/A
MOTOR CONTROL CENTER PANEL EQUIPMENT					
MOTOR CONTROL CENTER ENCLOSURE	MCC	1	HAMMOND	EN4SD24208GY	UL: A-11975111
MOTOR STARTER (CONTACTOR)	M1	1	SQUARE D	LC1D65AG7	N/A
MOTOR STARTER (OVERLOAD) 30-40A	M1	1	SQUARE D	LRD340L	N/A
MOTOR STARTER (CONTACTOR)	M2,M3,M4	3	SQUARE D	LC1D09G7	N/A
MOTOR STARTER (OVERLOAD) 1.6-2.5A	M2	1	SQUARE D	LRD07	N/A
MOTOR STARTER (OVERLOAD) 5.5-8A	M3	1	SQUARE D	LRD12	N/A
MOTOR STARTER (OVERLOAD) 2.5-4 A	M4	1	SQUARE D	LRD08	N/A
MASTER CONTROL PANEL EQUIPMENT					
MASTER CONTROL PANEL ENCLOSURE	MCP	1	HAMMOND	EN4SD42368	UL: CL-445595
RACK 8 SLOT	PLC	1	AUTOMATION DIRECT	P3-08B	14522F009B
RACK POWER SUPPLY	PLC	1	AUTOMATION DIRECT	P3-01AC	14709F007C2
P3000 CPU	PLC	1	AUTOMATION DIRECT	P3-550	14806F035D1
16 POINT DC INPUT CARD	PLC	4	AUTOMATION DIRECT	P3-16ND3	146308019 / 146308014 / 146308020 / 146308015
ANALOG COMBO CARD (8 IN 4 OUT)	PLC	1	AUTOMATION DIRECT	P3-8AD4DA-1	14729F012D
16 POINT RELAY OUTPUT CARD	PLC	2	AUTOMATION DIRECT	P3-16TR	147238050 / 147238045
TOUCH SCREEN 8 INCH COLOR	HMI	1	AUTOMATION DIRECT	EA9-T8CL	14519B029
POWER SUPPLY FOR TOUCH SCREEN	HMI	1	AUTOMATION DIRECT	EA-AC	N/A
CELLULAR 3G GATEWAY - STATIC IP HMI - AT&T	CM	1	SIERRA WIRELESS	LS300 / 1101489	CA81093129910
MODEM ANTENNA	CM	1	WILSON	301125	N/A
24VDC POWER SUPPLY	PS	1	IDEC	PS5R-D24	N/A
INTRINSIC SAFETY BARRIERS DIGITAL	ISB	30	MTL	7728+	N/A
INTRINSIC SAFETY BARRIERS ANALOG	ISB	2	MTL	7787+	N/A
INTRINSIC SAFETY RELAY	ISR	2	SYMCOM	ISS-101	N/A
INTRINSIC SAFETY LEVEL CONTROL	LC	1	SYMCOM	ISS-102-ACI-MC	N/A
CONVERTER (PULSE TO 4-20mA)	MPC1,2	2	LMI	MP100	N/A
FLOW METER DISPLAY/TRANSMITTER	FMT-701	1	GF SIGNET	3-9900-1P	61410240625
SIGNAL CONVERTER / ISOLATOR	SCI 1, 2	2	DWYER	SC4380	N/A
ENCLOSURE EQUIPMENT - SVE COMPRESSOR / CONTROL ROOM (NEC NON-CLASSIFIED)					
HEATER, 1.8 KW, 120 VAC , 1 PH W/ T-STAT		1	DAYTON	2HAD8	4104-2499-010
EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH		1	DAYTON	10D964	13772887
FAN THERMOSTAT		1	HONEYWELL	T6031A1136	N/A
FLUORESCENT LIGHT		2	COLUMBIA LIGHTING	XEM4-232-RA-EU	N/A
ENCLOSURE EQUIPMENT - SVE PROCESS ROOM (NEC CLASS 1, DIVISION 2)					
HEATER, 3.6 KW, 208 VAC, 1 PH		1	DAYTON	2CJF2	410659
HEATER THERMOSTAT		1	WHITE ROGERS	1687-9	N/A
EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH, EXP		1	DAYTON	10D997	13734774
FAN THERMOSTAT		1	HONEYWELL	T6031A1136	N/A
LIGHT FIXTURES, CLASS 1 DIVISION 2		4	KILLARK	VUXBGG-2-100X	N/A
EXTERIOR LIGHT FIXTURES		3	LUMAPRO	4VW95	E144499 / E144499 / E144499
ENCLOSURE EQUIPMENT - GROUNDWATER ENCLOSURE (NEC CLASS 1, DIVISION 2)					
HEATER, 3.6 KW, 208 VAC, 1 PH		2	DAYTON	2CJF2	111051, 410822
HEATER THERMOSTAT		2	COLUMBUS ELECTRIC	EPETD8DJ	N/A

National Environmental Systems
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MAJOR COMPONENT SUMMARY

PROJECT NUMBER: **13-214 (REVISION B OCTOBER 2015)**

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COMPONENT	TAG	QTY	MANUFACTURER	MODEL	SERIAL NUMBERS
EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH, EXP		1	DAYTON	10D997	13734777
EXHAUST FAN THERMOSTAT		1	COLUMBUS ELECTRIC	EPETD8DJ	N/A
LIGHT FIXTURES, CLASS 1 DIVISION 2		6	KILLARK	VUXBGG-2-100X	N/A
EXTERIOR LIGHT FIXTURES		3	LUMAPRO	4VW95	N/A

NES PROJECT: 13-214 (AMEC-REVIEW AVENUE)

WARRANTY

Optional pricing has been proposed and must be purchased separately at time of Equipment Purchase for the Warranty detailed below to be in effect.

RapidTech LLC d/b/a National Environmental Systems, warrants its packaged and manufactured equipment against any defect in material or workmanship, under normal use and storage for a period of THIRTY (30) MONTHS FROM THE DATE OF MANUFACTURE & INVOICE, regardless of system start-up date. In the event that products are found to be defective within the warranty period, RapidTech LLC d/b/a National Environmental Systems, sole obligation and remedy shall be the furnishing of replacements for any defective parts, and such replacement parts shall be furnished but not installed by RapidTech LLC d/b/a National Environmental Systems.

The warranty requires that the purchaser complete all operations and maintenance as detailed in each section of the Operation & Maintenance Manual supplied with the purchased system. Records detailing the performance of this maintenance must be made available to RapidTech LLC d/b/a National Environmental Systems at the time of claim. In addition installation must comply with nationally recognized electrical and mechanical standards as well as best engineering practices in effect at the time of purchase.

The product warranty expressed above is our only warranty and may not be verbally changed or modified by any representative of RapidTech LLC d/b/a National Environmental Systems All freight costs incurred in shipping parts to or from RapidTech LLC d/b/a National Environmental Systems, or to the manufacturer if necessary are at the expense of the customer.

RapidTech LLC dba National Environmental Systems, will invoice the cost of any replacement parts. These parts will be credited upon certification the original part was defective and the defective part was returned within one week of notifying RapidTech LLC d/b/a National Environmental Systems, of the malfunction. If the part is found to have been misused no credit will be issued. In order for RapidTech LLC d/b/a National Environmental Systems to ship a replacement part on account, all outstanding invoices must be current.

RapidTech LLC d/b/a National Environmental Systems, expressly disclaims any warranties, expressed or implied, including any warranty of merchantability or fit for particular purpose or any warranty arising from a course of dealing or usage of trade. Except to the extent required by applicable law. RapidTech LLC d/b/a National Environmental Systems, shall not be liable, in tort, contract or otherwise, for any loss or damage, whether direct, consequential or incidental, of any person or entity arising in connections with the equipment.

RAPIDTECH LLC D/B/A NATIONAL ENVIRONMENTAL SYSTEMS, WILL NOT BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES IN ANY CLAIM SUIT OR PROCEEDINGS ARISING UNDER WARRANTY, NOR WILL RAPIDTECH LLC D/B/A NATIONAL ENVIRONMENTAL SYSTEMS, ACCEPT ANY LIABILITY FOR CLAIMS FOR LABOR, LOSS OR PROFIT, REPAIRS OR OTHER EXPENSES INCIDENTAL TO REPLACEMENT.

SECTION 2 - MECHANICAL DRAWINGS

M-1, PROCESS & INSTRUMENTATION DIAGRAM

TABLE 1, INSTRUMENTATION & POWERED VALVE LIST

M-2, EQUIPMENT LAYOUT DRAWING(S)

M-3, TANK & LEVEL SWITCH DRAWING(S)

M-4, MOISTURE SEPARATOR LEVEL SWITCH

M-5, PRE-SEPARATION TANK DRAWING

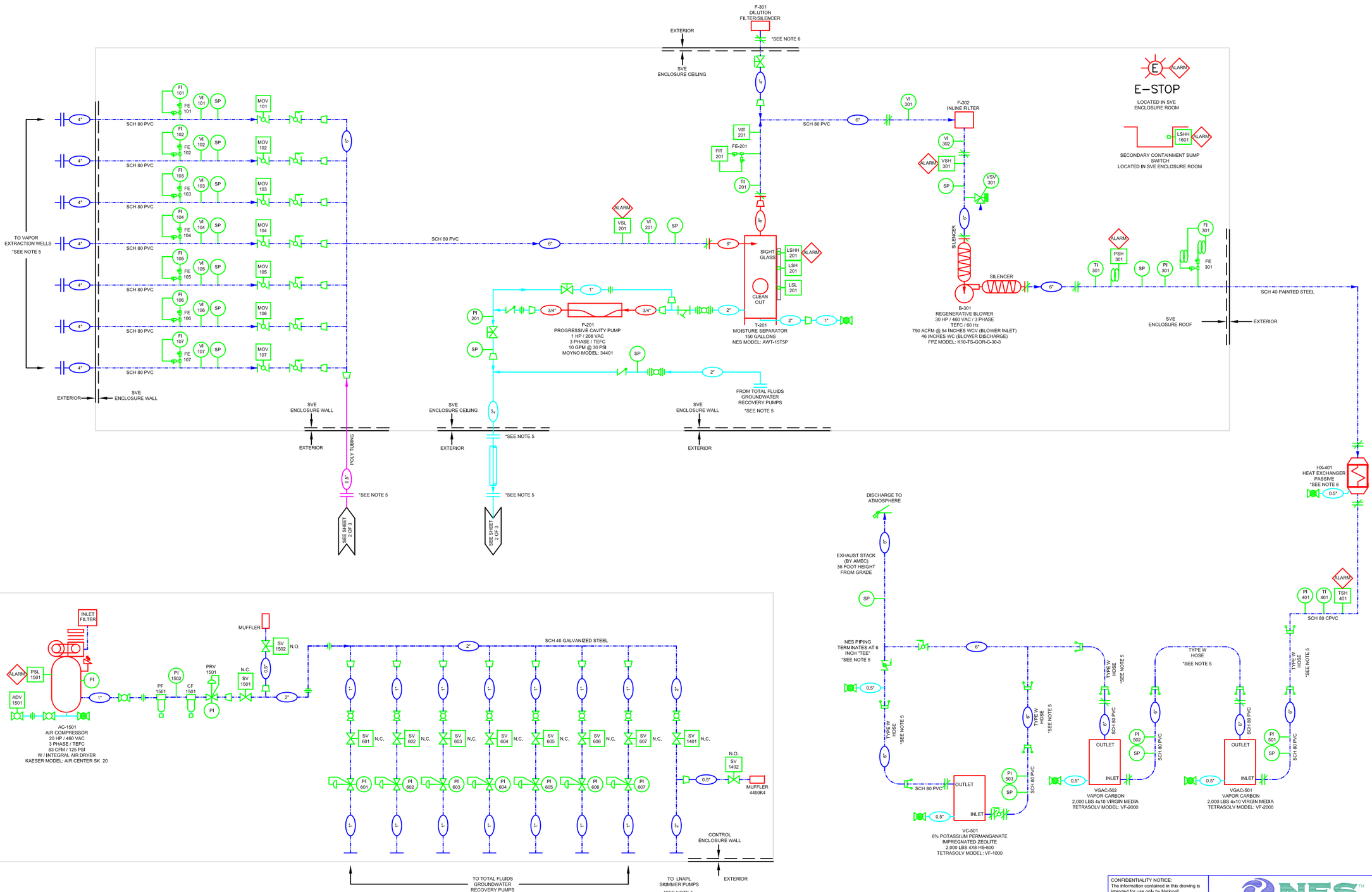
M-6, PRE-SEPARATION TANK DRAWING LEVEL SWITCH

M-7, OIL WATER SEPARATOR DRAWING

M-8, OWS EFFLUENT TANK (AQUEOUS) LEVEL SWITCH

M-9, OWS PRODUCT TANK (OIL) LEVEL SWITCH

M-10, 4000 GAL. PRODUCT TANK LEVEL SWITCHES



GENERAL NOTES:

1. PROCESS & INSTRUMENTATION DIAGRAM IS A REPRESENTATIVE DRAWING SHOWING EQUIPMENT SPECIFICATIONS, PROCESS PIPING, VALVES AND INSTRUMENTATION NOT TO BE INTERPRETED AS A LAYOUT DRAWING DEPICTING PLUMBING LOCATION, CONNECTIONS, OR FITTINGS.
2. NEC ELECTRICAL CLASSIFICATION:
   - SVE SYSTEM INTERIOR NEC CLASS I, DIVISION 2 LOCATION
   - CONTROL & AIR COMPRESSOR ROOM NEC NON-CLASSIFIED LOCATION
   - GROUNDWATER TREATMENT INTERIOR NEC CLASS I, DIVISION I LOCATION
   - ENCLOSURE EXTERORS NEC NON-CLASSIFIED LOCATION
3. REFER TO TABLE 1 FOR INSTRUMENTATION LIST
4. REFER TO TABLE 2 FOR INTERLOCKS
5. FIELD CONNECTION BY AMEC
6. SHIPPED LOOSE FOR FIELD INSTALLATION BY AMEC.
7. FUTURE T-802 & T-1402 PRODUCT TANKS WITH LEVEL SWITCH ASSEMBLIES

PE STAMP

REV	DESCRIPTION	DATE	APPROVED
B	CHANGED FIT-701 TO 0.75 INCH LINE W/ 3-2536-P0 SENSOR	10-14-15	CJJ
A	AS BUILT	05-15-15	MJS

REVISIONS

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84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

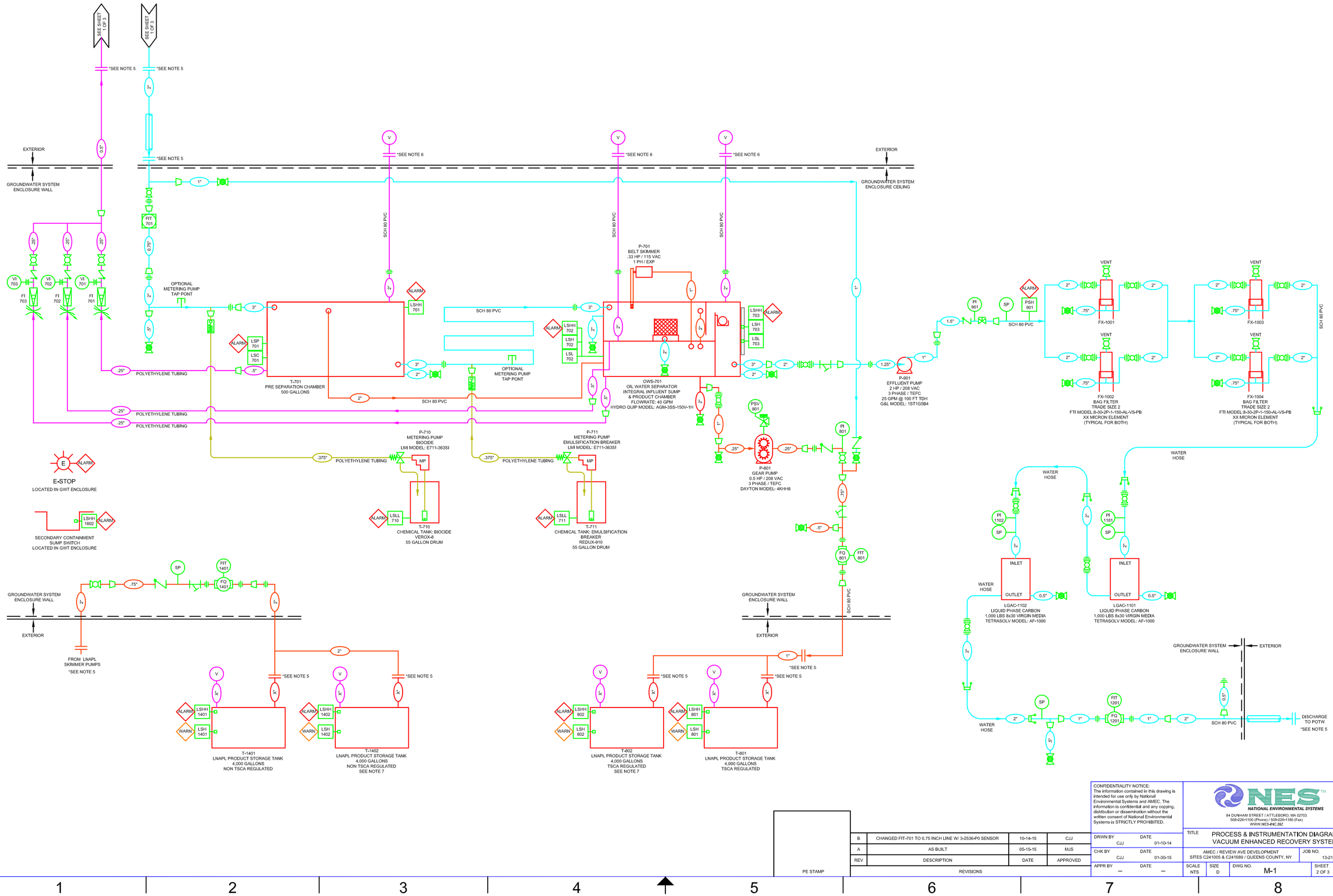
DRWN BY	CJJ
DATE	01-10-14
CHK BY	CJJ
DATE	01-30-15
APPR BY	—
DATE	—

TITLE: PROCESS & INSTRUMENTATION DIAGRAM
VACUUM ENHANCED RECOVERY SYSTEM

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	D	M-1	1 OF 3	B



REV.	DESCRIPTION	DATE	APPROVED
B	CHANGED FIT-701 TO 0.75 INCH LINE W/ 3-2536-P0 SENSOR	10-14-15	CJJ
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REVISIONS

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TITLE: PROCESS & INSTRUMENTATION DIAGRAM
VACUUM ENHANCED RECOVERY SYSTEM

DRWN BY: CJJ	DATE: 01-10-14		
CHK BY: CJJ	DATE: 01-30-15	AMEC / REVIEW AVE DEVELOPMENT SITES C241005 & C241089 / QUEENS COUNTY, NY	JOB NO. 13-214
APPR BY: —	DATE: —	SCALE: NTS / SIZE: D / DWG NO.: M-1	SHEET: 2 OF 3 / REV: B

INSTRUMENT IDENTIFICATION

INSTRUMENT TYPE / INSTRUMENT DESIGNATION — XX / XXX — LOCALLY MOUNTED INSTRUMENT W / REMOTE DISPLAY

INSTRUMENT TYPE / INSTRUMENT DESIGNATION — XX / XXX — LOCALLY MOUNTED INSTRUMENT W / DISPLAY

INSTRUMENT TYPE / INSTRUMENT DESIGNATION — XX / XXX — LOCALLY MOUNTED SWITCH

INSTRUMENTATION ABBREVIATIONS

ADV	AUTOMATIC DRAIN VALVE
CC	CYCLE COUNTER
CF	COALESCING FILTER
DPI	DIFFERENTIAL PRESSURE INDICATOR
DPT	DIFFERENTIAL PRESSURE TRANSMITTER
FE	FLOW ELEMENT
FI	FLOW INDICATOR
FIT	FLOW INDICATING TRANSMITTER
FM	FLOW METER
FP	FLOW PORT
FS	FLOW SWITCH
FSL	FLOW SWITCH LOW
FT	FLOW TOTALIZER
LI	LEVEL INDICATOR
LIT	LEVEL INDICATING TRANSMITTER
LS	LEVEL SWITCH
LSHH	LEVEL SWITCH HIGH-HIGH
LSH	LEVEL SWITCH HIGH
LSL	LEVEL SWITCH LOW
LSLL	LEVEL SWITCH LOW-LOW
LT	LEVEL TRANSMITTER
MOV	MOTOR OPERATED VALVE
OLH	OIL LEVEL HIGH
OLL	OIL LEVEL LOW
PF	PARTICULATE FILTER
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATING TRANSMITTER
PRV	PRESSURE REGULATING VALVE
PS	PRESSURE SWITCH
PSH	PRESSURE SWITCH HIGH
PSL	PRESSURE SWITCH LOW
PSV	PRESSURE SAFETY VALVE
PT	PRESSURE TRANSMITTER
SP	SAMPLE PORT
SV	SOLENOID VALVE
TE	TEMPERATURE ELEMENT
TI	TEMPERATURE INDICATOR
TIT	TEMPERATURE INDICATING TRANSMITTER
TS	TEMPERATURE SWITCH
TSH	TEMPERATURE SWITCH HIGH
TSL	TEMPERATURE SWITCH LOW
VFD	VARIABLE FREQUENCY DRIVE
VI	VACUUM INDICATOR
VIT	VACUUM INDICATING TRANSMITTER
VS	VACUUM SWITCH
VSH	VACUUM SWITCH HIGH
VSL	VACUUM SWITCH LOW
VSV	VACUUM SAFETY VALVE

PIPE DESIGNATION

- AIR LINE
- WATER LINE
- WATER LINE HEAT TRACED AND INSULATED
- CHEMICAL LINE
- PRODUCT LINE
- VENT LINE
- CONTROL LINE
- INTRINSICALLY SAFE LINE
- ANALOG LINE
- BREAK
- FLOW DIRECTION
- PIPE SIZE (X")

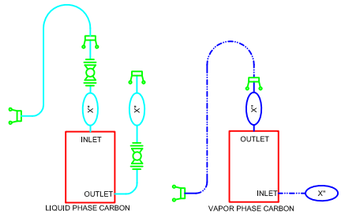
SYMBOLS

- ROTAMETER
- FLOW METER (FM XXX)
- ELAPSED TIME METER (ETM)
- AUTO DIALER (AD)
- TIMER (T)
- MOTOR (M)
- AMP METER (A)
- REMOTE TELEMETRY SYSTEM (RTS)
- VARIABLE FREQUENCY DRIVE (VFD)
- STATIC MIXER
- DISCHARGE SILENCER
- DILUTION AIR FILTER
- INLET/INLINE FILTER
- COALESCING FILTER (CF)
- PARTICULATE FILTER (PF)
- AUTOMATIC CONDENSATE DRAIN (CD)
- ALARM DESGINATION (ALARM)
- WARNING INDICATION (WARN)
- MULTIFUNCTION VALVE
- INJECT NOZZLE
- METERING PUMP INLET CHECK VALVE
- INDUSTRAIL INTERCHANGE COUPLER
- CONDUCTANCE PROBES
- COPPER COIL
- HOSE CONNECTION

SYMBOLS CONTINUED

- FILTER REGULATOR (FR)
- METERING PUMP (MP)
- GLOBE VALVE
- GATE VALVE
- BALL VALVE/ UNION
- BALL VALVE/DRAIN VALVE
- CHECK VALVE
- RAIN CAP
- BUTTERFLY VALVE
- Y-STRAINER
- RELIEF VALVE
- FEMALE CAMLOCK
- MALE CAMLOCK
- SOLENOID VALVE (SV XXX)
- PRESSURE REGULATOR
- SIPHON BREAK
- UNION
- CLEAR PVC
- MECHANICAL FLOAT
- PULSE-DAMPING SNUBBER
- PITOT TUBE
- SIGHT GLASS
- ALARM LIGHT (AL)
- RUN LIGHT (R)
- E-STOP (E)
- NEEDLE VALVE
- FLANGED CONNECTION
- REQUIRED FIELD CONNECTION
- FLEX CONNECTOR
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- MOTOR OPERATED BUTTERFLY VALVE (MOV XXX)
- AUTOMATIC DRAIN VALVE (ADV XXX)
- MOTOR OPERATED VALVE (MOV XXX)

SYMBOLS CONTINUED



REV	DESCRIPTION	DATE	APPROVED
B	CHANGED FIT-701 TO 0.75 INCH LINE W/ 3-2536-P0 SENSOR	10-14-15	CJJ
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REVISIONS

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DRWN BY	CJJ
DATE	01-10-14
CHK BY	CJJ
DATE	01-30-15
APPR BY	–
DATE	–

TITLE: P&ID MASTER LEGEND

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	D	M-1	3 OF 3	B

TABLE 1
INSTRUMENT SPECIALTY VALVE BOM

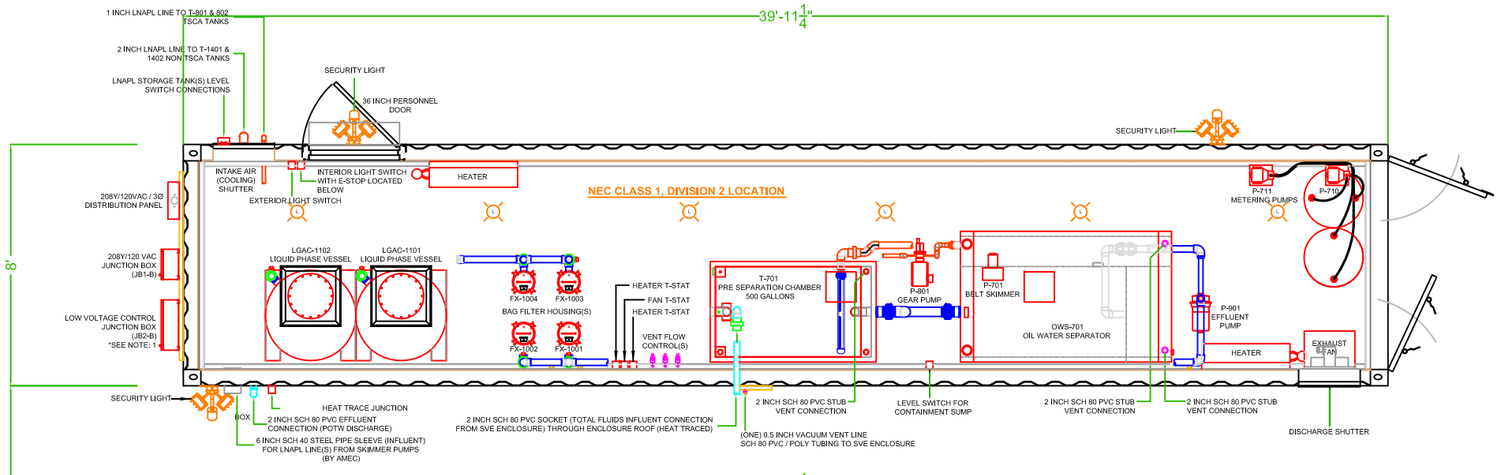
PROJECT NUMBER: 13-214 (REVISION B OCTOBER 2015)

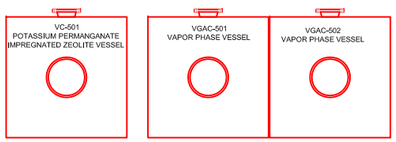
CLIENT PROJECT REFERENCE: AMEC - VACUUM ENHANCED RECOVERY SYSTEM / REVIEW AVE DEVELOPMENT - QUEENS COUNTY, NY

TAG	ITEM	MODEL	MANUFACTURER	SPECIFICATION
	100 SERIES PROCESS EQUIPMENT - SVE INLET MANIFOLD			
MOV-101 / MOV-107	MOTOR OPERATED VALVE, 4"	600-04DSPL	JOMAR	4" / CAST IRON BODY / 316 STAINLESS STEEL DISC / 416 STAINLESS STEEL STEM / BUNA-N SEAT
MOV-101 / MOV-107	MOTOR OPERATED VALVE ACTUATOR	ML4X/7BF07-152SMP-1	INDELAC	ELECTRIC ACTUATOR / NEMA 4,7&9 ENCLOSURE / 120 VAC / AUX SWITCHES / FAIL LAST POSITION
FI-101 / FI-107	FLOW INDICATOR (MAGNEHELIC)	2005	DWYER	0 - 5" WC D.P. RANGE (MINOR DIV. 0.10) / CAST ALUMINUM CASE / 4" ACRYLIC COVER / -20 IN Hg TO 15 PSIG PRESSURE LIMITS / 20 - 140 F RANGE / 0.125"
FE-101 / FE-107	FLOW ELEMENT PITOT TUBE	DS-300-4	DWYER	4 INCH AVERAGING STYLE PITOT TUBE / STAINLESS STEEL CONSTRUCTION W ITH BRASS ISOLATION VALVES / 0 - 200 F TEMPERATURE LIMITS
VI-101 / VI-107	VACUUM INDICATOR	LPG4-D7722N	DWYER	(-)100 TO 0 IWC-V / 2.5 INCH STEEL CASE / BRASS WETTED PARTS / 0.25 INCH BOTTOM MOUNT CONNECTION
	200 SERIES PROCESS EQUIPMENT - MOISTURE SEPARATOR & TRANSFER PUMP			
VI-201	VACUUM INDICATOR	LPG4-D7722N	DWYER	(-)100 TO 0 IWC-V / 2.5 INCH STEEL CASE / BRASS WETTED PARTS / 0.25 INCH BOTTOM MOUNT CONNECTION
VSL-201	VACUUM SWITCH	1950-20-2F	DWYER	DIFFERENTIAL PRESSURE SWITCH / 4 TO 20 IWC / 0.6 MAX DEAD BAND / (-)40 TO 140 F TEMP RATING / 45IWC MAX PRESSURE / SPDT SWITCH TYPE / 15AMP @ 125 VAC SWITCH RATING / 0.125 INCH PROCESS CONNECTION / ADJUSTABLE SET POINT
LSHH-201, LSH-201 & LSL-201	LEVEL SWITCH - MULTI-POSITION	LS-500-3 POS	FPI SENSORS	3-POSITION FLOAT STYLE / STAINLESS STEEL CONSTRUCTION / 2 INCH NPT CONNECTION / N.C. - H-H / N.O. - H / N.O. - L
FIT-201	FLOW INDICATOR	ISDP-006	DWYER	0 - 5 " WATER RANGE / 5 PSIG PRESS LIMITS / NEMA 4X ENCLOSURE RATING / 32 - 140 F TEMP RANGE / 0.125" CONNECTIONS
FE-201	FLOW ELEMENT	DS-300-6	DWYER	6 " AVERAGING PITOT TUBE / S.S. WITH BRASS ISOLATION VALVE / 0 - 200 F TEMP LIMITS
VIT-201	VACUUM TRANSMITTER	ISDP-010	DWYER	DPT - IS / 0 - 100" WATER RANGE / 9 PSIG PRESS LIMITS / NEMA 4X ENCLOSURE RATING / 32 - 140 F TEMP RANGE / 0.125" CONNECTIONS
PI-201	PRESSURE INDICATOR	SGY-D10522N	DWYER	0-100 PSI RANGE / 2.5 INCH STAINLESS STEEL CASE / BRASS WETTED PARTS / / GLYCERIN FILLED / 0.25 INCH BOTTOM MOUNT
TI-201	TEMPERATURE INDICATOR	1NFY8	AV	(-)20 - 120 F / 2.5 INCH STEM / 3 INCH DIAL / 0.5 INCH BACK-MOUNT / SS CONSTRUCTION
	300 SERIES PROCESS EQUIPMENT - SVE BLOWER			
VI-301 & VI-302	VACUUM INDICATOR	LPG4-D7722N	DWYER	(-)100 TO 0 IWC-V / 2.5 INCH STEEL CASE / BRASS WETTED PARTS / 0.25 INCH BOTTOM MOUNT CONNECTION
VSH-301	VACUUM SWITCH	1950P-8-2F	DWYER	PRESSURE SWITCH - XP - ADJUSTABLE / 1.5 TO 8 PSID / 1 MAX DEAD BAND @ 1.5 PSID / (-)40 TO 140 F TEMP RATING / 35 PSI MAX PRESSURE / SPDT SWITCH TYPE / 15AMP @ 125 VAC SWITCH RATING / 0.125 INCH PROCESS
VSV-301	VACUUM RELIEF VALVE	VRL9	FPZ	4 INCH PROCESS CONNECTION / 30 - 240 ADJUSTABLE RANGE / ALUMINUM CONSTRUCTION
PI-301	PRESSURE INDICATOR	LPG4-D8622N	DWYER	0 - 100 IWC / 2.5 INCH STEEL CASE / BRASS WETTED PARTS / 0.25 INCH BOTTOM MOUNT CONNECTION
PSH-301	PRESSURE SWITCH	1950P-2-2F	DWYER	PRESSURE SWITCH - XP - ADJUSTABLE / 0.5 TO 2 PSID / 0.3 MAX DEAD BAND @ 0.5 PSID / (-)40 TO 140 F TEMP RATING / 35 PSI MAX PRESSURE / SPDT SWITCH TYPE / 15AMP @ 125 VAC SWITCH RATING / 0.125 INCH PROCESS
TI-301	TEMPERATURE INDICATOR	1NFY4	AV	0 - 250 F / 2.5 INCH STEM / 3 INCH DIAL / 0.5 INCH BACK-MOUNT / SS CONSTRUCTION
FI-301	FLOW INDICATOR (MAGNEHELIC)	2005	DWYER	0 - 5" WC D.P. RANGE (MINOR DIV. 0.10) / CAST ALUMINUM CASE / 4" ACRYLIC COVER / -20 IN Hg TO 15 PSIG PRESSURE LIMITS / 20 - 140 F RANGE / 0.125"
FE-301	FLOW ELEMENT PITOT TUBE	DS-300-6	DWYER	6 INCH AVERAGING STYLE PITOT TUBE / STAINLESS STEEL CONSTRUCTION W ITH BRASS ISOLATION VALVES / 0 - 200 F TEMP LIMITS
	400 SERIES PROCESS EQUIPMENT - SVE DISCHARGE HEAT EXCHANGER			
PI-401	PRESSURE INDICATOR	LPG4-D8422N	DWYER	0 - 60" WC RANGE / 2.5 " STEEL CASE / BRASS WETTED PARTS / 0.25 " BOTTOM MOUNT
TI-401	TEMPERATURE INDICATOR	1NFY4	AV	0 - 250 F / 2.5 INCH STEM / 3 INCH DIAL / 0.5 INCH BACK-MOUNT / SS CONSTRUCTION
TSH-401	TEMPERATURE SWITCH	B400-120	UNITED ELECTRIC	0 - 225 F ADJUSTABLE / POLYCARBONATE ENCLOSURE / NICKEL PLATED BRASS IMMERSION PROBE (3/8" DIA X 2-1/8" L) / 0.5 INCH BOTTOM CONNECTION / SINGLE ACTUATION POINT
	500 SERIES PROCESS EQUIPMENT - VAPOR TREATMENT			
PI-501	PRESSURE INDICATOR	LPG4-D8422N	DWYER	0 - 60" WC RANGE / 2.5 " STEEL CASE / BRASS WETTED PARTS / 0.25 " BOTTOM MOUNT
PI-502	PRESSURE INDICATOR	LPG4-D8322N	DWYER	0 - 40" WC RANGE / 2.5 " STEEL CASE / BRASS WETTED PARTS / 0.25 " BOTTOM MOUNT
PI-503	PRESSURE INDICATOR	LPG4-D8222N	DWYER	0 - 25" WC RANGE / 2.5 " STEEL CASE / BRASS WETTED PARTS / 0.25 " BOTTOM MOUNT
	600 SERIES PROCESS EQUIPMENT - PUMP AIR SUPPLY MANIFOLD			
SV-601 / SV-607	SOLENOID VALVE, 1", N.C	8210G054	ASCO	SOLENOID VALVE / 1 INCH / N.C. / BRASS / 0 PSI MIN DP CLOSE / 120VAC.
PI-601 / PI-607	PRESSURE INDICATOR	4FLZ8	AV	0 - 160 PSI RANGE / 1.5" ABS CASE & ACRYLIC LENS / BRASS & BRONZE WETTED PARTS / 0.125" BACK MOUNT
	700 SERIES PROCESS EQUIPMENT - LIQUID SEPARATION			
VI-701,VI-702 & VI-703	VACUUM INDICATOR	LPG4-D7322N	DWYER	(-)25 TO 0 IWC-V / 2.5 INCH STEEL CASE / BRASS WETTED PARTS / 0.25 INCH BOTTOM MOUNT
FI-701,FI-702 & FI-703	FLOW INDICATOR	FL-4216-V	OMEGA	0 - 60 SCFH / ACRYLIC TUBE 316 SS FLOAT PVC ENDS EPR O-RINGS / BRASS NEEDLE VALVE / MAX PRESS 100PSIG @ 70F
FIT-701	REV B. FLOW INDICATOR SENSOR	3-2536-P0	GF SIGNET	PADDLE WHEEL FLOW SENSOR / 0.3-20 FPS RANGE 0.5-4" PIPE / POLYPROPYLENE PVDF TITANIUM
FIT-701	FLOW INDICATOR TRANSMITTER (SEE MCP INSTALLATION)	3-9900-1P	GF SIGNET	PANEL MOUNT TRANSMITTER / SINGLE CHANNEL / MULTIPARAMETER / 4-20mA / 24 VDC POWER / MAX TEMP 158 F/ NEMA 4X FACE PLATE
LSP-701 & LSC-701	LEVEL SWITCH - CONDUCTIVITY INSTALL FITTING	3E2C	GEMS	TOP MOUNT INSTALL FITTING FOR (2) 3R OR 3W CONDUCTIVITY RODS / SS BODY / CAST ALUMINUM HOUSING / 2" MNPT PROCESS / MAX PRESS 250 PSIG
LSP-701 & LSC-701	LEVEL SWITCH - CONDUCTIVITY	3R2C5	GEMS	CONDUCTIVITY LEVEL ROD / 2' x 1/4" 316 SS ROD WITH TEFLON SHEATH
LSHH-701	LEVEL SWITCH	LS-500-1 POS	FPI SENSORS	1-POSITION FLOAT STYLE / STAINLESS STEEL CONSTRUCTION / 2 INCH NPT CONNECTION / N.C. - H-H / N.O. - H / N.O. - L
LSHH-702, LSH-702 & LSL-702	LEVEL SWITCH - MULTI-POSITION	LS-500-3 POS	FPI SENSORS	3-POSITION FLOAT STYLE / STAINLESS STEEL CONSTRUCTION / 2 INCH NPT CONNECTION / N.C. - H-H / N.O. - H / N.O. - L
LSHH-703, LSH-703 & LSL-703	LEVEL SWITCH - MULTI-POSITION	LS-500-3 POS	FPI SENSORS	3-POSITION FLOAT STYLE / STAINLESS STEEL CONSTRUCTION / 2 INCH NPT CONNECTION / N.C. - H-H / N.O. - H / N.O. - L
LSLL-710	LEVEL SENSOR (BIOCIDE)	F7-SS2	DWYER	FLOAT SWITCH SG 0.75 / 316SS FLOAT, 316SS STEM / 300°F TEMP LIMIT / 450 PSIG PRESSURE LIMIT / 25 VA: 1A @ 200 VAC
LSLL-711	LEVEL SENSOR (EMULSIFICATION BREAKER)	F7-SS2	DWYER	FLOAT SWITCH SG 0.75 / 316SS FLOAT, 316SS STEM / 300°F TEMP LIMIT / 450 PSIG PRESSURE LIMIT / 25 VA: 1A @ 200 VAC
	800 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - OIL			
PI-801	PRESSURE INDICATOR	SGY-D10422N	DWYER	0 - 60 PSI RANGE / 2.5 " STAINLESS STEEL CASE / BRASS WETTED PARTS / 0.25 " BOTTOM MOUNT
FQ-801	FLOW METER	FTB-32P	OMEGA	8.25 to 400 GPH FLOW RANGE / 0.75 INCH PROCESS CONNECTIONS / BRASS AND ALUMINUM CONSTRUCTION / 1.8 PSI LOSS AT FULL FLOW / 1,000,000 NON-RESETTABLE TOTALIZER
FIT-801	FLOW TOTALIZER	M0505/0300	OMEGA	PULSE OUTPUT / OUTPUT FREQUENCY: 0.1 GAL/PULSE / MAX SWITCH CURRENT: 50mA / MAX SWITCH VOLTAGE: 50 Vac
LSH / LSHH-801	LEVEL SENSOR (ALARM / WARNING)	L500-2 POSITION	FPI SENSORS	2-POSITION FLOAT STYLE / STAINLESS STEEL CONSTRUCTION / 2 INCH NPT CONNECTION / N.C. - H-H / N.C. - H
	900 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - AQUEOUS			
PI-901	PRESSURE INDICATOR	SGY-D10522N	DWYER	0-60 PSI RANGE / 2.5 INCH STAINLESS STEEL CASE / BRASS WETTED PARTS / / GLYCERIN FILLED
PSH-901	PRESSURE SWITCH	CS-150	DWYER	10-150 PSIG ADJUSTABLE RANGE / 5 PSIG FIXED DEADBAND / 0.25 " BOTTOM MOUNT / BUNA-N & STEEL WETTED / 15 A @ 120 VAC SPDT
	1000 SERIES PROCESS EQUIPMENT - BAG FILTERS			
	1100 SERIES PROCESS EQUIPMENT - LGAC			
PI-1101 & PI-1102	PRESSURE INDICATOR	SGY-D10422N	DWYER	0-60 PSI RANGE / 2.5 INCH STAINLESS STEEL CASE / BRASS WETTED PARTS / / GLYCERIN FILLED / 0.25 INCH BOTTOM MOUNT
	1200 SERIES PROCESS EQUIPMENT - LGAC DISCHARGE FLOWMETER			
FQ-1201	FLOW METER	T10-1	NEPTUNE	1 - 50 GPM FLOW RANGE / BRONZE CONSTRUCTION / 1 INCH PROCESS CONNECTIONS / NON-RESETTABLE TOTALIZER
FIT-1201	FLOW TOTALIZER	TRICON / S REGISTER	NEPTUNE	SWITCH POWER: 10 WATTS (DC) / SWITCH CURRENT: 0.5 AMPS (DC) / SWITCH VOLTAGE: 200 VOLTS (DC) / (-40) TO 125 TEMPERATURE RANGE
	1400 SERIES PROCESS EQUIPMENT - LNAPL PUMPS			
SV-1401	SOLENOID VALVE, 2", N.C.	8215B080	ASCO	2 INCH PROCESS CONNECTION / NORMALLY CLOSED / ALUMINUM CONSTRUCTION / 0 PSI MIN DIFFERENTIAL PRESSURE TO CLOSE / 120VAC
SV-1402	SOLENOID VALVE, 1/2", N.O.	8210G034	ASCO	1/2 INCH PROCESS CONNECTION / NORMALLY OPEN / BRASS CONSTRUCTION / 120VAC
FQ-1401	FLOW METER	FTB-32P	OMEGA	POSITIVE DISPLACEMENT 8.25 to 400 GPH FLOW RANGE / 0.75 INCH PROCESS CONNECTIONS / BRASS AND ALUMINUM CONSTRUCTION / 1.8 PSI LOSS AT FULL FLOW / 1,000,000 NON-RESETTABLE TOTALIZER
FIT-1401	FLOW TOTALIZER	M0505/0300	OMEGA	PULSE OUTPUT / OUTPUT FREQUENCY: 0.1 GAL/PULSE / MAX SWITCH CURRENT: 50mA / MAX SWITCH VOLTAGE: 50 Vac
LSH / LSHH-1401	LEVEL SENSOR (ALARM / WARNING)	L500-2 POSITION	FPI SENSORS	2-POSITION FLOAT STYLE / STAINLESS STEEL CONSTRUCTION / 2 INCH NPT CONNECTION / N.C. - H-H / N.C. - H
	1500 SERIES PROCESS EQUIPMENT - AIR COMPRESSOR			
PI-1502	PRESSURE INDICATOR	SGY-D10722N	DWYER	0 - 200 PSI RANGE / 2.5 " STAINLESS STEEL CASE / BRASS WETTED PARTS / 0.25 " BOTTOM MOUNT
ADV-1501	AUTOMATIC DRAIN VALVE	ECO DRAIN 30	KAESER	0
PSL-1501	PRESSURE SWITCH	B424V	ASHCROFT	PRESSURE SWITCH / 5-100 PSI ACTUATION RANGE / 2.1-7 PSI DEAD BAND / 316 SS / 0.25 INCH PROCESS / 15 AMP RATING / 20-300 F TEMPERATURE LIMITS
SV-1501	SOLENOID VALVE, 2", N.C.	8215B080	ASCO	SOLENOID VALVE / 2 INCH / N.C. / ALUMINUM / 0 PSI MIN DP CLOSE / 120VAC
SV-1502	SOLENOID VALVE, 1/2", N.O.	8210G034	ASCO	SOLENOID VALVE / 0.5 INCH / N.O. / BRASS / 0 PSI MIN DP CLOSE / 120VAC.
	1600 SERIES PROCESS EQUIPMENT - ENCLOSURE SUMP			
LSHH-1601	LEVEL SENSOR (SVE ENCLOSURE)	F7-SB	DWYER	FLOAT SWITCH SG 0.60 / BUNA-N EPOXY 316 SS CONSTR / 220 F TEMP LIMIT / 150 PSIG PRESS LIMIT 0.125 IN PROCESS CONNECTION / 25 VA:1A @ 220 VAC
LSHH-1602	LEVEL SENSOR (GWT ENCLOSURE)	F7-SB	DWYER	FLOAT SWITCH SG 0.60 / BUNA-N EPOXY 316 SS CONSTR / 220 F TEMP LIMIT / 150 PSIG PRESS LIMIT 0.125 IN PROCESS CONNECTION / 25 VA:1A @ 220 VAC

NOT TO SCALE FINAL LOCATION BY AMEC

NORTH





SYSTEM ENCLOSURE(S)
PLANVIEW

GENERAL NOTES:

1. THIRD PARTY NEC INSPECTION STICKER (T.R. ARNOLD & ASSOCIATES, INC.) LOCATED WITHIN PANEL ENCLOSURE(S)
2. ENCLOSURES ROOFS ARE FITTED WITH STEEL CABLES FOR SAFETY TIE-OFF DURING ROOF-TOP OPERATIONS.
3. NOT ALL ITEMS SHOWN FOR DRAWING CLARITY.
4. HX-401, HX-401 EFFLUENT PLUMBING, VAPOR CARBON 6 INCH EFFLUENT STACK PLUMBING, SVE DILUTION FILTER, (T-701) VENT STACK TEE, (OWS-701) VENT STACK TEES, ALL INTAKE/ EXHAUST HOODS, SECURITY LIGHTING FIXTURES, AND GFCI RECEPTACLE COVERS SHIPPED LOOSE FOR SITE RE-INSTALLATION.

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	05-15-15	MJS

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DRWN BY	CJJ
DATE	01-21-14
CHK BY	CJJ
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DATE	—

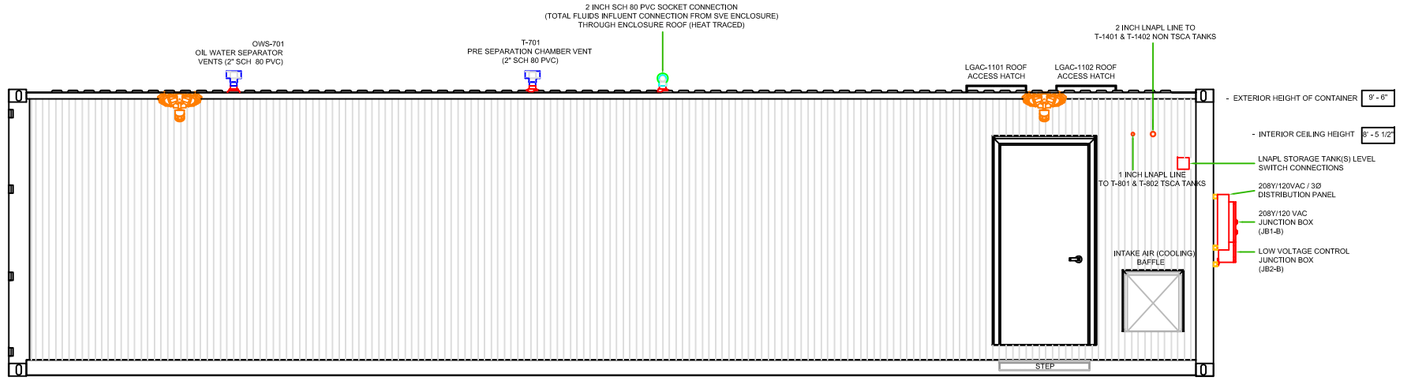
TITLE: VACUUM ENHANCED RECOVERY SYSTEM ENCLOSURE LAYOUT(S)

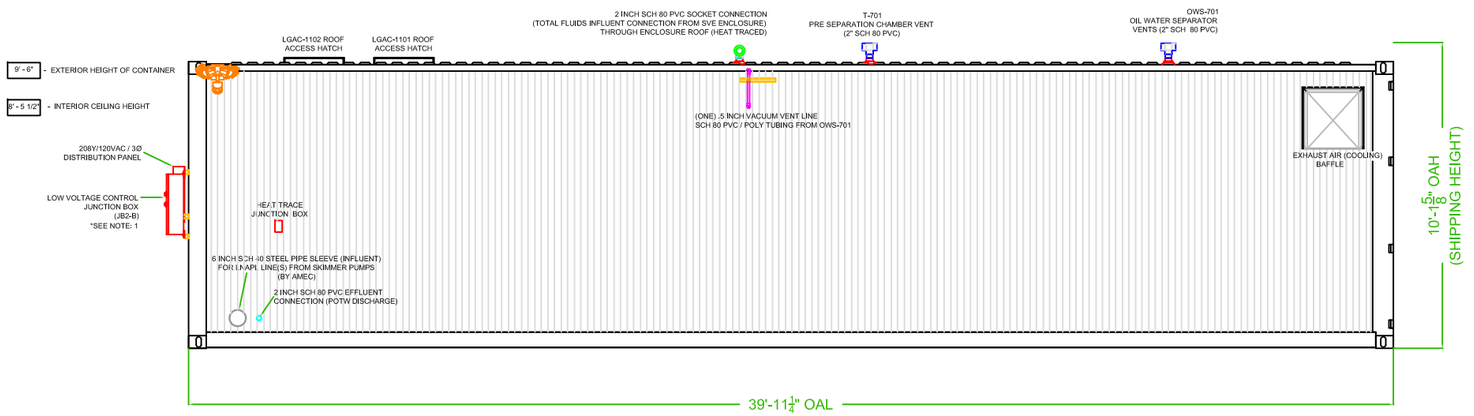
AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	D	M-2	1 OF 3	A

GROUNDWATER TREATMENT SYSTEM ENCLOSURE
NORTH EAST ELEVATIONAL VIEW





GROUNDWATER TREATMENT SYSTEM ENCLOSURE
SOUTH WEST ELEVATIONAL VIEW

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	05-15-15	MJS

REVISIONS

NES™
NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-ENC.BIZ

DRWN BY	CJJ
DATE	01-21-14
CHK BY	CJJ
DATE	01-30-15
APPR BY	—
DATE	—

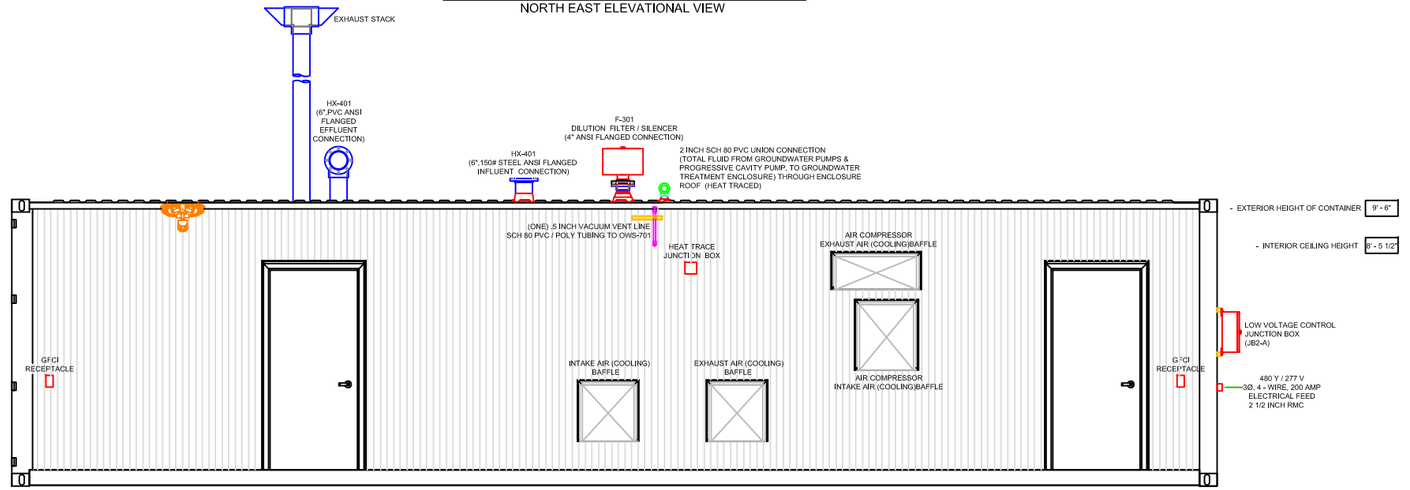
TITLE: VACUUM ENHANCED RECOVERY SYSTEM ENCLOSURE ELEVATIONAL(S)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

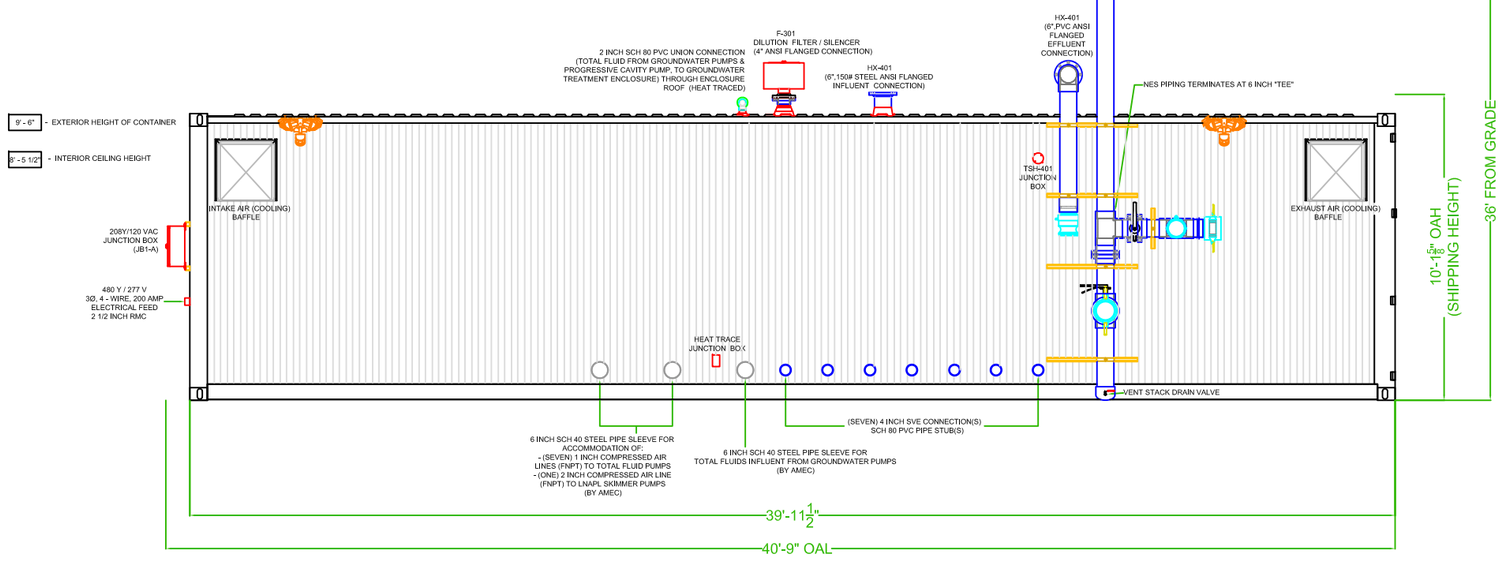
JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	D	M-2	2 OF 3	A

CONTROL & SVE TREATMENT SYSTEM ENCLOSURE
NORTH EAST ELEVATIONAL VIEW



CONTROL & SVE TREATMENT SYSTEM ENCLOSURE
SOUTH WEST ELEVATIONAL VIEW



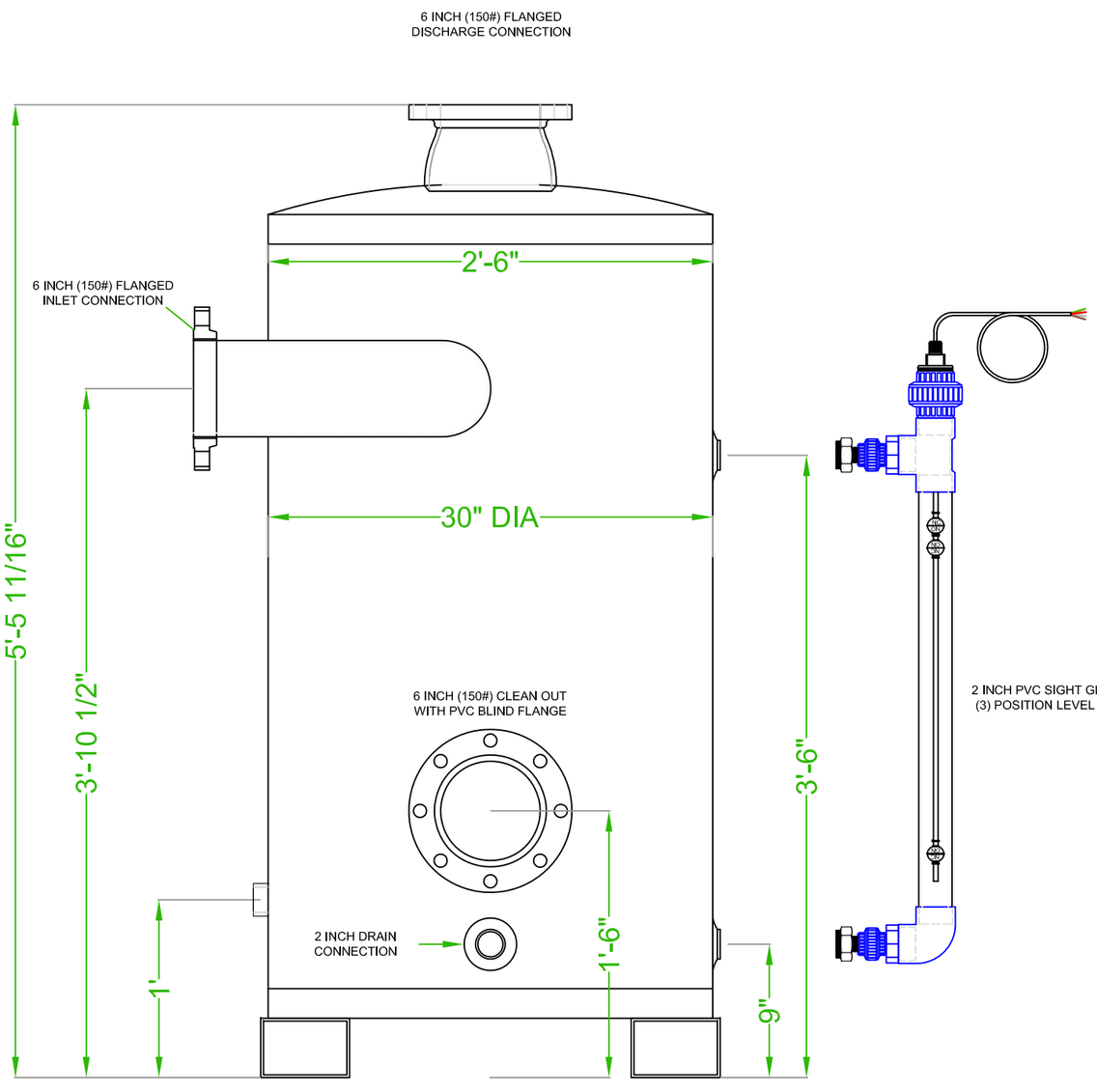
REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	05-15-15	MJS

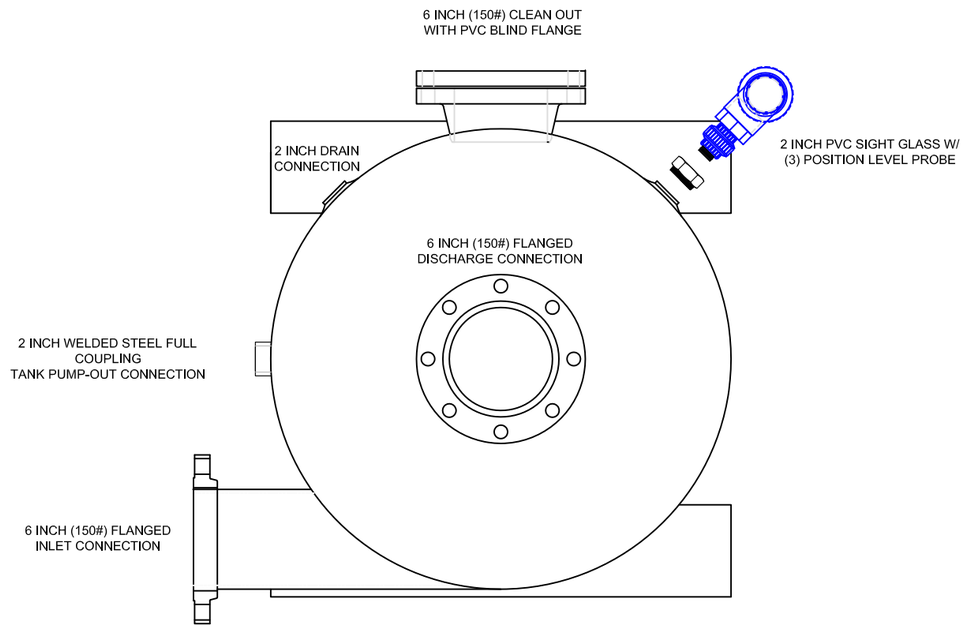
REVISIONS

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-ENC.BIZ

TITLE: VACUUM ENHANCED RECOVERY SYSTEM ENCLOSURE ELEVATIONAL(S)

DRWN BY: CJJ	DATE: 01-21-14		
CHK BY: CJJ	DATE: 01-30-15	AMEC / REVIEW AVE DEVELOPMENT SITES C241005 & C241089 / QUEENS COUNTY, NY	JOB NO. 13-214
APPR BY	DATE	SCALE: NTS / SIZE: D / DWG NO. M-2	SHEET 3 OF 3 / REV A





REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS

REVISIONS

NES™
NATIONAL ENVIRONMENTAL SYSTEMS
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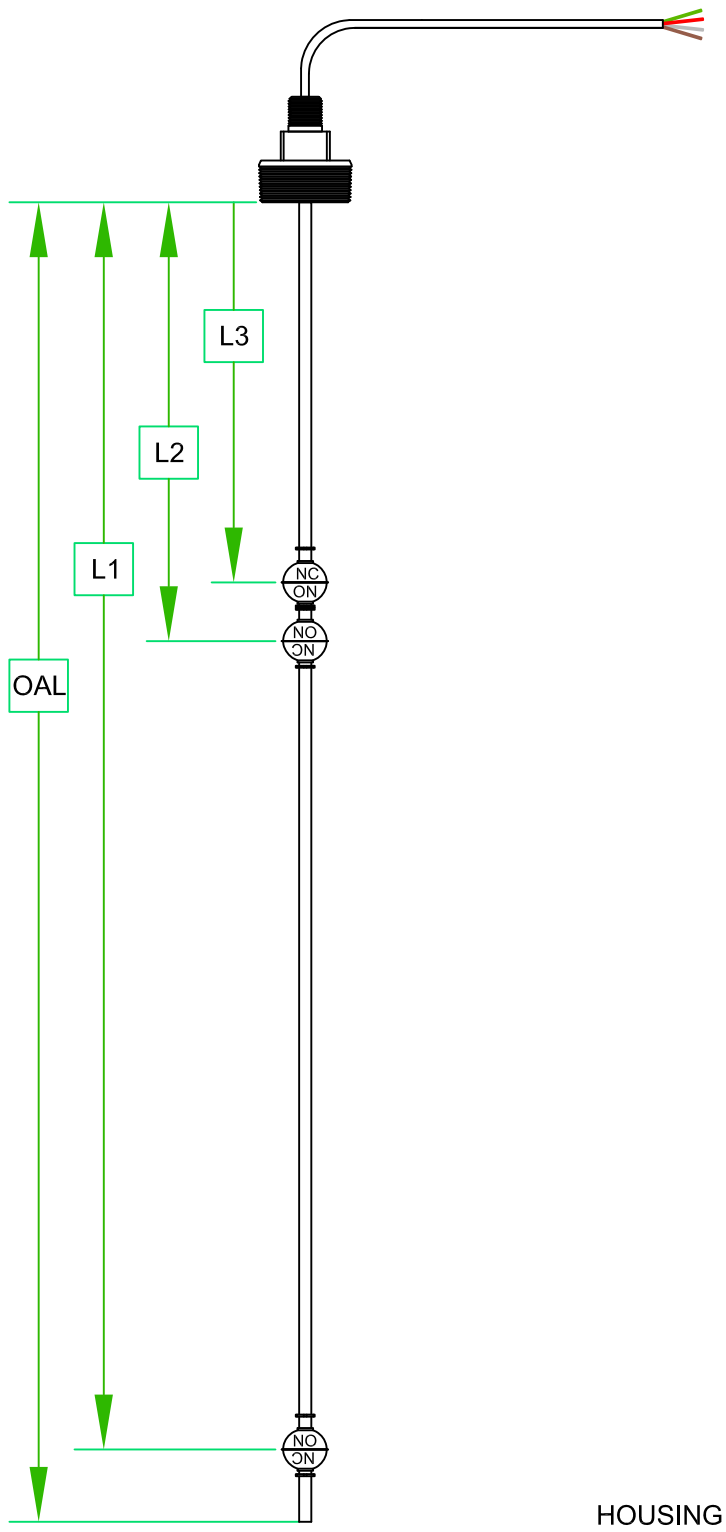
DRWN BY	MJS
DATE	10-20-14
CHK BY	CJJ
DATE	01-12-15
APPR BY	--
DATE	--

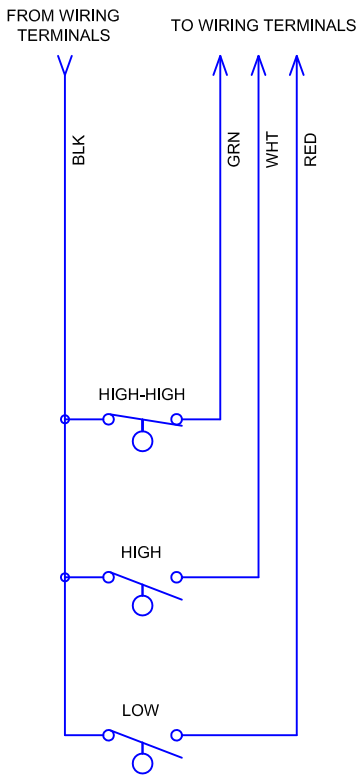
TITLE
150 GALLON MOISTURE SEPARATOR (T-201)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	M-3	1 OF 1	A

L3	GREEN	NORMALLYCLOSED	HIGH-HIGH
L2	WHITE	NORMALLY OPEN	HIGH
L1	RED	NORMALLY OPEN	LOW
	BLACK		COMMON





HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT
LISTING	UL

OAL - 33.75 INCHES
L1 - 31.75 INCHES
L2 - 11.25 INCHES
L3 - 9.75 INCHES
CABLE LENGTH - 120 INCHES

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	12-23-14	MJS

REVISIONS

DRWN BY	MJS
DATE	10-20-14
CHK BY	CJJ
DATE	12-23-14
APPR BY	--
DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

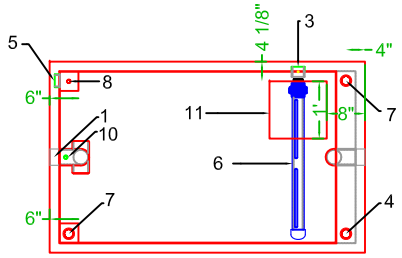
TITLE: 3 POSITION LEVEL SENSOR (LSHH-201, LSH-201, & LSL-201)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

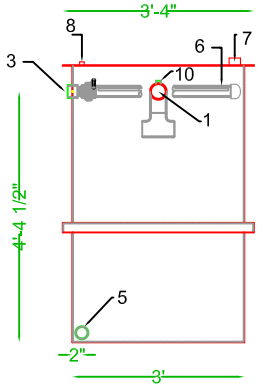
JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-4	1 0F 1	A

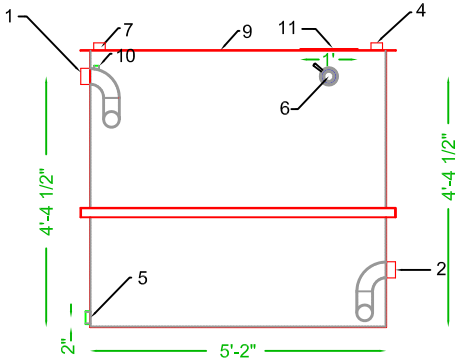
ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION
1	1	3" FNPT INLET	8	1	0.5 INCH FNPT VACUUM CONNECTION
2	1	3" FNPT OUTLET	9	1	REMOVABLE COVER
3	2	2" FNPT OIL OUTLET	10	1	0.5 INCH COUPLING (VENT)
4	3	2" FNPT VENT	11	1	12 INCH X 12 INCH X 1/4 INCH PLEXI-GLASS VIEWPORT
5	4	2" FNPT DRAIN			
6	1	PVC OIL SKIMMER			
7	1	2" FNPT PROBE CONNECTION			

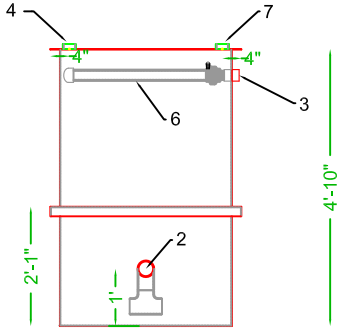


PLAN VIEW



FRONT VIEW





REAR VIEW

NOTES:
1. MATERIAL: 12 GAUGE 304 STAINLESS STEEL
2. GASKET: NEOPRENE
3. HARDWARE: 18-8 STAINLESS STEEL
4. INTERNAL SKIMMER PIPE: SCH 80 PVC
5: APPROXIMATE OPERATIONAL VOLUME: 500 GALLONS
6. SHIPPING WEIGHT: 475 LBS
7. OPERATING WEIGHT: 4,625
8. ALL WELDS TO BE PASSIVATED

REV	DESCRIPTION	DATE	APPROVED
A	AS-BUILT	01-12-15	CJJ

REVISIONS

DRWN BY CJJ DATE 10-16-14
CHK BY CJJ DATE 01-12-15
APPR BY DATE

NES NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

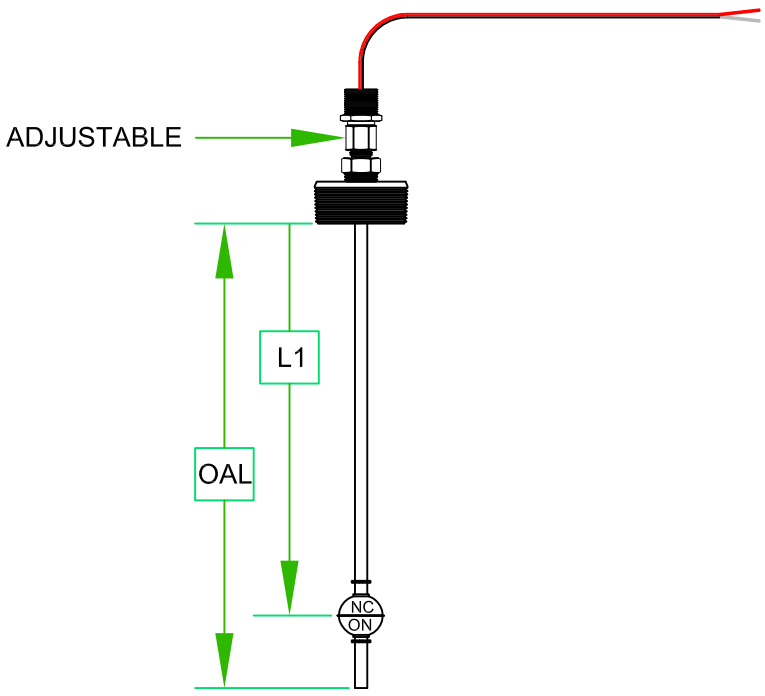
TITLE: PRE-SEPARATION TANK

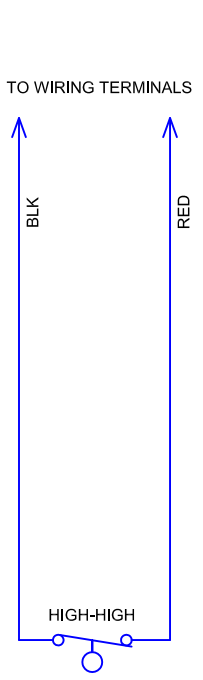
AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	C	M-5	1 OF 1	A

L1	RED BLACK	NORMALLY CLOSED	HIGH-HIGH COMMON





UL LISTED

HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT

OAL - 12 INCHES
L1 - 10 INCHES
18 AWG CONDUCTOR LENGTH - 120 INCHES
ADJUSTABILITY RANGE - 5 INCHES
NES FACTORY ADJUSTED HEIGHT - 8 $\frac{5}{8}$"

GENERAL NOTES:

1. UL LISTED PRODUCT
2. FOR TERMINAL BLOCK LOCATION SEE DRAWING (I-1)
3. FOR WIRING TERMINAL DESIGNATION SEE DRAWING (I-2)
4. IF PROBE IS ADJUSTABLE, L1 DIMENSION IS AT FULL EXTENSION, AND INCLUDES ALLOWANCE FOR ADJUSTABILITY

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS

DRWN BY	MJS	DATE	11-12-14
CHK BY	CJJ	DATE	01-12-15
APPR BY	--	DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

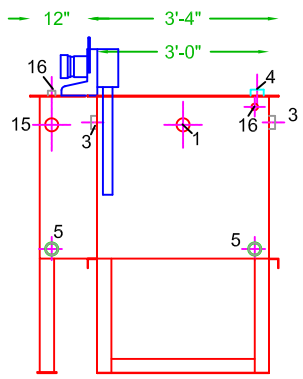
TITLE: 1 POSITION LEVEL SENSOR (ADJUSTABLE) (LSHH-701)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

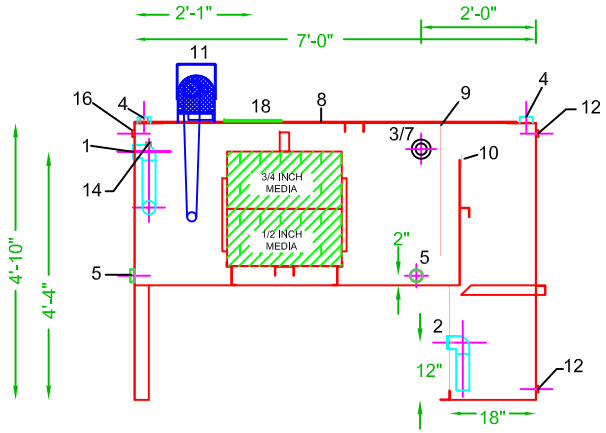
JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	M-6	1 OF 1	A

ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION
1	1	3" FNPT INLET	8	2	REMOVABLE COVER	15	1	2" FNPT OIL INLET
2	1	3" FNPT OUTLET	9	1	OIL STOP WEIR	16	2	0.5" VACUUM VENT PORT
3	2	2" FNPT OIL OUTLET	10	1	ADJ. OVERFLOW WEIR	17	0	2" FNPT PRODUCT OUTLET
4	3	2" FNPT VENT	11	1	ABANAKI BELT SKIMMER	18	1	12" X 12" PLEXI-GLASS
5	4	2" FNPT DRAIN	12	4	1" SIGHT GLASS PORTS			COVER CENTERED OVER
6	1	COALESCING PLATES	13	1	INTEGRAL PRODUCT TANK			PACKING
7	1	PVC OIL SKIMMER	14	1	0.5" FNPT PORT			

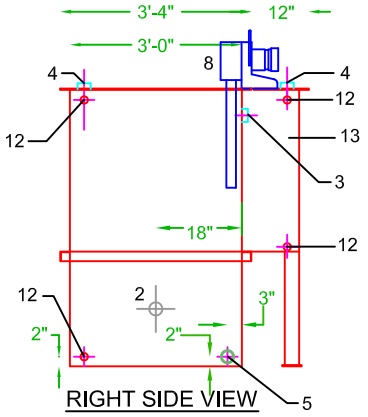
SHIPPING WEIGHT	1350 LBS
OPERATING WEIGHT	5670 LBS
SEPARATOR VOLUME	540 GALLONS
EFFLUENT TANK VOLUME	150 GALLONS
SLUDGE VOLUME	6 GALLONS
COALESCING AREA	12 FT^3
OPT. PRODUCT TANK VOL	120 GALLONS



LEFT SIDE VIEW



ELEVATION



RIGHT SIDE VIEW

GENERAL NOTES:
1. MATERIAL OF CONSTRUCTION: 12 GAUGE 304 STAINLESS STEEL
2. GASKET MATERIAL: NEOPRENE
3. HARDWARE CONSTRUCTION: 18-8 STAINLESS STEEL
4. INTERNAL PIPE: SCHEDULE 80 PVC
5. ALL WELDS ARE PASSIVATED

REV	DESCRIPTION	DATE	APPROVED
A	AS-BUILT	01-26-15	CJJ

REVISIONS

DRWN BY CJJ DATE 10-16-14
CHK BY DATE
APPR BY DATE

NES™ NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
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WWW.NES-INC.BIZ

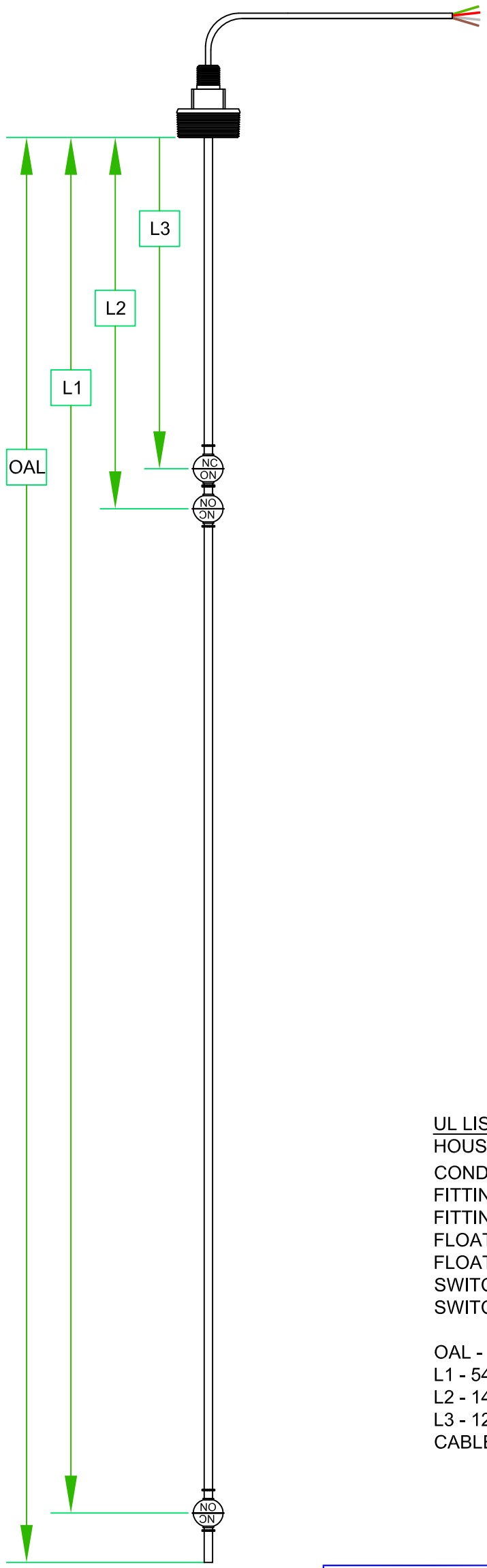
TITLE: MODEL AG-3SS-150V-IP

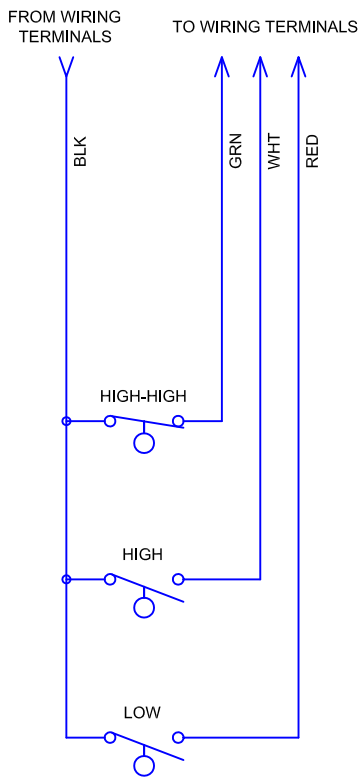
AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	C	M-7	1 OF 1	A

L3	GREEN	NORMALLYCLOSED	HIGH-HIGH
L2	WHITE	NORMALLY OPEN	HIGH
L1	RED	NORMALLY OPEN	LOW
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT

OAL - 56.75 INCHES
L1 - 54.75 INCHES
L2 - 14 INCHES
L3 - 12.5 INCHES
CABLE LENGTH - 120 INCHES

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS

REVISIONS

DRWN BY	MJS
DATE	11-12-14
CHK BY	CJJ
DATE	01-12-15
APPR BY	--
DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

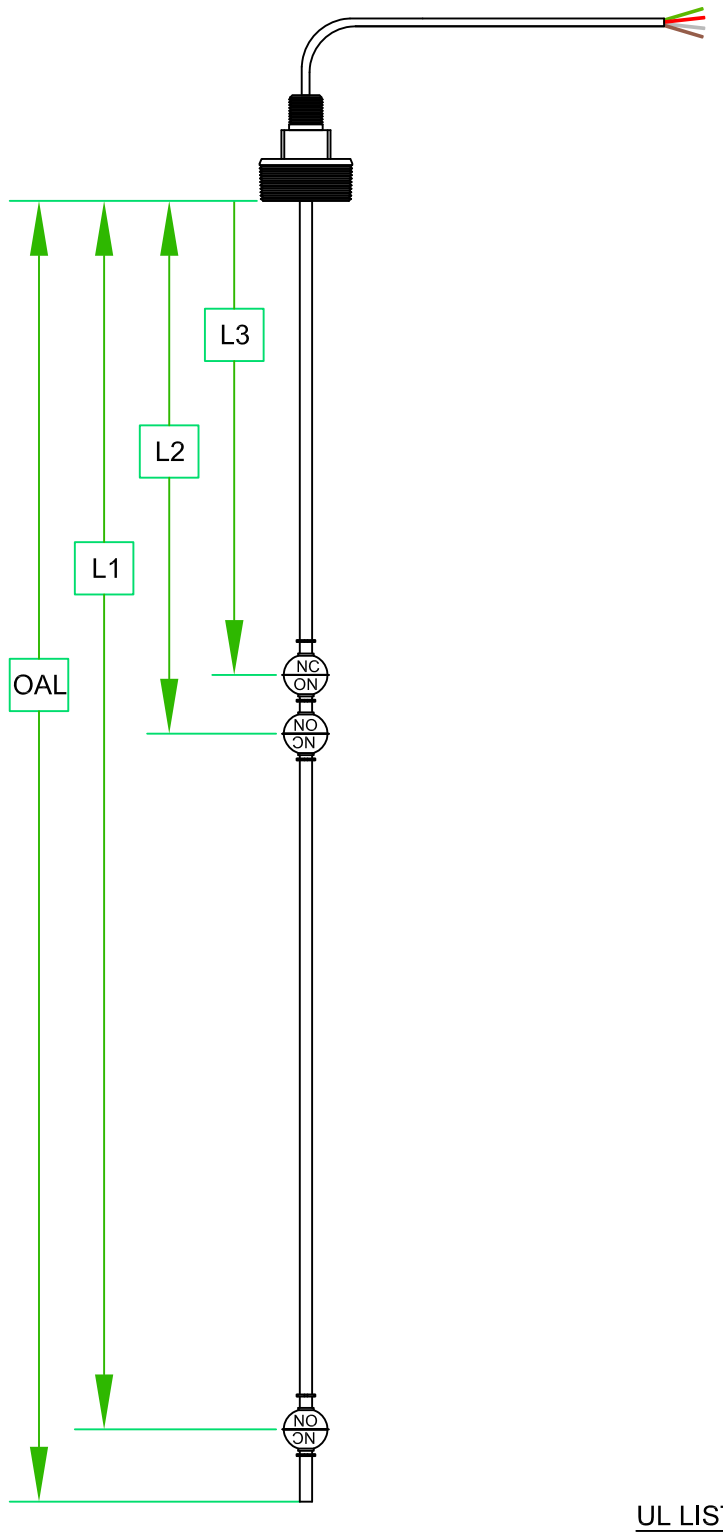
TITLE: 3 POSITION LEVEL SENSOR (LSHH-702, LSH-702, & LSL-702)

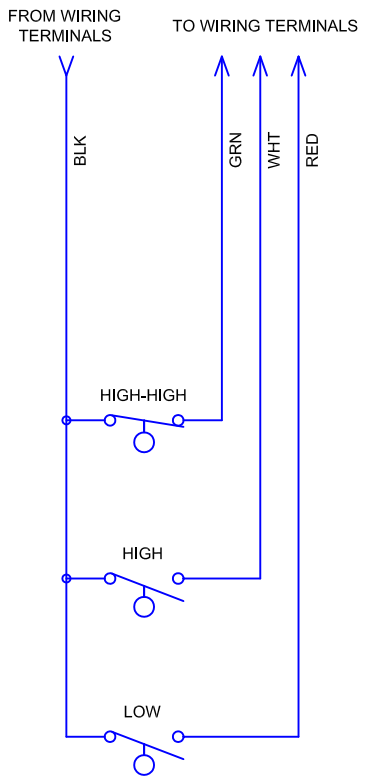
AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-8	1 OF 1	A

L3	GREEN	NORMALLYCLOSED	HIGH-HIGH
L2	WHITE	NORMALLY OPEN	HIGH
L1	RED	NORMALLY OPEN	LOW
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT

OAL - 33.25 INCHES
L1 - 31.25 INCHES
L2 - 13.5 INCHES
L3 - 12 INCHES
CABLE LENGTH - 120 INCHES

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS
REVISIONS			

DRWN BY	MJS
DATE	11-12-14
CHK BY	CJJ
DATE	01-12-15
APPR BY	--
DATE	--

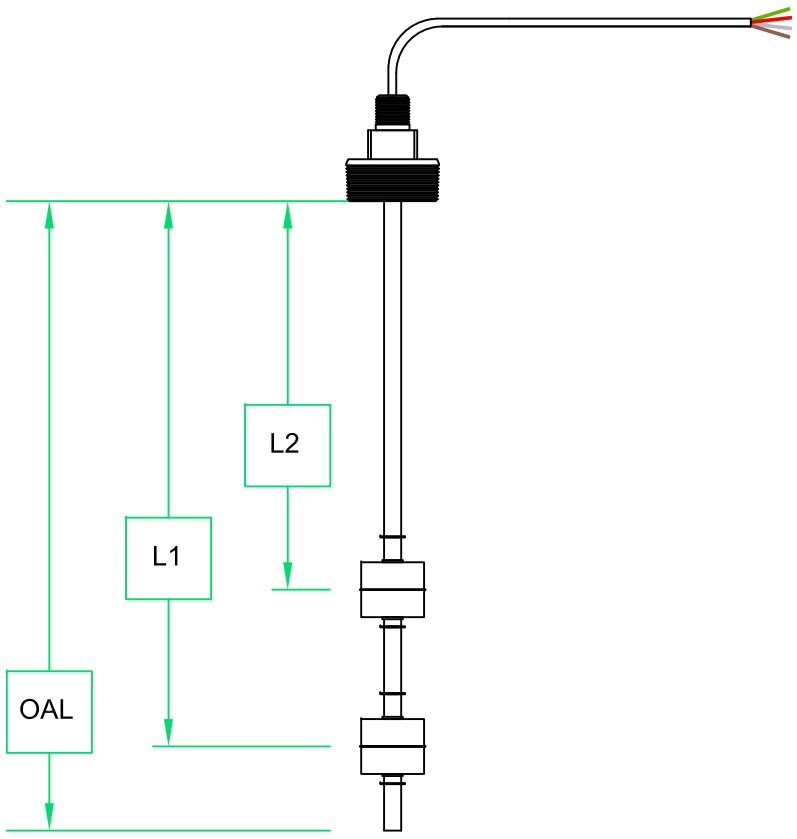
NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

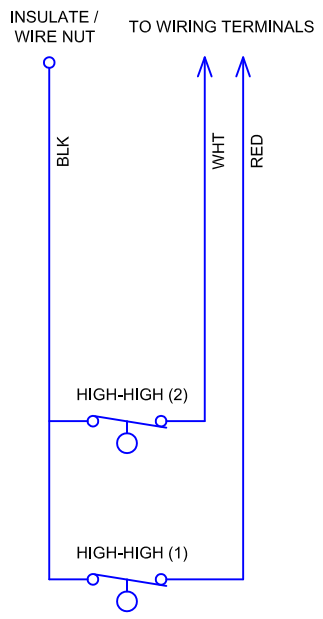
TITLE: 3 POSITION LEVEL SENSOR (LSHH-703, LSH-703, & LSL-703)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	M-9	1 OF 1	A

L2	WHITE	NORMALLY CLOSED	HIGH-HIGH (2)
L1	RED	NORMALLY CLOSED	HIGH-HIGH (1)
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
STEM DIAMETER	$\frac{1}{2}$ INCH
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT
SPECIFIC GRAVITY	0.6

OAL - 21 INCHES
L1 - 19 INCHES
L2 - 13.25 INCHES
CABLE LENGTH - 288 INCHES

GENERAL NOTES:

1. FOR TERMINAL BLOCK LOCATION SEE DRAWING (I-1)
2. FOR WIRING TERMINAL DESIGNATION SEE DRAWING (I-2)

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	06-02-15	RB

REVISIONS

DRWN BY	DATE
JAD	05-27-15
CHK BY	DATE
APPR BY	DATE

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
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TITLE: 2 POSITION LEVEL SENSOR
LSH & LSHH-801 / LSH & LSHH-1401

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-10	1 OF 1	A

SECTION 3 - CONTROL & ELECTRICAL DRAWINGS

TRA 3rd PARTY NEC INSPECTION

REMOTE ACCESS & HMI SUMMARY

TABLE 2, INTERLOCK SCHEDULE

I-1, MASTER CONTROL, MOTOR CONTROL, & JUNCTION PANEL LAYOUT(S)

TABLE 3, PANEL BILL OF MATERIALS

I-2, WIRING DIAGRAMS & TERMINAL DETAILS

TABLE 4, ELECTRICAL LOAD CALCULATIONS

E-1, ONE LINE DIAGRAM

E-2, ELECTRICAL BLOCK DIAGRAM

E-3, POWER DISTRIBUTION PANEL LAYOUT(S)

CODE REFERENCE PLATE

THIS MANUFACTURED STRUCTURE HAS BEEN CONSTRUCTED IN CONFORMANCE WITH THE FOLLOWING CODES:

- [x] 2014 NATIONAL ELECTRICAL CODE®
- [ ] _____ INTERNATIONAL BUILDING CODE
- [ ] _____ INTERNATIONAL MECHANICAL CODE
- [ ] _____ INTERNATIONAL PLUMBING CODE
- [ ] _____ INTERNATIONAL ENERGY CONSERVATION CODE
- [ ] _____ INTERNATIONAL RESIDENTIAL CODE
- [ ] _____ INTERNATIONAL FUEL GAS CODE
- [ ] _____ INTERNATIONAL FIRE CODE
- [ ] _____ UNIFORM BUILDING CODE
- [ ] _____ UNIFORM PLUMBING CODE
- [ ] _____ UNIFORM MECHANICAL CODE
- [ ] _____ NATIONAL STANDARD PLUMBING CODE
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____

INFORMATION ONLY

T. R. Arnold & Associates, Inc.
700 E. Beardsley Avenue
Post Office Box 1081
Elkhart, IN 46515

Form 401
Revised 03/21/2012

INSPECTION REPORT

Manufacturer N.E.S. File No. 6202 Date 1.20.15

Plant Location Attleboro, MA

TRA Inspector L. Baumgardner Accompanied By Kate Binder

Rate of Production On-call per _____ Labels Controlled by: ____ Manufacturer ✓ TRA

Inspection Emphasis:	
Structural	
Plumbing	
Mechanical	
Electrical	✗
Fire Safety	
Records	
Remedial Level:	

For Office Use Only	
Defects Logged	
Red Tags Logged	
Inspection Logged	
Reviewed By	
Comments	

Materials in Storage	
Lumber	
Trusses	
Plywood	
Particleboard	
Insulation	
Doors	
Windows	

Tests Observed	Pass	Fail
Gas High Pressure		
Gas Low Pressure		
Electrical Continuity		
Electrical Operational		
Electrical Polarity		
Dielectric Strength		
Supply		
DWV		
Fixture		
Equipment		
Egress Window Operation		

All Deficiencies Reinspected: Yes___ No___

Labeled Yard Units Inspected: Yes___ No___

Unlabeled Yard Units - Checked status of Q.C. records: Yes___ No___

Unlabeled Yard Units Inspected (Deviations noted on Form #402) _____

All other units checked for Deviations noted on previous Form #402(s): Yes___ No___

UNITS INSPECTED

STATION	SERIAL NUMBER	MODEL	DESTINATION
Final	13-214 a	13-214 a	Queens County, NY
	b	b	

T. R. Arnold & Associates, Inc.
700 E. Beardsley Avenue
Post Office Box 1081
Elkhart, IN 46515

Form 402
Revised 07/13/2011

Unit # 15-0107

DEFICIENCY REPORT

N.E.S.
MANUFACTURER AND PLANT

Jan. 20, 2015
DATE OF INSPECTION

PAGE 1 of _____

SERIAL NUMBER	DAPIA/CODE REFERENCE	DEFICIENCY/COMMENT
13-214		Factory inspection and witnessing of testing to approved design
		No deviations were noted.
		Assembly is approved to label as compliant to the 2014 NEC. (NFPA 70)

I have reviewed these inspection results and instituted procedures for correction of non-complying items.

Ken Barnes 01-20-2015
Manufacturer's Representative

The above report is a true and accurate account of the inspected unit(s) to the best of my knowledge.

Inspector

Time In 11:45 Time Out 1:30 Total inspection time including travel _____

Kate Bindas

From: Craft, Craig <ccraft@trarnold.com>
Sent: Thursday, January 15, 2015 2:20 PM
To: lee_kbi@hotmail.com
Cc: kwbindas@nes-inc.biz; Clouse, Jeff
Subject: NES Project 13-214 Package Review

Leroy:

The TRA WORK ORDER #15-0107 NY, NES Project /Serial Number 13-214 has been reviewed and found to be in compliance with the 2014 NEC.

If you have any questions you can reach me at the phone number/ e-mail below.

Sincerely,

Craig Craft
Senior Associate
TR Arnold & Associates, Inc.
Phone: 574/264-0745
Fax: 574/264-0740
ccraft@trarnold.com

NES PROJECT: 13-214 Rev. B, AUGUST 2015
AMEC / REVIEW AVE DEVELOPMENT – QUEENS COUNTY, NY

REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY

ALARMS – SEE INTERLOCK TABLE 2

NORMAL OPERATION
* Equipment will operate if the panel switch is in the AUTO position and no alarm is present.
* Equipment will operate if the panel switch is in the HAND position with or without an alarm condition for only 10 seconds.
* Conditions that will stop a motor in the hand position are an overload or emergency stop.
* HMI Timers must be set for each of the solenoid valves. Timers can be modified (using the HMI).

Entering the Valve Timer setpoints:
1.) From Main Menu**,** touch MOV or Solenoid Timers icon.
2.) Select desired solenoid valve, touch next to advance through 2 solenoid timer pages.
3.) Enter on and off times in desired (matching) cells. Touch appropriate cell and a keypad should appear for data entry. Time values must be in military time (i.e. 0=12:00am, 1300=1:00pm)
Note: Timers will energize only on an approaching value. To witness the timer energize, enter a time that is later than the present time (i.e. if it is 10 am, enter 1005). Otherwise the timer will not energize until the following day. Do not enter an on-time without also entering an off time since a 0 value will allow operation until midnight (12AM).

ALARM Email Settings

1. Email from: ReviewAve@nes-inc.com

2. Email to:
timothy.kessler@amecfw.com
daniel.berkowitz@amec.com
vincent.whelan@amec.com

3. Subject: Review Ave HMI

4. Body of Email - date / time / Alarm

Accessing the system remotely from a web connected computer:
1.) Enter IP address: 166.130.70.208 directly into the Microsoft Internet Explorer navigation bar (do not use a search engine program) and press Enter.
2.) C-More screen comes up, select bottom choice “Remote Access”.
3.) When connection icons appear choose the lower one ("with Firewall").
4.) Run program that pops up / downloads

REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY

5.) Run secondary program that pops up (if prompted).
(Note: for ease of access save EACON file to your desktop)

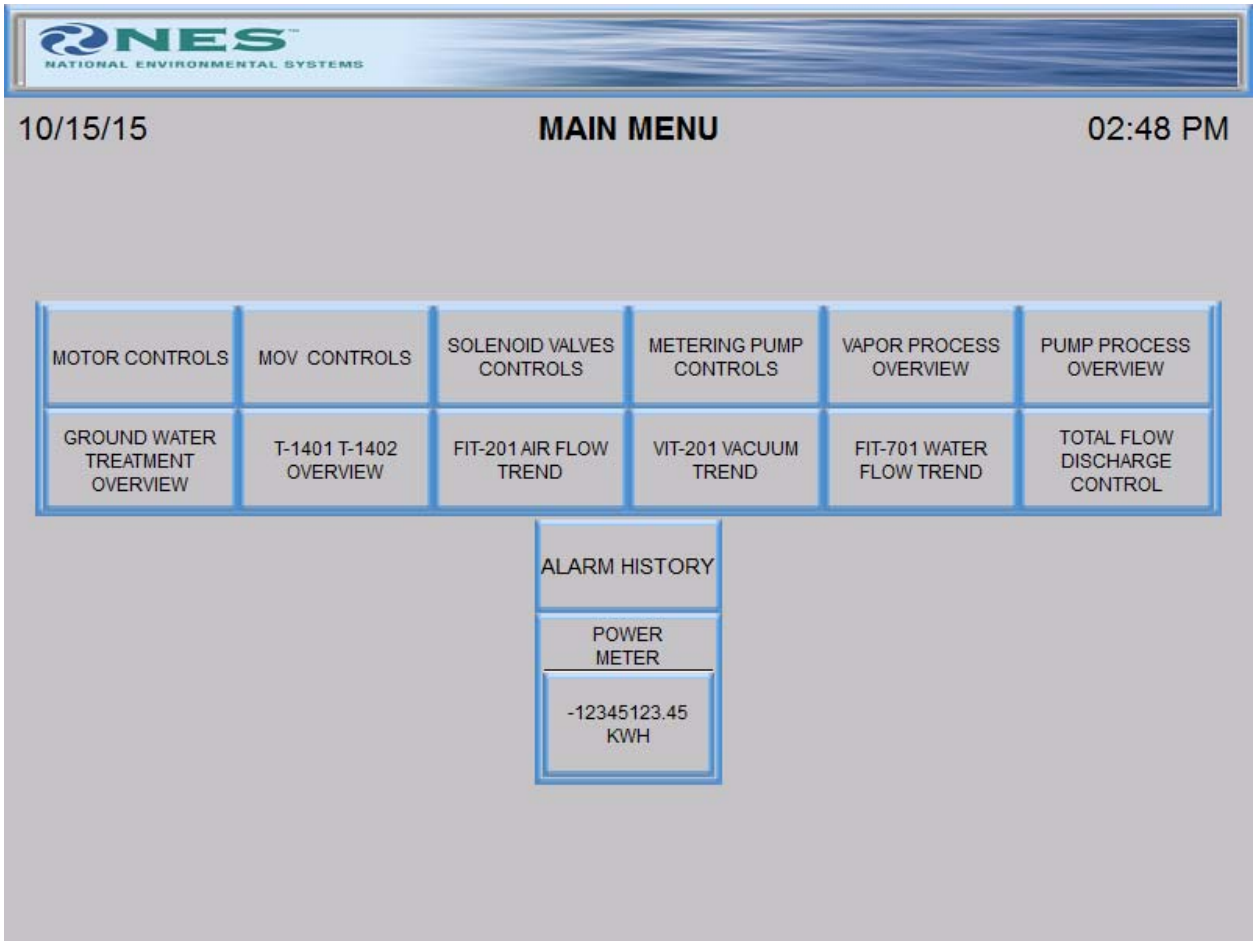
A.) Full Access: A password window appears. Enter the following:
User name: Review1
Password: review01
After a short delay the screens should appear. This allows complete remote operation.
B.) Limited Access: A password window appears. Enter the following:
User name: Review2
Password: review02
After a short delay the screens should appear. This allows viewing and changing of screens only.
C.) Advanced Settings Screen: Allows operator to maintain H/O/A in "HAND" mode for up to 5 minutes.
Password: 13214

PLEASE NOTE: IF REMOTE ACCESS IS BLOCKED (TIME-OUT ERROR)
Contact the company IT department to check if any of the port settings below are blocked:

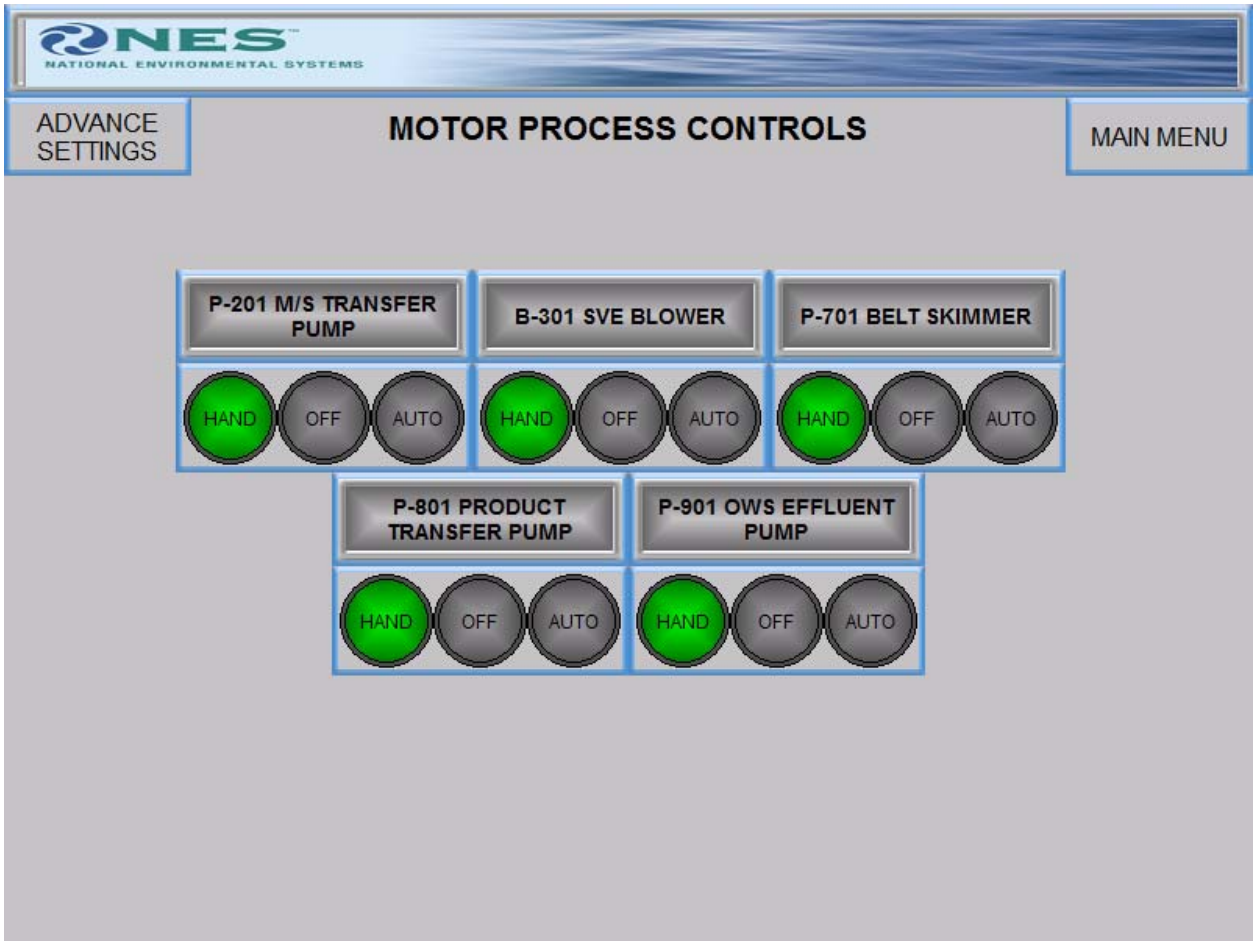
Port #	Function
11 102	Graphic Server
80	Web Server
25	Send Mail
21	FTP Service (for Data downloads)
110	Mail

Downloading Data Log files from a web connected computer:
1.) Enter FTP: //166.130.70.208 directly into the Microsoft Internet explorer title bar (do not use a search engine program) and press Enter.
2.) Select compact flash 1
3.) Select log files
4.) A file with a date and txt extension should appear. Do not open it within explorer. Right Click "target save as", then save it to your desired location. Open with Microsoft excel, Word, notepad or a similar program.

REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY

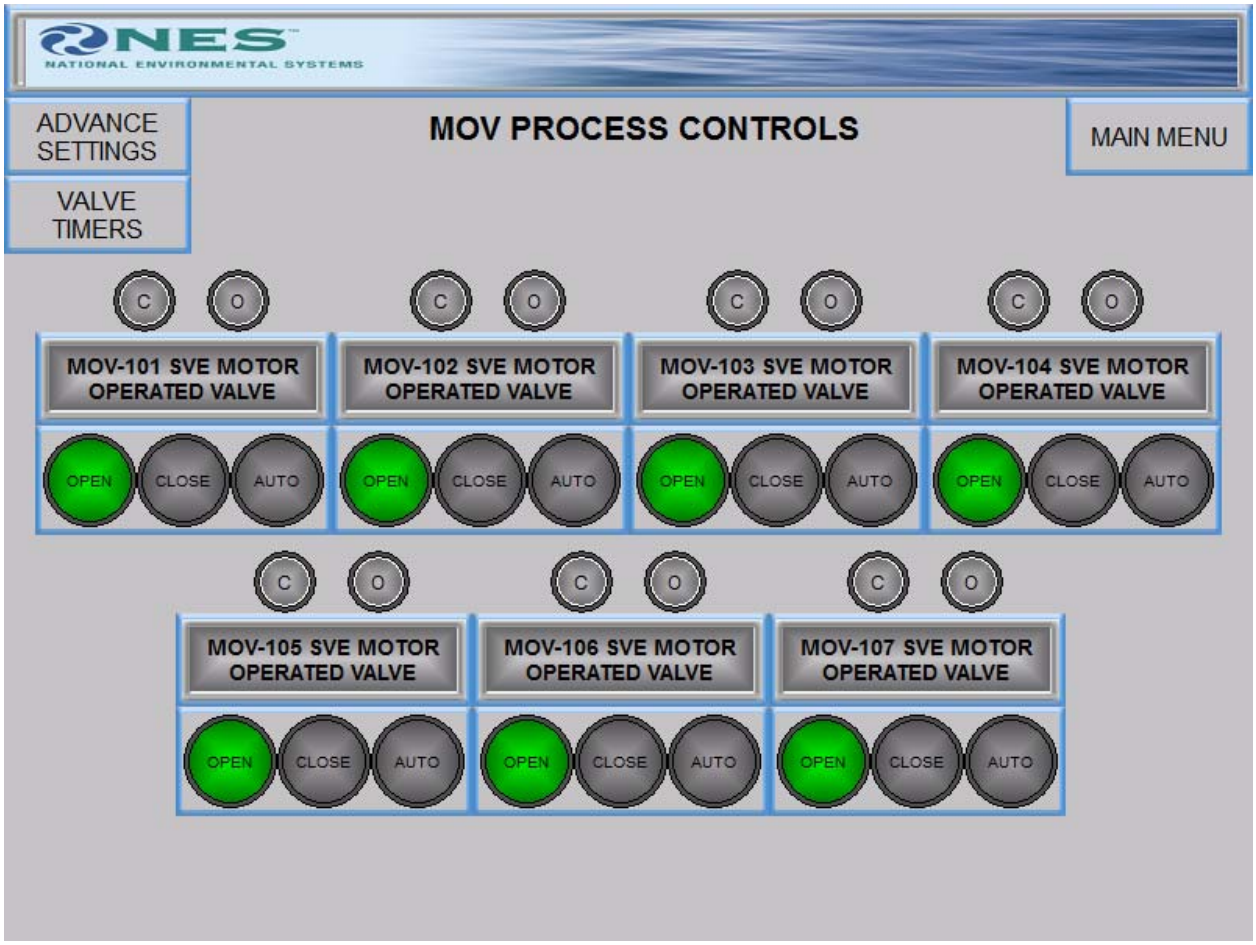


REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY



NES PROJECT: 13-214 Rev. B, AUGUST 2015
AMEC / REVIEW AVE DEVELOPMENT – QUEENS COUNTY, NY

REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY



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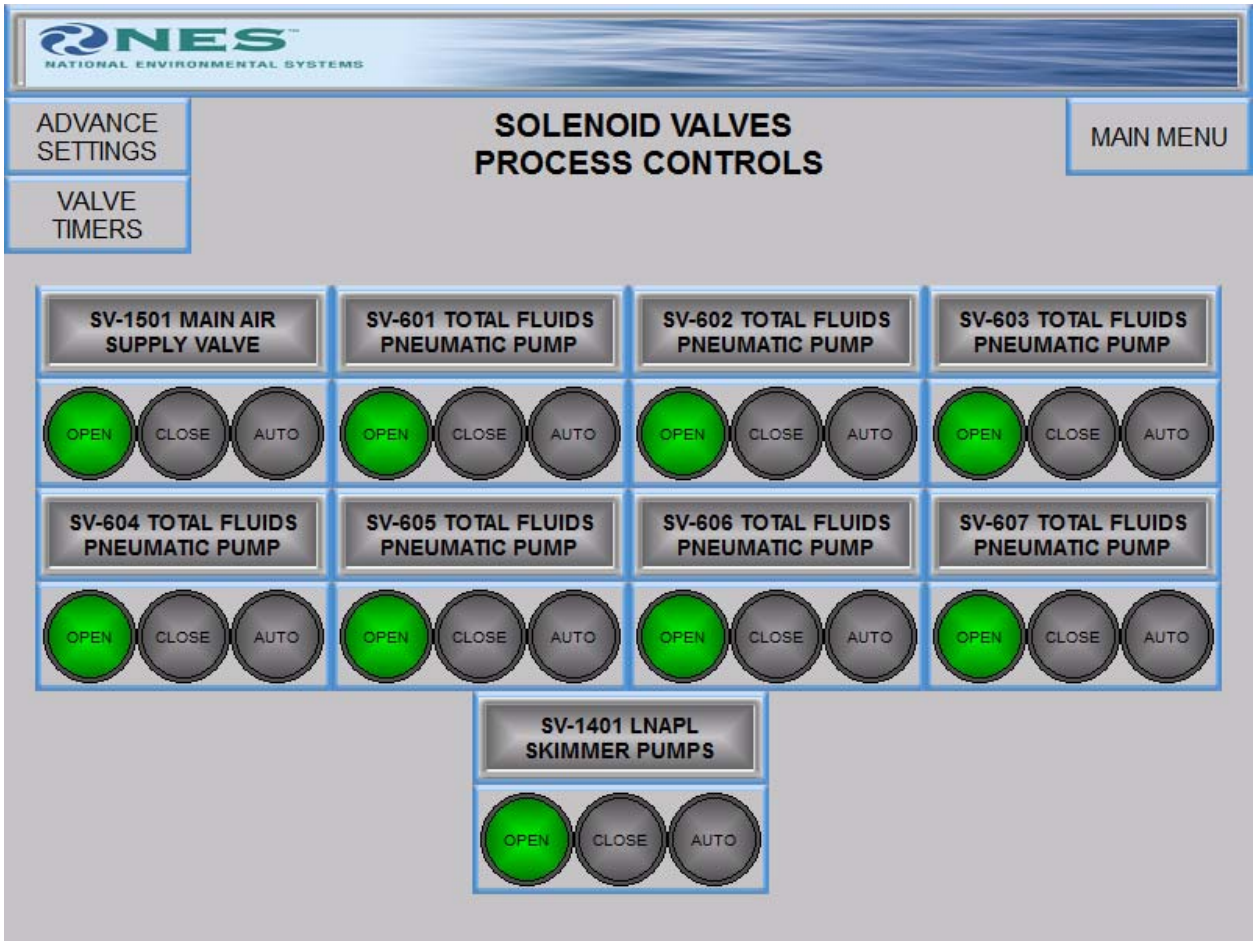
www.nes-inc.biz

REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY



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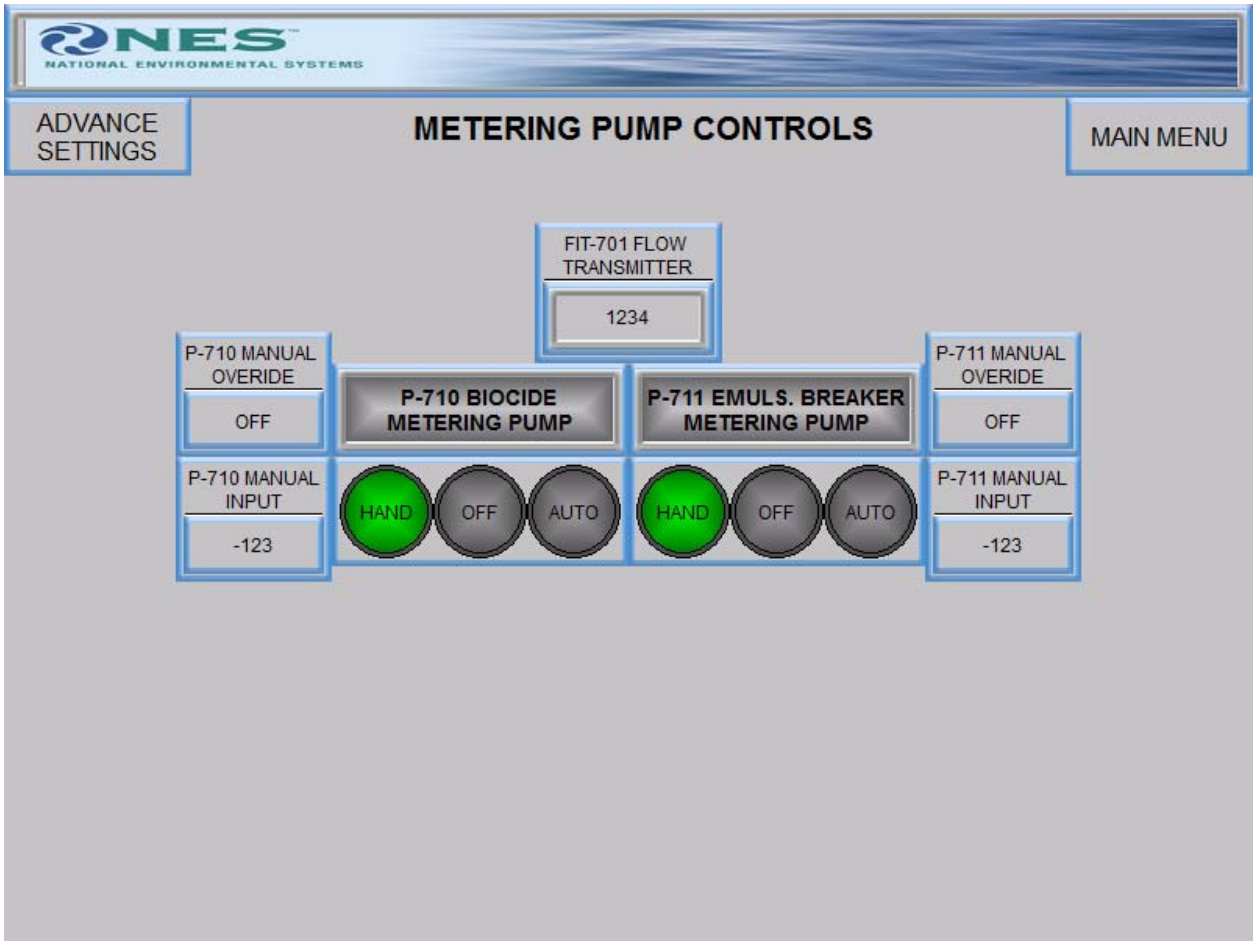
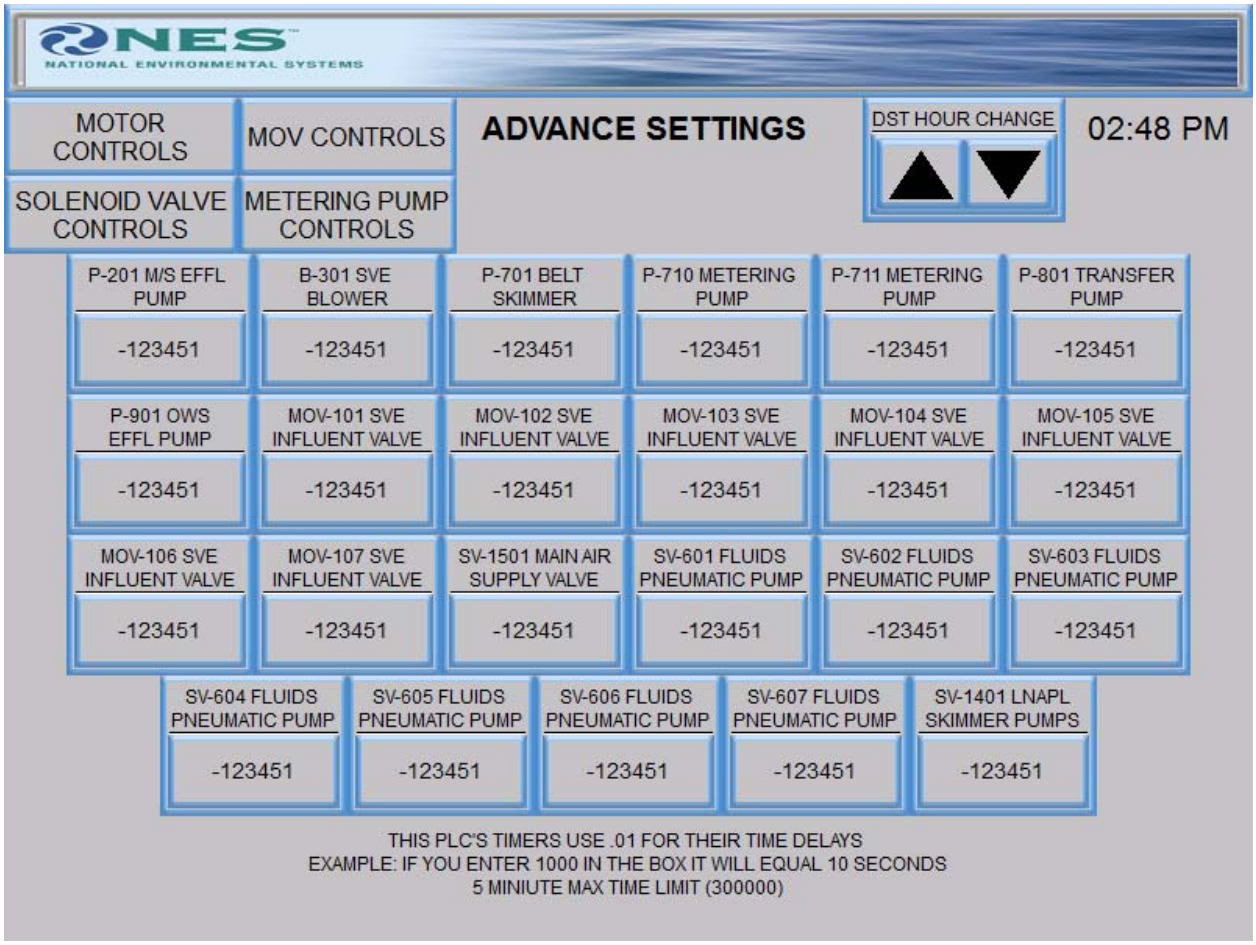
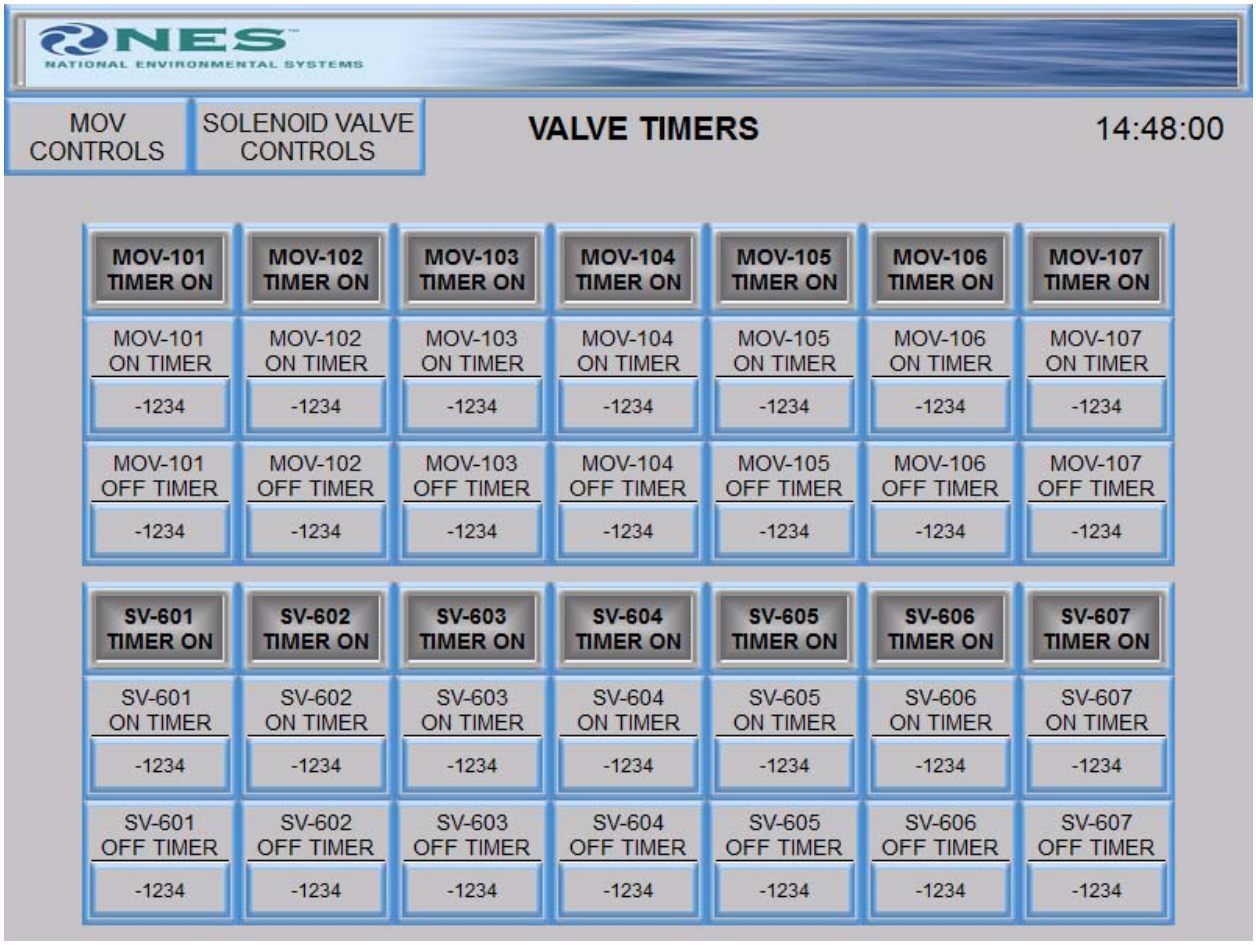


REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY



NES PROJECT: 13-214 Rev. B, AUGUST 2015
AMEC / REVIEW AVE DEVELOPMENT – QUEENS COUNTY, NY

REMOTE ACCESS INSTRUCTIONS & HMI SCREEN SUMMARY



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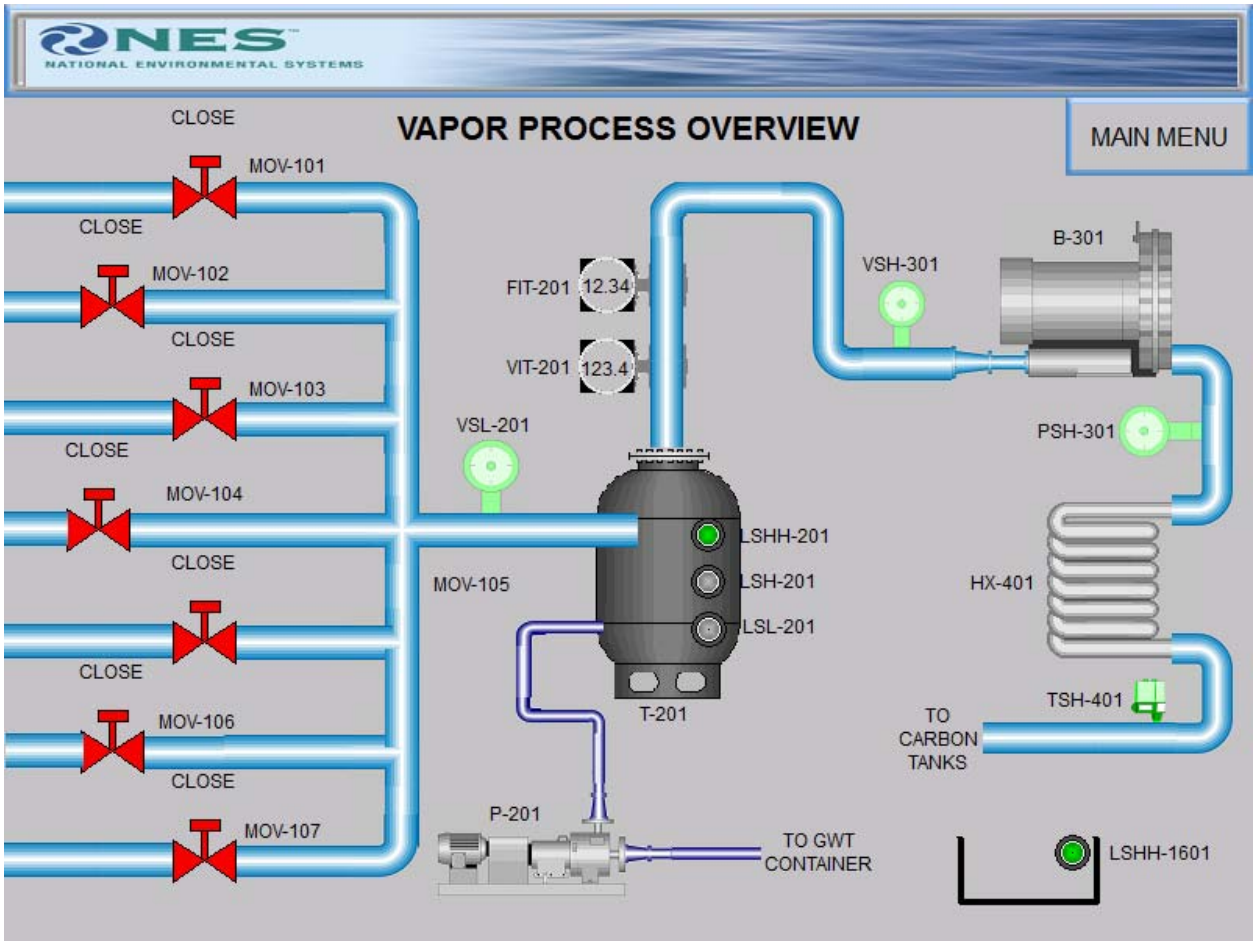

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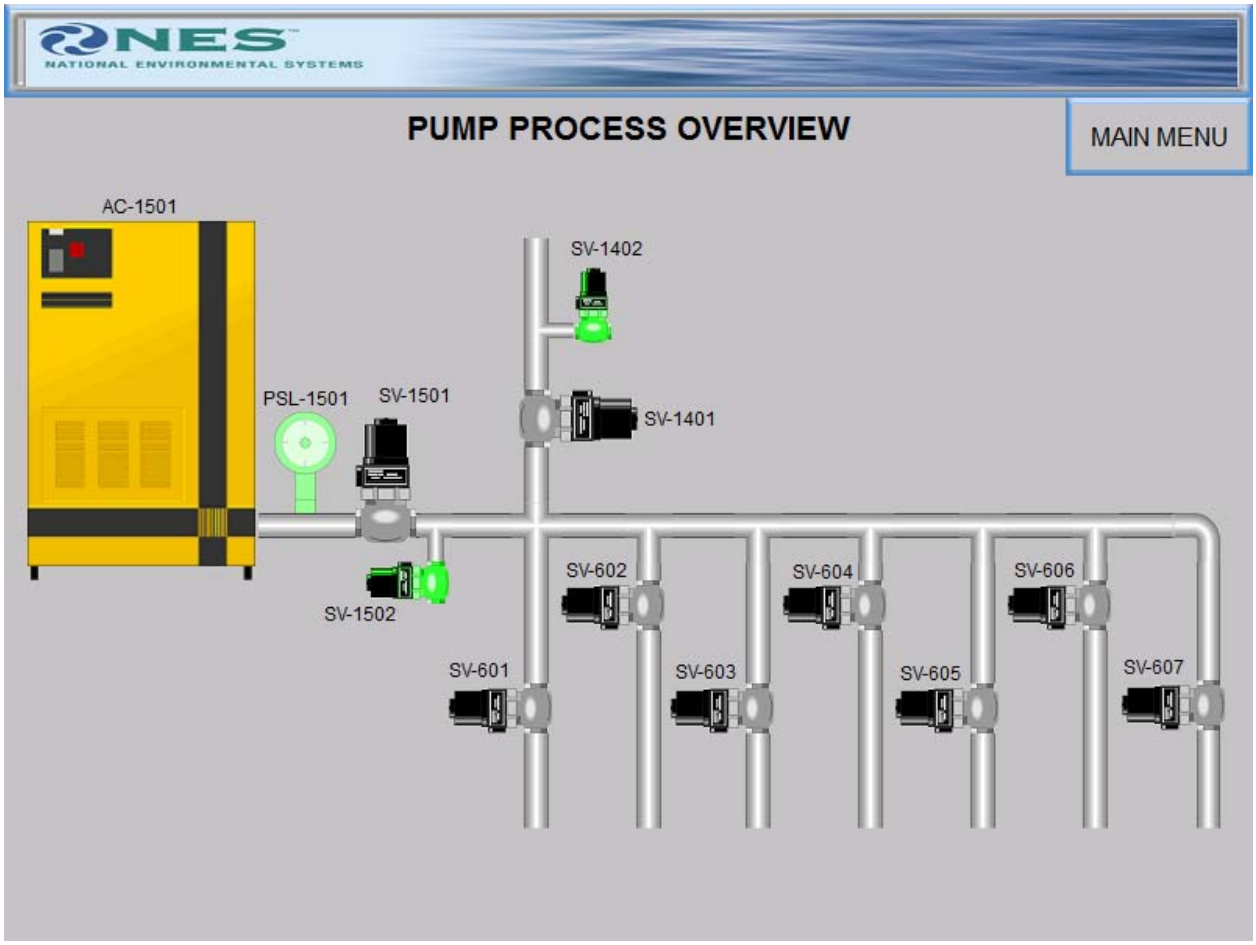

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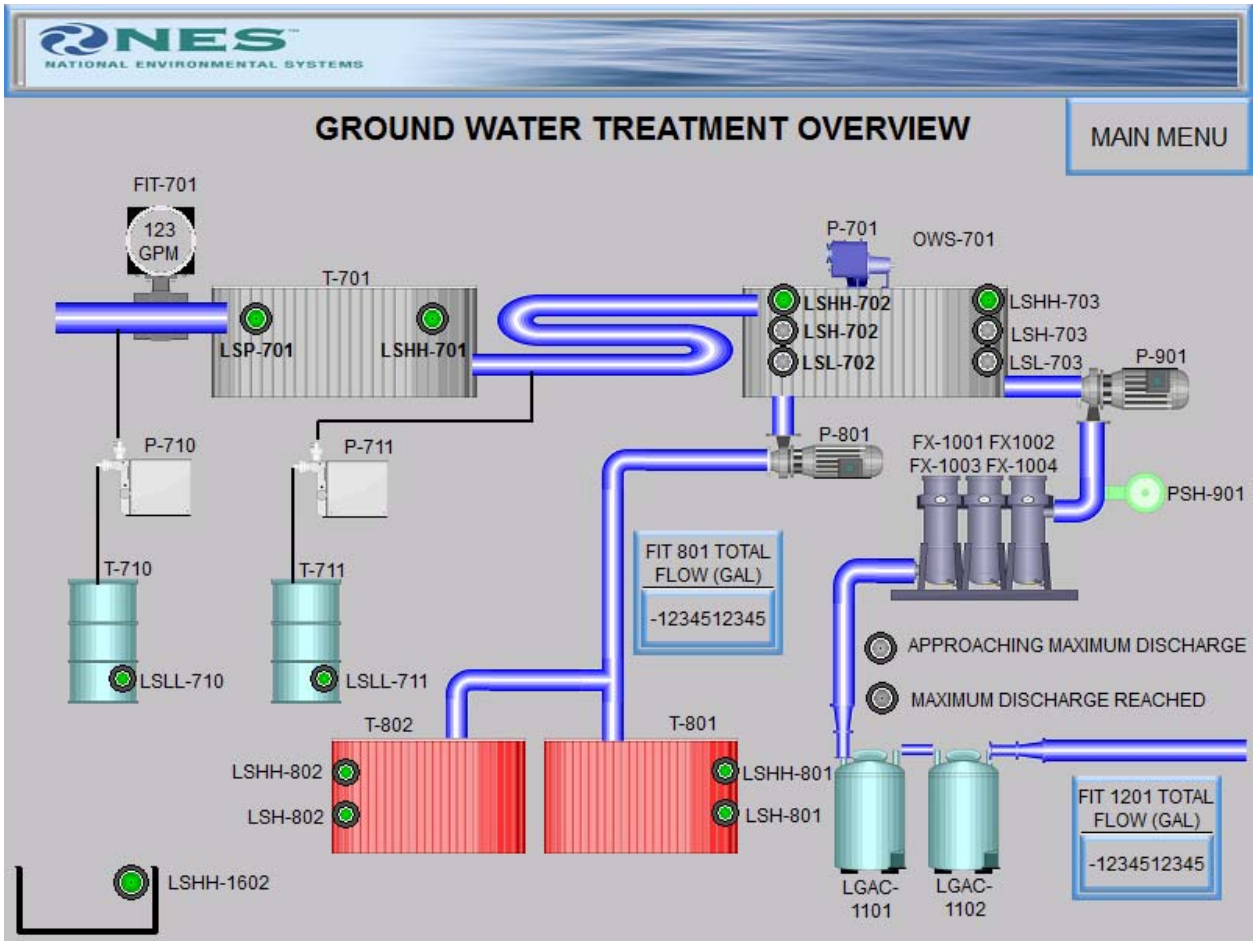

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AMEC / REVIEW AVE DEVELOPMENT – QUEENS COUNTY, NY

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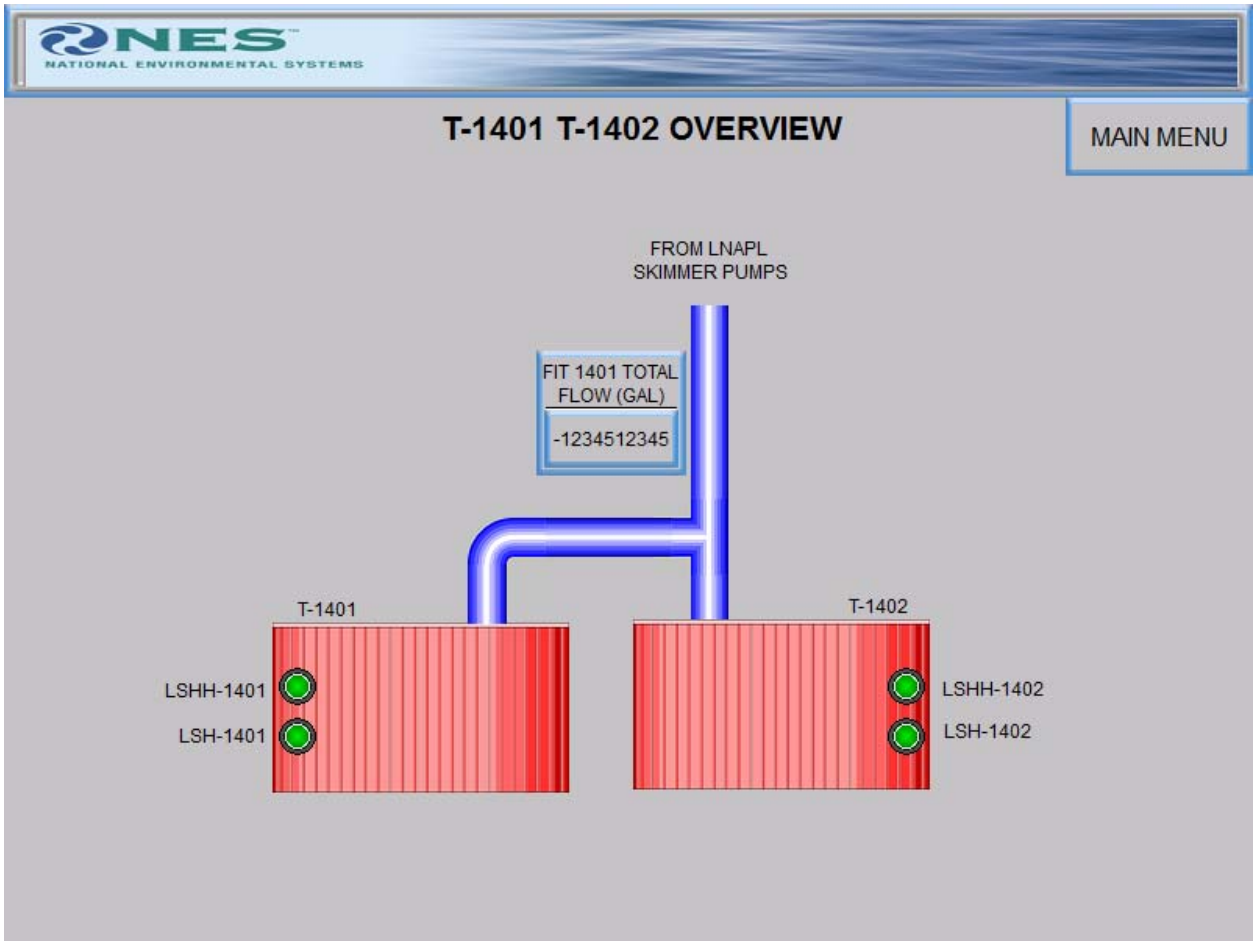

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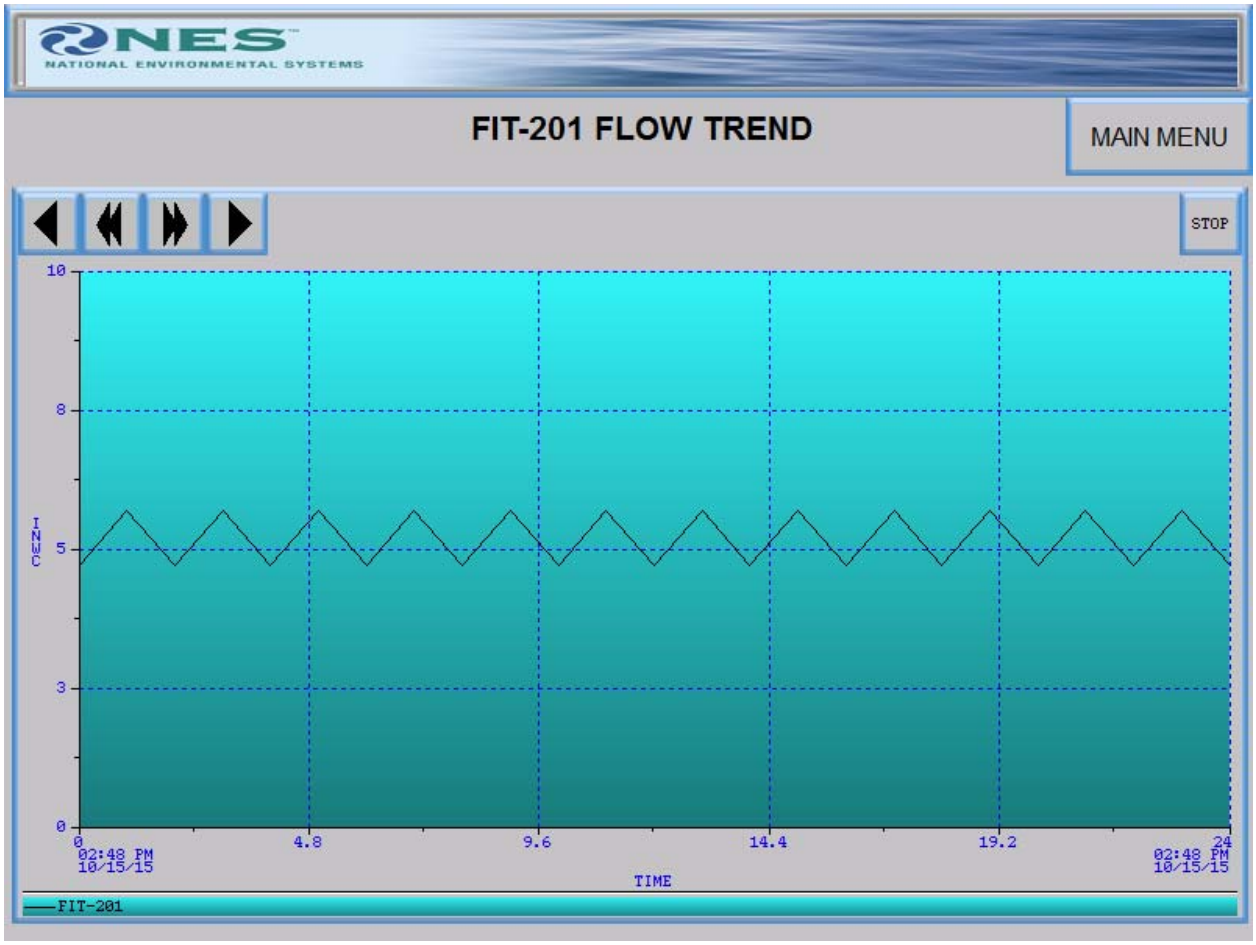

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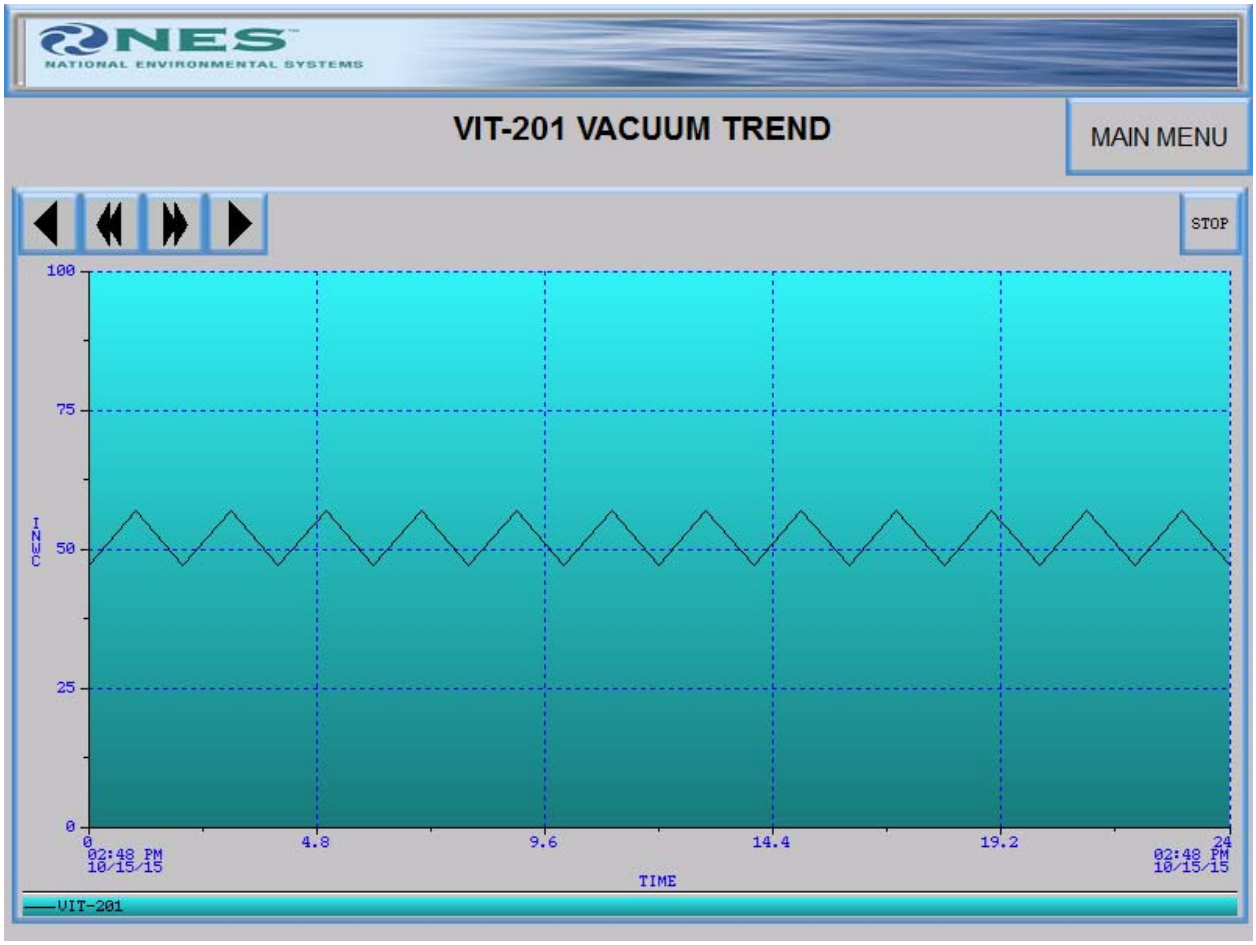

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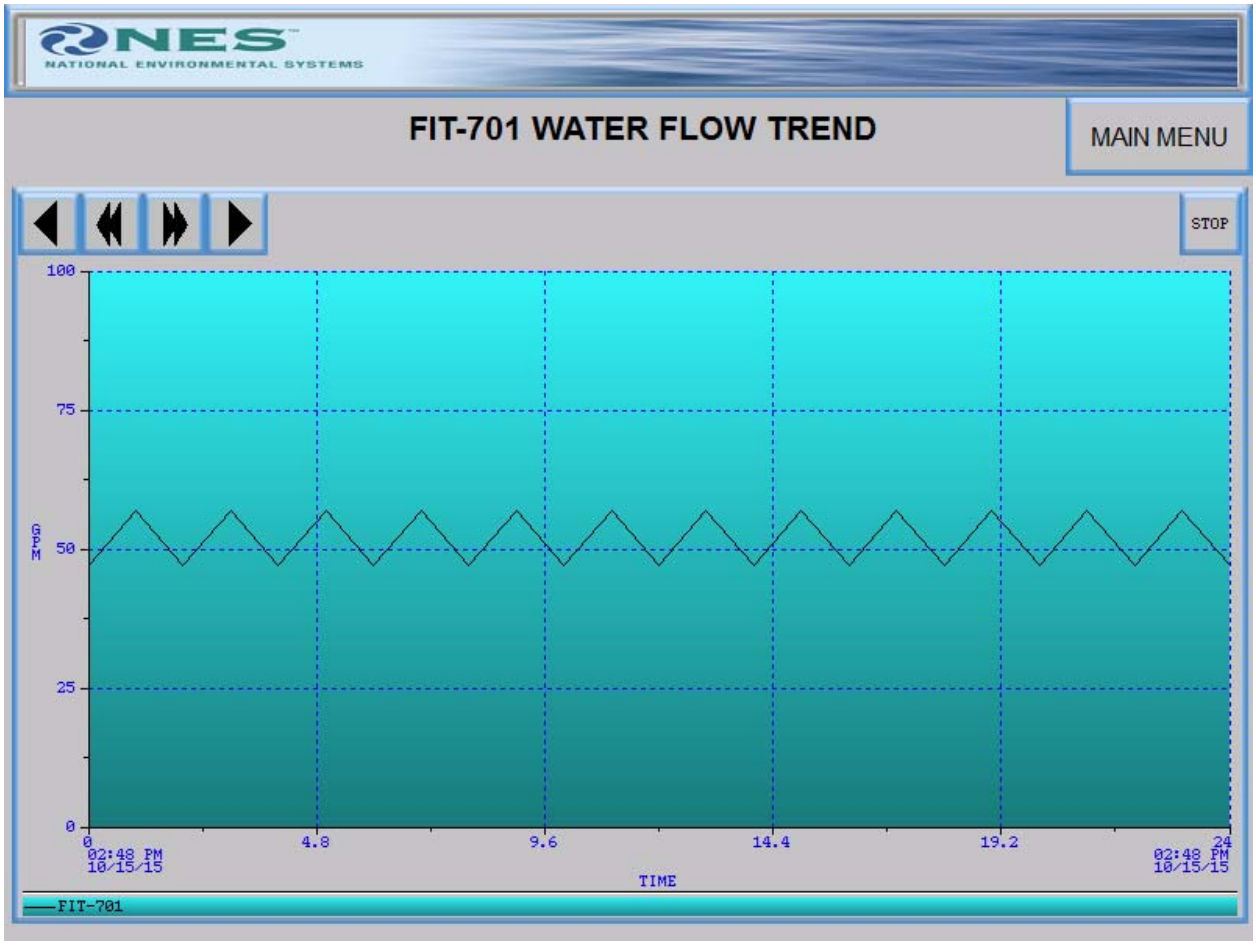

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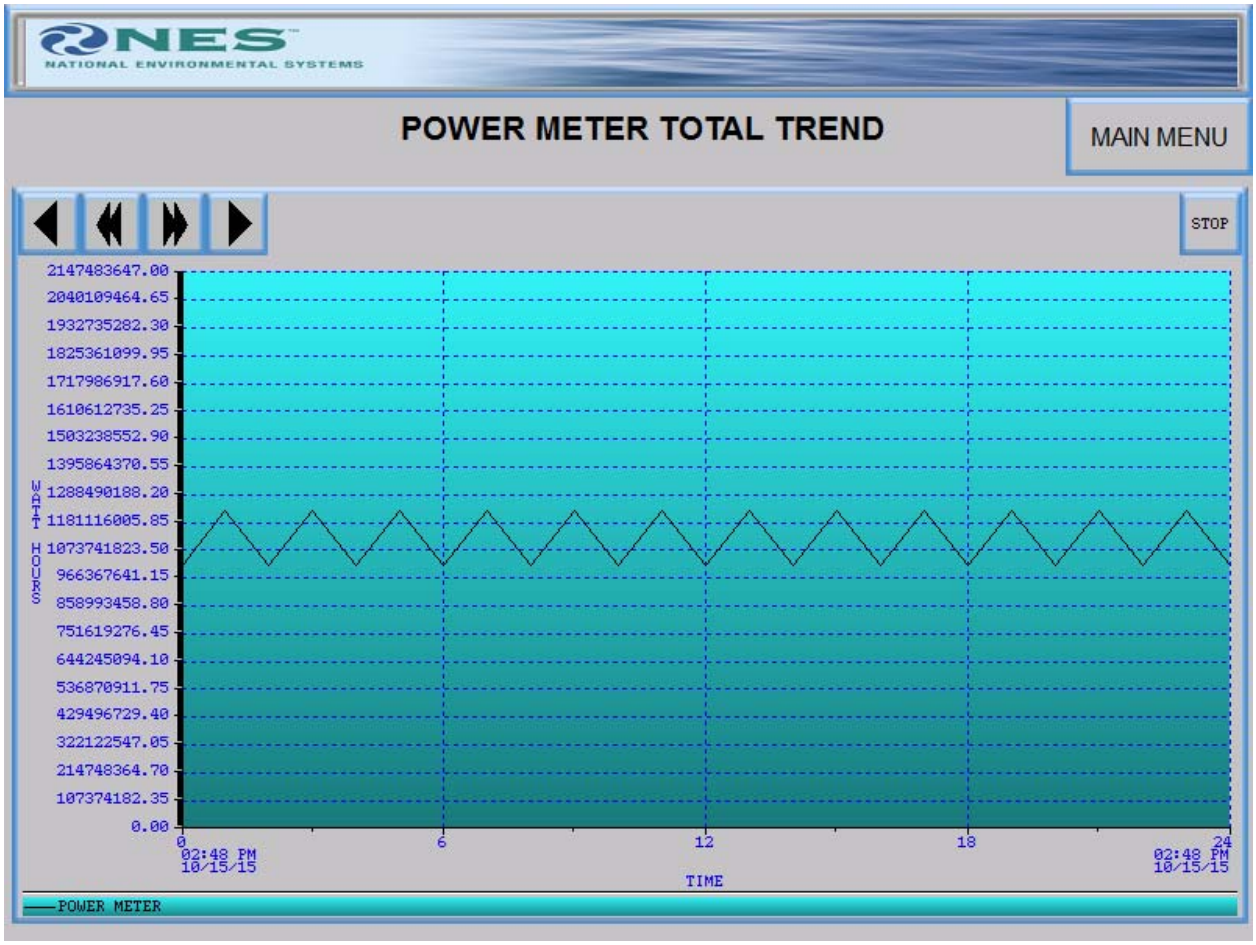

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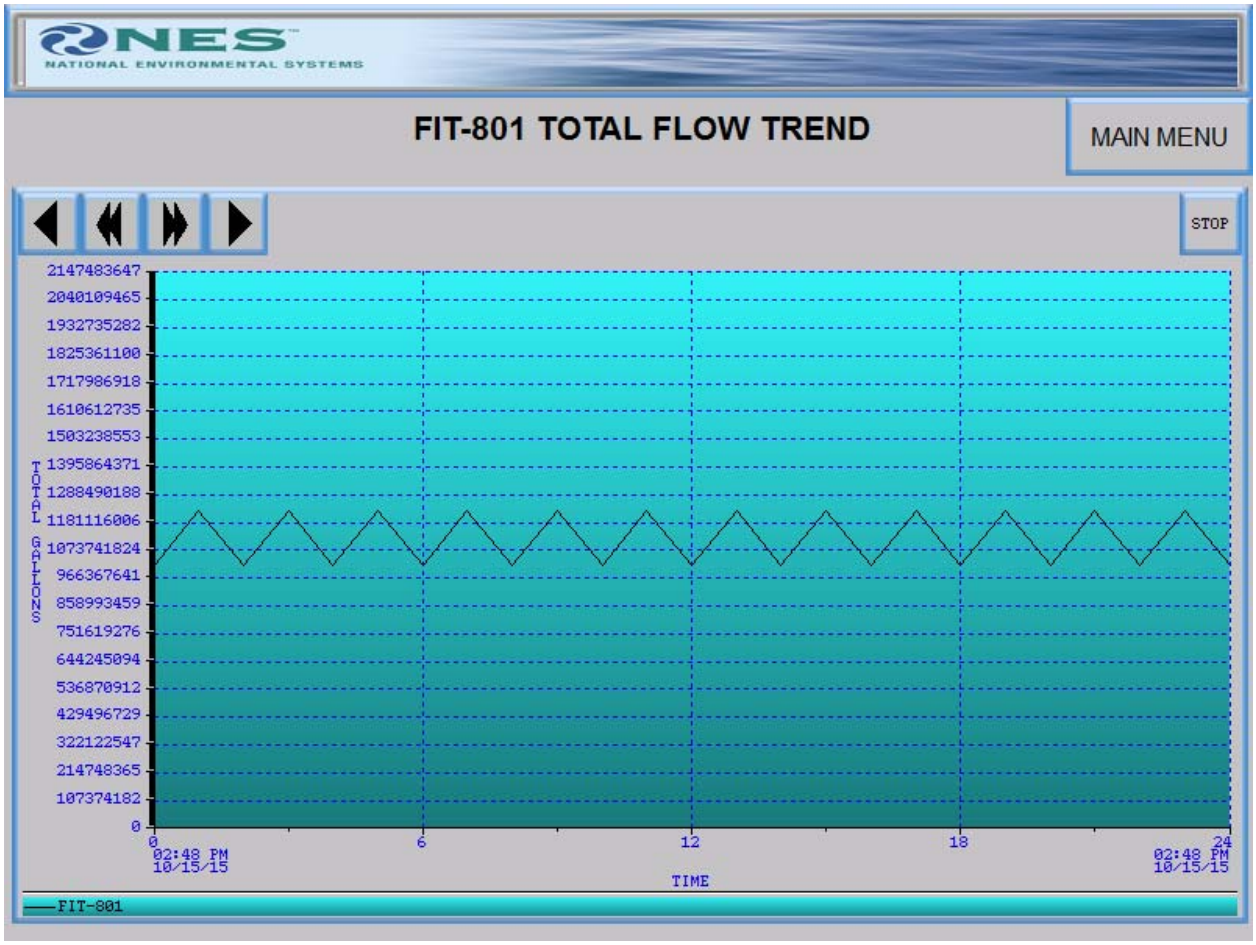

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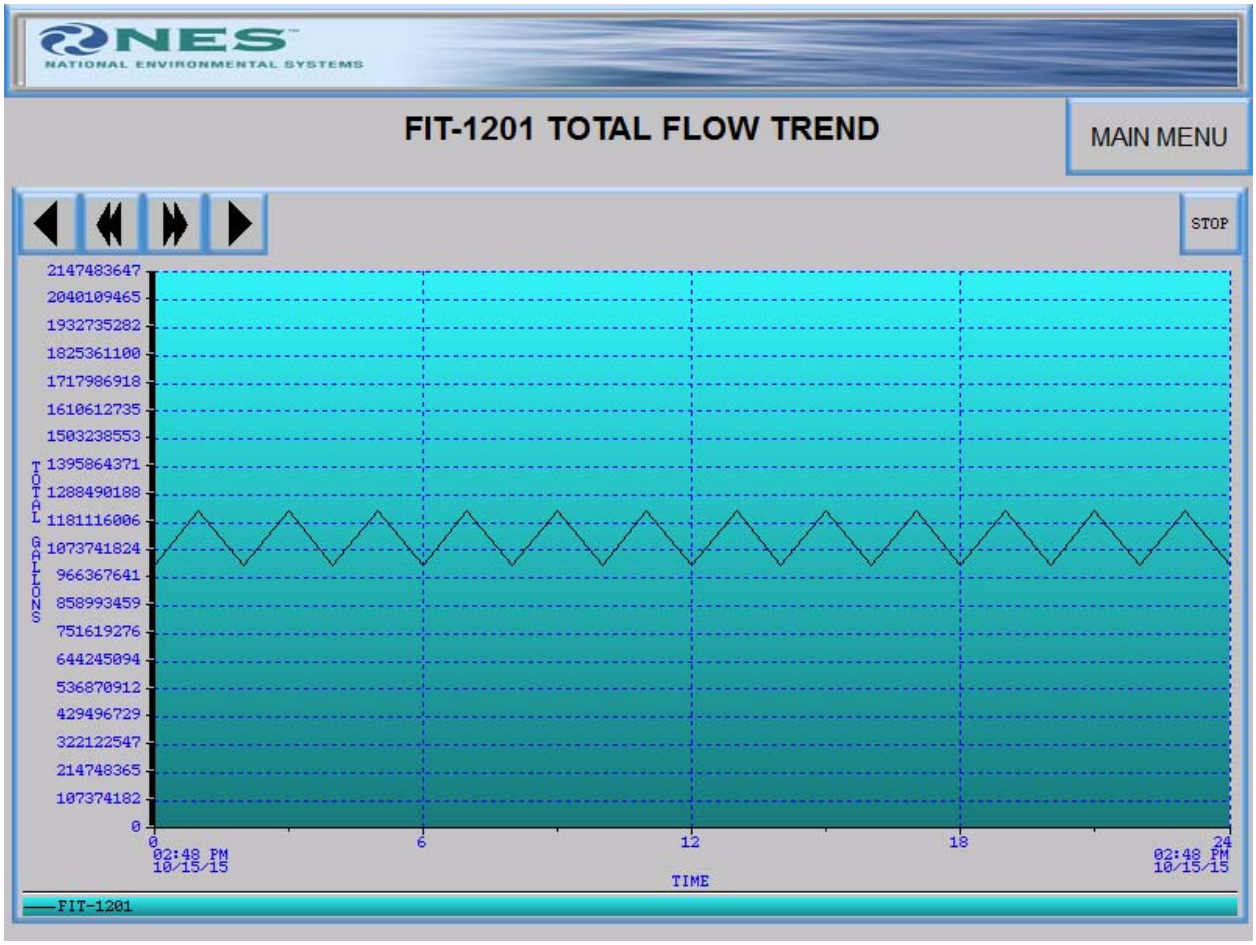

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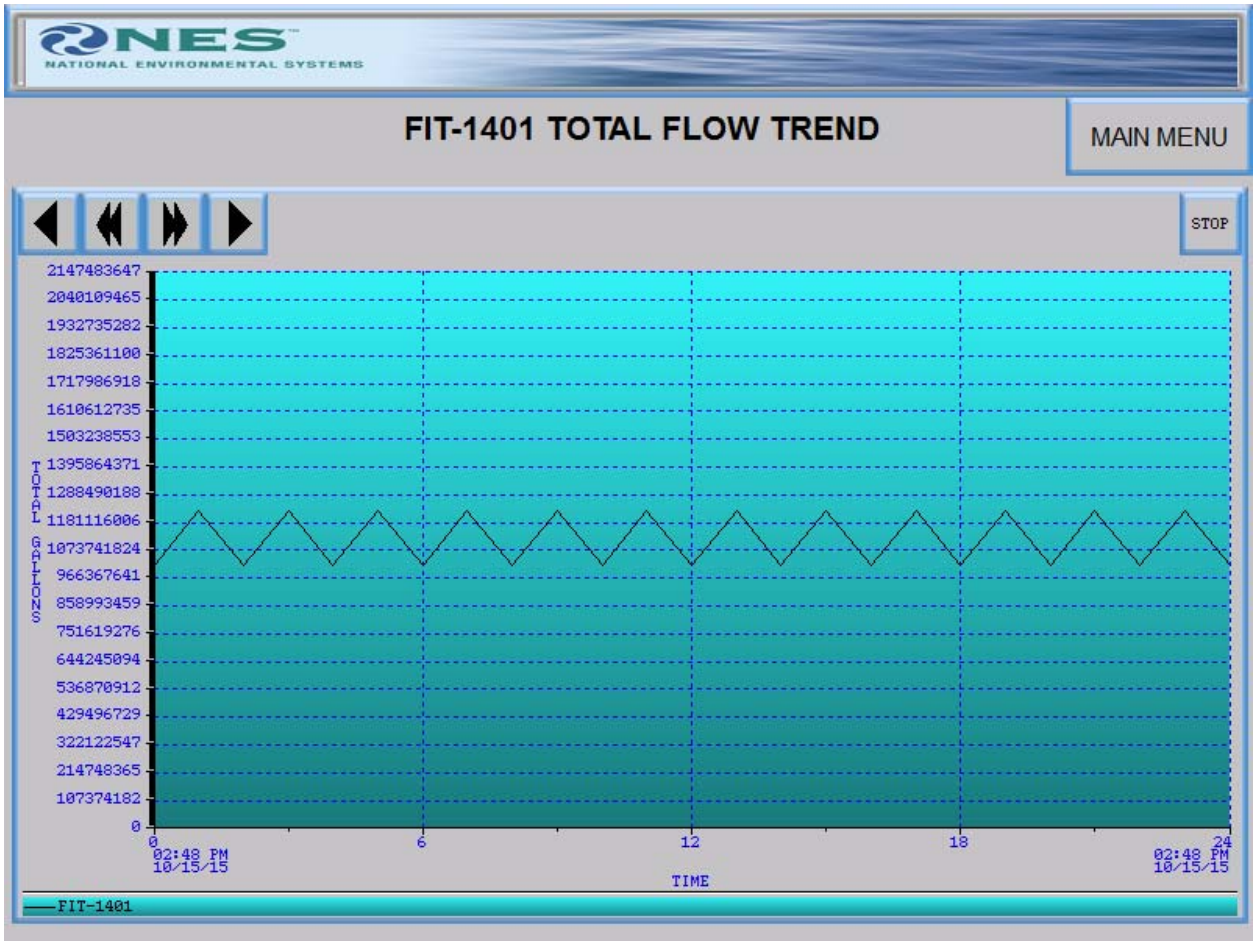

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TABLE 2
NES 13-214 - INTERLOCK SCHEDULE REVISION B (AUGUST 2015)
VACUUM ENHANCED RECOVERY SYSTEM
AMEC / REVIEW AVE DEVELOPMENT - SITES C241005 & C241089 / QUEENS COUNTY, NY

Interlock	Interlock ID	Interlock Description	MOV-101, SVE MOTOR OPERATED VALVE	MOV-102, SVE MOTOR OPERATED VALVE	MOV-103, SVE MOTOR OPERATED VALVE	MOV-104, SVE MOTOR OPERATED VALVE	MOV-105, SVE MOTOR OPERATED VALVE	MOV-106, SVE MOTOR OPERATED VALVE	MOV-107, SVE MOTOR OPERATED VALVE	P-201, MS TRANSFER PUMP	B-301, SVE BLOWER	SV-601, TOTAL FLUIDS PUMP AIR SUPPLY	SV-602, TOTAL FLUIDS PUMP AIR SUPPLY	SV-603, TOTAL FLUIDS PUMP AIR SUPPLY	SV-604, TOTAL FLUIDS PUMP AIR SUPPLY	SV-605, TOTAL FLUIDS PUMP AIR SUPPLY	SV-606, TOTAL FLUIDS PUMP AIR SUPPLY	SV-607, TOTAL FLUIDS PUMP AIR SUPPLY	P-701, PRODUCT BELT SKIMMER	P-710, BIOCIDE METERING PUMP	P-711, EMULS. BREAKER METERING PUMP	P-801, PRODUCT TRANSFER PUMP	P-901, OWS EFFLUENT PUMP	SV-1401, SKIMMER PUMP AIR SUPPLY (NORMALLY CLOSED)	SV-1402, SKIMMER PUMP AIR SUPPLY (NORMALLY OPEN)	SV-1601, AIR COMPRESSOR SUPPLY (NORMALLY CLOSED)	SV-1602, AIR COMPRESSOR SUPPLY (NORMALLY CLOSED)	OPERATOR INTERFACE	Adjustable Set Point (HMI Screen Display)	Warning Notification (HMI Screen Display)	Alarm Notification (HMI Screen Display)	Warning Notification (Local Panel Display)	Alarm Notification (Local Panel Display)	Manual Reset (Warning / Alarm)	Remote Warning Notification	Remote Alarm Notification	Event Log	Alarm Log	Data Log (10 Minutes)	INSTRUMENT TYPE
1		Emergency Stop	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O														D
2		HMI SVE MOV Programmable Timer	I/O	I/O	I/O	I/O	I/O	I/O	I/O																						Y											L
3		HMI Total Fluids SV Programmable Timer										I/O	I/O	I/O	I/O	I/O	I/O	I/O													Y											L
4	VSL-201	SVE Manifold Header Vacuum Switch - Low	O	O	O	O	O	O	O		O																					Y										D
5	LSHH-201	MS Level Switch - High/High	O	O	O	O	O	O	O	O	O																					Y										D
6	LSH-201	MS Level Switch - High								I																																D
7	LSL-201	MS Level Switch - Low								O																																D
8	FIT-201	SVE Air Flow																																								A
9	VIT-201	SVE Vacuum																																								A
10	VSH-301	SVE Blower Inlet Vacuum Switch - High	O	O	O	O	O	O	O		O																					Y										D
11	PSH-301	SVE Blower Discharge Pressure Switch - High	O	O	O	O	O	O	O		O																					Y										D
12	TSH-401	Heat Exchanger Discharge Temperature Switch - High	O	O	O	O	O	O	O		O																					Y										D
13	FIT-701	MS Transfer Pump Flow Indicating Transmitter																		P	P																				A
14	LSP-701	Non-Conductive Liquid Detected in Separator (Product)								O		O	O	O	O	O	O	O		O	O											Y										D
15	LSHH-701	Pre-Separator Level Switch High/High								O		O	O	O	O	O	O	O		O	O											Y										D
16	LSHH-702	OWS Level Switch (Product) - High/High								O		O	O	O	O	O	O	O	O	O	O	O										Y										D
17	LSH-702	OWS Level Switch (Product) High																				I										Y										D
18	LSL-702	OWS Level Switch (Product) - Low																				O										Y										D
19	LSHH-703	OWS Level Switch (Water) - High/High								O		O	O	O	O	O	O	O		O	O		O									Y										D
20	LSH-703	OWS Level Switch (Water) - High																					I									Y										D
21	LSL-703	OWS Level Switch (Water) - Low																					O									Y										D
22	LSLL-710	Chemical Tank Level Switch (Biocide) - Low																		O											Y										D
23	LSLL-711	Chemical Tank Level Switch (Emuls. Breaker) - Low																			O										Y										D
24	FIT-801	Flow Total Pulse from OWS Product Effl. Pump																																									D
25	LSHH-801	LNAPL Tank, T-801 Level Switch (TSCA) - High / High								O		O	O	O	O	O	O	O	O	O	O	O										Y										D
26	LSH-801	LNAPL Tank, T-801 Level Switch (TSCA) - High										O	O	O	O	O	O	O															Y									D
27	LSHH-802	LNAPL Tank, T-802 Level Switch (TSCA) - High / High								O		O	O	O	O	O	O	O	O	O	O	O										Y										D
28	LSH-802	LNAPL Tank, T-802 Level Switch (TSCA) - High										O	O	O	O	O	O	O															Y									D
29	PSH-901	Bag Filter Inlet Pressure Switch - High								O		O	O	O	O	O	O	O		O	O		O									Y										D
30	FIT-1201	Flow Total Pulse from System Effluent																																								D
31	FTH-1201	High Total Flow Discharge Warning																														Y			Y							L
32	FTHH-1201	High Total Flow Discharge Alarm	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O		O	O		O										Y									L
33	FIT-1401	Flow Total Pulse from Product Skimmer Pumps																																								D
34	LSHH-1401	LNAPL Tank, T-1401 Level Switch (NON TSCA) - High / High																						O	O							Y										D
35	LSH-1401	LNAPL Tank, T-1401 Level Switch (NON TSCA) - High																														Y			Y							D
36	LSHH-1402	LNAPL Tank, T-1402 Level Switch (NON TSCA) - High / High																						O	O							Y										D
37	LSH-1402	LNAPL Tank, T-1402 Level Switch (NON TSCA) - High																														Y			Y							D
38	PSL-1501	Air Compressor Pressure Switch - Low										O	O	O	O	O	O	O		O	O			O	O	O	O					Y										D
39	LSHH-1601	Secondary Containment Level Switch (SVE Enclosure) - High	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O					Y										D
40	LSHH-1602	Secondary Containment Level Switch (GWT Enclosure) - High	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O					Y										D
41	PM	Power meter pulse for Watt Hours (total energy usage)																																								A
42	MOV CLOSED	All MOV's Closed									O																				Y										L

Note: HMI - Human/Machine Interface

O - Off
I - On
I/O - On/Off Control
P - Propositional Control

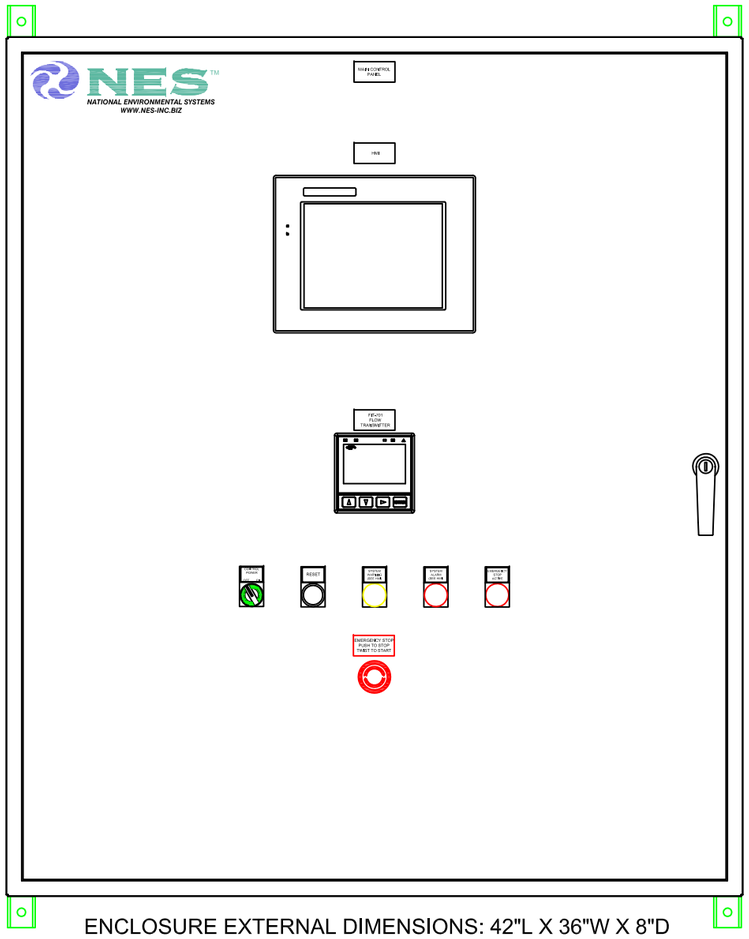
Y - Yes

A - Analog
D - Digital
L - Internal Logic

FTH-1201 High total flow discharge warning and FTHH-1201 high total flow discharge alarm automatically resets at midnight
LSH / LSHH-802 and LSH/LSHH-1402 not to be used / interlocks present - inputs jumped

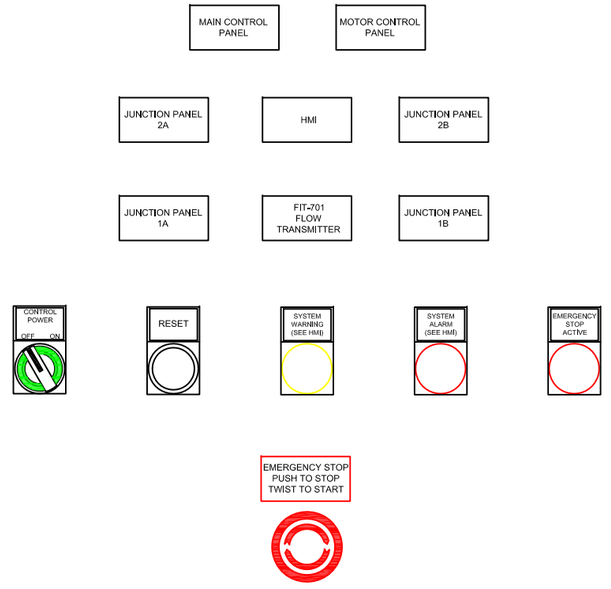
National Environmental Systems
84 Dunham Street - Attleboro, MA 02703
Phone: (508)226-1100; Fax: (508)226-1180; Email: Info@nes-inc.biz

PANEL EXTERIOR

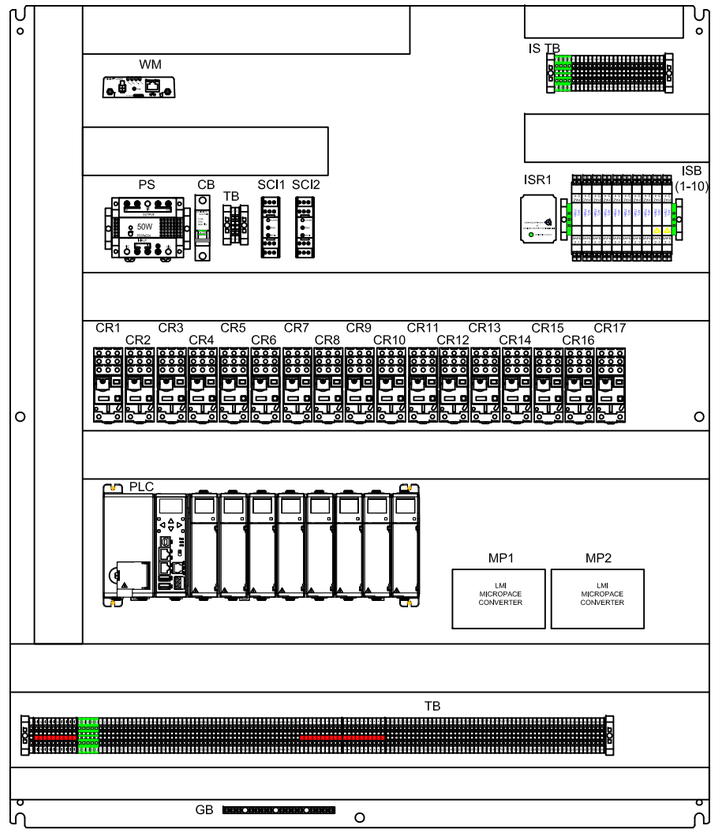


ENCLOSURE EXTERNAL DIMENSIONS: 42"L X 36"W X 8"D
*SEE NOTES: 1, 4 & 5

OPERATOR DETAILS



PANEL INTERIOR



LEGEND

CB - CONTROLS CIRCUIT BREAKER
CR - CONTROL RELAY
GB - GROUND BAR
HMI - HUMAN MACHINE INTERFACE
ISB - INTRINSICALLY SAFE BARRIER
ISR - INTRINSICALLY SAFE RELAY
IS TB - INTRINSICALLY SAFE TERMINAL BLOCKS
LC - LEVEL CONTROLLER
M - MOTOR STARTER
MP - MICROPACE ANALOG TO DIGITAL CONVERTER
PLC - PROGRAMMABLE LOGIC CONTROLLER
PS - POWER SUPPLY
SCI - SIGNAL CONVERTER / ISOLATOR
TB - TERMINAL BLOCK (SET)
WM - WIRELESS MODEM

GENERAL NOTES:

1. THIRD PARTY CERTIFICATION STICKER (T.R. ARNOLD & ASSOCIATES, INC.) LOCATED WITHIN PANEL ENCLOSURE. PANEL LOCATION: CONTROL & SVE TREATMENT SYSTEM ENCLOSURE INTERIOR.
2. THIRD PARTY CERTIFICATION STICKER (T.R. ARNOLD & ASSOCIATES, INC.) LOCATED WITHIN PANEL ENCLOSURE. PANEL LOCATION: GROUND WATER TREATMENT SYSTEM ENCLOSURE EXTERIOR.
3. CONTROL PANEL ASSEMBLY IS UL 508A LISTED
4. CONTROL PANEL ASSEMBLY IS UL 698A LISTED
5. H/O/A'S CONTROLLED BY HMI SCREEN
6. GROUND IN ACCORDANCE WITH N.E.C. ARTICLE 250.122 & LOCAL AUTHORITY HAVING JURISDICTION
7. REFER TO TABLE 3 FOR BILL OF MATERIALS

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	EMB

DRWN BY	RJD
DATE	02-11-14
CHK BY	RJD
DATE	01-12-15
APPR BY	
DATE	

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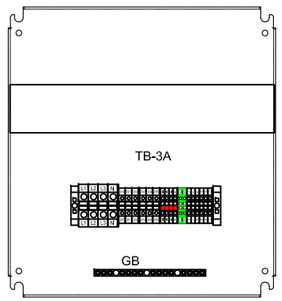
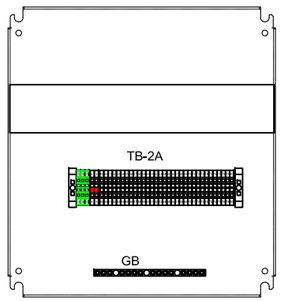
TITLE
CONTROL PANEL INTERIOR/EXTERIOR LAYOUT

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

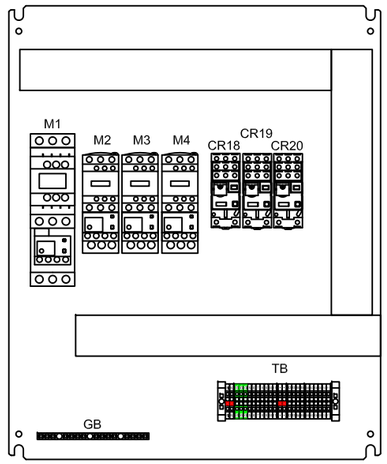
JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	I-1	1 OF 2	A



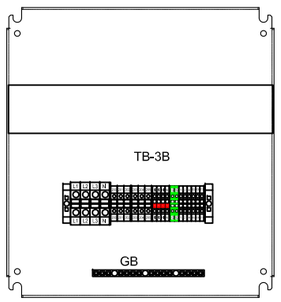
JUNCTION BOX (JB1-A) INTERIOR - SVE
EXTERNAL DIMENSIONS: 16"L X 12"W X 6"D
*SEE NOTE:3



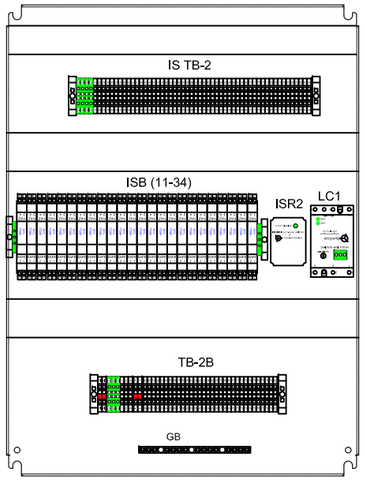
JUNCTION BOX (JB2-A) INTERIOR - SVE
EXTERNAL DIMENSIONS: 16"L X 12"W X 6"D
*SEE NOTE:3



MOTOR CONTROL PANEL
EXTERNAL DIMENSIONS: 24"L X 20"W X 8"D
*SEE NOTE:3



JUNCTION BOX (JB1-B) INTERIOR - GWT
EXTERNAL DIMENSIONS: 16"L X 12"W X 6"D
*SEE NOTE:3



JUNCTION BOX (JB2-B) INTERIOR - GWT
EXTERNAL DIMENSIONS: 24"L X 20"W X 6"D
*SEE NOTES: 2 & 4

REV	DESCRIPTION	DATE	APPROVED
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REVISIONS

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DATE	

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TITLE: JUNCTION BOX / MOTOR CONTROL INTERIOR LAYOUTS

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	I-1	2 OF 2	A

TABLE 3
PANEL BILL OF MATERIALS

PROJECT NUMBER: 13-214 (REVISION A MAY 2015)

CLIENT PROJECT REFERENCE: AMEC - VACUUM ENHANCED RECOVERY SYSTEM / REVIEW AVE DEVELOPMENT - QUEENS COUNTY, NY

TAG	QTY	ITEM	MANUFACTURER	MODEL
MOTOR CONTROL PANEL				
MCC	1	MOTOR CONTROL CENTER ENCLOSURE	HAMMOND	EN4SD24208GY
MCC	1	BACK PANEL	HAMMOND	EP2420
MCC	1	MOUNTING FEET	HAMMOND	EZPMFHD
MCC	1	LOCKING HANDLE	SCE	SCE-PLWKB
CR17-20	3	2 POLE RELAY	SQUARE D	RUMF2AB2F7
CR17-20	3	2 POLE RELAY BASE	SQUARE D	RUZSF3M
GB	1	GROUND BAR	SQUARE D	PKA15GTA
TB	5	GROUNDING TERMINALS	SQUARE D	NSYTRV22PE
TB	25	TERMINAL BLOCKS	SQUARE D	NSYTRV22
TB	4	END ANCHORS	SQUARE D	NSYTRAABV35
TB	10	END BARRIERS	SQUARE D	NSYTRAC22
M1	1	MOTOR STARTER (CONTACTOR)	SQUARE D	LC1D65AG7
M1	1	MOTOR STARTER (OVERLOAD) 37-50A	SQUARE D	LRD350L
M2,M3,M4	3	MOTOR STARTER (CONTACTOR)	SQUARE D	LC1D09G7
M2	1	MOTOR STARTER (OVERLOAD) 1.6-2.5A	SQUARE D	LRD07
M3	1	MOTOR STARTER (OVERLOAD) 7-10A	SQUARE D	LRD14
M4	1	MOTOR STARTER (OVERLOAD) 2.5-4 A	SQUARE D	LRD08
MASTER CONTROL PANEL				
MCP	1	MASTER CONTROL PANEL ENCLOSURE	HAMMOND	EN4SD42368GY
MCP	1	BACK PANEL	HAMMOND	EPP4236
MCP	1	MOUNTING FEET	HAMMOND	EZPMFHD
PLC	1	PLC CABLE	AUTOMATION DIRECT	EA-2CBL
PLC	1	RACK 8 SLOT	AUTOMATION DIRECT	P3-08B
PLC	1	RACK POWER SUPPLY	AUTOMATION DIRECT	P3-01AC
PLC	1	P3000 CPU	AUTOMATION DIRECT	P3-550
PLC	4	16 POINT DC INPUT CARD	AUTOMATION DIRECT	P3-16ND3
PLC	1	ANALOG COMBO CARD (8 IN 4 OUT)	AUTOMATION DIRECT	P3-8AD4DA-1
PLC	2	16 POINT RELAY OUTPUT CARD	AUTOMATION DIRECT	P3-16TR
PLC	1	FILL CARD	AUTOMATION DIRECT	P3-FILL
PLC	7	IO CARD CONNECTOR	AUTOMATION DIRECT	P3-RTB
HMI	1	TOUCH SCREEN 8 INCH COLOR	AUTOMATION DIRECT	EA9-T8C
HMI	1	POWER SUPPLY FOR TOUCH SCREEN	AUTOMATION DIRECT	EA-AC
CM	1	CELLULAR 3G GATEWAY - STATIC IP HMI - AT&T	SIERRA WIRELESS	LS300 / 1101489
CM	1	MODEM BRACKET	SIERRA WIRELESS	6000558
CM	1	MODEM ANTENNA	WILSON	301125
SCI 1, 2	2	SIGNAL CONVERTER / ISOLATOR	DYWER	SC4380
PS	1	24VDC POWER SUPPLY	IDEC	PS5R-D24
ISB	8	INTRINSIC SAFETY BARRIERS DIGITAL	MTL	7728+
ISB	2	INTRINSIC SAFTY BARRIER ANALOG	MTL	7787+
ISB	2	INTRINSIC SAFTY BARRIER STAND	MTL	ISP-7000
ISR	1	INTRINSIC SAFETY RELAY	SYMCOM	ISS-101
CB	1	6 AMP BREAKER	SQUARE D	MG24430
CR1	1	3 POLE RELAY 120VAC	SQUARE D	RUMF3AB2F7
CR2-17	16	2 POLE RELAY 120VAC	SQUARE D	RUMF2AB2F7
CR1-17	17	2 / 3 POLE RELAY BASE	SQUARE D	RUZSFEM
MPC1,2	2	CONVERTER (PULSE TO 4-20mA)	LMI	MP100
FIT-701	1	FLOW METER DISPLAY/TRANSMITTER	SIGNET	9900
GB	1	GROUND BAR	SQUARE D	PKA15GTA
TB	125	TERMINAL BLOCKS	SQUARE D	NSYTRV22
TB	15	GROUNDING TERMINAL BLOCKS	SQUARE D	NSYTRV22PE
TB	10	END ANCHORS	SQUARE D	NSYTRAABV35

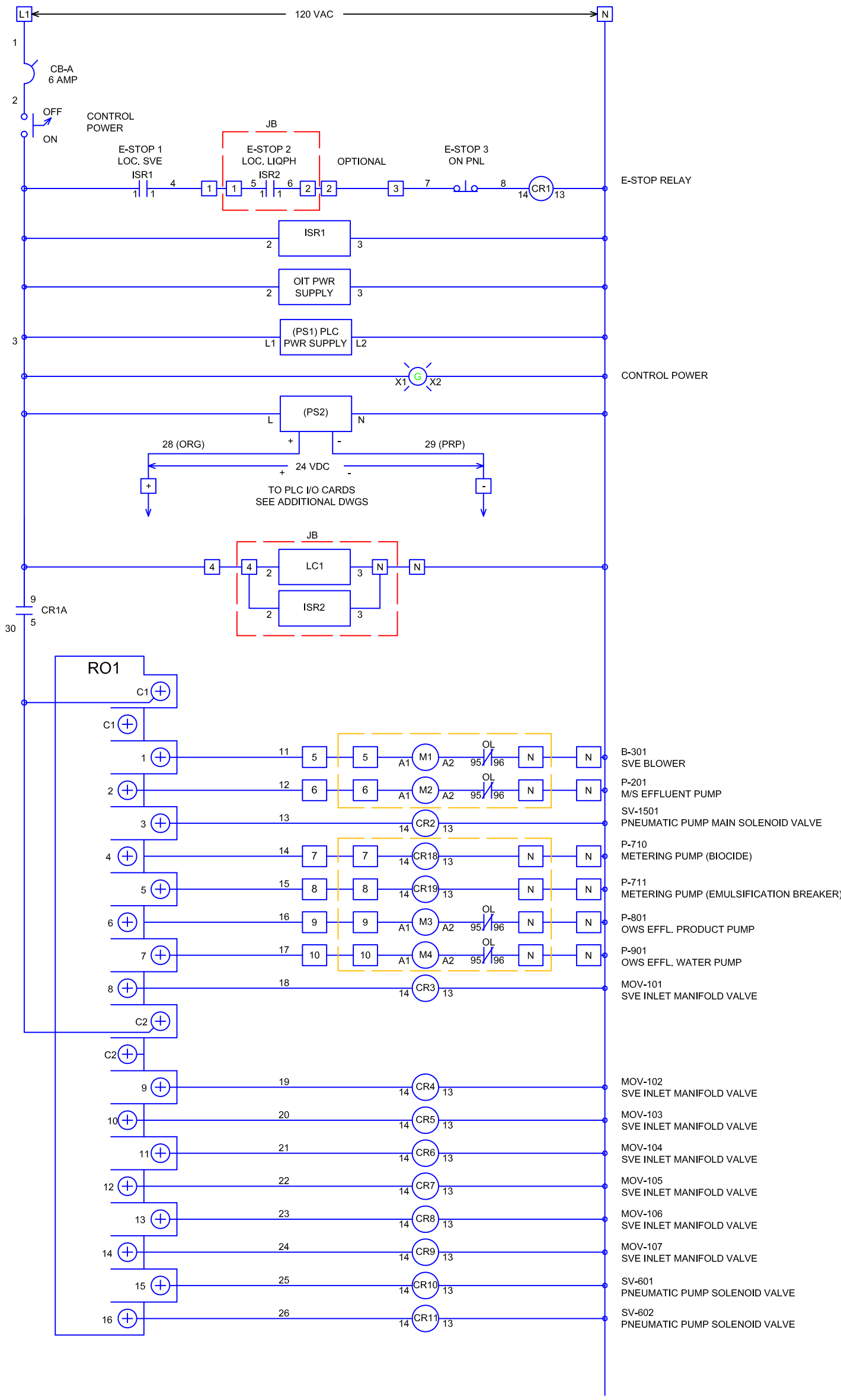
TABLE 3
PANEL BILL OF MATERIALS

PROJECT NUMBER: 13-214 (REVISION A MAY 2015)

CLIENT PROJECT REFERENCE: AMEC - VACUUM ENHANCED RECOVERY SYSTEM / REVIEW AVE DEVELOPMENT - QUEENS COUNTY, NY

TAG	QTY	ITEM	MANUFACTURER	MODEL
TB	10	END BARRIERS	SQUARE D	NSYTRAC22
IS TB	20	TERMINAL BLOCKS, BLUE	SQUARE D	NSTRV22BL
IS TB	10	END BARRIERS, BLUE	SQUARE D	NSYTRAC22BL
	1	SELECTOR SWITCH 2 WAY	SQUARE D	ZB5AK1233
	1	PUSH BUTTON	SQUARE D	ZB5AA2
	2	RED PILOT LIGHT	SQUARE D	ZB5AV043
	1	YELLOW PILOT LIGHT	SQUARE D	ZB5AVO53
	3	E-STOP BUTTON	SQUARE D	ZB5AS844
	2	E-STOP BOX	SQUARE D	XALD01H7
	2	MOUNTING LATCH	SQUARE D	ZB5AZ009
	1	GREEN LED LIGHT 120VAC	SQUARE D	ZB5AVG3
	2	RED LED LIGHT 120VAC	SQUARE D	ZB5AVG4
	1	YELLOW LED LIGHT 120VAC	SQUARE D	ZB5AVG5
	2	NORMALLY OPEN CONTACTS	SQUARE D	ZBE101
	3	NORMALLY CLOSED CONTACT	SQUARE D	ZBE102
JUNCTION BOXES				
JB1-A,JB1-B,JB2-A	3	JUNCTION BOXES	HAMMOND	EN4SD16126GY
JB-2B	3	BACK PANEL	HAMMOND	EP1612
JB2-B	1	JUNCTION BOXES	HAMMOND	EN4SD24206GY
JB2-B	1	BACK PANEL	HAMMOND	EP2420
ALL JB	4	MOUNTING FEET	HAMMOND	EZPMFHD
ALL JB	4	LOCKING HANDLE	SCE	SCE-PLWKB
TB	20	TERMINAL BLOCKS 50 AMP MAX	SQUARE D	NSYTRV62
TB	100	TERMINAL BLOCKS	SQUARE D	NSYTRV22
ISB	22	INTRINSIC SAFETY BARRIERS DIGITAL	MTL	7728+
IS TB	50	TERMINAL BLOCKS, BLUE	SQUARE D	NSTRV22BL
IS TB	10	END BARRIERS, BLUE	SQUARE D	NSYTRAC22BL
ISB	4	INTRINSIC SAFTY BARRIER STAND	MTL	ISP-7000
ISR	1	INTRINSIC SAFETY RELAY	SYMCOM	ISS-101
LC	1	INTRINSIC SAFETY LEVEL CONTROL	SYMCOM	ISS-102-ACI
POWER DISTRIBUTION				
	1	DISTRIBUTION PANEL 480Y/277V, 3 PHASE, 4 WIRE, 200 AMP MAIN	SQUARE D	NF430L2C
	1	TRANSFORMER, 480-208Y/120V, 45kVA	SQUARE D	EE45T3H
	1	DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 125 AMP MAIN	SQUARE D	QO330MQ125
	1	DISTRIBUTION PANEL COVER	SQUARE D	QOC342MQS
	1	DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 60 AMP MAIN	SQUARE D	QO320L125GRB
	2	CIRCUIT BREAKER, 3 POLE , 60 AMP	SQUARE D	QO360
	3	CIRCUIT BREAKER, 3 POLE , 15 AMP	SQUARE D	QO315
	3	CIRCUIT BREAKER, 2 POLE , 30 AMP	SQUARE D	QO230
	1	CIRCUIT BREAKER, 1 POLE , 20 AMP	SQUARE D	QO120
	15	CIRCUIT BREAKER, 1 POLE , 15 AMP	SQUARE D	QO115
PMX-100	1	POWER MONITOR TRANSMITTER	LEVITON	3500 / 3KUMT-02M

RELAY OUTPUT 1



LEGEND:

- MOTOR CONTROL PANEL LIMITS.
- JUNCTION PANEL LIMITS (SEE SHEETS 7, 8 AND DRAWING I-1).
- SHEET 3 YELLOW JUMPER WIRE (AWG#20) ON LSH, LSHH 802, AND 1402 (FUTURE USE)

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REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	05-15-15	EMB

REVISIONS

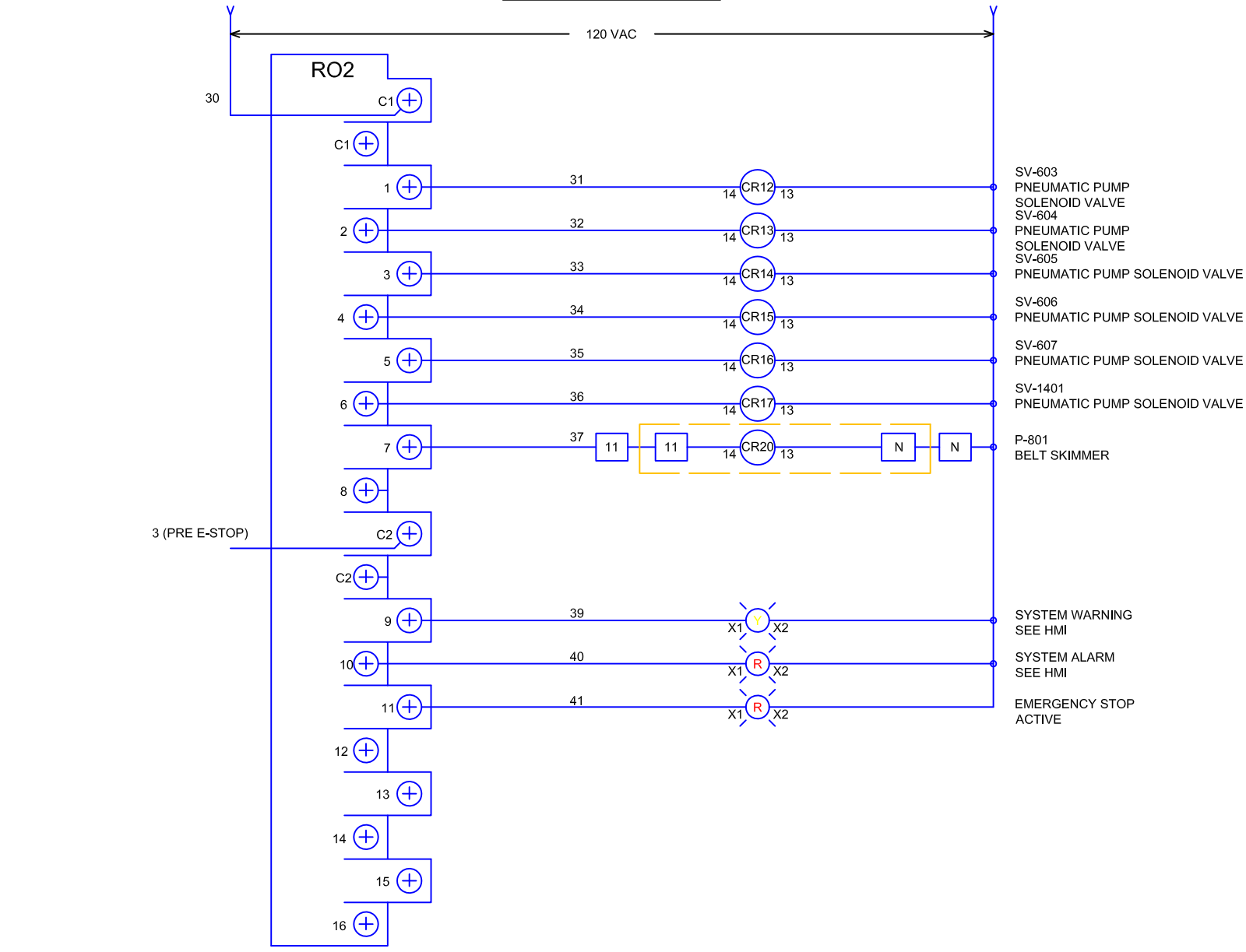
DRWN BY	RJD	DATE	05-14-14
CHK BY	RJD	DATE	01-12-15
APPR BY	--	DATE	--

TITLE: PLC WIRING DIAGRAM

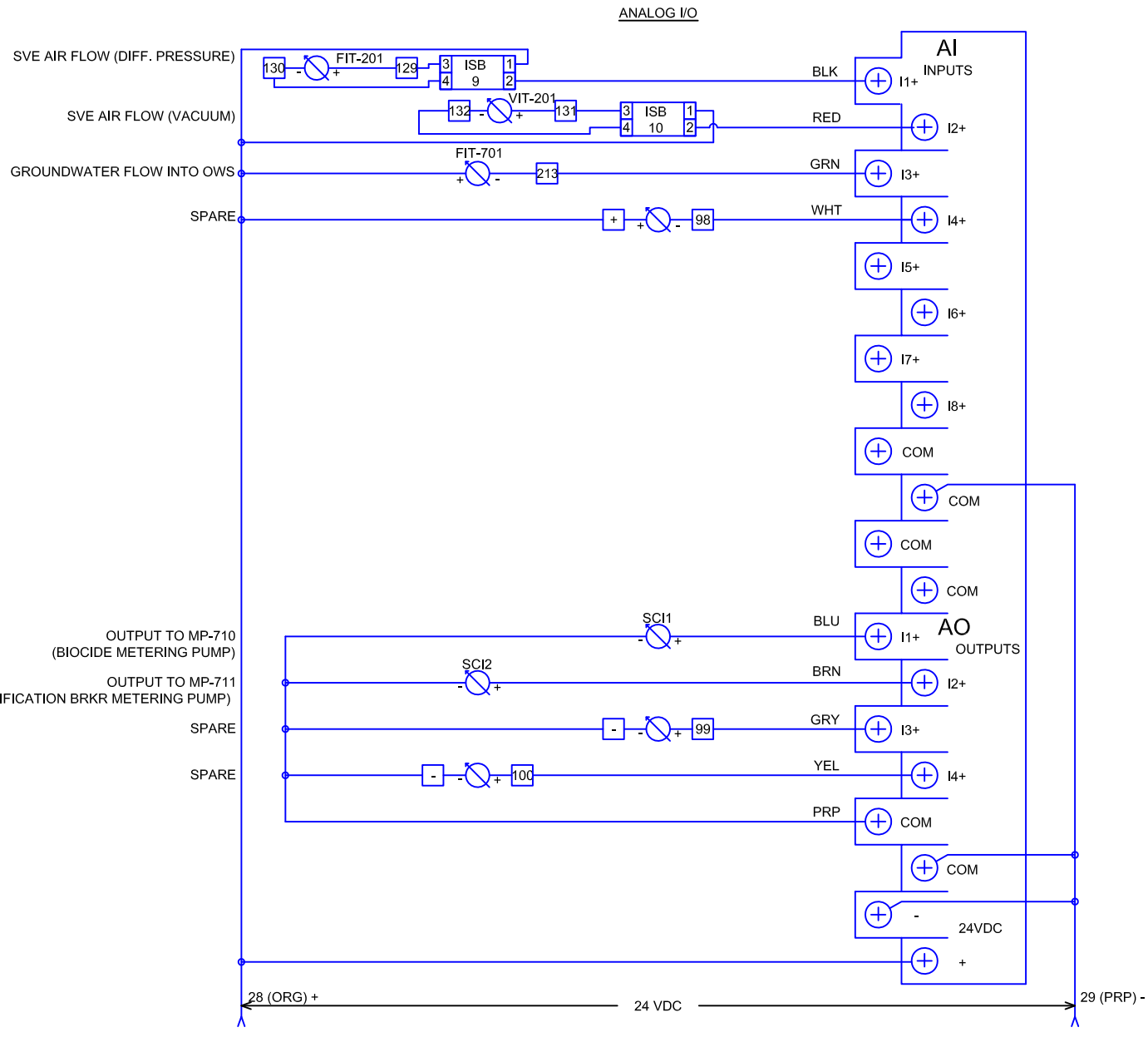
AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	I-2	1 OF 8	A

RELAY OUTPUT 2



ANALOG I/O



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JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	I-2	2 OF 8	A

DC INPUT 1

DI1A

RESET — 50 — 212 — BLK — C1 / 1
E-STOP ACTIVE — CR1B 12 4 — RED — 2
AIR COMPRESSOR LOW PRESS ALARM (OR N.O. FAULT MON) — PSL-1501 - 86 — GRN — 3
SVE LOW VACUUM SW — VSL-201 113 114 — ISB 3 4 1 2 — WHT — 4
C2
MOISTURE SEPARATOR LOW LEVEL SW — LSL-201 115 116 — ISB 1 — BLU — 5
MOISTURE SEPARATOR HIGH LEVEL SW — LSH-201 117 118 — ISB 2 — BRN — 6
MOISTURE SEPARATOR HIGH HIGH LEVEL SW — LSHH-201 119 120 — ISB 3 — GRY — 7
SVE HIGH VACUUM SW — VSH-301 121 122 — ISB 4 — YEL — 8
C3
SVE HIGH PRESSURE SW — PSH-301 123 124 — ISB 5 — BLK — 9
SVE HIGH TEMPERATURE SW — TSH-401 125 126 — ISB 6 — RED — 10
SVE SYSTEM FLOOR SUMP SW — LSHH-1601 127 128 — ISB 7 — GRN — 11
OWS WATER LOW SWITCH — LSL-703 133 134 — ISB 8 — 49 — 49 — WHT — 12
C4
OWS WATER HIGH SWITCH — LSH-703 135 136 — ISB 11 — 50 — 50 — BLU — 13
OWS WATER HIGH HIGH SWITCH — LSHH-703 137 138 — ISB 12 — 51 — 51 — BRN — 14
OWS PRODUCT LOW SWITCH — LSL-702 139 140 — ISB 13 — 52 — 52 — GRY — 15
OWS PRODUCT HIGH SWITCH — LSH-702 141 142 — ISB 14 — 53 — 53 — YEL — 16

29 (PRP) -

DC INPUT 2

DI2A

OWS PRODUCT HIGH HIGH SWITCH — LSHH-702 143 144 — ISB 15 — 54 — 54 — BLK — C1 / 1
HIGH FILTER PRESSURE — PSH-901 145 146 — ISB 16 — 55 — 55 — RED — 2
T-801 OWS PRODUCT EFFL TANK WARNING LEVEL SW — LSH-801 147 BLK WHT 148 — ISB 17 — 56 — 56 — GRN — 3
T-801 OWS PRODUCT EFFL TANK HIGH HIGH LEVEL SW — LSHH-801 149 RED GRN 150 — ISB 18 — 57 — 57 — WHT — 4
C2
(FUTURE) T-802 OWS PRODUCT EFFL TANK WARNING LEVEL SW — LSH-802 151 BLK WHT 152 — ISB 19 — 58 — 58 — BLU — 5
(FUTURE) T-802 OWS PRODUCT EFFL TANK HIGH HIGH LEVEL SW — LSHH-802 153 RED GRN 154 — ISB 20 — 59 — 59 — BRN — 6
T-1401 OWS PRODUCT EFFL TANK WARNING LEVEL SW — LSH-1401 155 BLK WHT 156 — ISB 21 — 60 — 60 — GRY — 7
T-1401 OWS PRODUCT EFFL TANK HIGH HIGH LEVEL SW — LSHH-1401 157 RED GRN 158 — ISB 22 — 61 — 61 — YEL — 8
C3
(FUTURE) T-1402 OWS PRODUCT EFFL TANK WARNING LEVEL SW — LSH-1402 159 BLK WHT 160 — ISB 23 — 62 — 62 — BLK — 9
(FUTURE) T-1402 OWS PRODUCT EFFL TANK HIGH HIGH LEVEL SW — LSHH-1402 161 RED GRN 162 — ISB 24 — 63 — 63 — RED — 10
T-801, 802 LNAPL STORAGE FLOW PULSE (OWS PRODUCT SKIMMER PUMP) — FT-801 163 164 — ISB 25 — 64 — 64 — GRN — 11
T-1401, 1402 LNAPL STORAGE FLOW PULSE (SKIMMER PUMPS) — FT-1401 165 166 — ISB 26 — 65 — 65 — WHT — 12
C4
SYSTEM EFFLUENT FLOW PULSE — FT-1201 167 168 — ISB 27 — 66 — 66 — BLU — 13
PRE-SEPARATOR HIGH HIGH LEVEL SW — LSHH-701 169 170 — ISB 28 — 67 — 67 — BRN — 14
PRE-SEPARATOR PRODUCT CONDUCTIVITY SENSOR — LC-1 C NO — 68 — 68 — GRY — 15
GROUNDWATER SYSTEM FLOOR SUMP SW — LSHH-1602 171 172 — ISB 29 — 69 — 69 — YEL — 16

28 (ORG) +

29 (PRP) - — 24 VDC — 28 (ORG) +

NOTES
1. TERMINALS FOR LSH & LSHH-802 AND LSH & LSHH-1402 LEVEL SWITCHES ARE FOR FUTURE CONNECTION. JUMPERS INSTALLED.

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TITLE: PLC WIRING DIAGRAM

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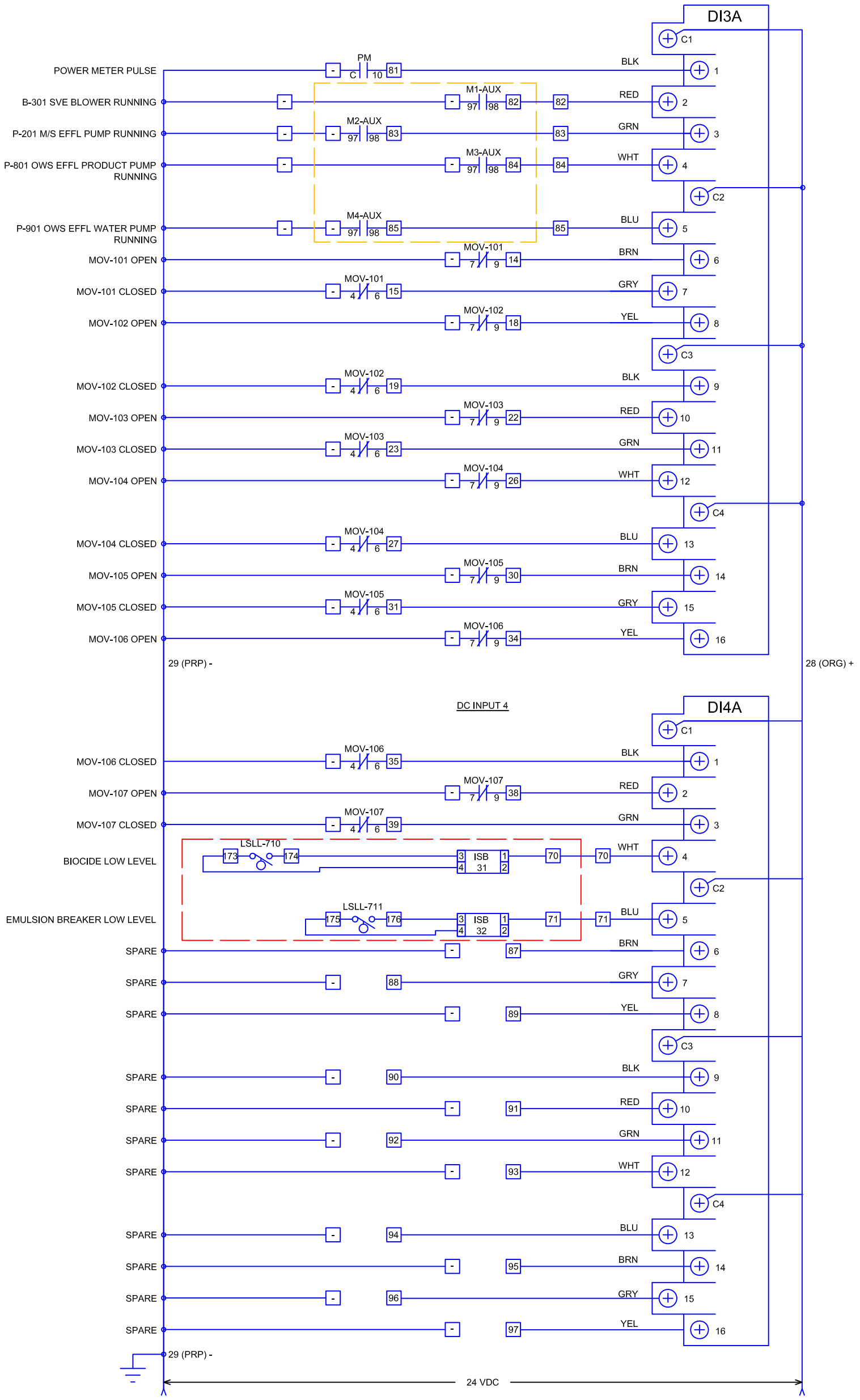
JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	I-2	3 OF 8	A

DC INPUT 3



DC INPUT 4

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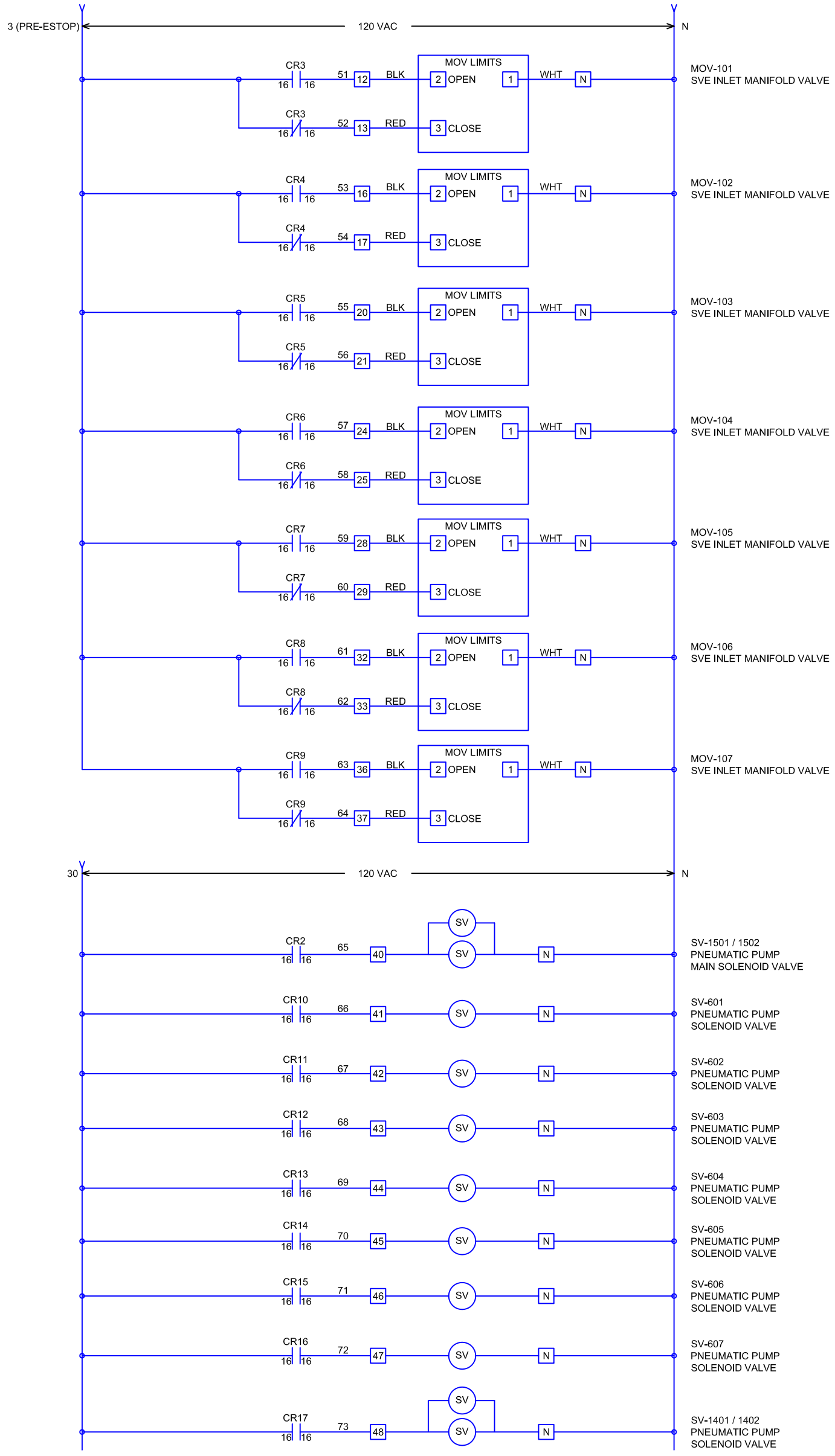
13-214	NTS	B	I-2	4 OF 8	A

VALVE WIRING



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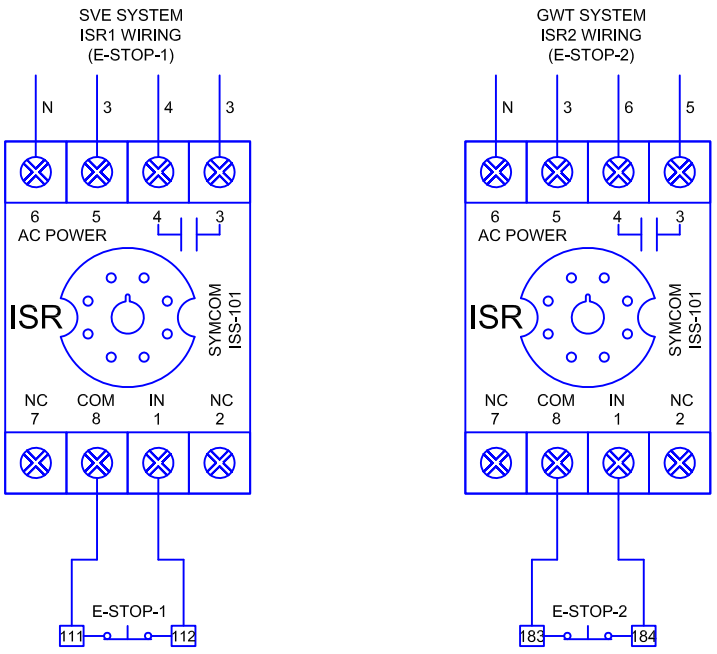
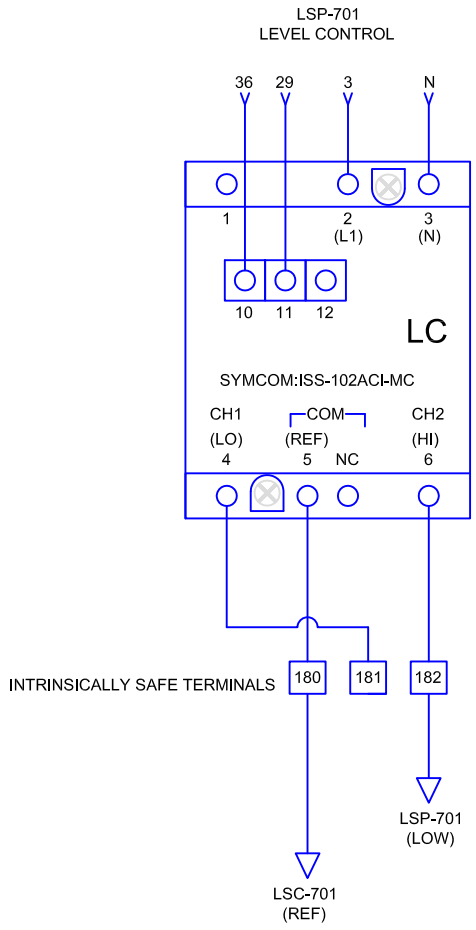
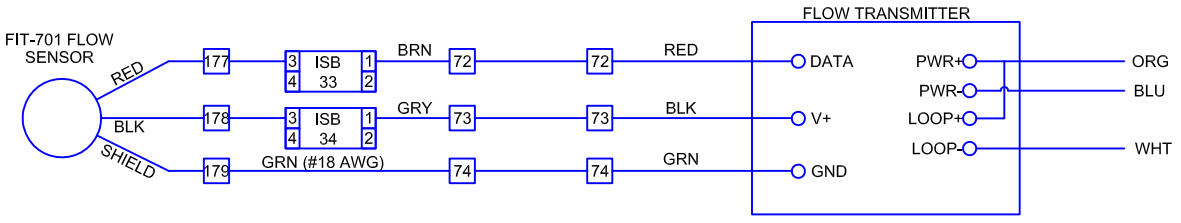
JOB NO. 13-214

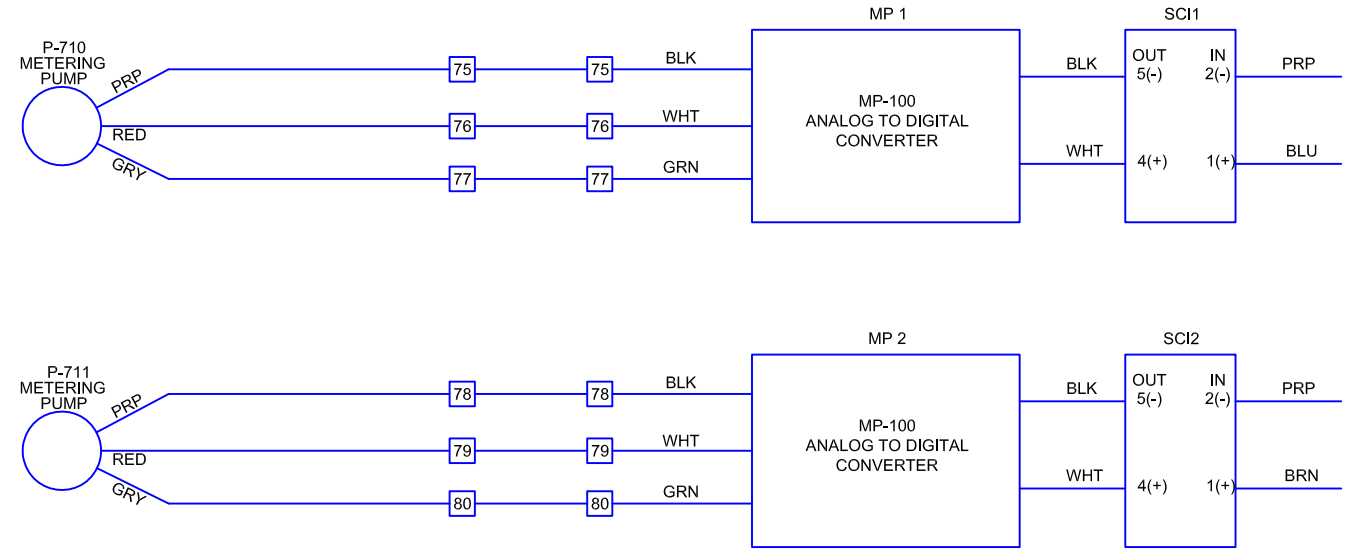
SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	I-2	5 OF 8	A

DEVICE WIRING









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WWW.NES-INC.BIZ

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	EMB

DRWN BY	RJD	DATE	05-14-14
CHK BY	RJD	DATE	01-12-15
APPR BY	--	DATE	--

TITLE: DEVICE WIRING DIAGRAM

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	I-2	6 OF 8	A

1 2

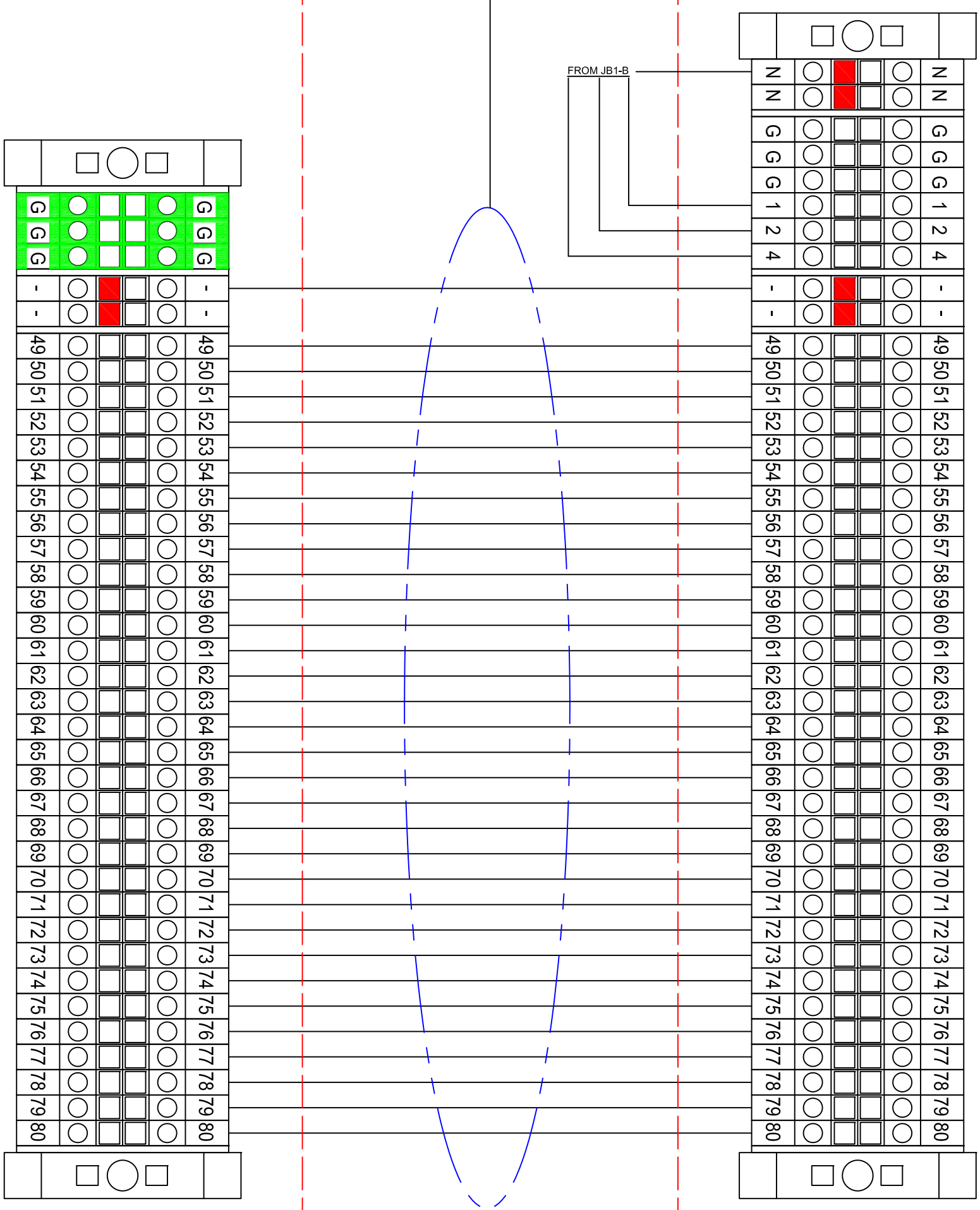
FIELD WIRING
TERMINALS

JUNCTION PANEL 2A

FIELD WIRING
BY CLIENT

JUNCTION PANEL 2B

FROM JB1-B



D C B A

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REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	EMB

REVISIONS

DRWN BY	RJD	DATE	05-14-14
CHK BY	RJD	DATE	01-12-15
APPR BY	--	DATE	--

TITLE
JB2-A, JB2-B FIELD TERMINAL WIRING

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS, NY

JOB NO. 13-214

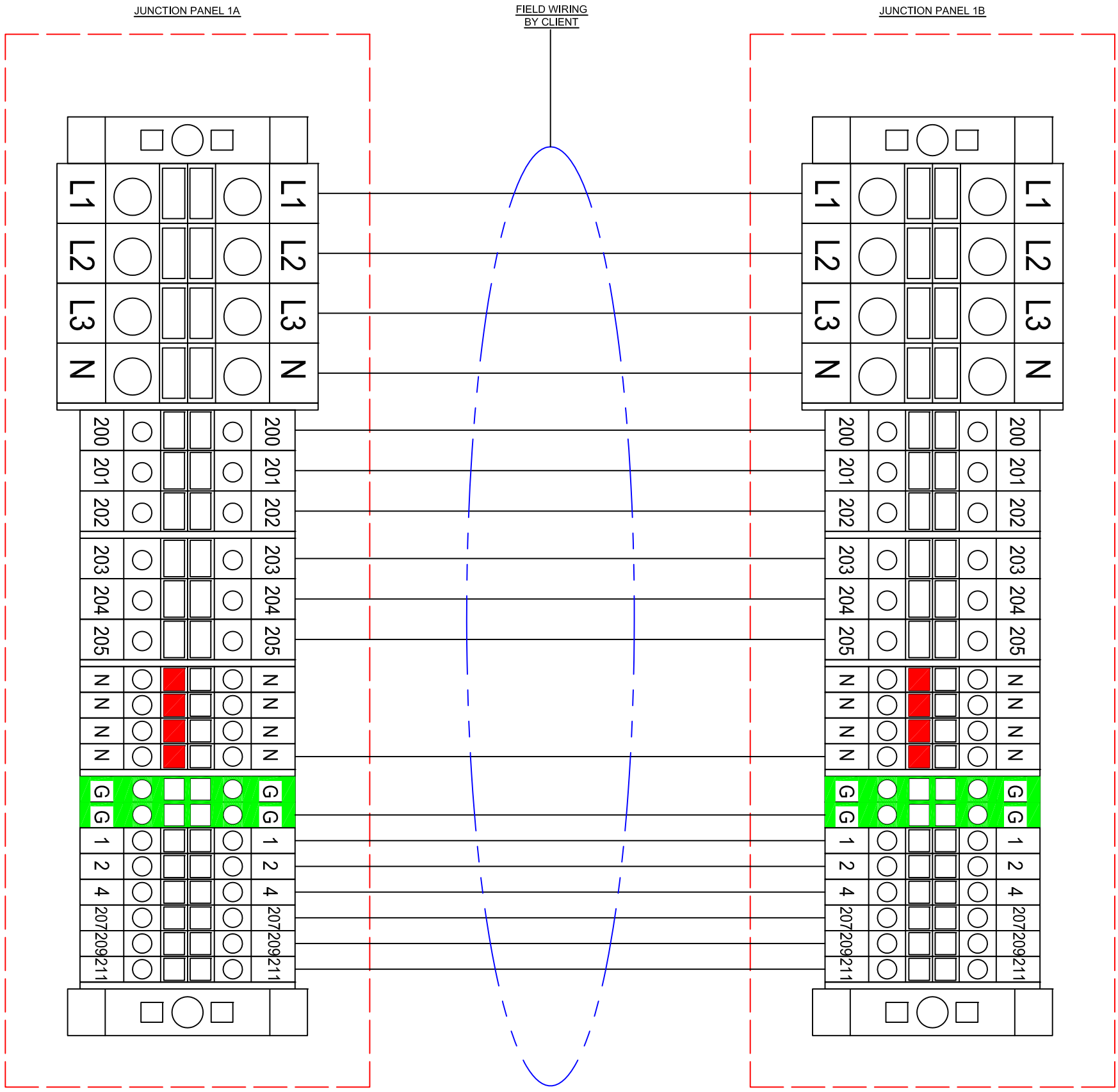
SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	I-2	7 OF 8	A

1 2

1 2

D C B A

FIELD WIRING
TERMINALS



REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	EMB

REVISIONS

DRWN BY	RJD	DATE 05-14-14
CHK BY	RJD	DATE 01-12-15
APPR BY	--	DATE --

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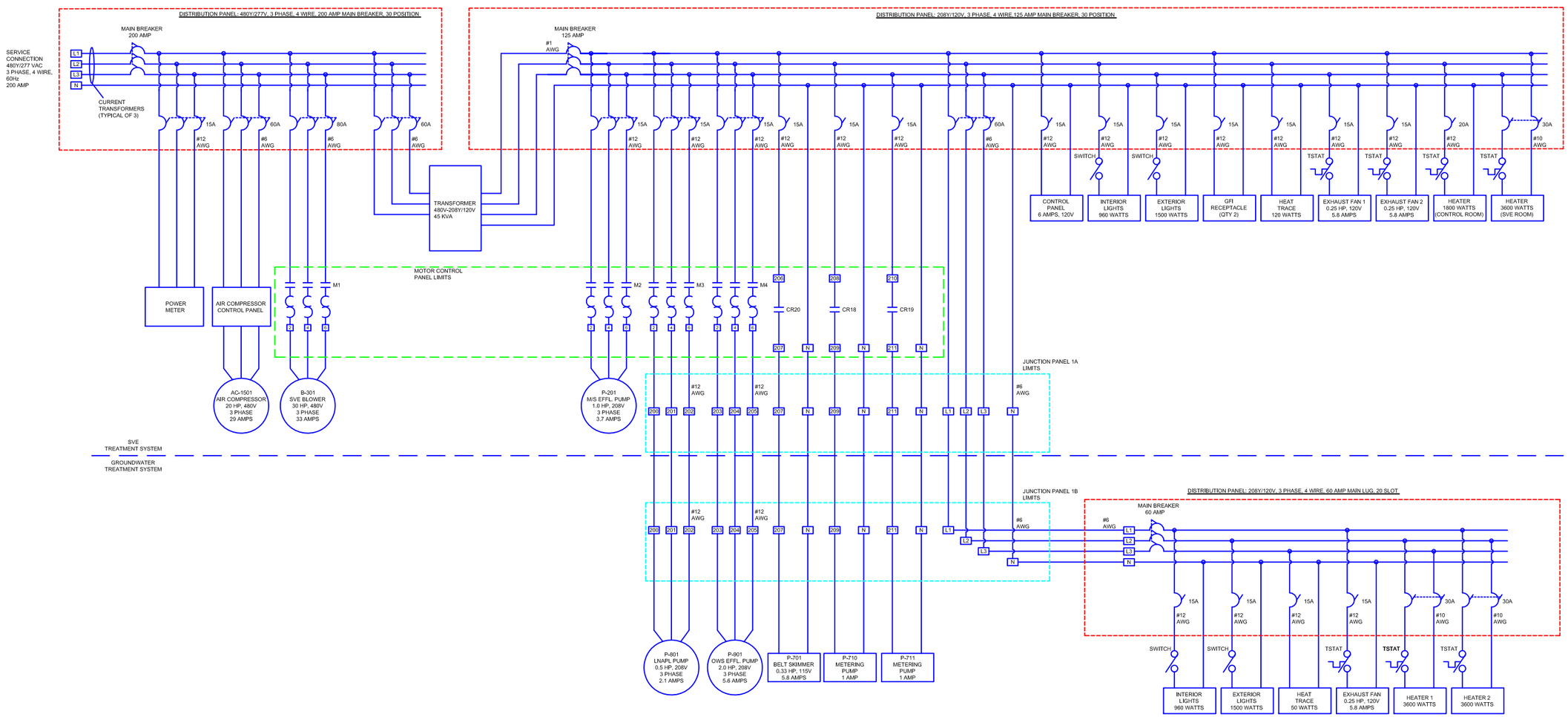
TITLE
JB1-A, JB1-B FIELD TERMINAL WIRING

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	I-2	8 OF 8	A



NOTES:

1. CONTROL PANEL SHALL BE UL 698A LISTED.
2. GROUND CONDUCTORS NOT SHOWN. INSTALL ALL GROUNDS PER LOCAL CODE.

LEGEND	
ABBREV.	DESCRIPTION
M	MOTOR STARTER
CB	CIRCUIT BREAKER
CR	CONTROL RELAY
TSTAT	THERMOSTAT
AWG	AMERICAN WIRE GAUGE
	DISTRIBUTION PANEL LIMIT
	MOTOR CONTROL CENTER LIMIT
	JUNCTIOM BOX LIMIT

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-07-15	EMB

REVISIONS

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DRWN BY	RJD
DATE	02-11-14
CHK BY	—
DATE	—
APPR BY	—
DATE	—

TITLE: LINE DIAGRAM

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	D	E-1	1 OF 1	A

ELECTRICAL
SERVICE ENTRANCE
480/277VAC / 200 AMP

DISTRIBUTION PANEL
480Y/277V, 3 PHASE, 4 WIRE
200 AMP

TRANSFORMER
480-208Y/120V
45kVA

DISTRIBUTION PANEL
208Y/120V, 3 PHASE, 4 WIRE
125 AMP

CONTROL
PANEL

MOTOR
CONTROL
CENTER

POWER
METER

SVE
TREATMENT SYSTEM

208Y/120 V
JUNCTION PANEL
1A

LOW VOLTAGE CONTROL WIRING
JUNCTION PANEL
2A

(3) #6 AWG
(9) # 12 AWG
(1) #6 AWG NEUTRAL
(3) #12 AWG NEUTRAL (FROM CONTROL PANEL)
(1) #6 AWG GROUND
(3) #14 AWG

(25) #14 AWG
(5) #14 AWG (SPARE)
(2) #14 AWG COMMON
(1) #20/8 AWG TWISTED SHIELDED CABLE
(1) #20/8 AWG TWISTED SHIELDED CABLE (SPARE)
(1) #12 AWG GROUND

(8) #14 AWG
(4) #14 AWG GROUND
INTRINSICALLY SAFE WIRING

LSHH-1401
LSH-1401
LNAPL STORAGE TANK
T-801

LSHH-1402
LSH-1402
(FUTURE - NOTE 3)
LNAPL STORAGE TANK
T-802

LSHH-801
LSH-801
LNAPL STORAGE TANK
T-1401

LSHH-802
LSH-802
(FUTURE - NOTE 3)
LNAPL STORAGE TANK
T-1402

DISTRIBUTION PANEL
208Y/120V, 3 PHASE, 4 WIRE
60 AMP

208Y/120 V
JUNCTION PANEL
1B

LOW VOLTAGE CONTROL WIRING
JUNCTION PANEL
2B

GROUNDWATER
TREATMENT SYSTEM

NOTES:
1. ALL FIELD INSTALLED CONDUCTORS TO BE SIZED FOR APPROPRIATE DISTANCES BY OTHERS.
2. GROUND CONDUCTORS NOT SHOWN. INSTALL ALL GROUNDS PER NEC ARTICLES 250.66, 250.122 , LOCAL ELECTRICAL CODES, AND PER THE AUTHORITY HAVING JURISDICTION.
3. TERMINALS FOR T-802 & T-1402 PRESENT FOR FUTURE CONNECTION

LEGEND	
ABBREV.	DESCRIPTION
AWG	AMERICAN WIRE GAUGE
	FACTORY WIRING
	FIELD WIRING
	ENCLOSURE LIMIT

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT DRAWING	05-15-15	RJD

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DRWN BY	MJS	DATE	02-11-14
CHK BY	RJD	DATE	01-12-15
APPR BY		DATE	

TITLE
ELECTRICAL BLOCK DIAGRAM

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	E-2	1 OF 1	A

1 2

D D

C C

B B

A A

THREE PHASE DISTRIBTION PANEL
480 VAC, 200 AMP, 4 WIRE

POWER METER	3P15A	1	2	3P60A	TRANSFORMER
		3	4		
		5	6		
(AC-1501) AIR COMPRESSOR PANEL	3P60A	7	8		
		9	10		
		11	12		
(B-301) SVE BLOWER	3P80A	13	14		
		15	16		
		17	18		
		19	20		
		21	22		
		23	24		
		25	26		
		27	28		
		29	30		

MAIN: 3P 200A

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT DRAWING	01-12-15	EMB

REVISIONS

DRWN BY	RJD
DATE	10-28-14
CHK BY	RJD
DATE	01-12-15
APPR BY	--
DATE	--

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TITLE
POWER DISTRIBUTION PANEL LAYOUT

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	E-3	1 OF 3	A

1 2

D D

C C

B B

A A

THREE PHASE DISTRIBTION PANEL
120 / 208 VAC, 125 AMP, 4 WIRE

MAIN: 3P 125A

(P-201) MOISTURE SEPARATOR EFFLUENT PUMP	3P15A	1	2	1P15A	CONTROL PANEL
		3	4	1P15A	LIGHTS (INTERIOR)
		5	6	1P15A	XP EXHAUST FAN
(P-801) L-NAPL PUMP	3P15A	7	8	1P15A	GFI RECEPTACLES (EXTERIOR)
		9	10	2P30A	XP HEATER
		11	12		
(P-901) OWS EFFLUENT PUMP	3P15A	13	14	1P20A	NON-XP HEATER
		15	16	1P15A	NON-XP FAN
		17	18	1P15A	LIGHTS (EXTERIOR)
SUB-FEED TO GWT CONTAINER	3P60A	19	20	1P15A	HEAT TRACE
		21	22	1P15A	COMPRESSOR AUTO DRAIN
		23	24		
(P-701) BELT SKIMMER	1P15A	25	26		
(P-710) METERING PUMP	1P15A	27	28		
(P-711) METERING PUMP	1P15A	29	30		

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT DRAWING	01-12-15	EMB

REVISIONS

DRWN BY: RJD	DATE: 10-28-14
CHK BY: RJD	DATE: 01-12-15
APPR BY: --	DATE: --

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TITLE
POWER DISTRIBUTION PANEL LAYOUT

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	E-3	2 OF 3	A

1 2

THREE PHASE DISTRIBTION PANEL
120 / 208 VAC, 60 AMP, 4 WIRE

MAIN	3P60A	1	2	2P30A	HEATER 1
		3	4		
		5	6	2P30A	HEATER 2
LIGHTS (INTERIOR)	1P15A	7	8		
LIGHTS (EXTERIOR)	1P15A	9	10		
HEAT TRACE	1P15A	11	12		
FAN	1P15A	13	14		
		15	16		
		17	18		
		19	20		

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT DRAWING	01-12-15	EMB

REVISIONS

DRWN BY	RJD
DATE	10-28-14
CHK BY	RJD
DATE	01-12-15
APPR BY	--
DATE	--

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TITLE
POWER DISTRIBUTION PANEL LAYOUT

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	E-3	3 OF 3	A

SECTION 4 - 100 SERIES PROCESS EQUIPMENT - SVE INLET MANIFOLD

MOTOR OPERATED VALVE, 4" - JOMAR MODEL 600-04DSPL

MOTOR OPERATED VALVE ACTUATOR - INDELAC MODEL ML4X/7BF07-152SMP-1

FLOW INDICATOR (MAGNEHELIC) - DWYER MODEL 2005

FLOW ELEMENT PITOT TUBE - DWYER MODEL DS-300-4

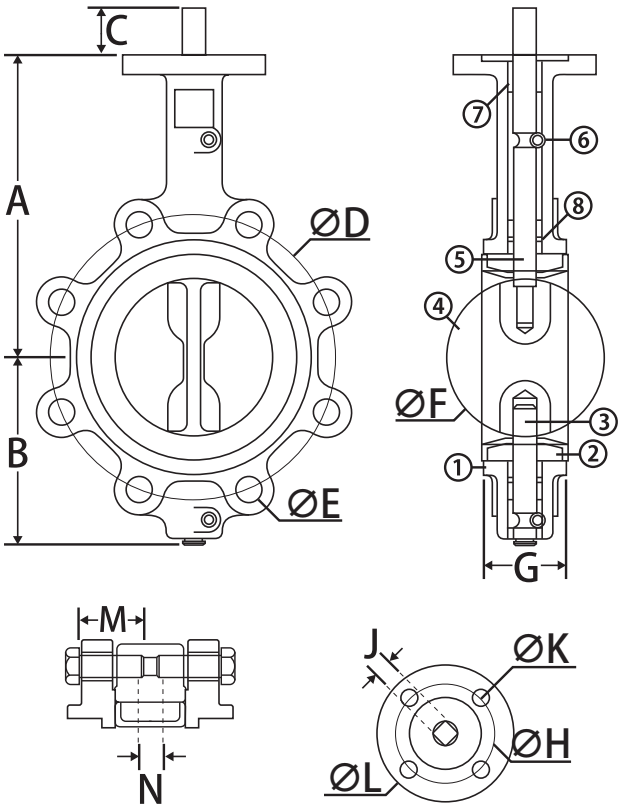
VACUUM INDICATOR - DWYER MODEL LPG4-D7722N

Butterfly Valve

Lug Style • Epoxy-Coated Ductile Iron Body

BFV-Lug

CRN# 0C09891.2



Features

- Designed for commercial and industrial applications up to 200 PSI
- Easily accepts actuator with ISO 5211 mounting flange
- Available in EPDM, PTFE, Buna, or Viton seats
- Meets API 609 & MSS SP-67
- Seat to flange seal eliminates the need for flange gaskets
- Series 600 Lug bodies are bidirectional for dead end service
- Epoxy coated finish
- Ideal for mounting pneumatic/electrical actuators
- Square stem for direct mount
- Wetted surfaces contain less than .25% lead content

Material Specifications

No.	Part	Materials
1	Body	Ductile Iron - Epoxy Coated
2	Seat	*Varies*
3	Lower Shaft*	410 Stainless Steel
4	Disc	CF8M Stainless Steel
5	Upper Shaft	410 Stainless Steel
6	Locating Pin (2)	Carbon Steel
7	Bushing (3)	PTFE
8	O-ring (2)	EPDM

Note: 2" - 12" Only, 14" - 36" are pin through shaft style

Seat Temperature Ranges

	Size	Buna-N	EPDM	Viton	PTFE
Temperature range (° F)	2" - 36"	10 to 180	-30 to 250	10 to 275	-20 to 250
Inline service (psi)	2" - 12"	200	200	200	200
	14" - 36"	150	150	150	150
Dead end service w/down stream flange (psi)	2" - 12"	200	200	200	100
Dead end service w/o down stream flange (psi)	2" - 12"	100	100	100	50

When ordering butterfly valves please specify the seat in the _ space with the following letter designations. E = EPDM P = PTFE V = VITON B = BUNA

Dimensions

Part No.	Size	A	B	C	D	E	F	G	H	J	K	L	M	N	Weight
600-02DS_L	2"	6.34	3.15	1.26	4.74	4 : 5/8"	2.07	1.65	1.97	0.35	4 : 0.28	3.03	1.50	5/8-11UNC	8.38
600-212DS_L	2-1/2"	6.89	3.50	1.26	5.50	4 : 5/8"	2.54	1.76	1.97	0.35	4 : 0.28	3.03	1.50	5/8-11UNC	9.26
600-03DS_L	3"	7.13	3.74	1.26	6.00	4 : 5/8"	3.10	1.78	1.97	0.35	4 : 0.28	3.03	1.50	5/8-11UNC	10.36
600-04DS_L	4"	7.87	4.49	1.26	7.50	8 : 5/8"	4.09	2.05	2.76	0.43	4 : 0.35	3.54	1.75	5/8-11UNC	19.84
600-05DS_L	5"	8.39	5.00	1.26	8.50	8 : 3/4"	4.85	2.14	2.76	0.55	4 : 0.35	3.54	1.75	3/4-11UNC	24.03
600-06DS_L	6"	8.90	5.47	1.26	9.51	8 : 3/4"	6.13	2.20	2.76	0.55	4 : 0.35	3.54	2.00	3/4-11UNC	31.31
600-08DS_B	8"	10.24	6.89	1.61	11.75	8 : 3/4"	7.97	2.39	4.02	0.67	4 : 0.47	4.92	2.00	3/4-11UNC	40.12
600-10DS_B	10"	11.50	7.99	1.61	14.25	12 : 7/8"	9.86	2.58	4.02	0.87	4 : 0.47	4.92	2.25	7/8-11UNC	59.08
600-12DS_B	12"	13.27	9.53	1.61	17.01	12 : 7/8"	11.87	3.03	4.02	0.87	4 : 0.47	5.51	2.50	7/8-11UNC	88.18
600-14DS_B	14"	14.49	10.55	1.77	18.74	12 : 1"	13.12	3.01	4.02	0.87	4 : 0.47	5.51			123.46
600-16DS_B	16"	15.75	12.17	2.02	21.26	16 : 1"	15.34	3.41	5.51	0.94	4 : 0.71	7.76			211.64
600-18DS_B	18"	16.54	12.91	2.02	22.76	16 : 1-1/8"	17.34	4.16	5.51	1.06	4 : 0.71	7.76			268.96
600-20DS_B	20"	18.90	14.21	2.53	25.00	20 : 1-1/8"	19.35	5.19	5.51	1.42	4 : 0.71	7.76			445.33
600-24DS_B	24"	22.13	18.07	2.76	29.51	20 : 1-1/4"	23.33	5.98	6.50	1.42	4 : 0.91	10.87			595.25
600-30DS_B*	30"	25.98	21.22				29.30	6.50							939.17
600-36DS_B*	36"	28.35	25.83				34.04	7.99							1604.96

*U-type Butterfly Valve, dimensions and drawings available upon request.

Note: Information subject to change without notice.

INDELAC MODEL
M SERIES

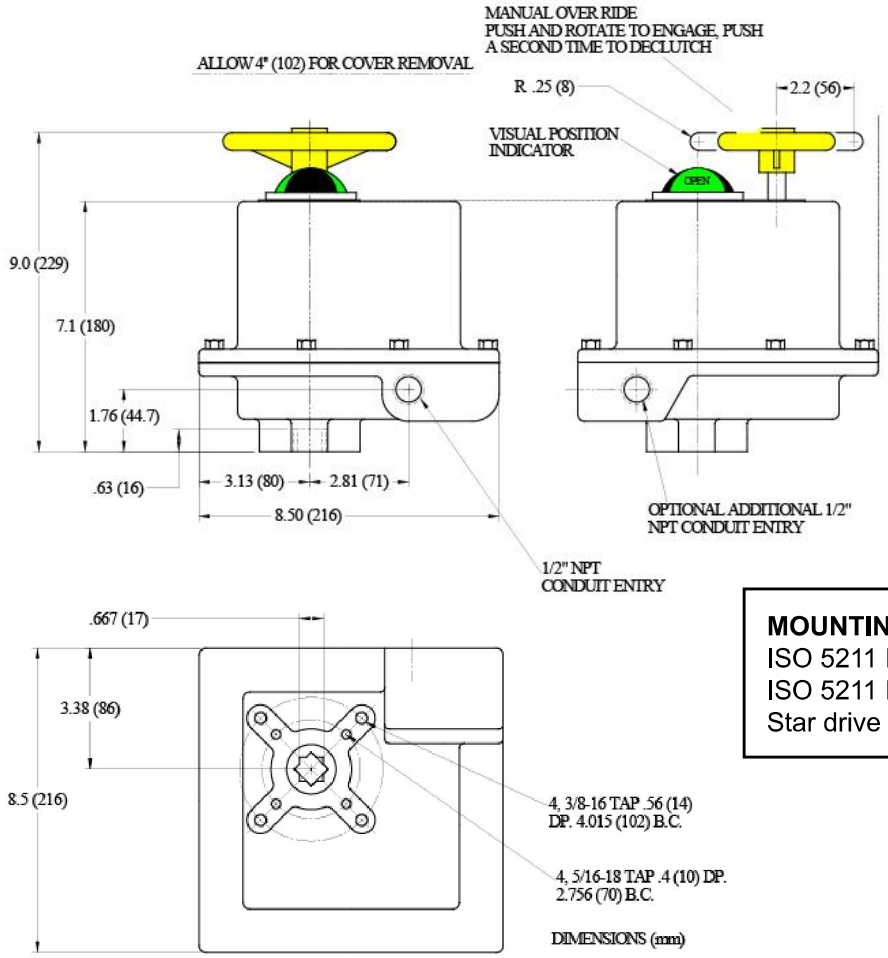
(400, 675, 1000 & 1,500 IN-LB) NEMA 7

ICI's M series rotary electric actuator was designed for quarter turn valve and damper applications requiring up to 1,500 lb-in torque. This industrial grade reversing actuator has been manufactured for over twenty-five years and has achieved an impeccable reputation for reliablity in applications requiring repeated superior performance year after year. This machine has a hardened steel spur gear drive train guaranteeing high efficiency, quiet operation and long trouble free life.

SPECIFICATIONS

TORQUE	MS	400 In-Lb	(45.2 Nm)
	MR	675 In-Lb	(76.3 Nm)
	ML	1,000 In-Lb	(113 Nm)
	MH	1,500 In-Lb	(169 Nm)
CYCLE TIME	MS		10 sec. / 90° 115 Vac, 230 Vac & 12 Vdc
			20 sec. / 90° 75% duty, 24 Vdc & 24 Vac
	MR & ML		15 sec. / 90° 115 Vac, 230 Vac & 12 Vac
			30 sec. / 90° 75% duty, 24 Vdc & 24 Vac
	MH		30 sec. / 90° 115 Vac, 230 Vac & 12 Vdc
			70 sec. / 90° 75% duty, 24 Vdc & 24 Vac
DUTY CYCLE	25% (standard)	115 Vac & 230 Vac	
	75% (optional)	12 Vdc, 24 Vdc & 24 Vac	
ENCLOSURE	NEMA 7, C, US certified by CSA		
COATING	Thermally bonded polyester powder		
POSITION IND.	Visual indicator		
	Wired for light indication		
SWITCHES	SPDT snap action, 15 Amps @ 250 Vac		
LUBRICATION	Permanent		
WEIGHT	MS, MR, ML	21 Lbs	
	MH	22 Lbs	
INSTALLATION	Universal		
TEMP. RANGE	-40°F to 150°F		
	Heater & Thermostat required 0°F & below		
OVERRIDE	Manual, declutching		

TECHNICAL DRAWINGS & WIRING DIAGRAM

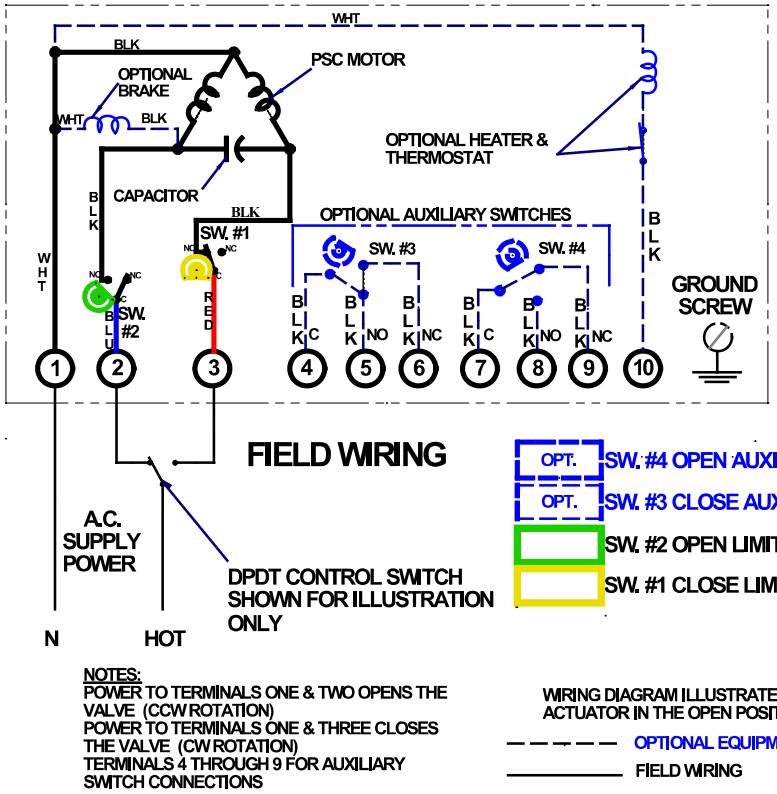


MOUNTING PAD
ISO 5211 F07 Star drive
ISO 5211 F10 BC & F07
Star drive MH only

ISO 5211 F07

MOTOR SPECIFICATIONS
Permanent split capacitor
115 Vac / 1Ph / 50-60 Hz (standard)
with thermal over load protection

		MR	MS	ML & MH
115 Vac (Std.)	FL	0.38	0.38	0.38
	LR	0.75	0.75	0.75
115 Vac Ext'ed Duty	FL	0.38	0.38	0.38
	LR	0.75	0.75	0.75
24 Vac	FL	0.7	0.9	1.1
	LR	3.2	3.2	3.2
24 Vdc	FL	0.7	0.9	1.1
	LR	3.2	3.2	3.2
12 Vdc	FL	1.3	1.7	2.2
	LR	4.2	4.2	4.2
208 Vac/1Ph/60Hz	FL	0.21	0.21	0.21
	LR	0.42	0.42	0.42
230 Vac/1Ph/60Hz	FL	0.18	0.18	0.18
	LR	0.38	0.38	0.38



NOTES:
POWER TO TERMINALS ONE & TWO OPENS THE VALVE (CCW ROTATION)
POWER TO TERMINALS ONE & THREE CLOSES THE VALVE (CW ROTATION)
TERMINALS 4 THROUGH 9 FOR AUXILIARY SWITCH CONNECTIONS

WIRING DIAGRAM ILLUSTRATES THE ACTUATOR IN THE OPEN POSITION
OPTIONAL EQUIPMENT
FIELD WIRING

INDELAC CONTROLS

AC Voltage Electric Actuator Installation, Operation & Maintenance Manual

TELEPHONE: +1-859-727-7890
TOLL FREE: +1-800-662-9424
FAX: +1-859-727-4070
E-MAIL: DVOGES@INDELAC.COM
MROBINSON@INDELAC.COM
TCAYWOOD@INDELAC.COM
SHIPPING ADDRESS: 6810 POWERLINE DR.-FLORENCE, KY. 41042

VISIT OUR WEBSITE AT WWW.INDELAC.COM

INTRODUCTION:

Thank you for selecting Indelac Controls, Inc. (*ICI*) for your valve or damper automation requirement. We at *ICI* are proud of our products and feel confident they will meet or exceed your expectations of quality and reliability.

Every precaution has been taken to insure that your equipment will arrive undamaged; however, accidents do occur. Therefore, the first thing you must do upon receipt of your package is to inspect it for damage. If the box is damaged there is a possibility that the equipment inside the box may be damaged as well. If this is the case YOU MUST FILE A CLAIM with the delivering CARRIER. All shipments are F.O.B. our factory and it is YOUR RESPONSIBILITY to file a claim for damages.

STORAGE:

If the actuators are scheduled for installation at a later date:

1. Store off the floor.
2. Store in a climate controlled building.
3. Store in a clean and dry area.

FOR FUTURE REFERENCE RECORD:

1. Actuator model number_____
2. Actuator enclosure type NEMA 4__, NEMA 4X__, NEMA 7___, NEMA 4 & 7_
3. Actuator output torque_____LB-IN
4. Motor characteristics, Voltage_____Hertz_____Phase_____
5. Actuator serial number_____
6. Date of installation_____Put into operation_____
7. Valve Data:
   - 7a. Manufacturer_____
   - 7b. Style & fig. No._____
   - 7c. Size_____
   - 7d. End connection_____
   - 7e. Material of construction, Body_____Stem & ball_____
   - 7f. Brake away torque_____LB-IN @_____PSI
   - 7g. Other helpful data_____

MEDIA:

1. System media_____
2. Temperature,_____(deg. F.) Maximum,_____. Minimum,_____.
3. Pressure_____PSI

*As this information is listed it is important to pay attention to all of the actuator specifications relative to the valve specifications and system requirements. If the actuator is not properly sized for the valve and application the life will be shortened or it may not work at all.

TOOLS REQUIRED:

ADDITIONAL TOOLS WILL BE REQUIRED FOR THE SCREWS TO MOUNT THE VALVE TO THE ACTUATOR.

R SERIES	
Cover Screws	9/64" Allen Wrench.
Terminal Strip Screws	1/8" Wide Flat Head Screwdriver.
Cam Set Screw	5/64" Allen Wrench.
Mounting Pad Screws	3/8" Socket.
S SERIES	
Cover Screws	SD, Phillips Head Screwdriver, Deep Base, 9/64 Allen Wrench, **NEMA 7** Enclosure, 7/16" Socket.
Position Indicator	5/64" Allen Wrench.
Terminal Strip Screws	1/8" Wide Flat Head Screwdriver.
Cam Set Screw	5/64" Allen Wrench.
Mounting Pad Screws	3/8" Socket.
M SERIES	
Cover Screws	5/32" Allen Wrench, **NEMA 7** Enclosure, 7/16" Socket.
Terminal Strip Screws	3/16" Wide Flat Head Screwdriver.
Cam Set Screw	5/64" Allen Wrench.
Mounting Pad Screws	½" Socket.
L SERIES	
Cover Screws	7/16" Socket.
Terminal Strip Screws	3/16" Wide Flat Head Screwdriver.
Cam Set Screw	5/64" Allen Wrench.
Mounting Pad Screws	9/16" Socket.
K SERIES	
Cover Screws	½" Socket.
Position Indicator	5/64" Allen Wrench.
Terminal Strip Screws	3/16" Wide Flat Head Screw Driver.
Cam Set Screw	5/64" Allen Wrench.
Mounting Pad Screws	¾" Socket.

SUGGESTED MAXIMUM TORQUE VALUES FOR FASTENERS (IN-LBS.)

SCREW SIZE	LOW CARBON STEEL	18-8 SS	316 SS	ALUMINUM
2-56	2.2	2.5	2.6	1.4
4-40	4.7	5.2	5.5	2.9
6-32	9	10	10	5
8-32	18	20	21	10
10-24	21	23	24	13
10.32	30	32	33	19
¼-20	65	75	79	45
5/16-18	129	132	138	80
3/8-16	212	236	247	143
½-13	465	517	542	313
5/8-11	1000	1110	1160	715

INSTALLATION:

The actuator is shipped in the open position from the factory, it is important to make sure the valve and actuator are in the same position before mounting the actuator on the valve.

1. Manually open valve.
2. Remove valve mechanical stops.

CAUTION: DO NOT REMOVE ANY PARTS NECESSARY FOR THE PROPER OPERATION OF THE VALVE, I.E., PACKING GLAND, GLAND NUT, ETC.

3. Check again that the valve and actuator are in the same position.
4. Install mounting hardware on valve, do not tighten bolts securely at this time, mount actuator to valve, and once actuator screws have been started securely tighten all nuts and bolts.

NOTE: ACTUATOR CONDUIT ENTRY IS NORMALLY POSITIONED PERPENDICULAR TO PIPE LINE.

5. Remove actuator cover.
6. Wire actuator using the wiring diagram inside cover.

CAUTION: BE SURE POWER IS OFF AT THE MAIN POWER BOX.

7. Turn on power to actuator.

CAUTION: USE EXTREME CAUTION, AS THERE ARE LIVE CIRCUITS THAT COULD CAUSE ELECTRICAL SHOCK OR DEATH.

8. Operate the valve to the close position, check the alignment.
9. Operate the valve to the open position, check the alignment.
10. Replace cover and secure cover screws.

CALIBRATION:

AFTER CHECKING THE ALIGNMENT OF THE VALVE PORT CALIBRATION MAY BE REQUIRED.

To Set The Open Position:

Operate valve to the open position by applying power to terminal connections #1 and #2, the valve will rotate counter clockwise, CCW, viewing top of actuator.

NOTE: WHEN THE ACTUATOR IS IN THE OPEN POSITION THE SETSCREW SECURING THE CAM TO THE SHAFT IS EASILY ACCESSIBLE.

1. If the valve did not open completely.
   - **a.** Loosen 8-32 set screw in top cam.
   - **b.** Rotate cam clockwise (CW) until the switch makes contact, listen carefully for a slight click. The valve will begin to rotate CCW, by making small incremental CW movements of the cam the valve can be positioned precisely in the desired position.
   - **c.** Securely tighten the setscrew.

2. If valve traveled too far open.

CAUTION: VALVES WITH MECHANICAL STOPS MAY BE DAMAGED OR CAUSE DAMAGE TO THE ACTUATOR IF ALLOWED TO TRAVEL TOO FAR.

   - **a.** Apply power to terminal connections #1 and #3, the valve will begin to rotate CW, allow it to travel to the mid position.
   - **b.** Follow directions of “To set open position”.

To Set The Close Position:

Operate valve to the close position by applying power to terminal connections #1 and #3, the valve will rotate CW viewing the top of the actuator.

NOTE: WHEN THE ACTUATOR IS IN THE OPEN POSITION THE SETSCREW SECURING THE CAM TO THE SHAFT IS EASILY ACCESSIBLE.

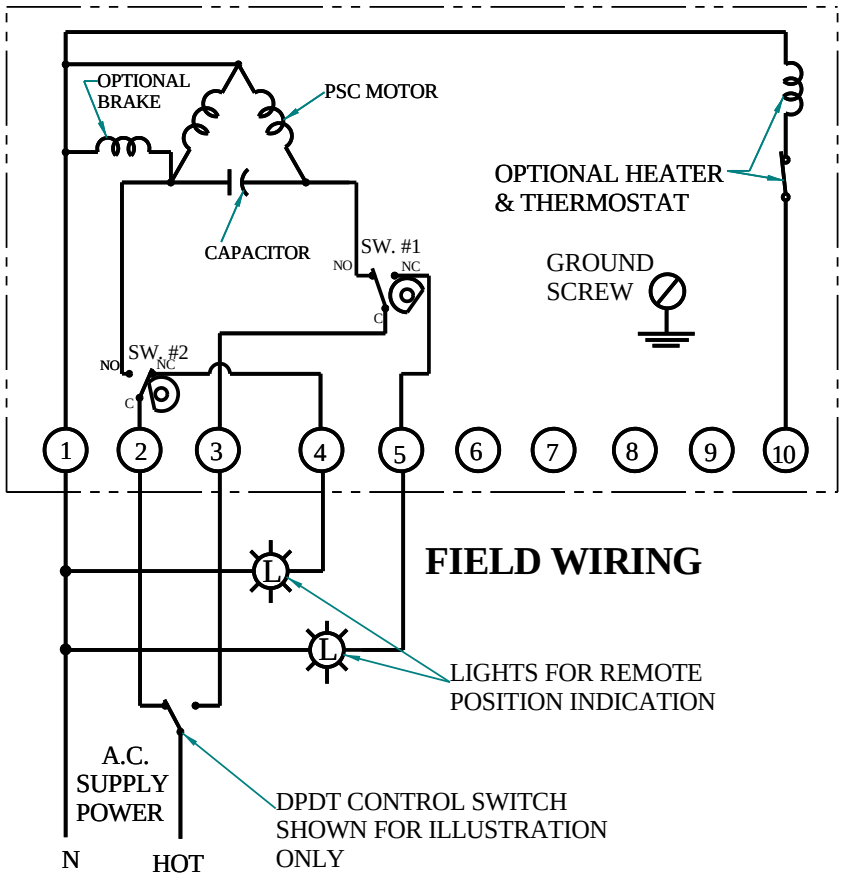
1. If valve did not close completely.
   - **a.** Loosen 8-32 set screw in bottom cam.
   - **b.** Rotate cam CCW until the switch makes contact, listen for a slight click. The valve will begin to rotate CW, by making small CCW incremental movements of the cam the valve can be positioned precisely in the close position.
   - **c.** Securely tighten the setscrew.

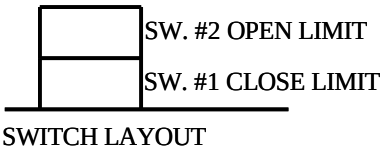
2. If the valve has traveled too far closed.

CAUTION: VALVES WITH MECHANICAL STOPS MAY BE DAMAGED OR CAUSE DAMAGE TO THE ACTUATOR IF ALLOWED TO TRAVEL TOO FAR CLOSED.

   - **a.** Apply power to terminal connections #1 and #2, the valve will begin to rotate CCW, allow it to travel to the mid position.
   - **b.** Follow directions of “To Set Close Position”.

WIRING DIAGRAM TWO POSITION ACTUATOR

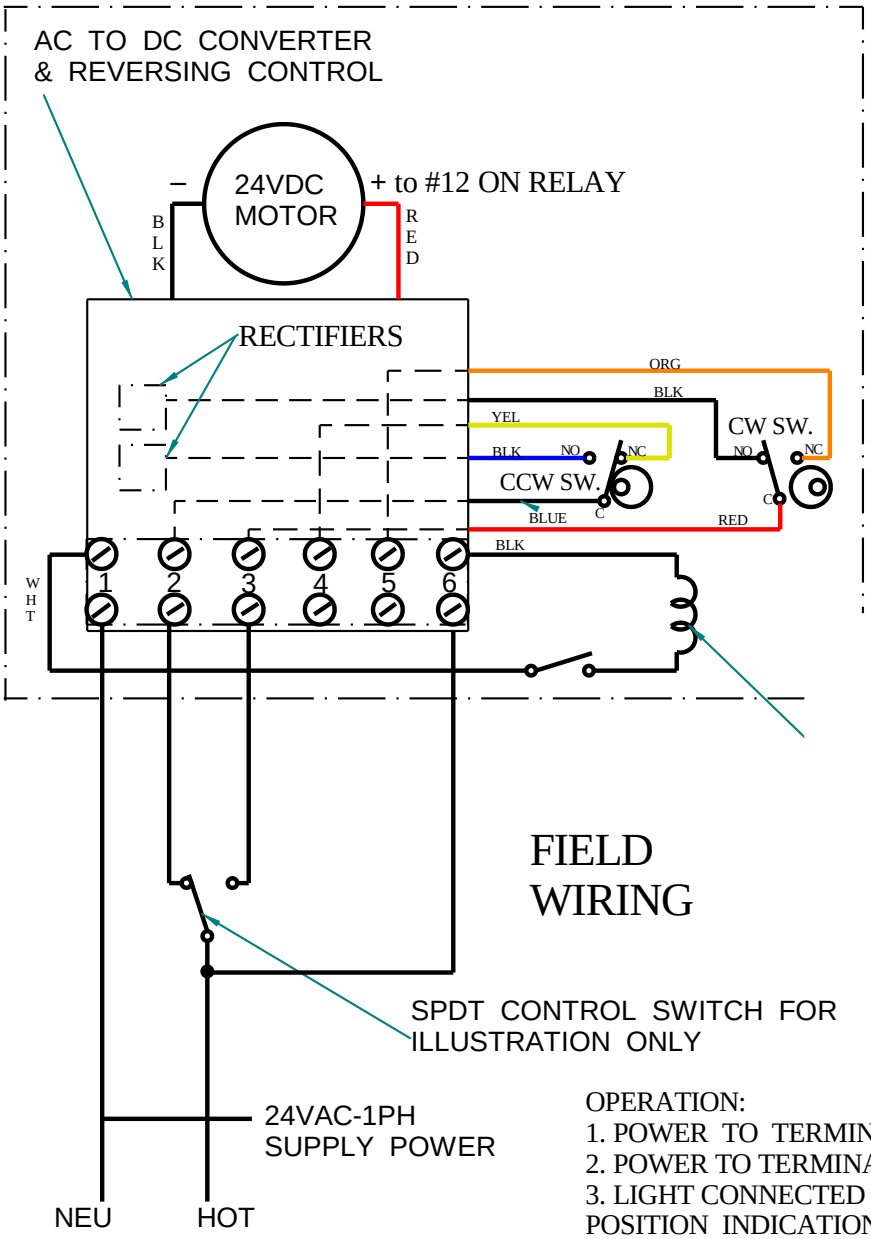




NOTES:
POWER TO TERMINALS ONE & TWO OPENS THE VALVE (CCW ROTATION)
POWER TO TERMINALS ONE & THREE CLOSES THE VALVE (CW ROTATION)
TERMINALS 4 & 5 ARE FOR LIGHT INDICATION

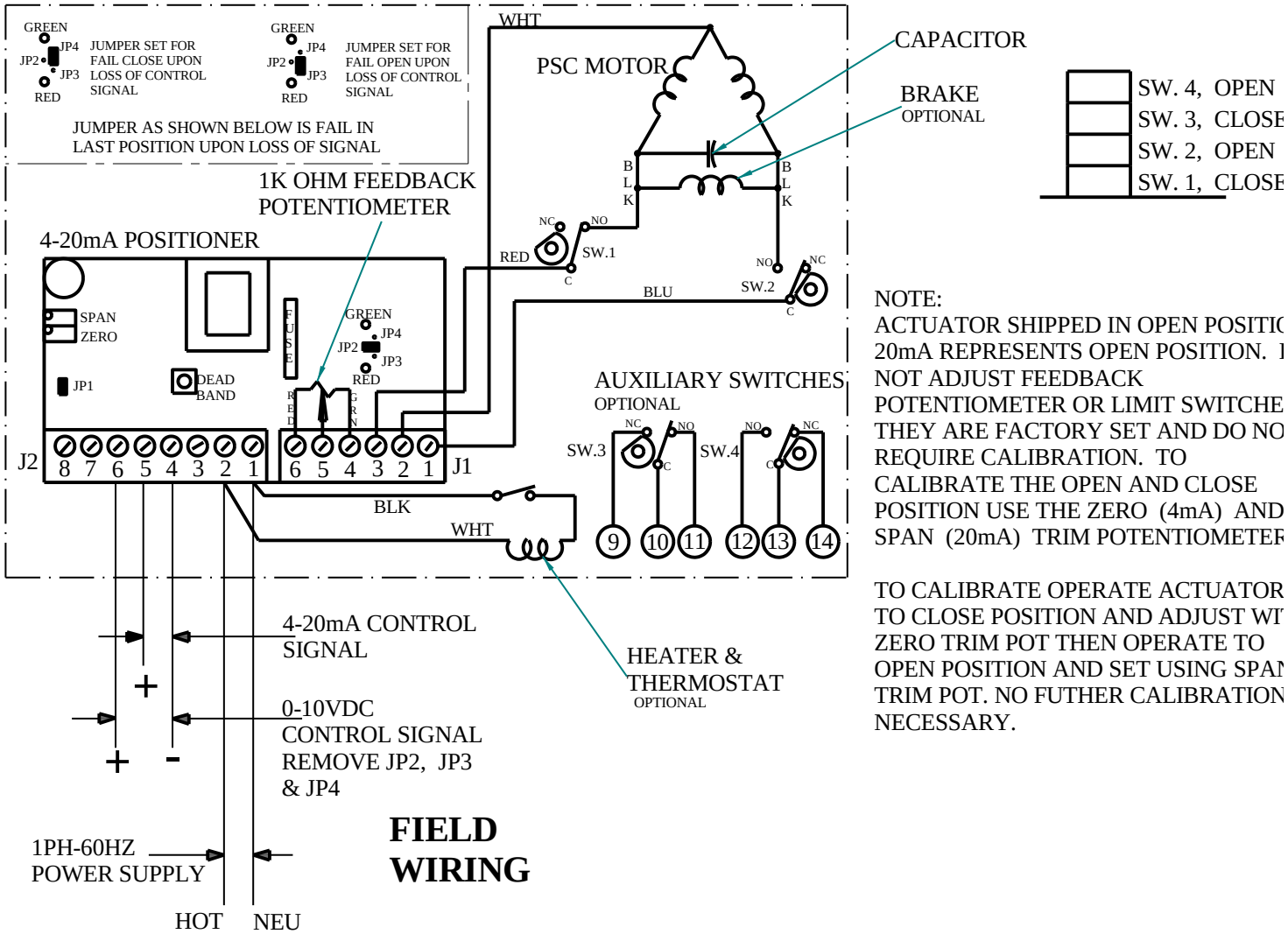
WIRING DIAGRAM ILLUSTRATES THE ACTUATOR IN THE OPEN POSITION

WIRING DIAGRAM FOR ML, MR & MS 24VAC ACTUATORS



OPERATION:
1. POWER TO TERMINALS 1 & 2 FOR CCW ROTATION.
2. POWER TO TERMINALS 1 & 3 FOR CW ROTATION.
3. LIGHT CONNECTED TO TERMINALS 1 & 4 FOR CW POSITION INDICATION.
4. LIGHT CONNECTED TO TERMINALS 1 & 5 FOR CCW POSITION INDICATION.

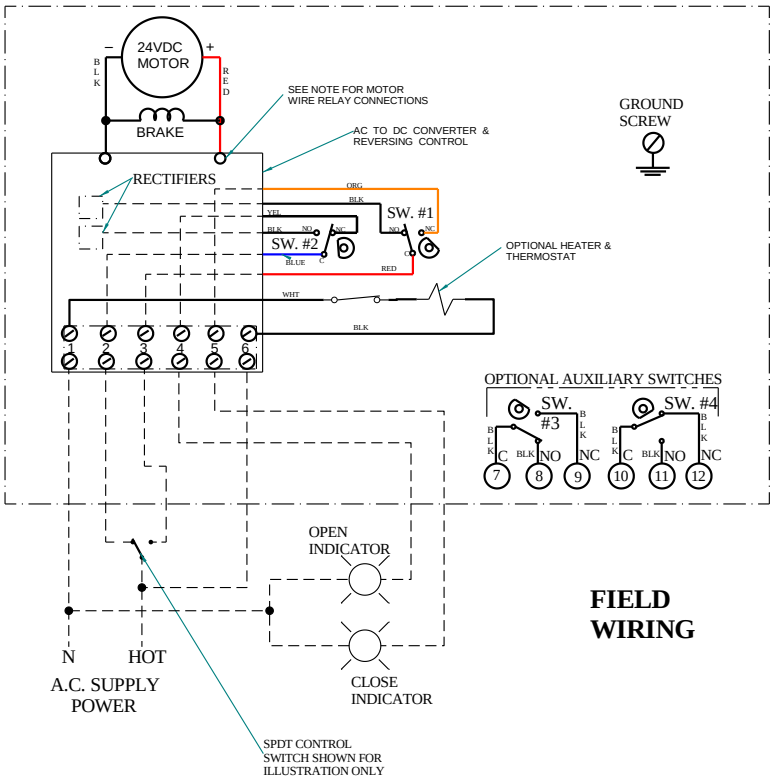
WIRING DIAGRAM FOR ACTUATORS WITH 4-20mA CONTROL

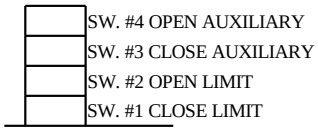


NOTE:
ACTUATOR SHIPPED IN OPEN POSITIC
20mA REPRESENTS OPEN POSITION. I
NOT ADJUST FEEDBACK
POTENTIOMETER OR LIMIT SWITCHE
THEY ARE FACTORY SET AND DO NO
REQUIRE CALIBRATION. TO
CALIBRATE THE OPEN AND CLOSE
POSITION USE THE ZERO (4mA) AND
SPAN (20mA) TRIM POTENTIOMETEF

TO CALIBRATE OPERATE ACTUATOR
TO CLOSE POSITION AND ADJUST WI
ZERO TRIM POT THEN OPERATE TO
OPEN POSITION AND SET USING SPAI
TRIM POT. NO FUTHER CALIBRATION
NECESSARY.

WIRING DIAGRAM FOR 24VAC ACTUATORS WITH 2 AUX. SWITCHES & OPTIONAL HEATER AND THERMOSTAT





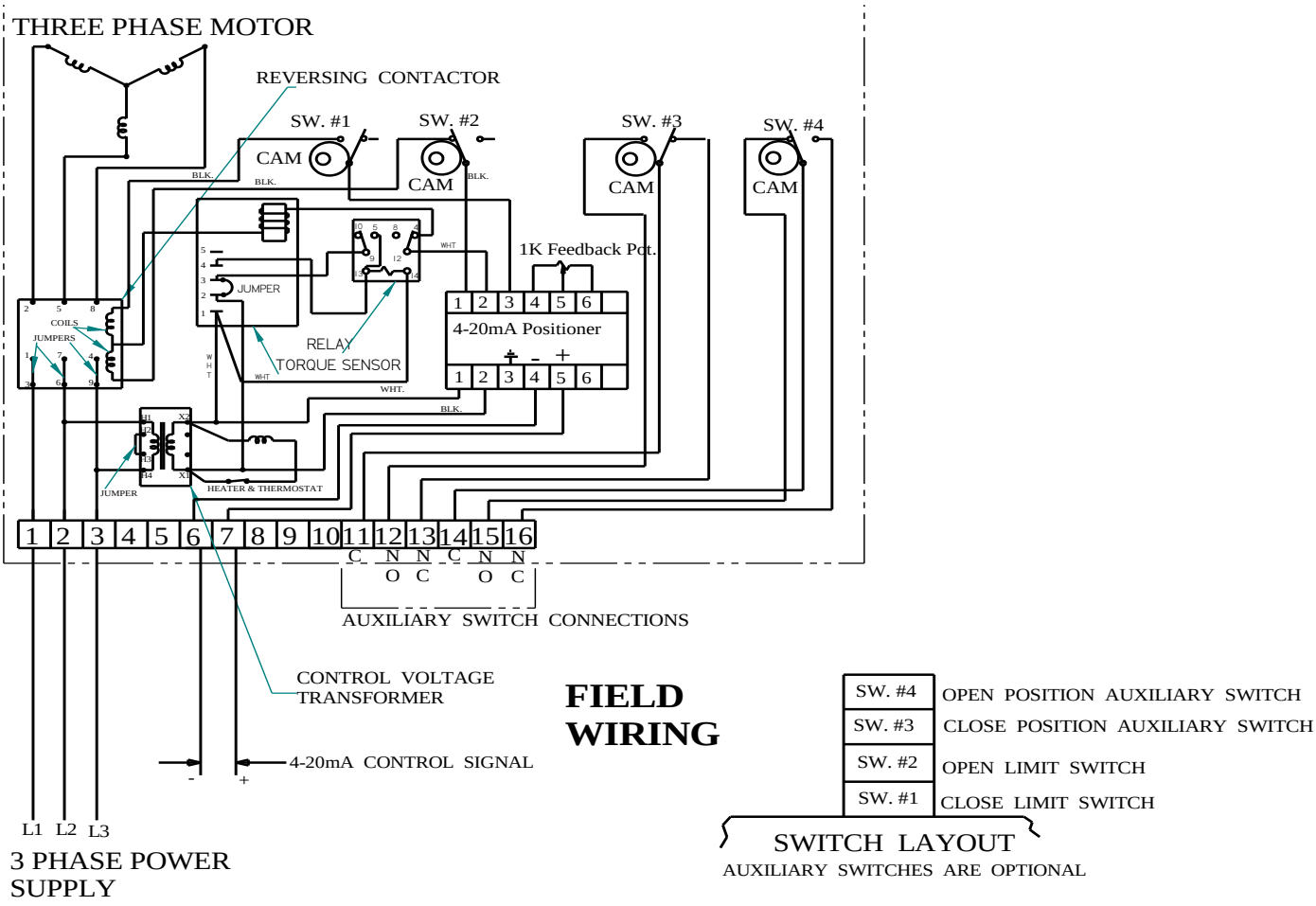
SWITCH LAYOUT

NOTES:
POWER TO TERMINALS ONE & TWO OPENS THE VALVE (CCW ROTATION)
POWER TO TERMINALS ONE & THREE CLOSES THE VALVE (CW ROTATION)
TERMINALS 4 THROUGH 9 FOR AUXILIARY SWITCH CONNECTIONS

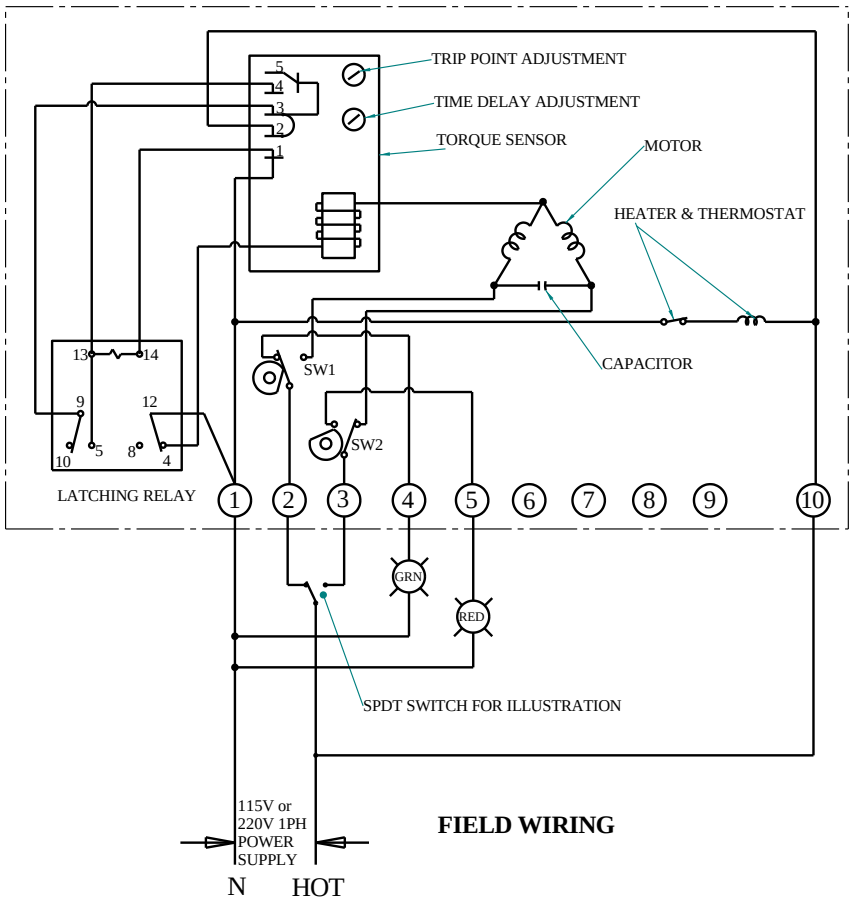
WIRING DIAGRAM ILLUSTRATES THE ACTUATOR IN THE OPEN POSITION

MOTOR WIRE RELAY CONNECTIONS:
"SD" 9 SECOND UNIT & "MH" = (+) PIN 12 // (-) PIN 9
ALL OTHERS = (+) PIN 9 // (-) PIN 12

WIRING DIAGRAM FOR ACTUATORS WITH TORQUE SENSOR AND 4-20mA CONTROL



WIRING DIAGRAM FOR ACTUATORS WITH TORQUE SENSOR (K SERIES)



OPERATION:
ACTUATOR IS SHOWN IN THE OPEN POSITION.

TRIP POINT IS SET AT ACTUATORS RATED TORQUE. TIME DELAY IS SET TO AVOID TRIP DUE TO INRUSH CURRENT.

POWER TO TERMINALS #1 & #2 FOR CCW ROTATION.
POWER TO TERMINALS #1 & #3 FOR CW ROTATION.

UNDER NORMAL OPERATION THE TORQUE SENSOR HAS NO AFFECT ON THE OPERATION OF THE ACTUATOR. HOWEVER, SHOULD THE ACTUATOR BECOME STALLED FOR ANY REASON WHAT SO EVER THE MOTOR CURRENT EXCEEDS THE TRIP POINT SETTING AND THE TORQUE SENSOR ACTIVATES THE LATCHING RELAY DISCONNECTING THE MOTOR FROM THE POWER SUPPLY. THE UNIT WILL NOT START AGAIN UNTIL THE POWER IS SHUT OFF AND REAPPLIED OR THE ACTUATOR IS GIVEN A SIGNAL TO ROTATE IN THE REVERSE DIRECTION. THE ACTUATOR WILL NOT COMPLETE ITS CYCLE UNTIL THE CAUSE FOR EXCESSIVE CURRENT IS TAKEN CARE OF.

HEATER AND THERMOSTAT ARE OPTIONAL.

MAINTENANCE:

After your ICI electric actuator has been properly installed there is little or no maintenance ever required. The gear train has been permanently lubricated at the factory and requires no routine maintenance. In the event it becomes necessary to perform maintenance on the actuator upon reassembling, we recommend using Lubriplate EMB grease.

INSTALL & SET AUXILIARY SWITCHES:

TOOLS REQUIRED:

1. COVER REMOVAL - PHILLIPS HEAD SCREWDRIVER
2. TERMINAL SCREWS - 1/8" WIDE SCREWDRIVER
3. CAM ADJUSTMENT - 5/64" ALLEN WRENCH
4. CUT WIRES - WIRE CUTTERS

NOTE:

Read these instructions completely before beginning installation, if you have any questions please call our service technician at 1-800-662-9424 for assistance.

PROCEDURE:

1. Turn off power supply to actuator.
2. Remove four (4) screws securing cover to gearbox, remove cover.
3. Remove two (2) 4-40 x 1" long screws securing switches to base.
4. Stack auxiliary switch (es) on top of existing limit switches.
5. Secure switches with 4-40 x 1 1/2" long screw if one auxiliary switch was added or 4-40 x 2" long screw if two auxiliary switches were added.
6. Install cam.
7. Using wire cutter snip the yellow and orange wires on limit switches and remove.
8. Connect the common (C) lead of third switch to terminal connection #4, the normally open (NO) to #5 and normally closed (NC) to #6. If a second auxiliary switch is being installed connect common (C) of top switch (#4 up from base) to terminal connection #7, the NO to #8 and NC to #9.

SET AUXILIARY SWITCH:

1. Turn on power to actuator.

CAUTION: At this time there are live circuits in the actuator; contact may cause electrical shock or death.

2. Operate actuator to the close position.
3. Rotate the third cam up from the base CCW so the setscrew is accessible and the round of the cam has switch arm compressed.
4. Rotate the cam CW until you hear the switch snap from the NO to the NC contact.
5. Lock cam in position by securing 8-32 x 1/4" long set screw to shaft.
6. Operate actuator to the open position.
7. Rotate top cam CW so set screw is accessible and round of cam has switch arm compressed.
8. Rotate top cam CCW until the switch snaps from the NO to the NC contact.
9. Lock cam in position by securing 8-32 x 1/4" long set screw to shaft.
10. Wire auxiliary switch to peripheral equipment, use terminal connections 4 through 9.
11. Test setting to assure proper operation.
12. If desired setting has not been achieved repeat steps 2 through 11.

13. Once proper settings have been accomplished replace cover and secure cover screws.

INSTALL & SET POWER OFF BRAKE:

TOOLS REQUIRED:

1. **5/32" ALLEN WRENCH**
2. **3/16" WIDE FLAT SCREWDRIVER**
3. **0.050 ALLEN WRENCH**
4. **PHILLIPS HEAD SCREWDRIVER (COVER REMOVAL: SD SERIES).**

NOTE:

Read instructions before beginning installation, see FIG. 1 for illustration, if you have any questions please call ICI at 1-800-662-9424.

PROCEDURE:

1. Turn off supply power to actuator.
2. Remove cover screws.
3. Remove cover.
4. Loosen and remove four screws (two screws on 2000 lb·in torque and higher) securing motor to gearbox.
5. Install motor brake/mounting bracket on top of the motor and replace the four screws removed in step 4 with four 6-32x2" screws supplied with kit.
6. Align the hole in the center of the brake with the OD of the 3/16" motor shaft extending through the top of the motor.
7. Tighten the four motor screws securely.
8. Slide the brake armature hub (round aluminum part with square drive on one end) onto the 3/16" dia. motor shaft and in to square opening in brake friction disc. NOTICE: Brake armature hub must engage brake friction disc.
9. Using .050 Allen wrench secure setscrew in brake armature hub to motor shaft.
10. Loosen and remove the blue wire nut on both sides of the motor capacitor. Connect the white brake wire to side of the capacitor with the red motor wire and replace the blue wire nut. Connect the black brake wire to the side of the capacitor with the brown motor wire and replace the blue wire nut.

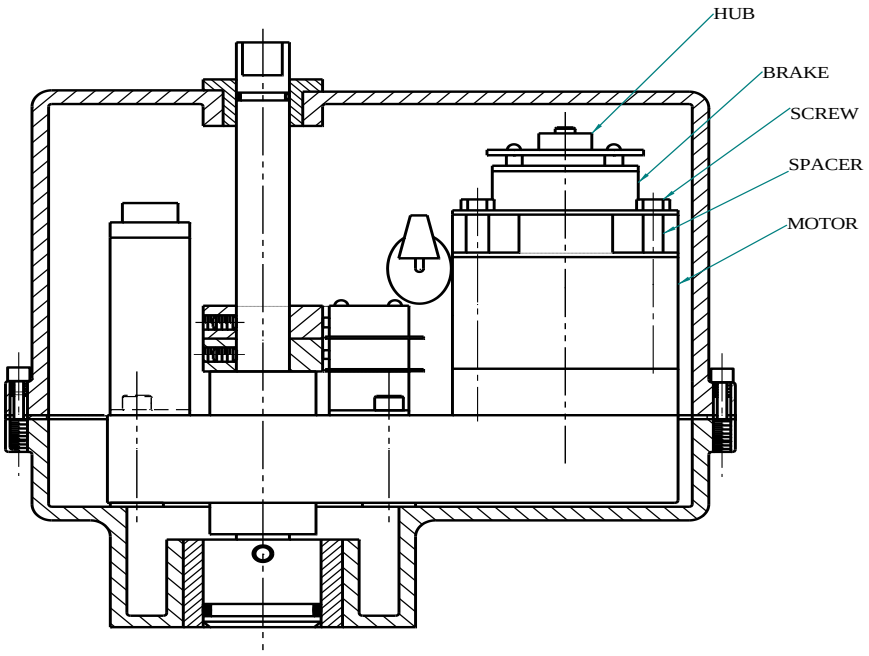


FIG. 1

INSTALL & SET POWER OFF BRAKE CONTINUED:

TO TEST:

CAUTION: TURN THE POWER SUPPLY ON TO TEST THE ACTUATOR, USE CAUTION WHEN TESTING THE ACTUATOR TO PREVENT ELECTRICAL SHOCK.

11. Apply power to terminals #1 and #2, actuator should rotate to the open position.
12. Apply power to terminals #1 and #3, actuator should rotate to the close position.
13. If assistance is required in performing these instructions please call your ICI distributor of call ICI direct at 1-800-662-9424.
14. Replace cover and cover gasket.
15. Secure cover screws.

NOTE: ACTUATORS PRODUCED AFTER 2000 DO NOT REQUIRE SPACER.

DUTY CYCLE:

ICI actuators rated 100 LB-IN up to 1500 LB-IN output torque are rated for 25% duty cycle at 100% ambient temperature at rated torque (75% duty cycle motors are available upon request). Actuators rated for 2000 LB-IN output torque and greater are rated for continuous duty. All direct current (dc) motors are rated for 75% duty cycle.

THERMAL OVER LOAD:

All alternating current (AC) motors are equipped with thermal over load protection to guard the motor against damage from overheating.

MECHANICAL OVER LOAD:

ICI' actuators are all designed to withstand stall conditions. It is not recommended to subject the unit to repeated stall conditions; however, should it occur the actuator would not experience gear damage.

ORDERING PARTS:

When ordering parts please specify:

- Actuator Model Number
- Actuator Serial Number
- Part Number
- Part Description

RECOMMENDED SPARE PARTS:

Two Position Actuators:	Set of cams and switches.
Modulating Actuators:	Set of cams, switches, feedback potentiometer and a positioning card.

NEMA 7 ENCLOSURE, GENERAL:

In general, operation and maintenance of a NEMA 7 electric actuator is no different than that of a NEMA 4 electric actuator. However, there are some precautions that must be followed.

1. **DO NOT** install in ambient temperatures that exceed 140 degrees F.
2. **DO NOT** under any circumstances remove the actuator cover while in a hazardous location when the contacts are still live, this could cause ignition of hazardous atmospheres.
3. **DO NOT** under any circumstances use a NEMA 7 electric actuator in a hazardous location that does not meet the specifications for which the actuator was designed. The actuator is clearly tagged with the NEMA classification it was designed for.
4. Mount, test and calibrate actuator on valve in non-hazardous location.
5. When removing the cover care must be taken not to scratch, scar or deform the flame path of the cover or base of the actuator, this will negate the NEMA 7 rating of the enclosure.
6. When replacing the cover on actuators rated NEMA 4 and 7 take care that the gasket is in place to assure the proper clearance after the cover is secured. After securing the cover screws check the clearance between the cover and the base, a .002" thick by 1/2" wide feeler gauge may not enter between the two mating faces more than .125".
7. All electrical connections must be to state and local codes and in accordance with the specifications for which the unit is being used.

**After proper installation the actuator will require little or no maintenance, in the event maintenance is required remove it from the hazardous location before attempting to work on it. If the actuator is in a critical application and down time is not permitted it is advisable to have a spare actuator in stock.*

INDELAC CONTROLS INC.

AMERICAN MADE ACTUATORS & CONTROLS

INDELAC 1-YEAR STANDARD WARRANTY POLICY:

INDELAC CONTROLS, INC. (ICI) WARRANTS THAT FOR A PERIOD OF 1 YEAR FROM THE DATE OF SHIPMENT IT WILL EITHER REPAIR OR REPLACE, AT ITS OPTION, ANY OF ITS PRODUCTS, WHICH PROVE TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP.

THIS WARRANTY DOES NOT COVER DAMAGE RESULTING FROM CAUSES SUCH AS ABUSE, MISUSE, MODIFICATION OR TAMPERING.

THIS WARRANTY IS EXTENDED ONLY TO THE REGISTERED PARTY, FOR WHICH THE PRODUCT SERIAL NUMBER MATCHES. THE EXTENDED WARRANTY OF ICI'S PRODUCT AND IS NOT TRANSFERABLE.

TO OBTAIN SERVICE UNDER THIS WARRANTY, THE PURCHASER MUST FIRST OBTAIN A RETURN AUTHORIZATION NUMBER FROM ICI. PRODUCTS MUST BE RETURNED TO ICI FREIGHT PREPAID FOR EVALUATION.

IF THE UNIT FAILED DUE TO POOR WORKMANSHIP OR MATERIALS THE UNIT WILL BE REPAIRED OR REPLACED. THE UNIT WILL BE RETURNED GROUND/STANDARD FREIGHT PAID BY ICI, IF AIR/RUSH SHIPMENT IS REQUESTED THE PURCHASER SHALL PAY THE DIFFERENCE.

THIS WARRANTY IS IN LIEU OF ALL OTHER OBLIGATIONS, LIABILITIES OR EXPRESSED WARRANTIES. ANY IMPLIED WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY ARE HEREBY EXPRESSLY EXCLUDED.

IN NO EVENT SHALL ICI BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING IN CONNECTION WITH THE USE OF ITS PRODUCTS, OR FOR ANY DELAY IN THE PERFORMANCE OF THIS WARRANTY DUE TO CAUSES BEYOND ITS CONTROL.

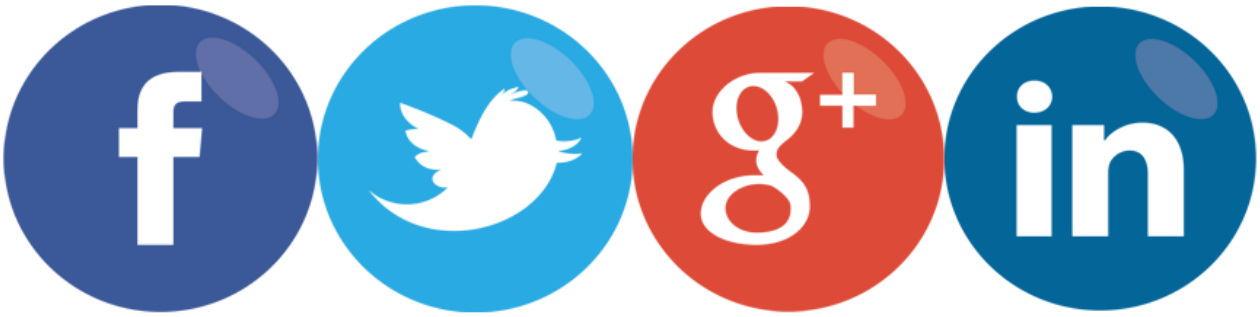
6810 POWERLINE DR.-FLORENCE, KY. 41042 - TELEPHONE 859-727-7890, TOLL FREE 1-800-662-9424
FAX. 859-727-4070, E-MAIL: DVOGES@INDELAC.COM, OR MROBINSON@INDELAC.COM
VISIT OUR WEBSITE AT WWW.INDELAC.COM

REGISTER ONLINE FOR INDELAC'S EXTENDED 2-YEAR WARRANTY

SYMPTOM	PROBLEM	SOLUTION
ACTUATOR DOES NOT RESPOND TO CONTROL SIGNAL.	Power not on Actuator wired wrong Wrong voltage Thermal overload activated Actuator and valve in opposite positions when actuator was mounted. Torque trip point set too low Torque trip delay set too short	Turn on power Check wiring diagram & rewire Check power supply & make appropriate changes Allow motor to cool, actuator will automatically reset Remove actuator and rotate 90 degrees & remount Increase trip point Increase delay time
ACTUATOR WILL NOT OPEN OR CLOSE COMPLETELY.	Travel limits set wrong Valve torque too high for actuator Mechanical stops not removed Torque trip point set too low Torque trip delay set too short	Reset cams. Install correct size actuator. Remove stops, CAUTION: Do not remove any part required for proper operation Increase trip point Increase delay time
VALVE OSCILLATES.	Valve torque too high for actuator Actuator without brake installed on butterfly valve Motor brake out of adjustment. Set screw loose in brake disc	Install correct size actuator. Install brake Adjust brake Adjust brake and tighten set-screw
MOTOR RUNS BUT OUTPUT SHAFT DOES NOT ROTATE.	Gear damage or sheared pin	Contact ICI or nearest distributor

NOTES

NOTES



Contact Information

Debbie Voges	dvoges@indelac.com	859-727-7890 ext. 100
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Talbot Caywood	tcaywood@indelac.com	859-727-7890 ext. 110

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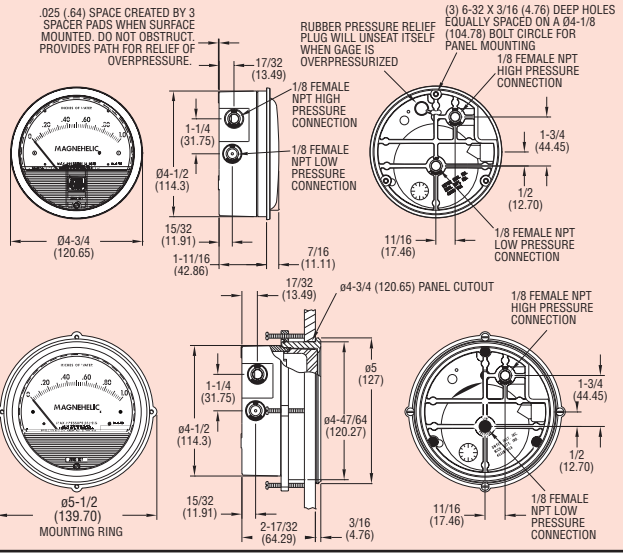
Series 2000

Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%

RoHS



Select the Dwyer® Magnehelic® gage for high accuracy – guaranteed within 2% of full-scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® gage movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

The Magnehelic® gage is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Mounting

A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. Although calibrated for vertical position, many ranges above 1″ may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4-9/16″ hole is required for flush panel mounting. Complete mounting and connection fittings, plus instructions, are furnished with each instrument. See pages 6 and 7 for more information on mounting accessories.

Flush, Surface or Pipe Mounted

Enclosure Mounted

SPECIFICATIONS

Service: Air and non-combustible, compatible gases (natural gas option available).
Note: May be used with hydrogen. Order a Buna-N diaphragm. Pressures must be less than 35 psi.
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of FS (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on - 00, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20 in Hg to 15 psig† (-0.677 to 1.034 bar); MP option: 35 psig (2.41 bar); HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. See Overpressure Protection Note on next page.
Temperature Limits: 20 to 140°F*
(-6.67 to 60°C). -20°F (-28°C) with low temperature option.
Size: 4″ (101.6 mm) diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Standard Accessories: Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapter, and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for three adapters in MP & HP gage accessories.)
Agency Approval: RoHS. **Note:** -SP models not RoHS approved.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

ACCESSORIES

Model A-432 Portable Kit
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft (2.7 m) of 3/16″ ID rubber tubing, standhang bracket and terminal tube with holder.

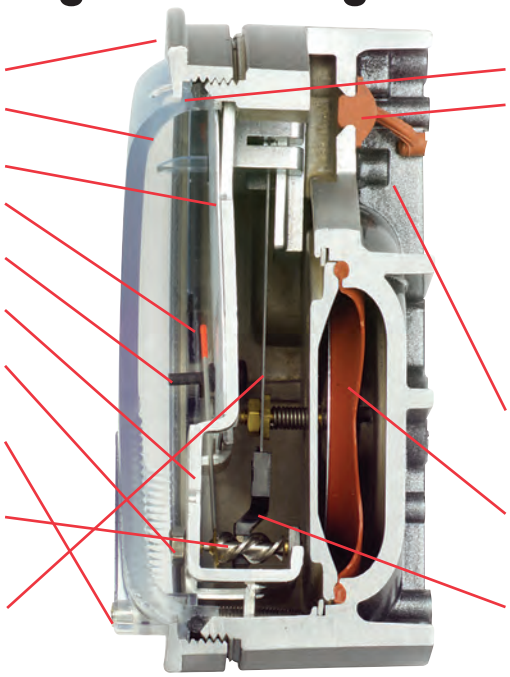
Model A-605 Air Filter Gage Accessory Kit
Adapts any standard Magnehelic® gage for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft (1.5 m) lengths of 1/4″ aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

A-605B Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two 4″ steel static tips, plastic tubing and mounting flange

A-605C Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two plastic static tips, plastic tubing and mounting flange

Series 2000

Magnehelic® Gage Models & Ranges



Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

O-ring seal for cover assures pressure integrity of case.

OVERPRESSURE PROTECTION
Blowout plug is comprised of a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (1.7 bar). To provide a free path for pressure relief, there are four spacer pads which maintain 0.023″ clearance when gage is surface mounted. Do not obstruct the gap created by these pads. The blowout plug is not used on models above 180″ of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm. The blowout plug should not be used as a system overpressure control. High supply pressures may still cause the gage to fail due to over pressurization, resulting in property damage or serious injury. Good engineering practices should be utilized to prevent your system from exceeding the ratings or any component.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

Model	Range Inches of Water
2000-00N†••	.05-0-.2
2000-00†••	0-.25
2000-0†•	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2012	0-12
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2120	0-120
2150	0-150
2160	0-160
2180*	0-180
2250*	0-250
Zero Center Ranges	
2300-00†••	0.125-0-0.125
2300-0†•	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model	Range PSI
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

Model	Range, CM of Water
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300
Zero Center Ranges	
2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

†These ranges calibrated for vertical scale position.
• Accuracy +/-3%
• • Accuracy +/-4%
*MP option standard
**HP option standard

Model	Range MM of Water
2000-6MM†••	0-6
2000-10MM†•	0-10
2000-15MM	0-15
2000-25MM	0-25
2000-30MM	0-30
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100
2000-125MM	0-125
2000-150MM	0-150
2000-200MM	0-200
2000-250MM	0-250
2000-300MM	0-300
Zero Center Ranges	
2300-6MM†••	3-0-3
2300-10MM†•	5-0-5
2300-20MM†•	10-0-10

Model	Range, Pa
2000-60NPA†••	10-0-50
2000-60PA†••	0-60
2000-100PA†•	0-100
2000-125PA†•	0-125
2000-250PA	0-250
2000-300PA	0-300
2000-500PA	0-500
2000-750PA	0-750
2000-1000PA	0-1000
Zero Center Ranges	
2300-60PA†••	30-0-30
2300-100PA†•	50-0-50
2300-120PA	60-0-60
2300-200PA	100-0-100
2300-250PA	125-0-125
2300-300PA	150-0-150
2300-500PA	250-0-250
2300-1000PA	500-0-500

Model	Range, kPa
2000-0.5KPA	0-0.5
2000-1KPA	0-1
2000-1.5KPA	0-1.5
2000-2KPA	0-2
2000-2.5KPA	0-2.5
2000-3KPA	0-3
2000-4KPA	0-4
2000-5KPA	0-5
2000-8KPA	0-8
2000-10KPA	0-10
2000-15KPA	0-15
2000-20KPA	0-20
2000-25KPA	0-25
2000-30KPA	0-30
Zero Center Ranges	
2300-1KPA	.5-0-.5
2300-2KPA	1-0-1
2300-2.5KPA	1.25-0-1.25
2300-3KPA	1.5-0-1.5

Dual Scale Air Velocity Units
For use with pitot tube

Model	Range in W.C./ Velocity F.P.M.
2000-00AV†••	0-.25/300-2000
2000-0AV†•	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2005AV	0-5.0/2000-8800
2010AV	0-10/2000-12500

Dual Scale English/Metric Models

Model	Range, in w.c.	Range, Pa or kPa
2000-00D†••	0-.25	0-62 Pa
2000-0D†•	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
2002D	0-2.0	0-500 Pa
2003D	0-3.0	0-750 Pa
2004D	0-4.0	0-1.0 kPa
2005D	0-5.0	0-1.25 kPa
2006D	0-6.0	0-1.5 kPa
2008D	0-8.0	0-2.0 kPa
2010D	0-10	0-2.5 kPa
2015D	0-15	0-3.7 kPa
2020D	0-20	0-5 kPa
2025D	0-25	0-6.2 kPa
2050D	0-50	0-12.4 kPa
2060D	0-60	0-15 kPa

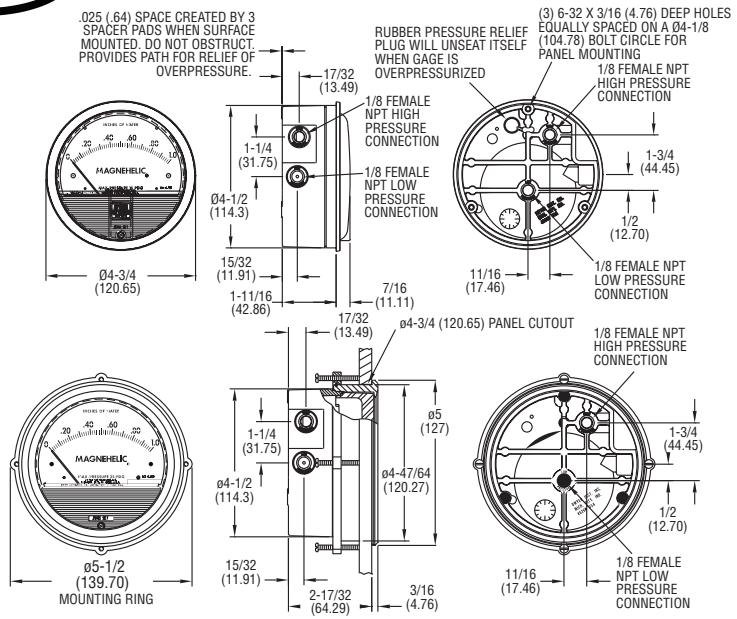
VELOCITY AND VOLUMETRIC FLOW UNITS
Scales are available on the Magnehelic® that read in velocity units (FPM, m/s) or volumetric flow units (SCFM, m^3/s, m^3/h). Stocked velocity units with dual range scales in inches w.c. and feet per minute are shown above. For other ranges contact the factory.
When ordering volumetric flow scales please specify the maximum flow rate and its corresponding pressure. Example: 0.5 in w.c. = 16,000 CFM.

ACCESSORIES
A-321, Safety Relief Valve
A-448, 3-piece magnet kit for mounting Magnehelic® gage directly to magnetic surface
A-135, Rubber gasket for panel mounting

A-310A 3-Way Vent Valves
In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

Bulletin A-27

Magnehelic® Differential Pressure Gage



**The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.*

STANDARD GAGE ACCESSORIES: Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapters and three flush mounting adapters with screws.

MP AND HP GAGE ACCESSORIES: Mounting ring and snap ring retainer substituted for 3 adaptors, 1/4" compression fittings replace 1/8" pipe thread to rubber tubing adaptors.

OVERPRESSURE PROTECTION: Standard Magnehelic® Differential Pressure Gages are rated for a maximum pressure of 15 psig and should not be used where that limit could be exceeded. Models employ a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (excludes MP and HP models). To provide a free path for pressure relief, there are four spacer pads which maintain .023″ clearance when gage is surface mounted. Do not obstruct the gap created by these pads.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. (MP model has polycarbonate cover).
Accuracy: ±2% of full scale (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on -00, - 00N, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20″ Hg to 15 psig.† (-0.677 bar to 1.034 bar); MP option: 35 psig (2.41 bar), HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.
Temperature Limits: 20 to 140°F (-6.67 to 60°C). *Low temperature models available as special option.
Size: 4″ (101.6 mm) diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Agency Approvals: RoHS.

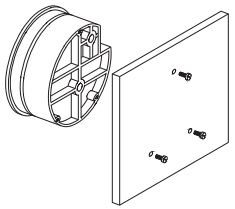
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options.

Note: May be used with hydrogen when ordering Buna-N diaphragm. Pressure must be less than 35 psi.

INSTALLATION

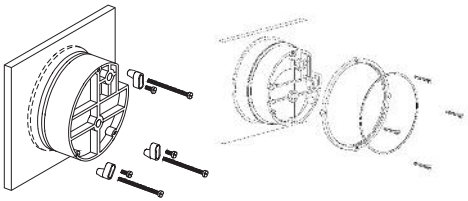
Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F (60°C). Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.
All standard Magnehelic® Differential Pressure Gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range models of 0.5" w.c. plus 0.25" w.c. and metric equivalents must be used in the vertical position only.

SURFACE MOUNTING



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

FLUSH MOUNTING



Provide a 4-9/16" dia. (116 mm) opening in panel. Provide a 4-3/4" dia. (120 mm) opening for MP and HP models. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adapters, firmly secured in place.

PIPE MOUNTING

To mount gage on 1-1/4" - 2" pipe, order optional A-610 pipe mounting kit.

TO ZERO GAGE AFTER INSTALLATION

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

OPERATION

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.
Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.
Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.
When one side of the gage is vented in dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

A. For portable use of temporary installation use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with flexible rubber or vinyl tubing.
B. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended.

MAINTENANCE

No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves should be used in permanent installations. The Series 2000 is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

WARNING

Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended.

TROUBLE SHOOTING TIPS

Gage won't indicate or is sluggish.

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O"ring damaged, missing.
5. Pressure sensor, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F (-7°C), order gage with low temperature, (LT) option.

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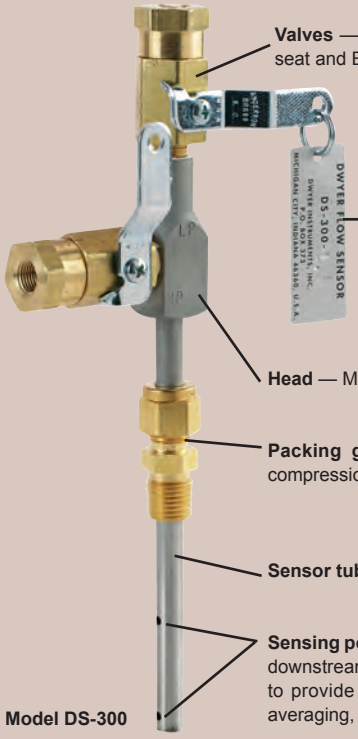
Series DS

In-Line Flow Sensors

Use with the Dwyer® Differential Pressure Gages or Transmitters



Valves — Standard, brass with TFE seat and Buna-N O-ring

Nameplate — Stainless steel permanently attached with split ring. Includes complete size and model information.

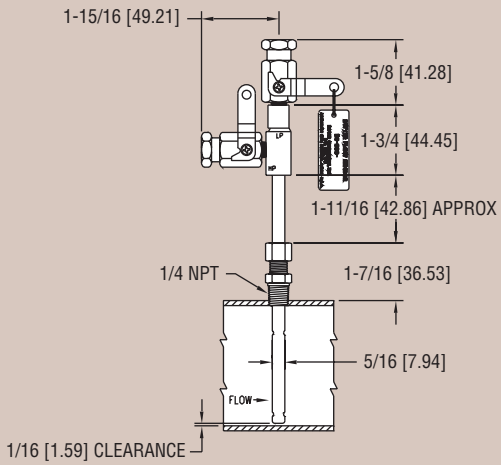
Head — Machined stainless steel.

Packing gland — Parker CPI brass compression fitting.

Sensor tube — 304 SS.

Sensing ports — Multiple upstream and downstream ports sized and positioned to provide effective accurate pressure averaging, even at lower velocities.

Model DS-300



In-Line Flow Sensors are averaging Pitot tubes that provide accurate and convenient flow rate sensing for schedule 40 pipe. When purchased with a Dwyer® Capsuhelic® differential pressure gage of appropriate range, the result is a flow indicating system delivered off the shelf at an economical price.

Pitot tubes have been used in flow measurement for years. Conventional pitot tubes sense velocity pressure at only one point in the flowing stream. Therefore, a series of measurements must be taken across the stream to obtain a meaningful average flow rate. The Dwyer® flow sensor eliminates the need for "traversing" the flowing stream because of its multiple sensing points and built-in averaging capability.

The Series DS-300 flow sensors are designed to be inserted in the pipeline through a compression fitting. They are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® gage kit. Standard valves are rated at 200 psig (13.7 bar) and 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 flow sensors are available for pipe sizes from 1″ to 10″.

DS-400 Averaging Flow Sensors are quality constructed from extra strong 3/4″ dia. stainless steel to resist increased forces encountered at higher flow rates with both air and water. This extra strength also allows them to be made in longer insertion lengths up to 24 inches (61 cm). All models include convenient and quick-acting quarter-turn ball valves to isolate the sensor for zeroing. Process connections to the valve assembly are 1/8″ female NPT. A pair of 1/8″ NPT X 1/4″ SAE 45° flared adapters are included, compatible with hoses used in the Model A-471 Portable Capsuhelic® Gage Kit. Supplied solid brass mounting adapter has a 3/4″ dia. compression fitting to lock in required insertion length and a 3/4″ male NPT thread for mounting in a Threaded Branch Connection.

Select model with suffix which matches pipe size

Model DS-300-1″
Model DS-300-1-1/4″
Model DS-300-1-1/2″
Model DS-300-2″
Model DS-300-2-1/2″
Model DS-300-3″
Model DS-300-4″
Model DS-300-6″
Model DS-300-8″
Model DS-300-10″

Model DS-400-6″
Model DS-400-8″
Model DS-400-10″
Model DS-400-12″
Model DS-400-14″
Model DS-400-16″
Model DS-400-18″
Model DS-400-20″
Model DS-400-24″

OPTIONS & ACCESSORIES

DS-300 or DS-400 Less Valves. To order, add suffix **-LV**

A-160, Threaded Branch Connection, 3/8″ NPT, forged steel, 3000 psi

A-161, Brass Bushing, 1/4″ x 3/8″

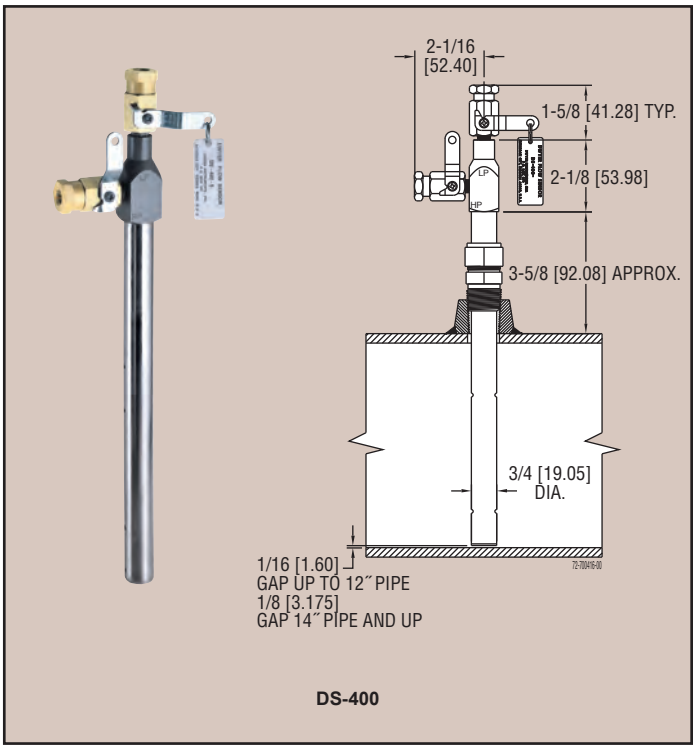
How To Order

Merely determine the pipe size into which the flow sensor will be mounted and designate the size as a suffix to Model DS-300. For example, a flow sensor to be mounted in a 2″ pipe would be a Model No. DS-300-2″.

For non-critical water and air flow monitoring applications, the chart below can be utilized for ordering a stock Capsuhelic® differential pressure gage for use with the DS-300 flow sensor. Simply locate the maximum flow rate for the media being measured under the appropriate pipe size and read the Capsuhelic® gage range in inches of water column to the left. The DS-300 sensor is supplied with installation and operating instructions, Bulletin F-50. It also includes complete flow conversion information for the three media conditions shown in the chart below. This information enables the user to create a complete differential pressure to flow rate conversion table for the sensor and differential pressure gage employed. Both the Dwyer® Capsuhelic® gage and flow sensor feature excellent repeatability so, once the desired flow rate is determined, deviation from that flow in quantitative measure can be easily determined. You may wish to order the adjustable signal flag option for the Capsuhelic® gage to provide an easily identified reference point for the proper flow.

Capsuhelic® gages with special ranges and/or direct reading scales in appropriate flow units are available on special order for more critical applications. Customer supplied data for the full scale flow (quantity and units) is required along with the differential pressure reading at that full flow figure. Prior to ordering a special Capsuhelic® differential pressure gage for flow read-out, we recommend you request Bulletin F-50 to obtain complete data on converting flow rates of various media to the sensor differential pressure output. With this bulletin and after making a few simple calculations, the exact range gage required can easily be determined.

Large 3/4 Inch Diameter for Extra Strength in Lengths to 24 Inches



DS-400

Gage Range (in w.c.)	Media @ 70°F	Full Range Flows by Pipe Size (Approximate)									
		1″	1-1/4″	1-1/2″	2″	2-1/2″	3″	4″	6″	8″	10″
2	Water (GPM)	4.8	8.3	11.5	20.5	30	49	86	205	350	560
	Air @ 14.7 PSIA (SCFM)	19.0	33.0	42.0	65.0	113	183	330	760	1340	2130
	Air @ 100 PSIG (SCFM)	50.0	90.5	120.0	210.0	325	510	920	2050	3600	6000
5	Water (GPM)	7.7	14.0	18.0	34.0	47	78	138	320	560	890
	Air @ 14.7 PSIA (SCFM)	30.0	51.0	66.0	118.0	178	289	510	1200	2150	3400
	Air @ 100 PSIG (SCFM)	83.0	142.0	190.0	340.0	610	820	1600	3300	5700	10000
10	Water (GPM)	11.0	19.0	25.5	45.5	67	110	195	450	800	1260
	Air @ 14.7 PSIA (SCFM)	41.0	72.0	93.0	163.0	250	410	725	1690	3040	4860
	Air @ 100 PSIG (SCFM)	120.0	205.0	275.0	470.0	740	1100	2000	4600	8100	15000
25	Water (GPM)	18.0	32.0	40.5	72.0	108	173	310	720	1250	2000
	Air @ 14.7 PSIA (SCFM)	63.0	112.0	155.0	255.0	390	640	1130	2630	4860	7700
	Air @ 100 PSIG (SCFM)	185.0	325.0	430.0	760.0	1200	1800	3300	7200	13000	22000
50	Water (GPM)	25.0	44.0	57.5	100.0	152	247	435	1000	1800	
	Air @ 14.7 PSIA (SCFM)	90.0	161.0	205.0	360.0	560	900	1600	3700	6400	
	Air @ 100 PSIG (SCFM)	260.0	460.0	620.0	1050.0	1700	2600	4600	10000	18500	
100	Water (GPM)	36.5	62.0	82.0	142.0	220	350	620	1500		
	Air @ 14.7 PSIA (SCFM)	135.0	230.0	300.0	505.0	800	1290	2290	5000		
	Air @ 100 PSIG (SCFM)	370.0	660.0	870.0	1500.0	2300	3600	6500	15000		

Model A-471 Portable Kit

For portable operation, the A-471 Capsuhelic® Portable Gage Kit is available complete with tough polypropylene carrying case, mounting bracket, 3-way manifold valve, two 10' high pressure hoses, and all necessary fittings.

See page 16 for complete information on the Capsuhelic® gage

Capsuhelic® Gage Shown Installed In A-471 Portable Kit

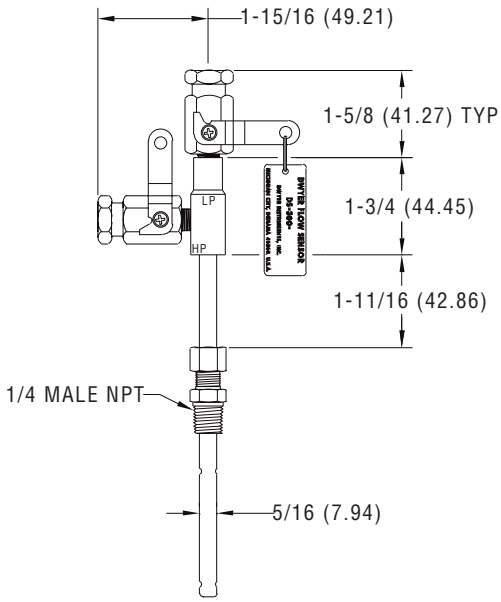
Series 631B Capsuhelic® Wet/Wet Differential Pressure Transmitter

Low pressure transmitter for use with DS-300/400 flow sensors. Use Series 631B Capsuhelic® Wet/Wet Differential Pressure Transmitter.

See page 65 for additional details.

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations



Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

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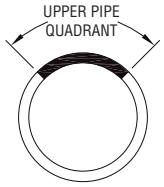
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

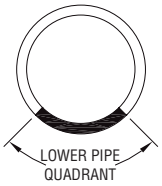
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

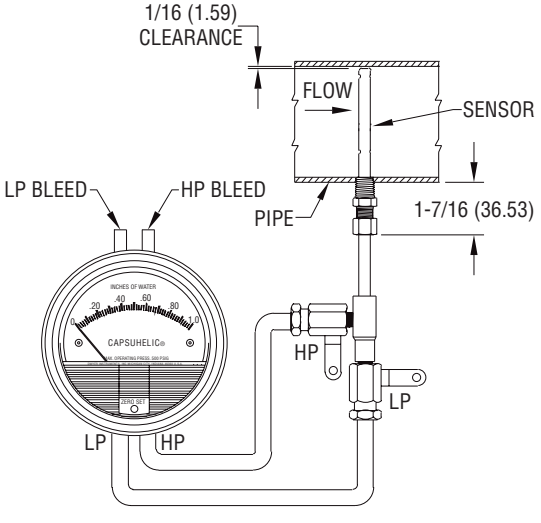
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

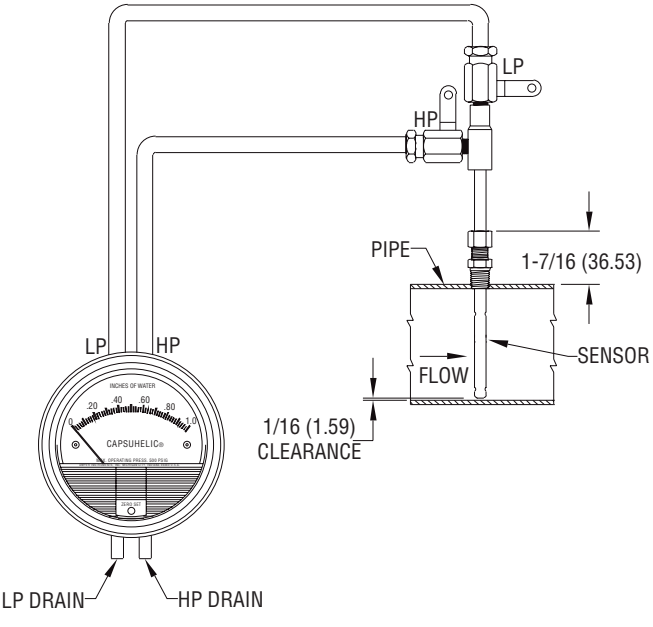
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

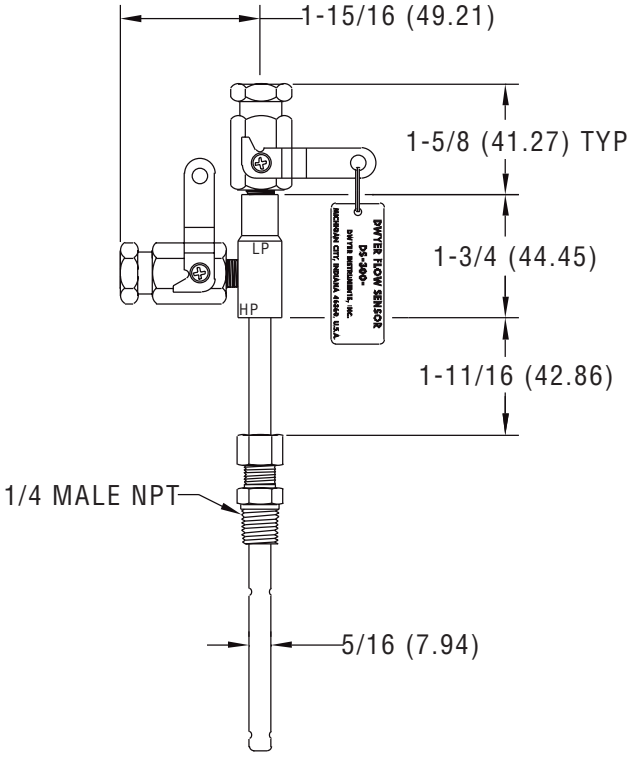
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 “Flow of Fluids Through Valves, Fittings and Pipe.” It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient “K”	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Water @ 70°F (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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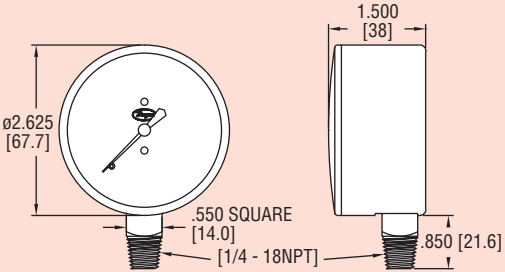
Series LPG4

2.5″ Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2″ Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range	Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)	**LPG4-D8322N**	0-40 in w.c. (0-10 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)	**LPG4-D8422N**	0-60 in w.c. (0-15 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)	**LPG4-D8522N**	0-80 in w.c. (0-20 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)	**LPG4-D8622N**	0-100 in w.c. (0-25 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)	**LPG4-D8722N**	0-160 in w.c. (0-40 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)	**LPG4-D8922N**	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)	**LPG4-D9022N**	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)	**LPG4-D9122N**	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)	**LPG4-D9222N**	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)	**LPG4-D9322N**	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)	**LPG4-D9422N**	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)	**LPG4-D9522N**	-40-0-60 in w.c. (-10-0-0.15 kPa)

OPTION
For NIST traceable calibration certificate, use order code NISTCAL-PG1.

SECTION 5 - 200 SERIES PROCESS EQUIPMENT - MOISTURE SEPARATOR & TRANSFER PUMP

VACUUM INDICATOR - DWYER MODEL LPG4-D7722N

VACUUM SWITCH - DWYER MODEL 1950-20-2F

MOISTURE SEPARATOR, 150 GAL - NES MODEL 150 GAL

LEVEL SWITCH - MULTI-POSITION - FPI SENSORS MODEL LS-500-3 POS

FLOW INDICATOR - DWYER MODEL ISDP-006

FLOW ELEMENT - DWYER MODEL DS-300-6

VACUUM TRANSMITTER - DWYER MODEL ISDP-010

PROGRESSIVE CAVITY PUMP - MOYNO MODEL 34401

PROGRESSIVE CAVITY MOTOR, 1 HP, 208 VAC, 3PH, TEFC - BALDOR MODEL M3546

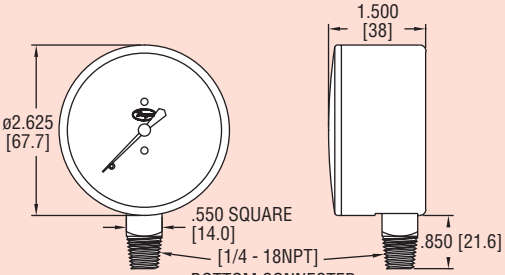
PRESSURE INDICATOR - DWYER MODEL SGY-D10522N

TEMPERATURE INDICATOR - AV MODEL 1NFY8

Series LPG4

2.5″ Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2″ Gage



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SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

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LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)	**LPG4-D8922N**	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)	**LPG4-D9022N**	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)	**LPG4-D9122N**	-8-0-16 in w.c. (-2-0-4 kPa)
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LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)	**LPG4-D9322N**	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)	**LPG4-D9422N**	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)	**LPG4-D9522N**	-40-0-60 in w.c. (-10-0-0.15 kPa)

OPTION
For NIST traceable calibration certificate, use order code NISTCAL-PG1.

Series 1950 Explosion-Proof Differential Pressure Switches

Specifications - Installation and Operating Instructions

Series 1950 Explosion-Proof Differential Pressure Switches combine the best features of the Series 1900 Pressure Switch with an integral explosion-proof and weather-proof housing. Each unit is UL & CSA listed; FM approved for use in Class I, Groups C & D; Class II, Groups E, F, & G; and Class III atmospheres (NEMA 7 & 9). They are totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches w.c. and from .5 to 50 psi (3.4 to 345 kPa).

Easy access to the SPDT switch for electrical hook-up is provided by removing the top plate of the three-part aluminum housing. Adjustment to the set point of the switch can be made without disassembling the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

CAUTION
For use only with air or compatible gases. Use of the Model 1950 switch with explosive media connected to the Low pressure port (including differential pressure applications in such media) is not recommended. Switch contact arcing can cause an explosion inside the switch housing which, while contained, may render the switch inoperative. If switch is being used to sense a single positive pressure relative to atmosphere, run a line from the low pressure port to a non-hazardous area free of combustible gases. This may increase response time on -0 and -00 models.

Note: The last number-letter combination in the model number identifies the switch's electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In case of special models, a number 1 rating is the same as 2; a number 3 or 4 rating is 10A 125, 250, 480 VAC; 1/8 H.P. 125 VAC; 1/4 H.P. 250 VAC; a number 5 or 6 rating is 1A 125 VAC. Letter B indicates a Buna-N diaphragm; N = Neoprene; S = Silicone; and V = Viton®.

UL and CSA Listed, FM Approved For
CL. I GR. C, D - CL. II GR. E, F, G - CL. III

Series 1950 Switches
Operating ranges and deadbands

To order specify Model Number	Operating Range: Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-02-2S	0.03 to 0.10	0.025	0.05
1950-00-2F	0.07 to 0.15	0.04	0.05
1950-0-2F	0.15 to 0.5	0.10	0.15
1950-1-2F	0.4 to 1.6	0.15	0.20
1950-5-2F	1.4 to 5.5	0.3	0.4
1950-10-2F	3.0 to 11.0	0.4	0.5
1950-20-2F	4.0 to 20.0	0.4	0.6
Model Number	Operating Range: PSI	Approximate Dead Band	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2.0	0.3 psi	0.3 psi
1950P-8-2F	1.5 to 8.0	1.0 psi	1.0 psi
1950P-15-2F	3.0 to 15.0	0.9 psi	0.9 psi
1950P-25-2F	4.0 to 25.0	0.7 psi	0.7 psi
1950P-50-2F	15.0 to 50	1.0 psi	1.5 psi

SPECIFICATIONS
Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits:
Continuous: 1950's - 45″ w.c. (0.11 bar);
1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar).
Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: IP54, NEMA 3, 7 and 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8″ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, UL, CSA, FM.

RESPONSE TIME: Because of restrictive effect of flame arrestors, switch response time may be as much as 10-25 seconds where applied pressures are near set point.

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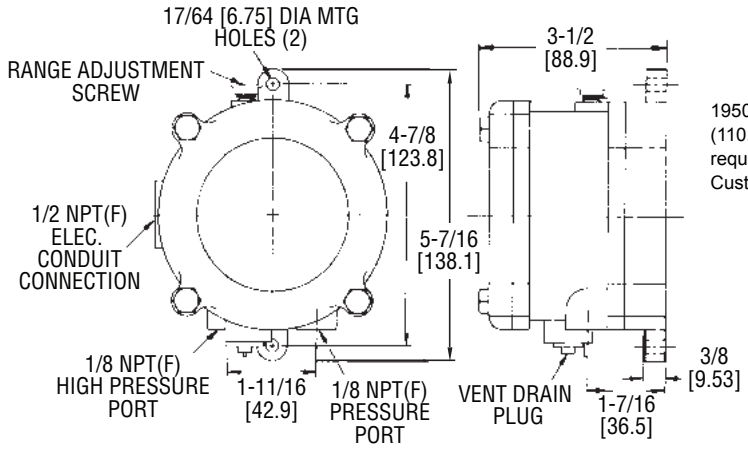

1950-02: 7-3/4″ (196.9) dia. x 4-11/32″ (110.3) depth. For complete dimensions request drawing 28-700175-00 from our Customer Service Department

1950 Switch Outline Dimensions

INSTALLATION

1. Select a location free from excess vibration and corrosive atmospheres where temperatures will be within the limits noted under Specifications on reverse. Switch may be installed outdoors or in areas where the hazard of explosion exists. See reverse for specific types of hazardous service.

2. Mount standard switches with the diaphragm in a vertical plane and with switch lettering and nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical.

3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4″ O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8″ female NPT pressure ports as noted below:

A. Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HIGH PRESS, and from source of lower pressure to low pressure port marked LOW PRESS.

B. Pressure only (above atmospheric pressure) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.

C. Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.

4. To make electrical connections, remove the three hex head screws from the cover and after loosening the fourth captive screw, swing the cover aside. Electrical connections to the standard single pole, double throw snap switch are provided by means of terminals marked “COM” (common), “NO” (norm open), “NC” (norm closed). The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point. Switch loads for standard models should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with an increase in ambient temperature, load inductance, or cycling rate. Whenever an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

ADJUSTMENT: To Change the Set point

1. Remove the plastic cap and turn the slotted Adjust-ment Screw at the top of the housing clockwise to raise the set point pressure and counterclockwise to lower the set point. After calibration, replace the plastic cap and re-check the set point.

2. The recommended procedure for calibrating or checking calibration is to use a “T” assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.

3. For highly critical applications check the set point adjustment and if necessary, reset it as noted in step A.

MAINTENANCE

The moving parts of these switches need no maintenance or lubrication. The only adjustment is that of the set point. Care should be taken to keep the switch reasonably clean. Periodically the vent drain plug should be rotated, then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch. The Series 1950 Explosion-Proof Differential Pressure Switch is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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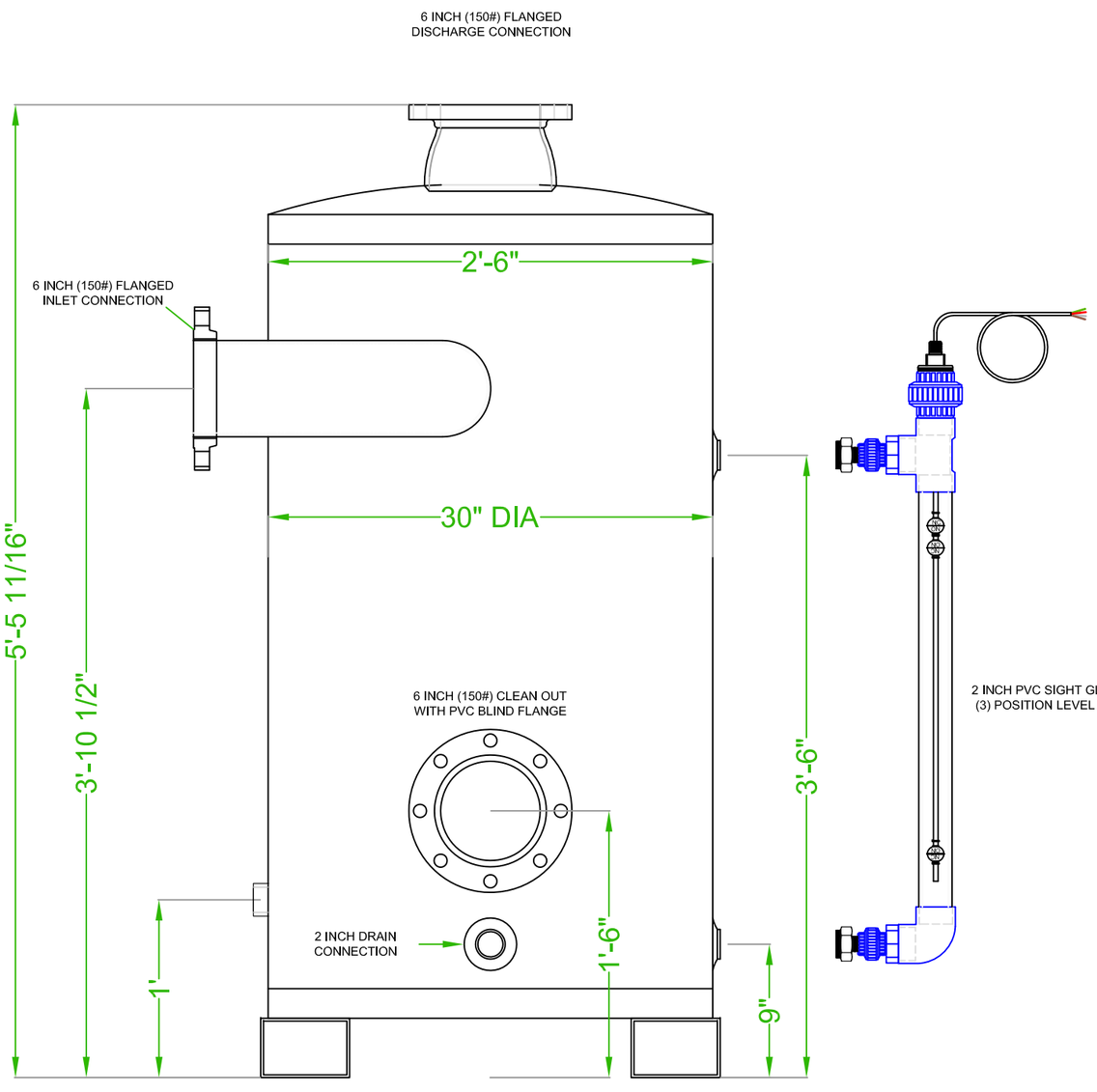

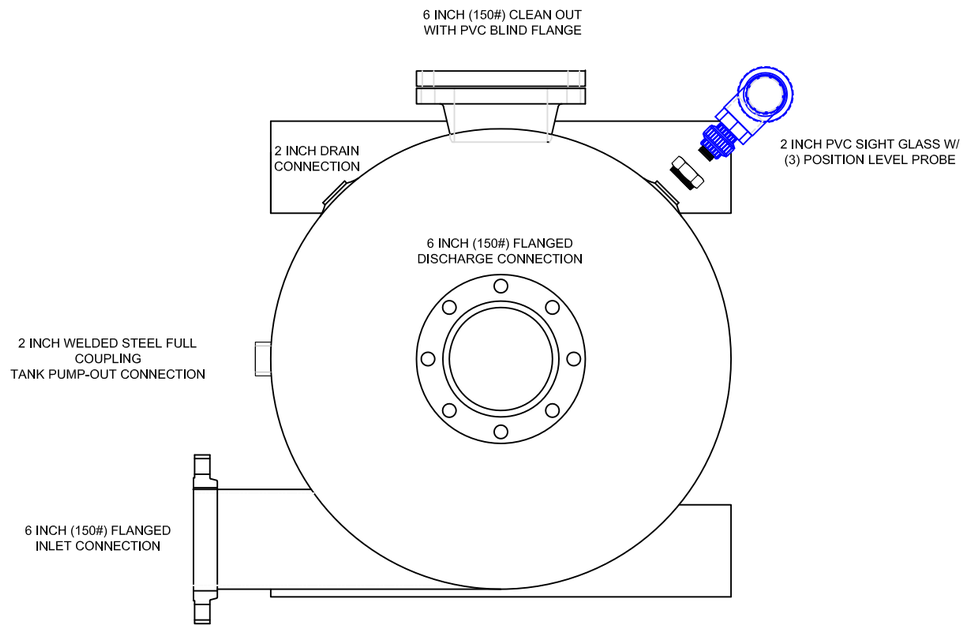

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS

REVISIONS

NES™
NATIONAL ENVIRONMENTAL SYSTEMS
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DRWN BY	MJS
DATE	10-20-14
CHK BY	CJJ
DATE	01-12-15
APPR BY	--
DATE	--

TITLE
150 GALLON MOISTURE SEPARATOR (T-201)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	M-3	1 OF 1	A

MOISTURE SEPARATOR

GENERAL THEORY

The moisture separator removes liquids from the process stream in soil venting applications to help protect the blower from corrosion and mineral deposits caused by water.

DESIGN INFORMATION

NES moisture separators operate on the principles of cyclonic section aided by velocity reduction. The moisture separator inlet pipe is set tangential to the tank wall, a stringer pipe extends down past the separator inlet is placed in the center of the tank. The moisture laden air stream is forced into a cyclonic rotation. The centrifugal force produced throws the water droplets to the outer wall of the separator where they fall and collect at the bottom. Additional efficiency is produced when the velocity is reduced to values between 1500 fpm and 6000 fpm. For a separator of this type, moisture separation efficiency is typically 95% or greater for moisture droplets greater than 10 micron.

CONSTRUCTION

NES moisture separators are constructed of carbon steel with bronze drain valves, removable lid with EPDM gasket, mechanical ball and float assembly standard for drum style separators. Sight glass, emergency high-level switch and pump out switches are optional. Tank style separators are standard with carbon steel construction, bronze drain valves, flanged clean-out port, sight glass and emergency high level switch. Pump-out switches and mist eliminator are optional. All separators are primed and coated with a rust inhibitor to prevent corrosion.

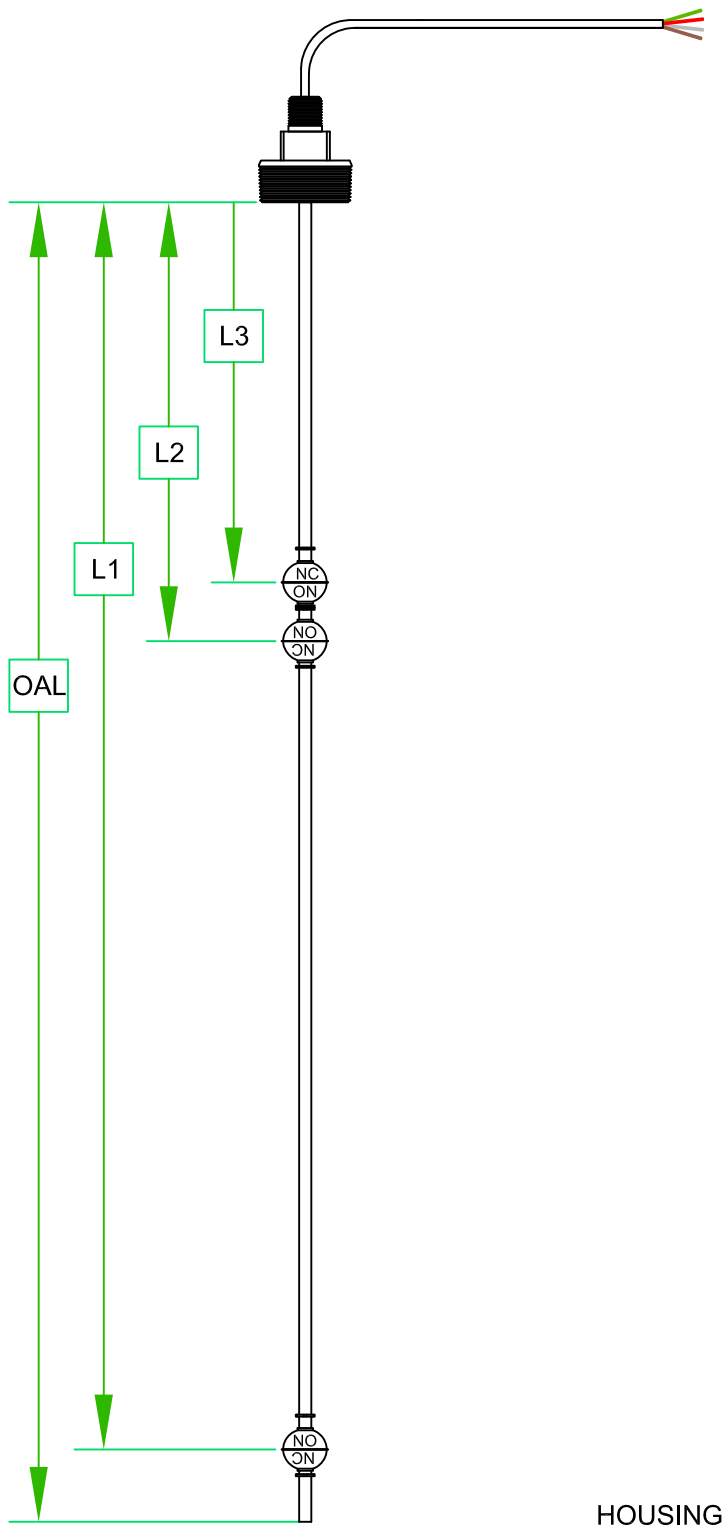
National Environmental Systems
Phone 508-226-1100 Fax 508-226)-1180 84 Dunham Street Attleboro, MA 02703
www.nes-inc.biz

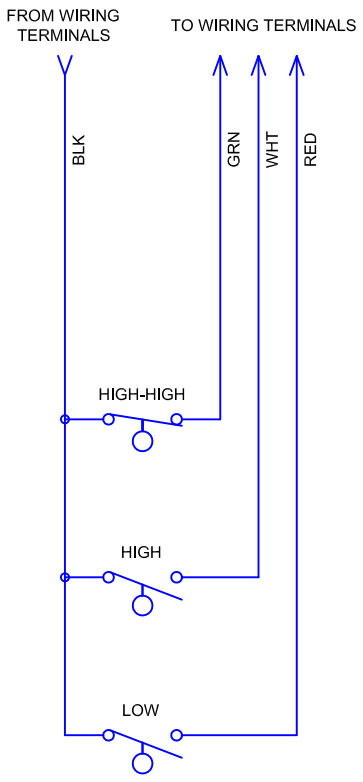
Tank Style Moisture Separator

* 120 gallon total capacity
* Carbon Steel construction, exterior primed & painted
* 4" MNPT Tangential Inlet - Vapor
* Demister
* 4" FNPT Outlet - Vapor
* 2" Clear PVC Sight Glass
* Clean-out Man-way
* 1" Ball drain valve
* 2" MPT Pump Out - Liquid
* (3) Position High Level Switch

National Environmental Systems
Phone 508-226-1100 Fax 508-226)-1180 84 Dunham Street Attleboro, MA 02703
www.nes-inc.biz

L3	GREEN	NORMALLYCLOSED	HIGH-HIGH
L2	WHITE	NORMALLY OPEN	HIGH
L1	RED	NORMALLY OPEN	LOW
	BLACK		COMMON





HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT
LISTING	UL

OAL - 33.75 INCHES
L1 - 31.75 INCHES
L2 - 11.25 INCHES
L3 - 9.75 INCHES
CABLE LENGTH - 120 INCHES

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	12-23-14	MJS

REVISIONS

DRWN BY	MJS
DATE	10-20-14
CHK BY	CJJ
DATE	12-23-14
APPR BY	--
DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

TITLE: 3 POSITION LEVEL SENSOR (LSHH-201, LSH-201, & LSL-201)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

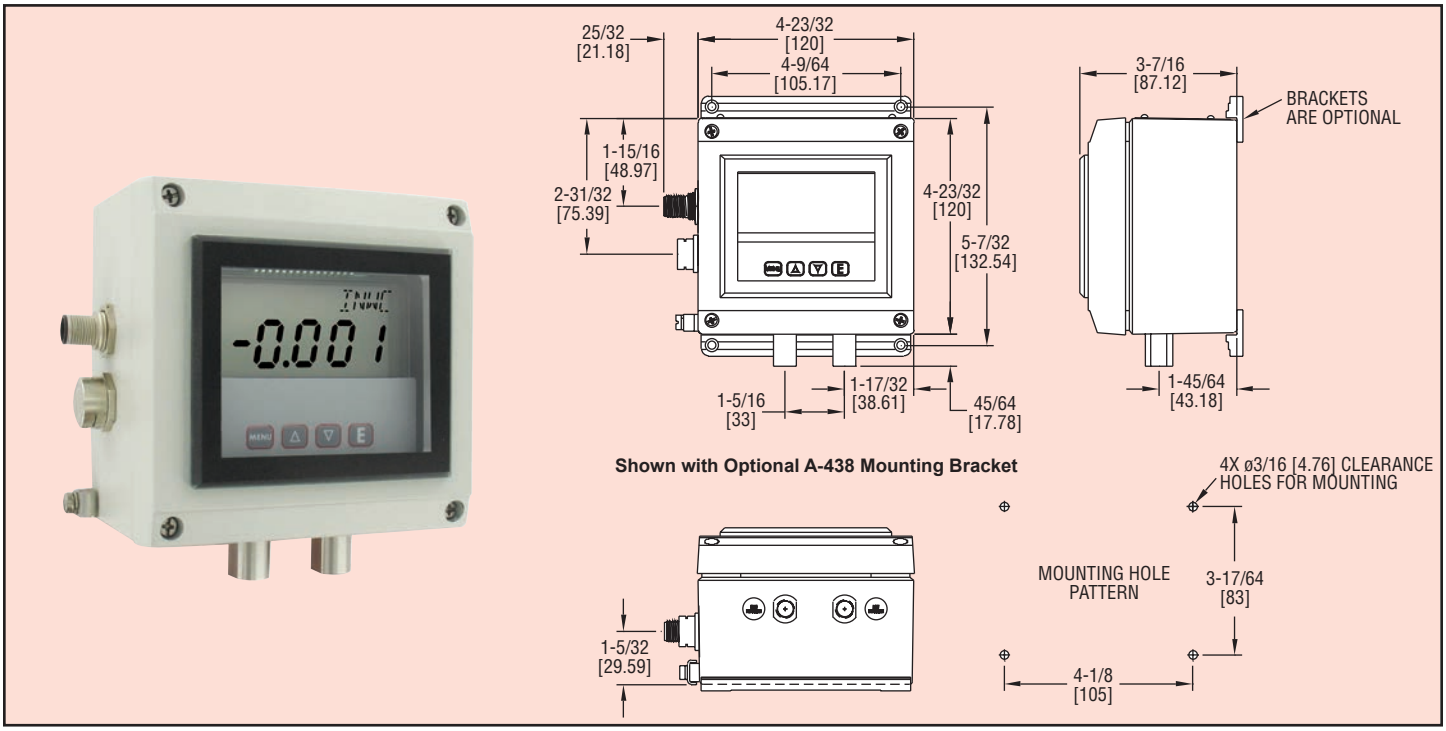
JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-4	1 0F 1	A

Series ISDP

Intrinsically Safe Differential Pressure Transmitter

For Hazardous Zone Pressure and Flow Applications



The ISDP Differential Pressure Transmitter provides a 4-20 mA process output, a robust NEMA 4X (IP66) enclosure, plus a large LCD display that can be programmed to read in pressure, velocity or flow. The ISDP offers simplified programming via a Menu key that enables the user to select: security level; English or Metric engineering units; pressure, velocity or flow operation, K-factor for use with various Pitot tubes and flow sensors, circular or rectangular duct size for volumetric flow operation, plus many more. The Series ISDP Differential Pressure Transmitter is powered on its two wire loop with 10-35 VDC via its integral M-12 four pin male connector. The ISDP provides a 0.5% full-scale accuracy on ranges from 0.25 in w.c. to 100 in w.c. as well as bi-directional models up to 10 in w.c. These features make the Series ISDP Differential Pressure Transmitter the ideal instrument for monitoring pressures or air flows in hazardous zones having a Class I Div. I Groups A, B, C, D; Class II Div. I Groups E, F, G; Class III Div. I ratings.

Model	Range
ISDP-002	0 - 0.25 in w.c.
ISDP-004	0 - 1 in w.c.
ISDP-006	0 - 5 in w.c.
ISDP-007	0 - 10 in w.c.
ISDP-008	0 - 25 in w.c.
ISDP-009	0 - 50 in w.c.
ISDP-010	0 - 100 in w.c.
ISDP-012	-0.25 / +0.25 in w.c.
ISDP-014	-1.0 / +1.0 in w.c.
ISDP-015	-2.5 / +2.5 in w.c.
ISDP-016	-5.0 / +5.0 in w.c.
ISDP-017	-10 / +10 in w.c.

ACCESSORIES

A-231, 16´ (5 m) Shielded Cable with 4 Pin Female M-12 Connection
A-486, 4.9´ (1 m) Shielded Cable with 4 Pin Female M-12 Connection
A-487, 9.8´ (3 m) Shielded Cable with 4 Pin Female M-12 Connection
A-488, 33´ (10 m) Shielded Cable with 4 Pin Female M-12 Connection
A-295, Female 4 Pin M-12 to Cable Gland Connector
MTL5041, Intrinsically Safe Galvanic Isolator
MTL7706, Intrinsically Safe Zener Barrier
A-438, Surface Mounting Brackets

SPECIFICATIONS

Service: Air and non-corrosive gases.
Wetted Materials: Ranges 5˝ and greater: glass, PVC, silicon, alumina ceramic, epoxy, RTV, gold, aluminum, stainless steel and nickel; Ranges 1˝ and lower: stainless steel, silicone, gold and ceramic.
Housing Materials: Aluminum, glass.
Accuracy: ±0.5% at 77°F (25°C) including hysteresis and repeatability (after 1 hour warm-up).
Stability: < ±1% per year.
Pressure Limits: Ranges ≤ 2.5 in w.c. = 2 psi; 5˝: 5 psi; 10˝: 5 psi; 25˝: 5 psi; 50˝: 5 psi; 100˝: 9 psi.
Temperature Limits: 32 to 140°F (0 to 60°C).
Compensated Temperature Limits: 32 to 140°F (0 to 60°C).
Thermal Effects: 0.020%/°F (0.036/°C) from 77°F (25°C).
Power Requirements: 10-35 VDC.
Output Signal: 4-20 mA DC.
Zero & Span Adjustments: Accessible via menus.
Response Time: 250 ms (damping set to 1).
Display: 4 digit LCD 0.6˝ H.
Electrical Connections: M-12 4 PIN Connector.
Process Connections: 1/8˝ female NPT.
Enclosure Rating: Designed to meet NEMA 4X (IP66).
Mounting Orientation: Mount unit in vertical plane.
Weight: 2 lb 10 oz (1.19 kg).
Agency Approvals: CE: CENELEC EN 61326/55024: 2003; IEC 61000-4-2/3/4/6: 2001/2006/2004/2005; CENELEC EN 55011: 2006; 2004/108/EC EMC Directive. FM Intrinsically Safe CLI Div I GR: A, B, C, D; CLII Div I GR: E, F, G; CLIII Div I.

OPTION

For NIST traceable calibration certificate, add suffix -NIST to model numbers.
Example: ISDP-004-NIST

For factory calibration certificate, add suffix -FC to model numbers.
Example: ISDP-004-FC

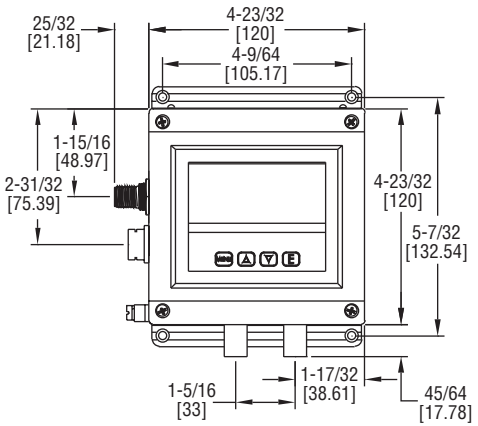
Process Tubing Options: See page 547 (Gage Tubing Accessories)

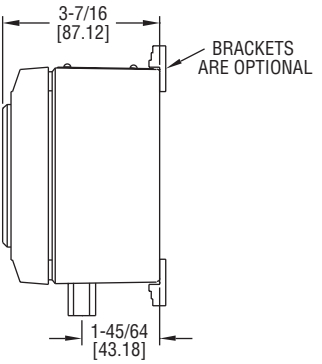
Series ISDP Intrinsically Safe Differential Pressure Transmitter

Specifications - Installation and Operating Instructions

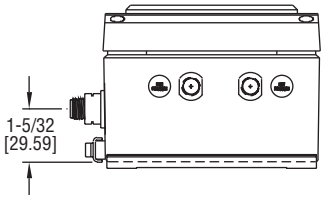
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, IN 46360, U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
www.dwyer-inst.com
e-mail: info@dwyermail.com

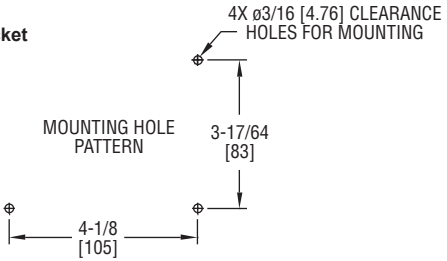
DIMENSIONS



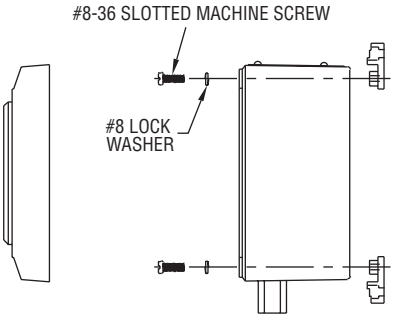


Shown with Optional A-438 Mounting Bracket





OPTIONAL A-438 BRACKET MOUNTING DIAGRAM



BRACKET ASSEMBLY

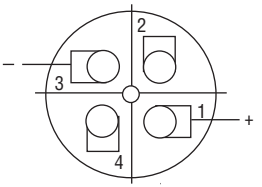
SPECIFICATIONS
Service: Air and non-corrosive gases.
Wetted Materials: Ranges 5″ and greater: glass, PVC, silicon, alumina ceramic, epoxy, RTV, gold, aluminum, stainless steel and nickel; Ranges 1″ and lower: stainless steel, silicone, gold and ceramic.
Housing Materials: Aluminum, glass.
Accuracy: ±0.5% at 77°F (25°C) including hysteresis and repeatability (after 1 hour warm-up).
Stability: < ±1% per year.
Pressure Limits: Ranges ≤ 2.5 in. w.c. = 2 psi;
5″: 5 psi; 10″: 5 psi; 25″: 5 psi; 50″: 5 psi; 100″: 9 psi.
Temperature Limits: 32 to 161.6°F (0 to 72°C).
Compensated Temperature Limits: 32 to 140°F (0 to 60°C).
Thermal Effects: 0.020%/°F (0.036/°C) from 77°F (25°C).
Power Requirements: 10-35 VDC.
Output Signal: 4-20 mA DC.
Zero & Span Adjustments: Accessible via menus.
Response Time: 250 ms (dampening set to 1).
Display: 4 digit LCD 0.6″ height.
Electrical Connections: M12 4 PIN Connector.
Process Connections: 1/8 female NPT.
Enclosure Rating: Designed to meet NEMA 4x (IP66).
Mounting Orientation: Mount unit in horizontal plane.
Size: 4.73″ x 4.73″ x 3.43″ (120 mm x 120 mm x 87.1 mm).
Weight: 2 lb 10 oz (1.19 kg).
Agency Approvals: FM Approved: IS / I, II, III / 1 / ABCDEFG / T4 Ta = 0°C to 72° - 19-443480-50; ENTITY; TYPE 4X (US AND CANADA) I / 0 AEx ia / IIC / T4 Ta = 0°C to 72° - 19-443480-50; ENTITY; TYPE 4X (US) I / 0 / Ex ia / IIC / T4 Ta = 0°C to 72° - 19-443480-50; ENTITY; TYPE 4X (CANADA) CE. CENELEC EN 61326/55024: 2003; IEC 61000-4-2/3/4/6: 2001/2006/2004/2005; CENELEC EN 55011: 2006; 2004/108/EC EMC Directive.

Intrinsic Safety Information

Entity Parameters
Ui = 28VDC
Ii = 93mA
Ci = 22 nF
Li = 400 uH
Pi = 651mW

Notes:
1. Remove power from the instrument before carrying out any servicing.
2. Use only FM approved Associated Apparatus.
3. The earth terminal on the housing must be wired to a local earth ground in the hazardous area.
4. Refer to control drawing 19-443480-50, Page 15, for installation requirements.

M-12 Connector



A-231 M-12 Cable Colors
PIN 1 is Brown (positive)
PIN 3 is Blue (negative)

Use Model A-231 shielded cable with 4 pin Female M-12 connection.

2-WIRE CONNECTION

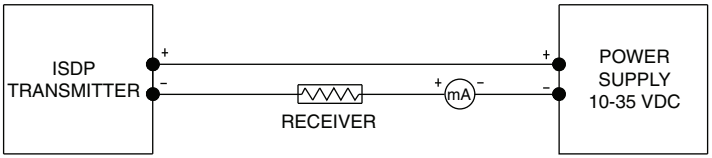


Fig. C

-------2-Wire Operation- An external power supply delivering 10 - 35 VDC with minimum current capability of 40 mA DC (per transmitter) must be used to power the control loop. See Fig. C for connection of the power supply, transmitter, and receiver. The range of the appropriate receiver load resistance (RL) for the DC power supply voltage available is expressed by the formula and graph in Fig. D.

POWER SUPPLY VOLTAGE - VDC (2-WIRE CONNECTION)

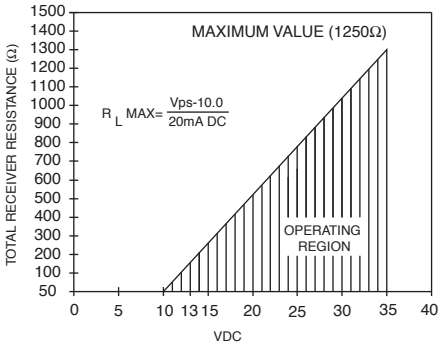


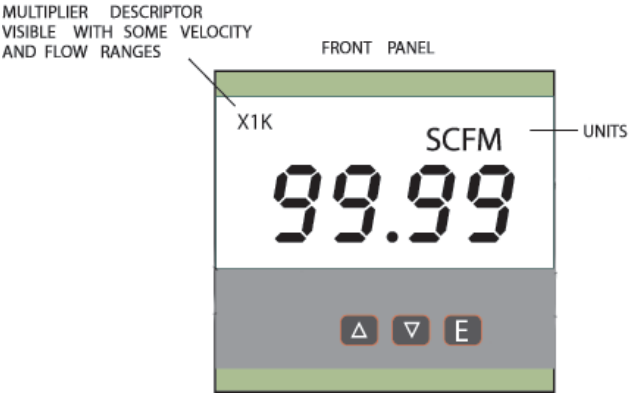
Fig. D

INSTALLATION

Mount the instrument in a location that will not be subject to excessive temperature, shock or vibration.

Pressure Connections

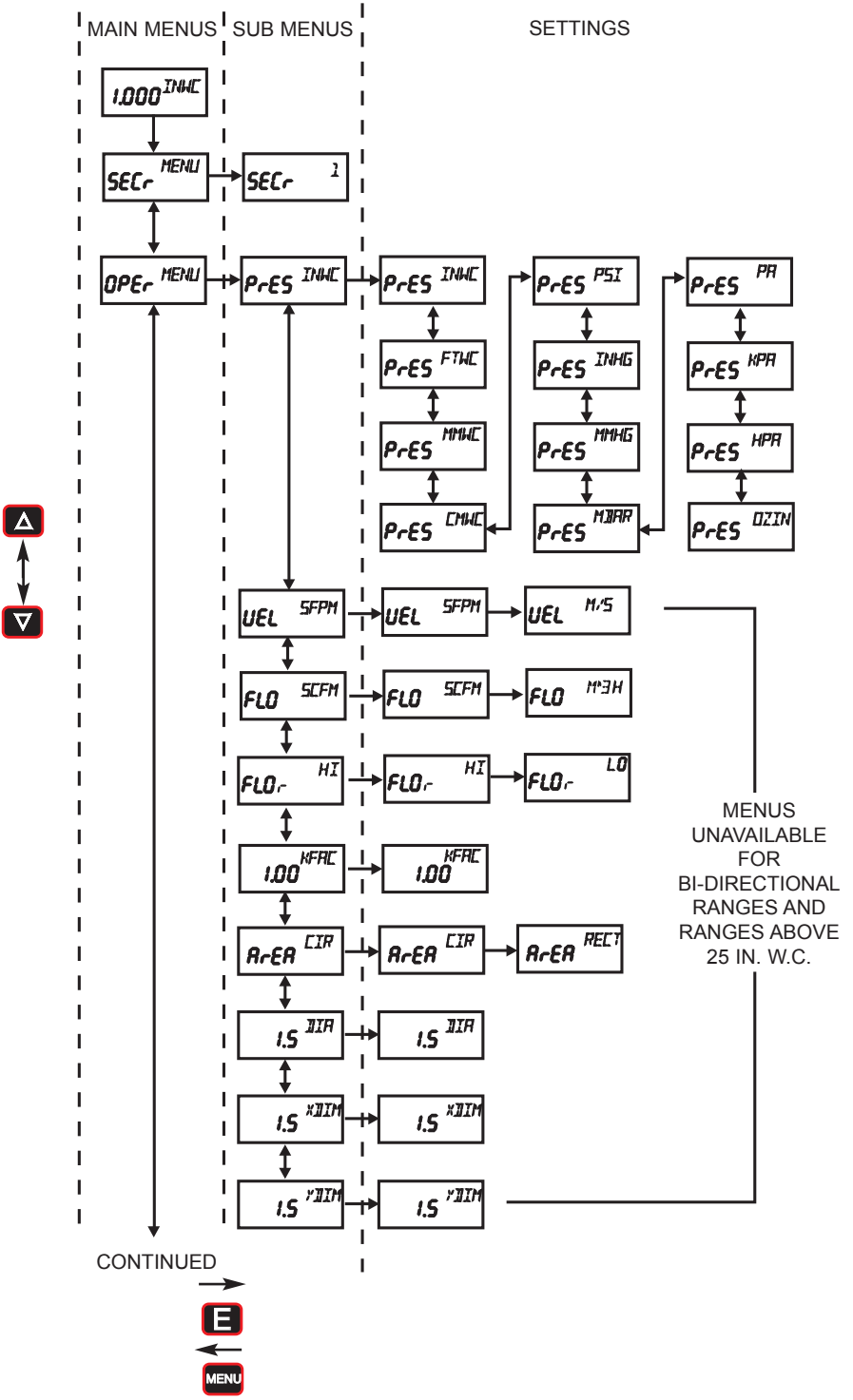
Use 1/8″ male NPT fittings. When tightening fittings, grasp the brass fitting on the ISDP with a 1/2″ wrench to prevent the fitting on the ISDP from turning.

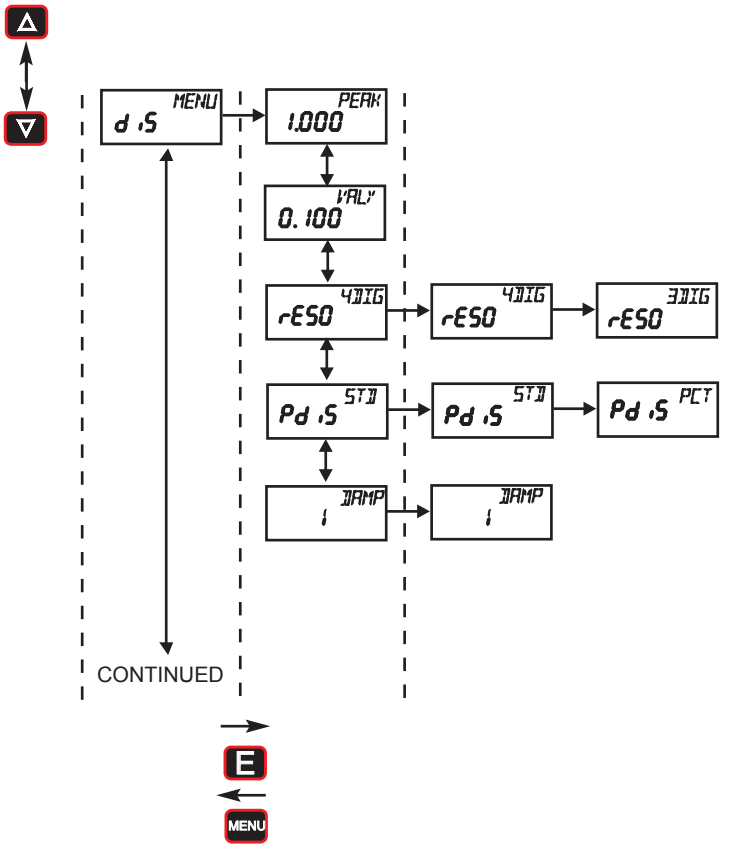


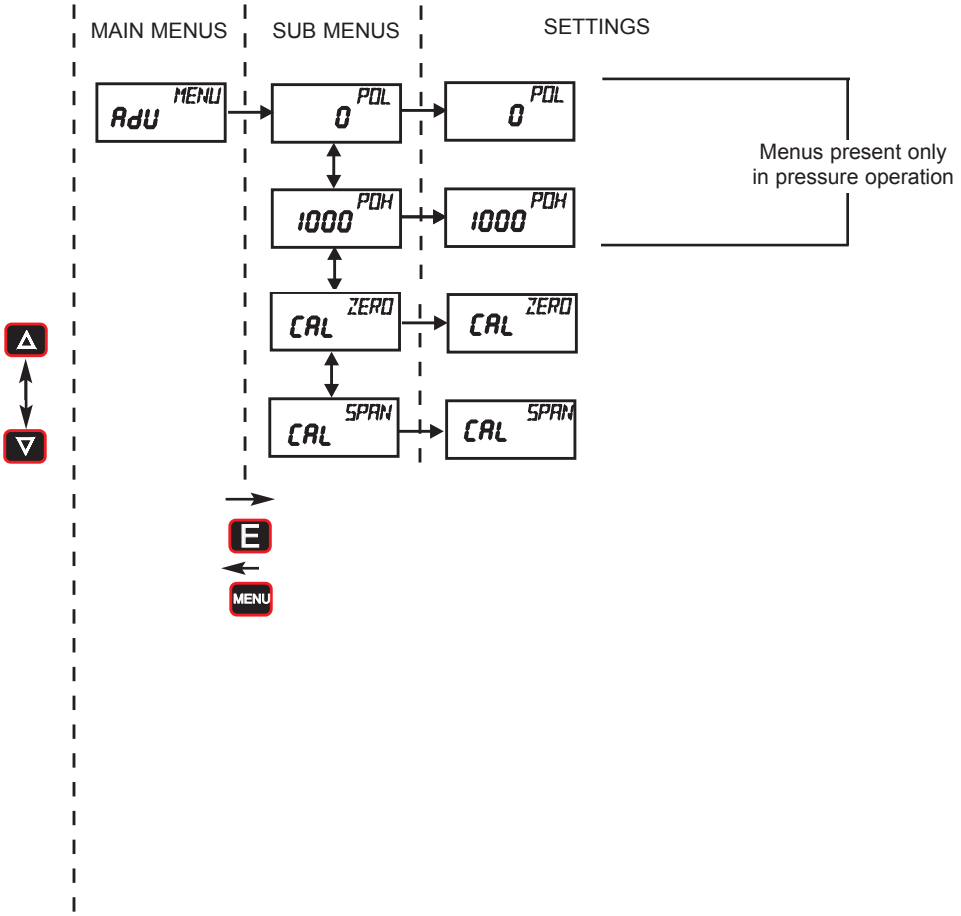
KEY FUNCTIONS

	HOME POSITION FUNCTION	MAIN MENU FUNCTION	SUB MENU FUNCTION
MENU	Allows access to the menus	Return to home position	Return to previous menu
UP ARROW		Sequences through menus	Increments a value
DOWN ARROW		Sequences through menus	Decrements a value
ENTER	Displays full scale range of unit	Enter into SUB MENU	Changes a value or setting. Press ENTER and display will blink. Adjust with UP or DOWN arrows. Press ENTER to store. Display will stop blinking. Peak/Valley SUB MENU resets display to present value.

MENU MAP


MAIN MENUS
SUB MENUS
SETTINGS
1.000 INWC
SECr MENU
SECr 1
OPEr MENU
PrES INWC
PrES INWC
PrES FTWC
PrES MMWC
PrES CMWC
PrES PSI
PrES INHG
PrES MMHG
PrES MBAR
PrES PA
PrES KPA
PrES HPA
PrES OZIN
UEL SFPM
UEL SFPM
UEL M/S
FLO SCFM
FLO SCFM
FLO M^3H
FLOr HI
FLOr HI
FLOr LO
1.00 KFAC
1.00 KFAC
ArEA CIR
ArEA CIR
ArEA RECT
1.5 DIA
1.5 DIA
1.5 XDIM
1.5 XDIM
1.5 YDIM
1.5 YDIM
MENUS UNAVAILABLE FOR BI-DIRECTIONAL RANGES AND RANGES ABOVE 25 IN. W.C.
CONTINUED
E
MENU


MENU
d ,S
PEAK
1.000
VALY
0.100
rESO
4DIG
rESO
4DIG
rESO
3DIG
Pd ,S
STD
Pd ,S
STD
Pd ,S
PCT
DAMP
1
DAMP
1
CONTINUED
E
MENU


MAIN MENUS
SUB MENUS
SETTINGS
MENU
AdU
POL
0
POL
0
POH
1000
POH
1000
ZERO
CAL
ZERO
CAL
SPAN
CAL
SPAN
CAL
Menus present only
in pressure operation
E
MENU

Model Chart	
Model	**Range**
ISDP-002	0-0.25″
ISDP-004	0-1″ WC
ISDP-005	0-2.5″ WC
ISDP-006	0-5″ WC
ISDP-007	0-10″ WC
IDSP-008	0-25″ WC
ISDP-009	0-50″ WC
ISDP-010	0-100″ WC
ISDP-011	-0.1/+0.1″ WC
ISDP-012	-0.25/+0.25″ WC
ISDP-013	-0.5/+0.5″ WC
ISDP-014	-1.0/+1.0″ WC
ISDP-015	-2.5/+2.5″ WC
ISDP-016	-5.0/+5.0″ WC
ISDP-017	-10/+10″ WC

Main Menu Selections (Upper Right Display Reads *MENU*)

SECr Security - Lock out access to menus and settings.

OPEr Operation - Selection of Pressure, Velocity or Flow and corresponding engineering units.

diS Display - Monitor and adjust display related settings: Peak, Valley, display resolution, % output and dampening.

AdJ Advanced functions - Modify advanced function parameters, transmitter output scaling, and calibration.

MAIN MENUS and SUB MENUS

SECr (Security) MAIN MENU

SECr is the only SUB MENU in the security MENU. When the security SUB MENU is selected, the present security level is displayed in the upper right hand display. To change the security level, adjust the number displayed to the number shown in the following table for the desired security level.

Security Level Displayed	Access	Password Value to Enter
1	All menus access	10
2	All settings locked	70

The password values shown in the table cannot be altered, so retain a copy of these pages for future reference.

OPEr (Operation) MAIN MENU

The OPEr MENU selects the measurement type of the instrument.
The SUB MENUS are:

PrES - Pressure
KFAC - K Factor
XDIM - X Dimension
VEL - Velocity
ArEA - Area
YDIM - Y Dimension
FLO - Flow
DIA - Diameter

If the instrument is set for Velocity, the OPEr MENU will have an additional KFAC SUB MENU. If the instrument is set for Flow, the OPEr MENU will have additional KFAC and ArEA SUB MENUS. These will be discussed under Velocity and Flow. When scrolling through the OPEr SUB MENUS, the measurement type the unit is currently set for will show the units in the upper right display. The other measurement types will have a blank upper right display.

Units visible, so unit is presently set to measure pressure

Units not visible

Units not visible

P-ES (Pressure) SUB MENU

For pressure measurement, the following units are available:

INWC - Inches of water column
FTWC - Feet of water column
MMWC - Millimeters of water column
CMWC - Centimeters of water column
PSI - Pounds per square inch
INHG - Inches of mercury
MMHG - Millimeters of mercury
MBAR - Millibar
PA - Pascal
KPA - Kilopascals
HPA - Hectopascals
OZIN - Ounce inches

Table 1 Pressure Range vs. Available Units

INWC	FTWC	MMWC	CMWC	PSI	INHG	MMHG	MBAR	PA	KPA	HPA	OZIN
.1000		2.540	.2540			.1868	.2491	24.91		.2491	
.2500		6.350	.6350			.4671	.6227	62.27		.6227	.1445
.5000		12.70	1.270			.9342	1.245	124.5	.1245	1.245	.2890
1.000		25.40	2.540			1.868	2.491	249.1	.2491	2.491	.5780
2.500	.2083	63.50	6.350		.1839	4.671	6.227	622.7	.6227	6.227	1.445
5.000	.4167	127.0	12.70	.1806	.3678	9.342	12.45	1245	1.245	12.45	2.890
10.00	.8333	254.0	25.40	.3613	.7356	18.68	24.91	2491	2.491	24.91	5.780
25.00	2.083	635.0	63.50	.9032	1.839	46.71	62.27	6227	6.227	62.27	14.45
50.00	4.167	1270	127.0	1.806	3.678	93.42	124.5		12.45	124.5	28.90
100.0	8.333	2540	254.0	3.613	7.356	186.8	249.1		24.91	249.1	57.80

NOTE: OVFL (over flow) or UnFL (under flow) will appear when the ranges have been exceeded above or below full scale by 2%.

VEL (Velocity) SUB MENU

For velocity measurement, the following units are available:

SFPM - Standard feet per minute
M/S - Meters per second

Table 2 Available Velocity Ranges

INPUT RANGE INWC	SFPM RANGE	M/S RANGE
0 - 0.1	0 - 1266	0 - 6.431
0 - 0.25	0 - 2002	0 - 10.17
0 - 0.5	0 - 2832	0 - 14.39
0 - 1	0 - 4004	0 - 20.35
0 - 2.5	0 - 6332	0 - 32.17
0 - 5	0 - 8954	0 - 45.48
0 - 10	0 - 12.66 x IK	0 - 64.33
0 - 25	0 - 20.02 x IK	0 - 101.7

NOTE: Air velocity and flow readings are based upon standard dry air conditions with an ambient temperature of 70°F and a barometric pressure of 29.92 INHG.

FLO (Flow) SUB MENU

For flow measurements the following units are available:

SCFM - Standard cubic feet per minute

M^3H - Cubic meters per hour

FLO r (Flow Range) SUB MENU

LO - 99.99 x 1K flow range

HI - 999.9 x 1K flow range

Tables 3 -6 show the flow ranges available, and the maximum duct size that can be set for each input range.

Table 3

FLOr = LO Maximum Duct Size (English)

RANGE IN WC	SCFM RANGE	MAX. DUCT SIZE, SQ. FT.
0.1	99.99 x 1K	78.9
0.25	99.99 x 1K	49.9
0.5	99.99 x 1K	35.3
1	99.99 x 1K	24.9
2.5	99.99 x 1K	15.7
5	99.99 x 1K	11.1
10	99.99 x 1K	7.8
25	99.99 x 1K	4.9

Table 4

FLOr = HI Maximum Duct Size (English)

RANGE IN WC	SCFM RANGE	MAX. DUCT SIZE, SQ. FT.
0.1	999.9 x 1K	789.8
0.25	999.9 x 1K	499.5
0.5	999.9 x 1K	353.1
1	999.9 x 1K	249.7
2.5	999.9 x 1K	157.9
5	999.9 x 1K	111.7
10	999.9 x 1K	78.9
25	999.9 x 1K	49.9

Table 5

FLOr = LO Maximum Duct Size (Metric)

RANGE IN WC	M^3/Hr RANGE	MAX. DUCT SIZE M^2
0.1	99.99 x 1K	4.32
0.25	99.99 x 1K	2.73
0.5	99.99 x 1K	1.93
1	99.99 x 1K	1.37
2.5	99.99 x 1K	0.86
5	99.99 x 1K	0.61
10	99.99 x 1K	0.43
25	99.99 x 1K	0.27

Table 6

FLOr = HI Maximum Duct Size (Metric)

RANGE IN WC	M^3/Hr Range	MAX. DUCT SIZE, M^2
0.1	999.9 x 1K	43.19
0.25	999.9 x 1K	27.31
0.5	999.9 x 1K	19.3
1	999.9 x 1K	13.64
2.5	999.9 x 1K	8.63
5	999.9 x 1K	6.10
10	999.9 x 1K	4.31
25	999.9 x 1K	2.73

KFAC SUB MENU

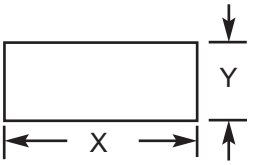
KFAC K Factor - becomes accessible if the instrument is set for Velocity or Flow. When the Digihelic® II Controller is used with a Pitot tube, the manufacturer may specify a K Factor. The adjustment range is 0.01 to 2.00. The factory setting is 1.

AREA, DIA, XDIM and YDIM SUB MENUS

These SUB MENUS become accessible if the instrument is set for flow. When measuring flow, the area of the duct must be specified. Tables 3 and 4 show the input range vs maximum flow and duct size. For a rectangular duct the maximum size is specified in square feet or meters. For a circular duct the maximum size is specified as the diameter. X, Y and circular dimensions are entered in feet with 0.01 foot resolution for FLOW = LO and 0.1 foot resolution for FLOW = HI, or entered in millimeters with 1 millimeter resolution.

AREA - Area, select CIR for a circular duct or RECT for a rectangular duct. If a circular duct is selected, the DIA SUB MENU will be activated. If a rectangular duct is selected, the XDIM and YDIM SUB MENUS will be activated.

DIA - Diameter, enter the diameter of a duct
XDIM - Enter the "X" dimension of a duct
YDIM - Enter the "Y" dimension of a duct



dSP (Display) MAIN MENU

PEAK - Peak value
VALY - Valley value
ZERO - Zero
RESO - Resolution
PdSP - Process display
DAMP - Dampening level

PEAK (Peak) SUB MENU

The Peak feature stores the highest pressure reading the instrument has measured since the last reset or power up. At power up PEAK is reset to the present pressure reading. To manually reset the PEAK value, press the ENTER key while in the PEAK SUB MENU.

VALY (Valley) SUB MENU

The valley feature stores the lowest pressure reading the instrument has measured since the last reset or power up. At power up VALY is reset to the present pressure reading. To manually reset the VALY value, press the ENTER key while in the VALY SUB MENU.

rESO (Resolution) SUB MENU

The Series ISDP Controller is capable of displaying four digits of resolution.
However, at very low pressures the instability of the pressure may cause fluctuations in the least significant digit causing the least significant digit to be of little value.
Three digit resolution (3DIG) can only be active when there is at least one digit to the right of a decimal.

3DIG - Set display for 3 digit resolution
4DIG - Set display for 4 digit resolution

Pd.S (Process Display) SUB MENU

STD - Display reads pressure, velocity, or flow values
PCT - Display reads % of full scale value

When the display is reading percent, PCT is displayed in the upper right of the display. The percent display is only available in pressure operation.

DAMP (Dampening) SUB MENU

Adjust from 1-16

Dampening stabilizes the display from instabilities due to things such as vibration and excessive pressure fluctuations. The dampening setting adjusts the amount of readings that are averaged for each display update. Adjust the dampening value until the display reads a stable value for the application.

AdJ (Advanced) MAIN MENU

POL - Process output low
POH - Process output high
ZERO - Zero calibration
SPAN - Span calibration

POL and POH (Process Output Low and High) SUB MENUS

This feature is used in pressure operation only.

Process output low and high are used to scale the 4-20 mA output. Set POL to the desired display reading for 4mA output, and set POH to the desired display reading for 20 mA output. POH must be higher than POL. POL may be adjusted 2% BELOW minimum scale up to POH. POH may be adjusted from POL to 2% ABOVE maximum scale.

ZERO and SPAN (Calibration of Zero and Span) SUB MENUS

The lower display reads CAL in this mode.

ZERO Calibration

NOTE: For accurate calibration, DO NOT apply any pressure when performing this function.

With the display reading ZERO, press the ENTER key. The upper display will blink. Press ENTER again to complete the zeroing of the instrument or press the MENU key to cancel.

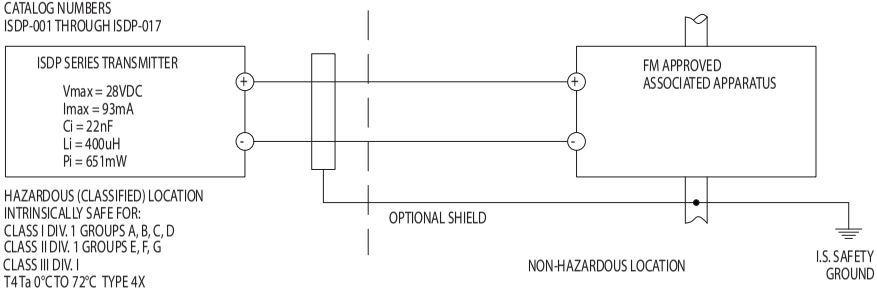
SPAN Calibration

With the display set to SPAN, apply full scale pressure to the unit. Press the ENTER key. The upper display will blink. Press ENTER again to complete the calibration or press the MENU key to cancel.

Maintenance

Upon final installation of the Series ISDP intrinsically Safe Differential Pressure Transmitter, no routine maintenance is required. The Series ISDP is not field serviceable and should not be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

CATALOG NUMBERS
ISDP-001 THROUGH ISDP-017



HAZARDOUS (CLASSIFIED) LOCATION
INTRINSICALLY SAFE FOR:
CLASS I DIV. 1 GROUPS A, B, C, D
CLASS II DIV. 1 GROUPS E, F, G
CLASS III DIV. I
T4 Ta 0°C TO 72°C TYPE 4X
OR
CLASS I, ZONE 0, GROUPS IIC
T4 Ta 0°C TO 72°C TYPE 4X

1. THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO FM APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN:
   Voc OR Uo OR Vt $\leq$ Vmax, Isc OR It $\leq$ Imax $\leq$ Ca OR Co $\geq$ Ci + Ccable, La OR Lo $\geq$ Li + Lcable, Po $\leq$ Pi
2. EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR VDC.
3. DIVISION 1 HAZARDOUS (CLASSIFIED) LOCATIONS INSTALLATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE NFPA 70, ARTICLE 504; ZONE 0 HAZARDOUS LOCATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE NFPA 70, ARTICLE 505; IN US. INSTALLATIONS MUST BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE CSA C22.1, PART 1, APPENDIX F; IN CANADA. ALL INSTALLATIONS MUST BE IN ACCORDANCE WITH ISA RP-12.6.
4. NO REVISIONS WITHOUT PRIOR APPROVAL FROM FM RESEARCH.
5. THE ASSOCIATED APPARATUS MANUFACTURERS INSTALLATION INSTRUCTIONS MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
6. WARNING - ENCLOSURE PARTS ARE CONSTRUCTED OF ALUMINUM. ENCLOSURE MUST BE PROTECTED FROM MECHANICAL FRICTION AND IMPACT WITH IRON/STEEL TO PREVENT IGNITION CAPABLE SPARKS.
7. SUBSTITUTION OF PARTS MAY IMPAIR INTRINSIC SAFETY. RETURN TO MANUFACTURER FOR ANY REPAIRS.
8. ADDITIONAL SUFFIXES AT (ALUMINUM TAG), COO (CERTIFICATE OF ORGIN), FC (FACTORY CALIBRATION CERTIFICATE), NIST (NIST TRACEABLE)

CD = CRITICAL DIMENSION
STANDARD TOLERANCES UNLESS NOTED:
ALL DECIMAL DIMENSIONS ± .005
ALL ANGLES ± 1°

F M C O N T R O L D R A W I N G

SCALE 1:1

NO.	CHANGES	BY/DATE
4	UPDATE TO ZONES PER DWK 06-11-14, ECR 35481	PFA 6-23-14
3	REVISED NOTE 3 TO ADD CANADIAN ELECTRICAL CODE PER ECR #25003	KAS 05-05-09
2	ADDED CLASS II AND III RATINGS PER ECR #23754	AJB 8-6-08
1	CLASS II AND CLASS III RATINGS REMOVED ITEM 6 PER ECR #22759	KAS 01-15-08

DATE 01-02-08
DWN BY KAS
CHKD CAR
APPD LRR

NAME: FM CONTROL DRAWING ISDP

ACAD2002

MATERIAL
FINISH

DWYER INSTRUMENTS, INC.
MICHIGAN CITY, INDIANA 46360 U.S.A.

FR. NO. 19-443480-50

19-443480-50

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, IN 46360, U.S.A.
Phone: 219/879-8000 www.dwyer-inst.com
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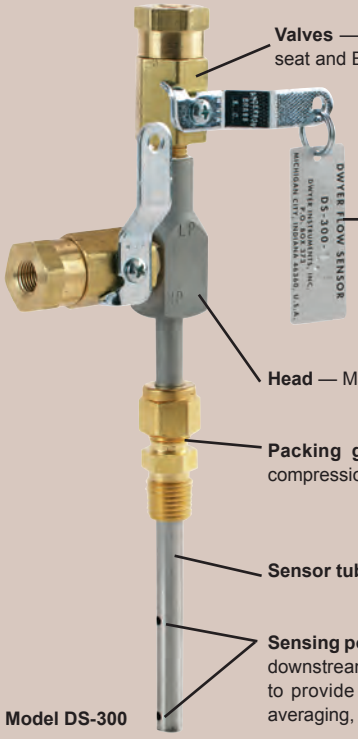
Printed in U.S.A. 12/14
FR# 19-443480-00 Rev. 3

Series DS

In-Line Flow Sensors

Use with the Dwyer® Differential Pressure Gages or Transmitters



Valves — Standard, brass with TFE seat and Buna-N O-ring

Nameplate — Stainless steel permanently attached with split ring. Includes complete size and model information.

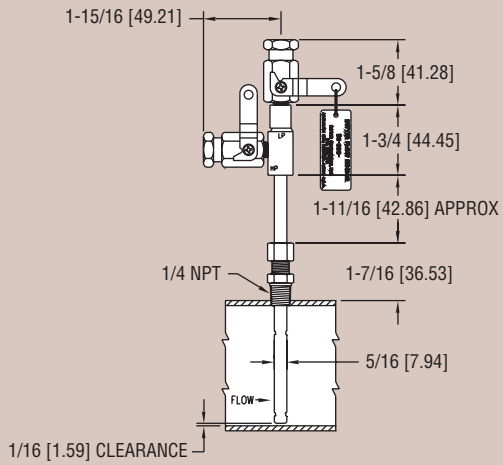
Head — Machined stainless steel.

Packing gland — Parker CPI brass compression fitting.

Sensor tube — 304 SS.

Sensing ports — Multiple upstream and downstream ports sized and positioned to provide effective accurate pressure averaging, even at lower velocities.

Model DS-300



In-Line Flow Sensors are averaging Pitot tubes that provide accurate and convenient flow rate sensing for schedule 40 pipe. When purchased with a Dwyer® Capsuhelic® differential pressure gage of appropriate range, the result is a flow indicating system delivered off the shelf at an economical price.

Pitot tubes have been used in flow measurement for years. Conventional pitot tubes sense velocity pressure at only one point in the flowing stream. Therefore, a series of measurements must be taken across the stream to obtain a meaningful average flow rate. The Dwyer® flow sensor eliminates the need for "traversing" the flowing stream because of its multiple sensing points and built-in averaging capability.

The Series DS-300 flow sensors are designed to be inserted in the pipeline through a compression fitting. They are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® gage kit. Standard valves are rated at 200 psig (13.7 bar) and 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 flow sensors are available for pipe sizes from 1″ to 10″.

DS-400 Averaging Flow Sensors are quality constructed from extra strong 3/4″ dia. stainless steel to resist increased forces encountered at higher flow rates with both air and water. This extra strength also allows them to be made in longer insertion lengths up to 24 inches (61 cm). All models include convenient and quick-acting quarter-turn ball valves to isolate the sensor for zeroing. Process connections to the valve assembly are 1/8″ female NPT. A pair of 1/8″ NPT X 1/4″ SAE 45° flared adapters are included, compatible with hoses used in the Model A-471 Portable Capsuhelic® Gage Kit. Supplied solid brass mounting adapter has a 3/4″ dia. compression fitting to lock in required insertion length and a 3/4″ male NPT thread for mounting in a Threaded Branch Connection.

Select model with suffix which matches pipe size

Model DS-300-1″
Model DS-300-1-1/4″
Model DS-300-1-1/2″
Model DS-300-2″
Model DS-300-2-1/2″
Model DS-300-3″
Model DS-300-4″
Model DS-300-6″
Model DS-300-8″
Model DS-300-10″

Model DS-400-6″
Model DS-400-8″
Model DS-400-10″
Model DS-400-12″
Model DS-400-14″
Model DS-400-16″
Model DS-400-18″
Model DS-400-20″
Model DS-400-24″

OPTIONS & ACCESSORIES

DS-300 or DS-400 Less Valves. To order, add suffix **-LV**

A-160, Threaded Branch Connection, 3/8″ NPT, forged steel, 3000 psi

A-161, Brass Bushing, 1/4″ x 3/8″

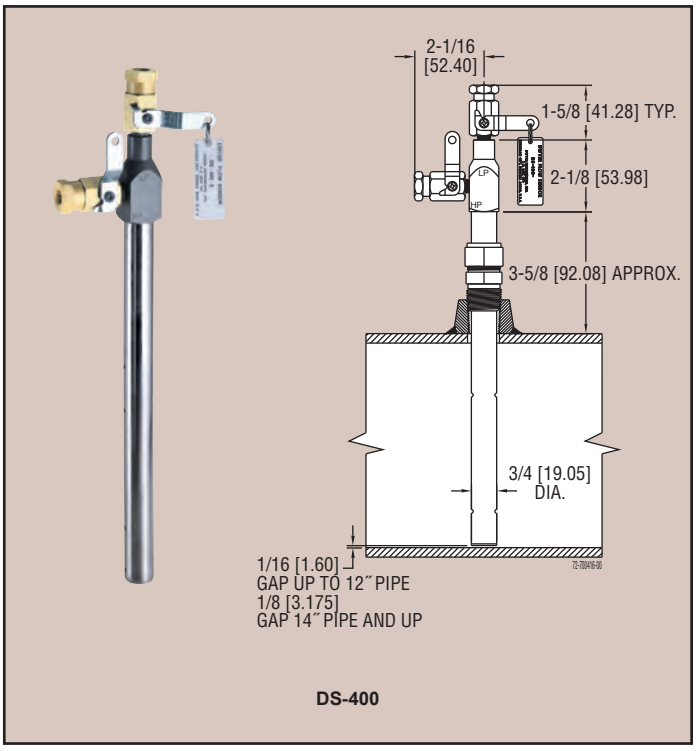
How To Order

Merely determine the pipe size into which the flow sensor will be mounted and designate the size as a suffix to Model DS-300. For example, a flow sensor to be mounted in a 2″ pipe would be a Model No. DS-300-2″.

For non-critical water and air flow monitoring applications, the chart below can be utilized for ordering a stock Capsuhelic® differential pressure gage for use with the DS-300 flow sensor. Simply locate the maximum flow rate for the media being measured under the appropriate pipe size and read the Capsuhelic® gage range in inches of water column to the left. The DS-300 sensor is supplied with installation and operating instructions, Bulletin F-50. It also includes complete flow conversion information for the three media conditions shown in the chart below. This information enables the user to create a complete differential pressure to flow rate conversion table for the sensor and differential pressure gage employed. Both the Dwyer® Capsuhelic® gage and flow sensor feature excellent repeatability so, once the desired flow rate is determined, deviation from that flow in quantitative measure can be easily determined. You may wish to order the adjustable signal flag option for the Capsuhelic® gage to provide an easily identified reference point for the proper flow.

Capsuhelic® gages with special ranges and/or direct reading scales in appropriate flow units are available on special order for more critical applications. Customer supplied data for the full scale flow (quantity and units) is required along with the differential pressure reading at that full flow figure. Prior to ordering a special Capsuhelic® differential pressure gage for flow read-out, we recommend you request Bulletin F-50 to obtain complete data on converting flow rates of various media to the sensor differential pressure output. With this bulletin and after making a few simple calculations, the exact range gage required can easily be determined.

Large 3/4 Inch Diameter for Extra Strength in Lengths to 24 Inches



DS-400

Gage Range (in w.c.)	Media @ 70°F	Full Range Flows by Pipe Size (Approximate)									
		1″	1-1/4″	1-1/2″	2″	2-1/2″	3″	4″	6″	8″	10″
2	Water (GPM)	4.8	8.3	11.5	20.5	30	49	86	205	350	560
	Air @ 14.7 PSIA (SCFM)	19.0	33.0	42.0	65.0	113	183	330	760	1340	2130
	Air @ 100 PSIG (SCFM)	50.0	90.5	120.0	210.0	325	510	920	2050	3600	6000
5	Water (GPM)	7.7	14.0	18.0	34.0	47	78	138	320	560	890
	Air @ 14.7 PSIA (SCFM)	30.0	51.0	66.0	118.0	178	289	510	1200	2150	3400
	Air @ 100 PSIG (SCFM)	83.0	142.0	190.0	340.0	610	820	1600	3300	5700	10000
10	Water (GPM)	11.0	19.0	25.5	45.5	67	110	195	450	800	1260
	Air @ 14.7 PSIA (SCFM)	41.0	72.0	93.0	163.0	250	410	725	1690	3040	4860
	Air @ 100 PSIG (SCFM)	120.0	205.0	275.0	470.0	740	1100	2000	4600	8100	15000
25	Water (GPM)	18.0	32.0	40.5	72.0	108	173	310	720	1250	2000
	Air @ 14.7 PSIA (SCFM)	63.0	112.0	155.0	255.0	390	640	1130	2630	4860	7700
	Air @ 100 PSIG (SCFM)	185.0	325.0	430.0	760.0	1200	1800	3300	7200	13000	22000
50	Water (GPM)	25.0	44.0	57.5	100.0	152	247	435	1000	1800	
	Air @ 14.7 PSIA (SCFM)	90.0	161.0	205.0	360.0	560	900	1600	3700	6400	
	Air @ 100 PSIG (SCFM)	260.0	460.0	620.0	1050.0	1700	2600	4600	10000	18500	
100	Water (GPM)	36.5	62.0	82.0	142.0	220	350	620	1500		
	Air @ 14.7 PSIA (SCFM)	135.0	230.0	300.0	505.0	800	1290	2290	5000		
	Air @ 100 PSIG (SCFM)	370.0	660.0	870.0	1500.0	2300	3600	6500	15000		

Model A-471 Portable Kit

For portable operation, the A-471 Capsuhelic® Portable Gage Kit is available complete with tough polypropylene carrying case, mounting bracket, 3-way manifold valve, two 10' high pressure hoses, and all necessary fittings.

See page 16 for complete information on the Capsuhelic® gage

Capsuhelic® Gage Shown Installed In A-471 Portable Kit

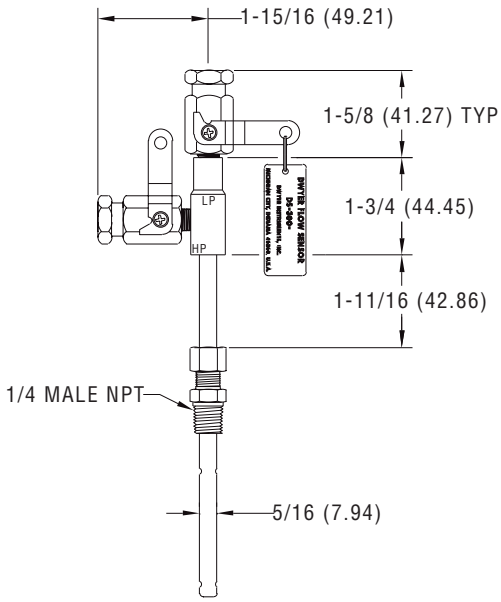
Series 631B Capsuhelic® Wet/Wet Differential Pressure Transmitter

Low pressure transmitter for use with DS-300/400 flow sensors. Use Series 631B Capsuhelic® Wet/Wet Differential Pressure Transmitter.

See page 65 for additional details.

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations



Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

DWYER INSTRUMENTS, INC.
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Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

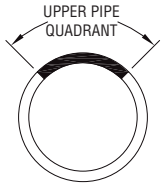
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

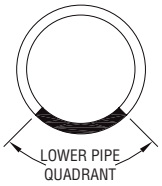
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

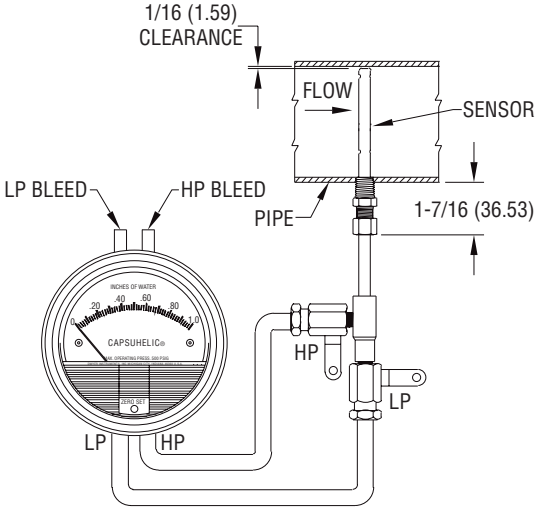
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

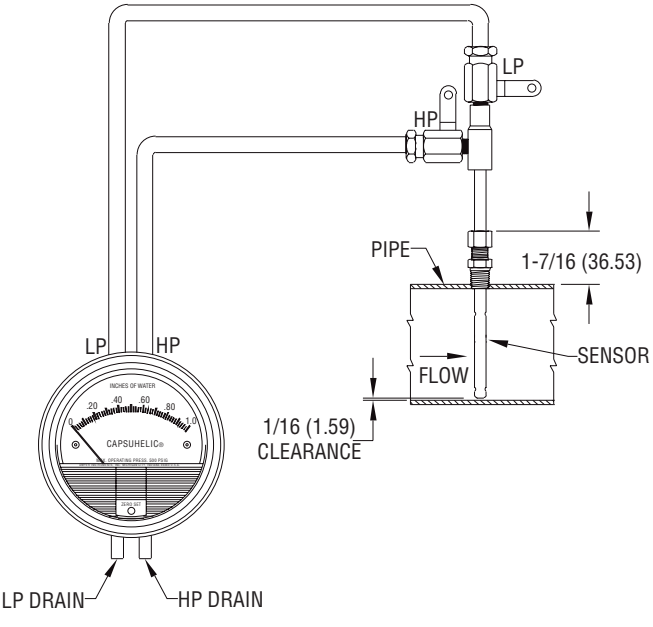
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

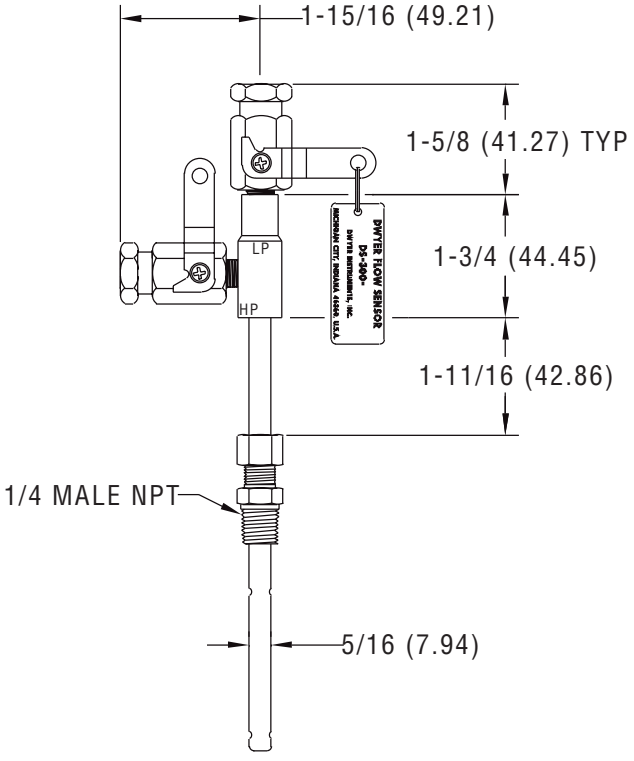
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 “Flow of Fluids Through Valves, Fittings and Pipe.” It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient “K”	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Water @ 70°F (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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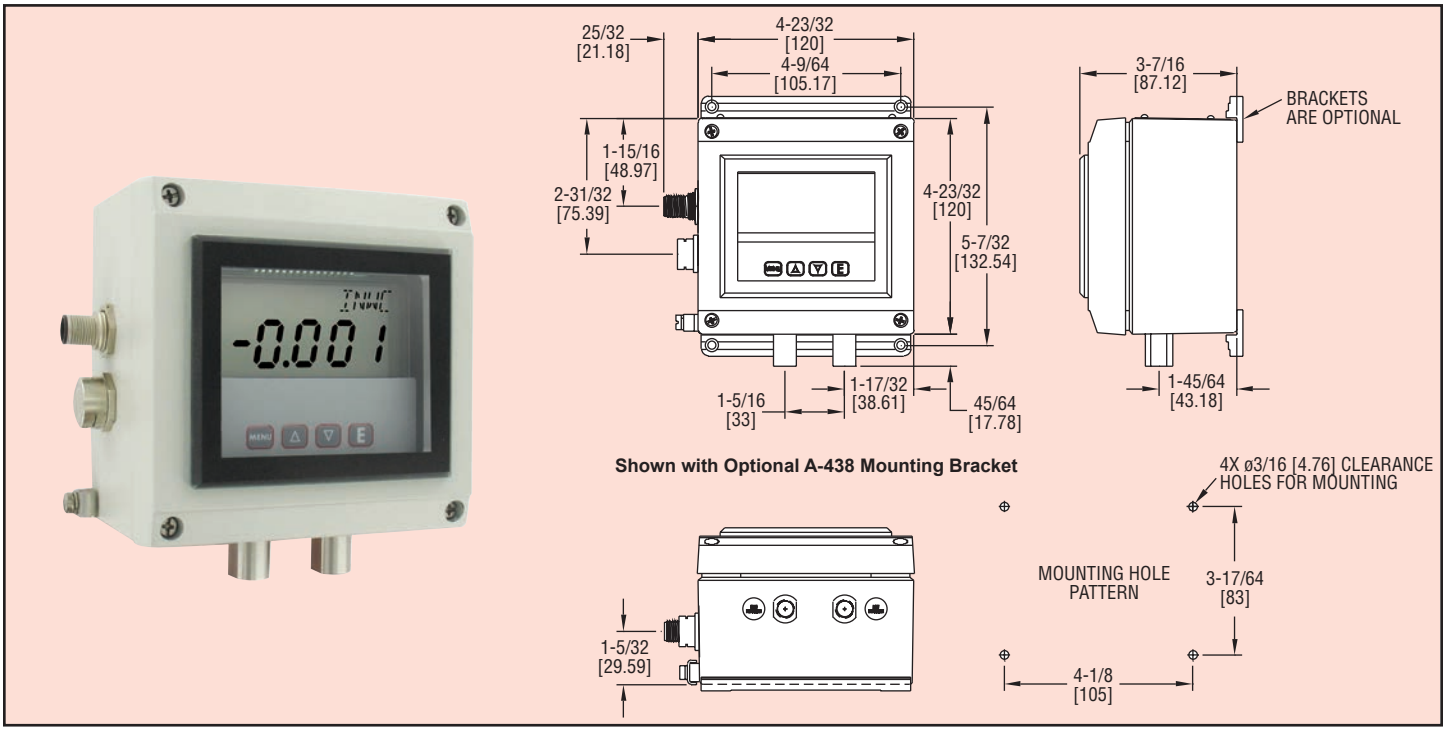
Series ISDP

Intrinsically Safe Differential Pressure Transmitter

For Hazardous Zone Pressure and Flow Applications



The ISDP Differential Pressure Transmitter provides a 4-20 mA process output, a robust NEMA 4X (IP66) enclosure, plus a large LCD display that can be programmed to read in pressure, velocity or flow. The ISDP offers simplified programming via a Menu key that enables the user to select: security level; English or Metric engineering units; pressure, velocity or flow operation, K-factor for use with various Pitot tubes and flow sensors, circular or rectangular duct size for volumetric flow operation, plus many more. The Series ISDP Differential Pressure Transmitter is powered on its two wire loop with 10-35 VDC via its integral M-12 four pin male connector. The ISDP provides a 0.5% full-scale accuracy on ranges from 0.25 in w.c. to 100 in w.c. as well as bi-directional models up to 10 in w.c. These features make the Series ISDP Differential Pressure Transmitter the ideal instrument for monitoring pressures or air flows in hazardous zones having a Class I Div. I Groups A, B, C, D; Class II Div. I Groups E, F, G; Class III Div. I ratings.

Model	Range
ISDP-002	0 - 0.25 in w.c.
ISDP-004	0 - 1 in w.c.
ISDP-006	0 - 5 in w.c.
ISDP-007	0 - 10 in w.c.
ISDP-008	0 - 25 in w.c.
ISDP-009	0 - 50 in w.c.
ISDP-010	0 - 100 in w.c.
ISDP-012	-0.25 / +0.25 in w.c.
ISDP-014	-1.0 / +1.0 in w.c.
ISDP-015	-2.5 / +2.5 in w.c.
ISDP-016	-5.0 / +5.0 in w.c.
ISDP-017	-10 / +10 in w.c.

ACCESSORIES

A-231, 16´ (5 m) Shielded Cable with 4 Pin Female M-12 Connection
A-486, 4.9´ (1 m) Shielded Cable with 4 Pin Female M-12 Connection
A-487, 9.8´ (3 m) Shielded Cable with 4 Pin Female M-12 Connection
A-488, 33´ (10 m) Shielded Cable with 4 Pin Female M-12 Connection
A-295, Female 4 Pin M-12 to Cable Gland Connector
MTL5041, Intrinsically Safe Galvanic Isolator
MTL7706, Intrinsically Safe Zener Barrier
A-438, Surface Mounting Brackets

SPECIFICATIONS

Service: Air and non-corrosive gases.
Wetted Materials: Ranges 5˝ and greater: glass, PVC, silicon, alumina ceramic, epoxy, RTV, gold, aluminum, stainless steel and nickel; Ranges 1˝ and lower: stainless steel, silicone, gold and ceramic.
Housing Materials: Aluminum, glass.
Accuracy: ±0.5% at 77°F (25°C) including hysteresis and repeatability (after 1 hour warm-up).
Stability: < ±1% per year.
Pressure Limits: Ranges ≤ 2.5 in w.c. = 2 psi; 5˝: 5 psi; 10˝: 5 psi; 25˝: 5 psi; 50˝: 5 psi; 100˝: 9 psi.
Temperature Limits: 32 to 140°F (0 to 60°C).
Compensated Temperature Limits: 32 to 140°F (0 to 60°C).
Thermal Effects: 0.020%/°F (0.036/°C) from 77°F (25°C).
Power Requirements: 10-35 VDC.
Output Signal: 4-20 mA DC.
Zero & Span Adjustments: Accessible via menus.
Response Time: 250 ms (damping set to 1).
Display: 4 digit LCD 0.6˝ H.
Electrical Connections: M-12 4 PIN Connector.
Process Connections: 1/8˝ female NPT.
Enclosure Rating: Designed to meet NEMA 4X (IP66).
Mounting Orientation: Mount unit in vertical plane.
Weight: 2 lb 10 oz (1.19 kg).
Agency Approvals: CE: CENELEC EN 61326/55024: 2003; IEC 61000-4-2/3/4/6: 2001/2006/2004/2005; CENELEC EN 55011: 2006; 2004/108/EC EMC Directive. FM Intrinsically Safe CLI Div I GR: A, B, C, D; CLII Div I GR: E, F, G; CLIII Div I.

OPTION

For NIST traceable calibration certificate, add suffix -NIST to model numbers.
Example: ISDP-004-NIST

For factory calibration certificate, add suffix -FC to model numbers.
Example: ISDP-004-FC

Process Tubing Options: See page 547 (Gage Tubing Accessories)

Series ISDP Intrinsically Safe Differential Pressure Transmitter

Specifications - Installation and Operating Instructions

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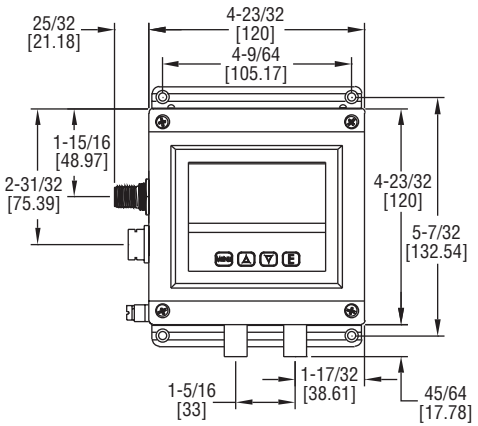
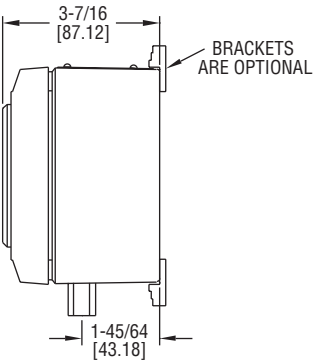
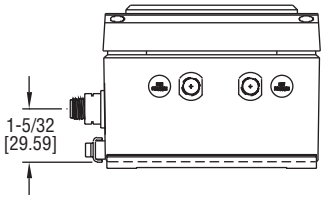
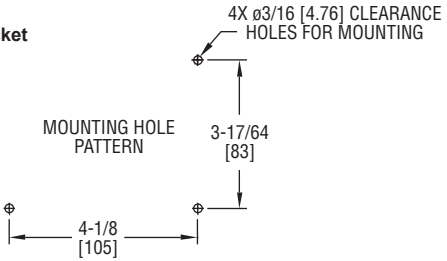
DIMENSIONS



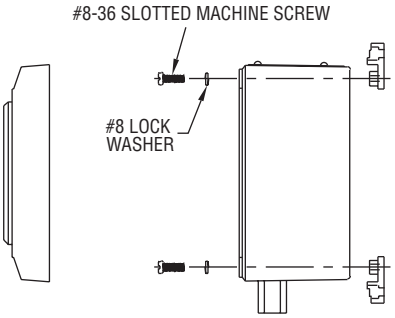


Shown with Optional A-438 Mounting Bracket





OPTIONAL A-438 BRACKET MOUNTING DIAGRAM



BRACKET ASSEMBLY

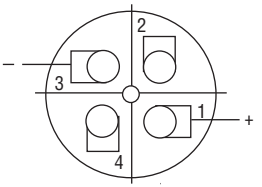
SPECIFICATIONS
Service: Air and non-corrosive gases.
Wetted Materials: Ranges 5″ and greater: glass, PVC, silicon, alumina ceramic, epoxy, RTV, gold, aluminum, stainless steel and nickel; Ranges 1″ and lower: stainless steel, silicone, gold and ceramic.
Housing Materials: Aluminum, glass.
Accuracy: ±0.5% at 77°F (25°C) including hysteresis and repeatability (after 1 hour warm-up).
Stability: < ±1% per year.
Pressure Limits: Ranges ≤ 2.5 in. w.c. = 2 psi;
5″: 5 psi; 10″: 5 psi; 25″: 5 psi; 50″: 5 psi; 100″: 9 psi.
Temperature Limits: 32 to 161.6°F (0 to 72°C).
Compensated Temperature Limits: 32 to 140°F (0 to 60°C).
Thermal Effects: 0.020%/°F (0.036/°C) from 77°F (25°C).
Power Requirements: 10-35 VDC.
Output Signal: 4-20 mA DC.
Zero & Span Adjustments: Accessible via menus.
Response Time: 250 ms (dampening set to 1).
Display: 4 digit LCD 0.6″ height.
Electrical Connections: M12 4 PIN Connector.
Process Connections: 1/8 female NPT.
Enclosure Rating: Designed to meet NEMA 4x (IP66).
Mounting Orientation: Mount unit in horizontal plane.
Size: 4.73″ x 4.73″ x 3.43″ (120 mm x 120 mm x 87.1 mm).
Weight: 2 lb 10 oz (1.19 kg).
Agency Approvals: FM Approved: IS / I, II, III / 1 / ABCDEFG / T4 Ta = 0°C to 72° - 19-443480-50; ENTITY; TYPE 4X (US AND CANADA) I / 0 AEx ia / IIC / T4 Ta = 0°C to 72° - 19-443480-50; ENTITY; TYPE 4X (US) I / 0 / Ex ia / IIC / T4 Ta = 0°C to 72° - 19-443480-50; ENTITY; TYPE 4X (CANADA) CE. CENELEC EN 61326/55024: 2003; IEC 61000-4-2/3/4/6: 2001/2006/2004/2005; CENELEC EN 55011: 2006; 2004/108/EC EMC Directive.

Intrinsic Safety Information

Entity Parameters
Ui = 28VDC
Ii = 93mA
Ci = 22 nF
Li = 400 uH
Pi = 651mW

Notes:
1. Remove power from the instrument before carrying out any servicing.
2. Use only FM approved Associated Apparatus.
3. The earth terminal on the housing must be wired to a local earth ground in the hazardous area.
4. Refer to control drawing 19-443480-50, Page 15, for installation requirements.

M-12 Connector



A-231 M-12 Cable Colors
PIN 1 is Brown (positive)
PIN 3 is Blue (negative)

Use Model A-231 shielded cable with 4 pin Female M-12 connection.

2-WIRE CONNECTION

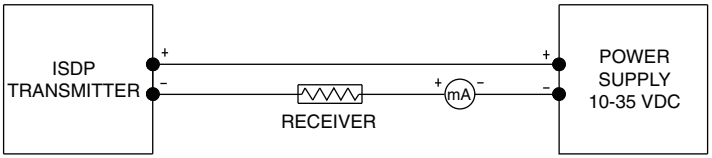


Fig. C

-------2-Wire Operation- An external power supply delivering 10 - 35 VDC with minimum current capability of 40 mA DC (per transmitter) must be used to power the control loop. See Fig. C for connection of the power supply, transmitter, and receiver. The range of the appropriate receiver load resistance (RL) for the DC power supply voltage available is expressed by the formula and graph in Fig. D.

POWER SUPPLY VOLTAGE - VDC (2-WIRE CONNECTION)

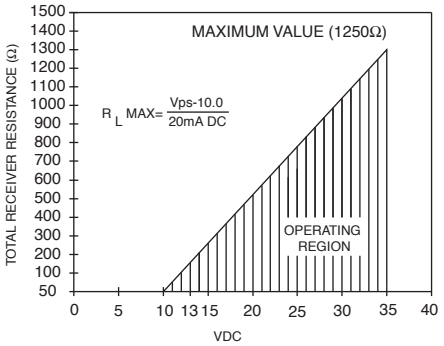


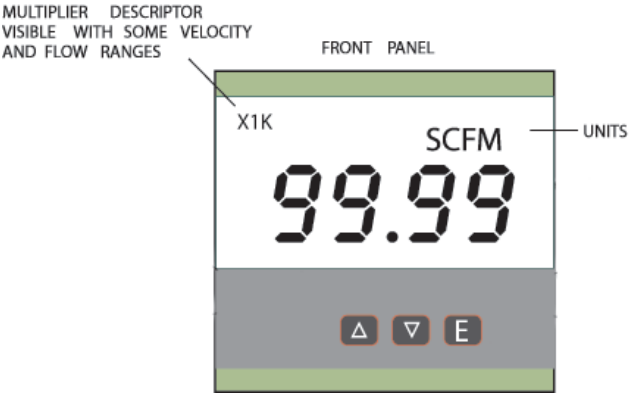
Fig. D

INSTALLATION

Mount the instrument in a location that will not be subject to excessive temperature, shock or vibration.

Pressure Connections

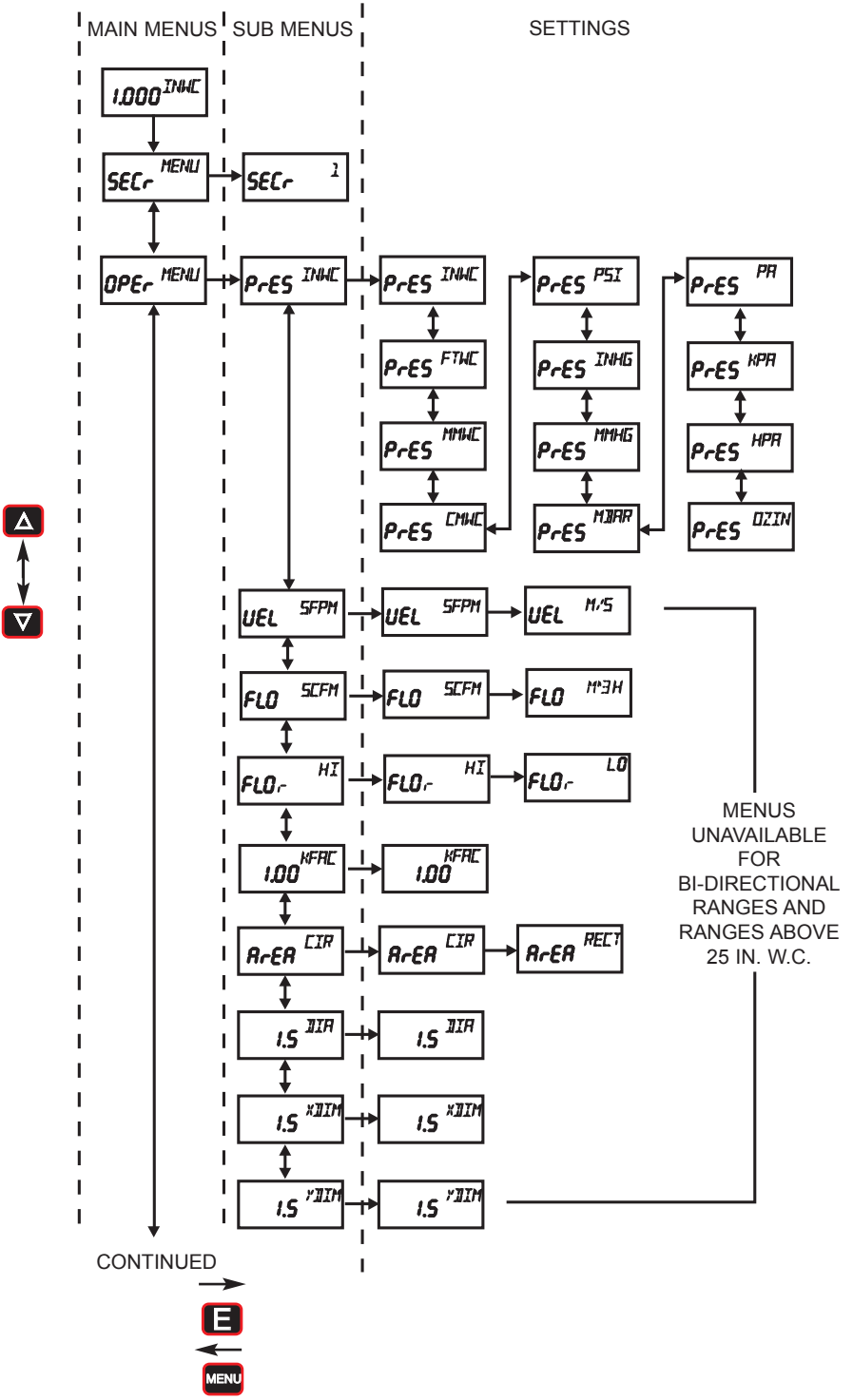
Use 1/8″ male NPT fittings. When tightening fittings, grasp the brass fitting on the ISDP with a 1/2″ wrench to prevent the fitting on the ISDP from turning.

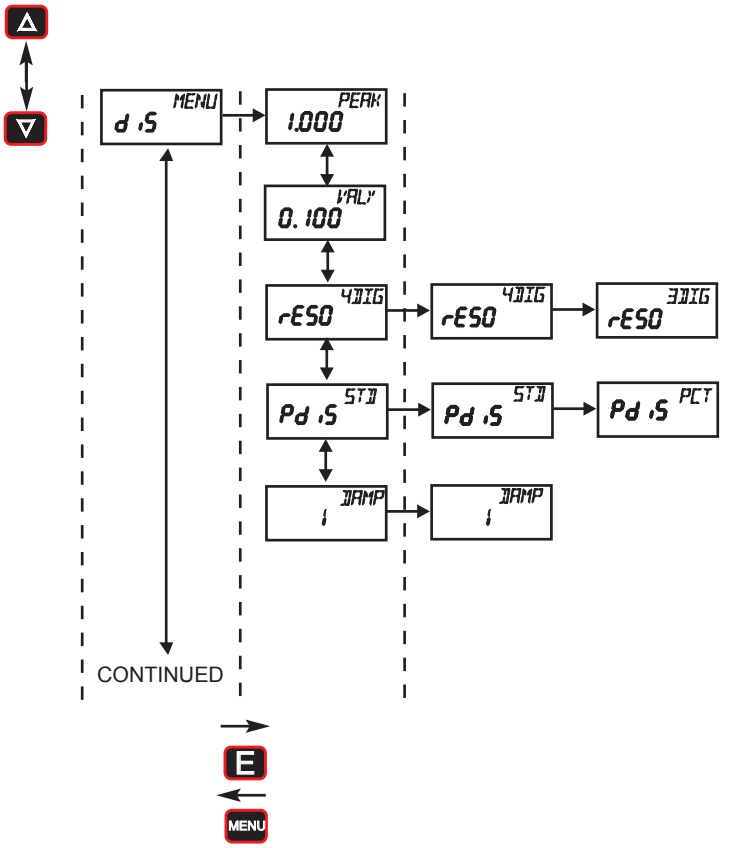


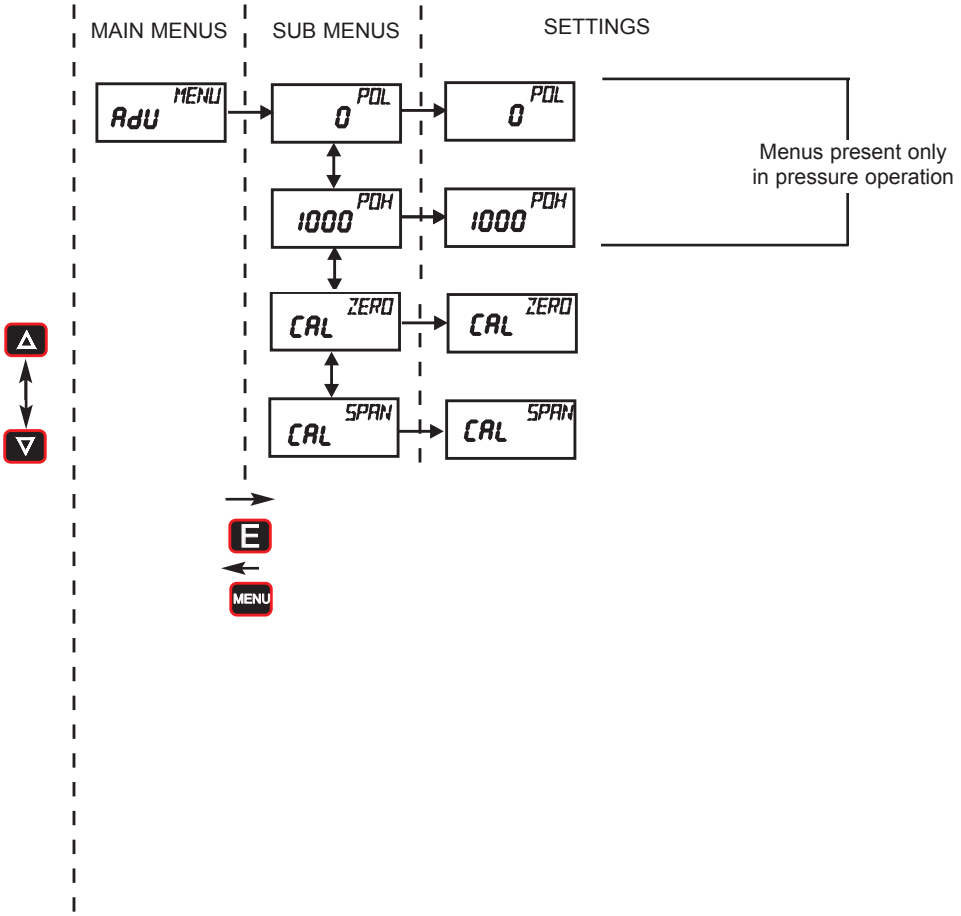
KEY FUNCTIONS

	HOME POSITION FUNCTION	MAIN MENU FUNCTION	SUB MENU FUNCTION
MENU	Allows access to the menus	Return to home position	Return to previous menu
UP ARROW		Sequences through menus	Increments a value
DOWN ARROW		Sequences through menus	Decrements a value
ENTER	Displays full scale range of unit	Enter into SUB MENU	Changes a value or setting. Press ENTER and display will blink. Adjust with UP or DOWN arrows. Press ENTER to store. Display will stop blinking. Peak/Valley SUB MENU resets display to present value.

MENU MAP


MAIN MENUS
SUB MENUS
SETTINGS
1.000 INWC
SECr MENU
SECr 1
OPEr MENU
PrES INWC
PrES INWC
PrES FTWC
PrES MMWC
PrES CMWC
PrES PSI
PrES INHG
PrES MMHG
PrES MBAR
PrES PA
PrES KPA
PrES HPA
PrES OZIN
UEL SFPM
UEL SFPM
UEL M/S
FLO SCFM
FLO SCFM
FLO M^3H
FLOr HI
FLOr HI
FLOr LO
1.00 KFAC
1.00 KFAC
ArEA CIR
ArEA CIR
ArEA RECT
1.5 DIA
1.5 DIA
1.5 XDIM
1.5 XDIM
1.5 YDIM
1.5 YDIM
MENUS UNAVAILABLE FOR BI-DIRECTIONAL RANGES AND RANGES ABOVE 25 IN. W.C.
CONTINUED
E
MENU


MENU
d ,S
PEAK
1.000
VALY
0.100
rESO
4DIG
rESO
4DIG
rESO
3DIG
Pd ,S
STD
Pd ,S
STD
Pd ,S
PCT
DAMP
1
DAMP
1
CONTINUED
E
MENU


MAIN MENUS
SUB MENUS
SETTINGS
MENU
AdU
POL
0
POL
0
POH
1000
POH
1000
ZERO
CAL
ZERO
CAL
SPAN
CAL
SPAN
CAL
Menus present only
in pressure operation
E
MENU

Model Chart	
Model	**Range**
ISDP-002	0-0.25″
ISDP-004	0-1″ WC
ISDP-005	0-2.5″ WC
ISDP-006	0-5″ WC
ISDP-007	0-10″ WC
IDSP-008	0-25″ WC
ISDP-009	0-50″ WC
ISDP-010	0-100″ WC
ISDP-011	-0.1/+0.1″ WC
ISDP-012	-0.25/+0.25″ WC
ISDP-013	-0.5/+0.5″ WC
ISDP-014	-1.0/+1.0″ WC
ISDP-015	-2.5/+2.5″ WC
ISDP-016	-5.0/+5.0″ WC
ISDP-017	-10/+10″ WC

Main Menu Selections (Upper Right Display Reads *MENU*)

SECr Security - Lock out access to menus and settings.

OPEr Operation - Selection of Pressure, Velocity or Flow and corresponding engineering units.

diS Display - Monitor and adjust display related settings: Peak, Valley, display resolution, % output and dampening.

AdJ Advanced functions - Modify advanced function parameters, transmitter output scaling, and calibration.

MAIN MENUS and SUB MENUS

SECr (Security) MAIN MENU

SECr is the only SUB MENU in the security MENU. When the security SUB MENU is selected, the present security level is displayed in the upper right hand display. To change the security level, adjust the number displayed to the number shown in the following table for the desired security level.

Security Level Displayed	Access	Password Value to Enter
1	All menus access	10
2	All settings locked	70

The password values shown in the table cannot be altered, so retain a copy of these pages for future reference.

OPEr (Operation) MAIN MENU

The OPEr MENU selects the measurement type of the instrument.
The SUB MENUS are:

PrES - Pressure
KFAC - K Factor
XDIM - X Dimension
VEL - Velocity
ArEA - Area
YDIM - Y Dimension
FLO - Flow
DIA - Diameter

If the instrument is set for Velocity, the OPEr MENU will have an additional KFAC SUB MENU. If the instrument is set for Flow, the OPEr MENU will have additional KFAC and ArEA SUB MENUS. These will be discussed under Velocity and Flow. When scrolling through the OPEr SUB MENUS, the measurement type the unit is currently set for will show the units in the upper right display. The other measurement types will have a blank upper right display.

Units visible, so unit is presently set to measure pressure

Units not visible

Units not visible

P-ES (Pressure) SUB MENU

For pressure measurement, the following units are available:

INWC - Inches of water column
FTWC - Feet of water column
MMWC - Millimeters of water column
CMWC - Centimeters of water column
PSI - Pounds per square inch
INHG - Inches of mercury
MMHG - Millimeters of mercury
MBAR - Millibar
PA - Pascal
KPA - Kilopascals
HPA - Hectopascals
OZIN - Ounce inches

Table 1 Pressure Range vs. Available Units

INWC	FTWC	MMWC	CMWC	PSI	INHG	MMHG	MBAR	PA	KPA	HPA	OZIN
.1000		2.540	.2540			.1868	.2491	24.91		.2491	
.2500		6.350	.6350			.4671	.6227	62.27		.6227	.1445
.5000		12.70	1.270			.9342	1.245	124.5	.1245	1.245	.2890
1.000		25.40	2.540			1.868	2.491	249.1	.2491	2.491	.5780
2.500	.2083	63.50	6.350		.1839	4.671	6.227	622.7	.6227	6.227	1.445
5.000	.4167	127.0	12.70	.1806	.3678	9.342	12.45	1245	1.245	12.45	2.890
10.00	.8333	254.0	25.40	.3613	.7356	18.68	24.91	2491	2.491	24.91	5.780
25.00	2.083	635.0	63.50	.9032	1.839	46.71	62.27	6227	6.227	62.27	14.45
50.00	4.167	1270	127.0	1.806	3.678	93.42	124.5		12.45	124.5	28.90
100.0	8.333	2540	254.0	3.613	7.356	186.8	249.1		24.91	249.1	57.80

NOTE: OVFL (over flow) or UnFL (under flow) will appear when the ranges have been exceeded above or below full scale by 2%.

VEL (Velocity) SUB MENU

For velocity measurement, the following units are available:

SFPM - Standard feet per minute
M/S - Meters per second

Table 2 Available Velocity Ranges

INPUT RANGE INWC	SFPM RANGE	M/S RANGE
0 - 0.1	0 - 1266	0 - 6.431
0 - 0.25	0 - 2002	0 - 10.17
0 - 0.5	0 - 2832	0 - 14.39
0 - 1	0 - 4004	0 - 20.35
0 - 2.5	0 - 6332	0 - 32.17
0 - 5	0 - 8954	0 - 45.48
0 - 10	0 - 12.66 x IK	0 - 64.33
0 - 25	0 - 20.02 x IK	0 - 101.7

NOTE: Air velocity and flow readings are based upon standard dry air conditions with an ambient temperature of 70°F and a barometric pressure of 29.92 INHG.

FLO (Flow) SUB MENU

For flow measurements the following units are available:

SCFM - Standard cubic feet per minute

M^3H - Cubic meters per hour

FLO r (Flow Range) SUB MENU

LO - 99.99 x 1K flow range

HI - 999.9 x 1K flow range

Tables 3 -6 show the flow ranges available, and the maximum duct size that can be set for each input range.

Table 3

FLOr = LO Maximum Duct Size (English)

RANGE IN WC	SCFM RANGE	MAX. DUCT SIZE, SQ. FT.
0.1	99.99 x 1K	78.9
0.25	99.99 x 1K	49.9
0.5	99.99 x 1K	35.3
1	99.99 x 1K	24.9
2.5	99.99 x 1K	15.7
5	99.99 x 1K	11.1
10	99.99 x 1K	7.8
25	99.99 x 1K	4.9

Table 4

FLOr = HI Maximum Duct Size (English)

RANGE IN WC	SCFM RANGE	MAX. DUCT SIZE, SQ. FT.
0.1	999.9 x 1K	789.8
0.25	999.9 x 1K	499.5
0.5	999.9 x 1K	353.1
1	999.9 x 1K	249.7
2.5	999.9 x 1K	157.9
5	999.9 x 1K	111.7
10	999.9 x 1K	78.9
25	999.9 x 1K	49.9

Table 5

FLOr = LO Maximum Duct Size (Metric)

RANGE IN WC	M^3/Hr RANGE	MAX. DUCT SIZE M^2
0.1	99.99 x 1K	4.32
0.25	99.99 x 1K	2.73
0.5	99.99 x 1K	1.93
1	99.99 x 1K	1.37
2.5	99.99 x 1K	0.86
5	99.99 x 1K	0.61
10	99.99 x 1K	0.43
25	99.99 x 1K	0.27

Table 6

FLOr = HI Maximum Duct Size (Metric)

RANGE IN WC	M^3/Hr Range	MAX. DUCT SIZE, M^2
0.1	999.9 x 1K	43.19
0.25	999.9 x 1K	27.31
0.5	999.9 x 1K	19.3
1	999.9 x 1K	13.64
2.5	999.9 x 1K	8.63
5	999.9 x 1K	6.10
10	999.9 x 1K	4.31
25	999.9 x 1K	2.73

KFAC SUB MENU

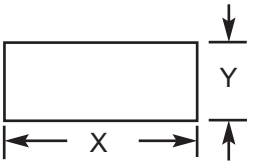
KFAC K Factor - becomes accessible if the instrument is set for Velocity or Flow. When the Digihelic® II Controller is used with a Pitot tube, the manufacturer may specify a K Factor. The adjustment range is 0.01 to 2.00. The factory setting is 1.

AREA, DIA, XDIM and YDIM SUB MENUS

These SUB MENUS become accessible if the instrument is set for flow. When measuring flow, the area of the duct must be specified. Tables 3 and 4 show the input range vs maximum flow and duct size. For a rectangular duct the maximum size is specified in square feet or meters. For a circular duct the maximum size is specified as the diameter. X, Y and circular dimensions are entered in feet with 0.01 foot resolution for FLOW = LO and 0.1 foot resolution for FLOW = HI, or entered in millimeters with 1 millimeter resolution.

AREA - Area, select CIR for a circular duct or RECT for a rectangular duct. If a circular duct is selected, the DIA SUB MENU will be activated. If a rectangular duct is selected, the XDIM and YDIM SUB MENUS will be activated.

DIA - Diameter, enter the diameter of a duct
XDIM - Enter the "X" dimension of a duct
YDIM - Enter the "Y" dimension of a duct



dSP (Display) MAIN MENU

PEAK - Peak value
VALY - Valley value
ZERO - Zero
RESO - Resolution
PdSP - Process display
DAMP - Dampening level

PEAK (Peak) SUB MENU

The Peak feature stores the highest pressure reading the instrument has measured since the last reset or power up. At power up PEAK is reset to the present pressure reading. To manually reset the PEAK value, press the ENTER key while in the PEAK SUB MENU.

VALY (Valley) SUB MENU

The valley feature stores the lowest pressure reading the instrument has measured since the last reset or power up. At power up VALY is reset to the present pressure reading. To manually reset the VALY value, press the ENTER key while in the VALY SUB MENU.

rESO (Resolution) SUB MENU

The Series ISDP Controller is capable of displaying four digits of resolution.
However, at very low pressures the instability of the pressure may cause fluctuations in the least significant digit causing the least significant digit to be of little value.
Three digit resolution (3DIG) can only be active when there is at least one digit to the right of a decimal.

3DIG - Set display for 3 digit resolution
4DIG - Set display for 4 digit resolution

Pd.S (Process Display) SUB MENU

STD - Display reads pressure, velocity, or flow values
PCT - Display reads % of full scale value

When the display is reading percent, PCT is displayed in the upper right of the display. The percent display is only available in pressure operation.

DAMP (Dampening) SUB MENU

Adjust from 1-16

Dampening stabilizes the display from instabilities due to things such as vibration and excessive pressure fluctuations. The dampening setting adjusts the amount of readings that are averaged for each display update. Adjust the dampening value until the display reads a stable value for the application.

AdJ (Advanced) MAIN MENU

POL - Process output low
POH - Process output high
ZERO - Zero calibration
SPAN - Span calibration

POL and POH (Process Output Low and High) SUB MENUS

This feature is used in pressure operation only.

Process output low and high are used to scale the 4-20 mA output. Set POL to the desired display reading for 4mA output, and set POH to the desired display reading for 20 mA output. POH must be higher than POL. POL may be adjusted 2% BELOW minimum scale up to POH. POH may be adjusted from POL to 2% ABOVE maximum scale.

ZERO and SPAN (Calibration of Zero and Span) SUB MENUS

The lower display reads CAL in this mode.

ZERO Calibration

NOTE: For accurate calibration, DO NOT apply any pressure when performing this function.

With the display reading ZERO, press the ENTER key. The upper display will blink. Press ENTER again to complete the zeroing of the instrument or press the MENU key to cancel.

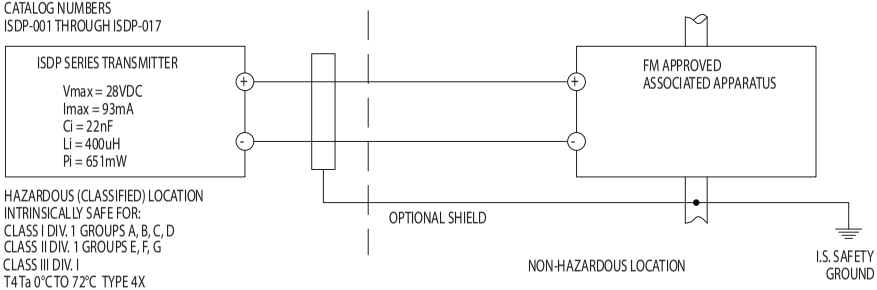
SPAN Calibration

With the display set to SPAN, apply full scale pressure to the unit. Press the ENTER key. The upper display will blink. Press ENTER again to complete the calibration or press the MENU key to cancel.

Maintenance

Upon final installation of the Series ISDP intrinsically Safe Differential Pressure Transmitter, no routine maintenance is required. The Series ISDP is not field serviceable and should not be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

CATALOG NUMBERS
ISDP-001 THROUGH ISDP-017



HAZARDOUS (CLASSIFIED) LOCATION
INTRINSICALLY SAFE FOR:
CLASS I DIV. 1 GROUPS A, B, C, D
CLASS II DIV. 1 GROUPS E, F, G
CLASS III DIV. I
T4 Ta 0°C TO 72°C TYPE 4X
OR
CLASS I, ZONE 0, GROUPS IIC
T4 Ta 0°C TO 72°C TYPE 4X

1. THE INTRINSIC SAFETY ENTITY CONCEPT ALLOWS THE INTERCONNECTION OF TWO FM APPROVED INTRINSICALLY SAFE DEVICES WITH ENTITY PARAMETERS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM WHEN:
   Voc OR Uo OR Vt $\leq$ Vmax, Isc OR It $\leq$ Imax $\leq$ Ca OR Co $\geq$ Ci + Ccable, La OR Lo $\geq$ Li + Lcable, Po $\leq$ Pi
2. EQUIPMENT CONNECTED TO THE ASSOCIATED APPARATUS MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR VDC.
3. DIVISION 1 HAZARDOUS (CLASSIFIED) LOCATIONS INSTALLATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE NFPA 70, ARTICLE 504; ZONE 0 HAZARDOUS LOCATIONS MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE NFPA 70, ARTICLE 505; IN US. INSTALLATIONS MUST BE IN ACCORDANCE WITH THE CANADIAN ELECTRICAL CODE CSA C22.1, PART 1, APPENDIX F; IN CANADA. ALL INSTALLATIONS MUST BE IN ACCORDANCE WITH ISA RP-12.6.
4. NO REVISIONS WITHOUT PRIOR APPROVAL FROM FM RESEARCH.
5. THE ASSOCIATED APPARATUS MANUFACTURERS INSTALLATION INSTRUCTIONS MUST BE FOLLOWED WHEN INSTALLING THIS EQUIPMENT.
6. WARNING - ENCLOSURE PARTS ARE CONSTRUCTED OF ALUMINUM. ENCLOSURE MUST BE PROTECTED FROM MECHANICAL FRICTION AND IMPACT WITH IRON/STEEL TO PREVENT IGNITION CAPABLE SPARKS.
7. SUBSTITUTION OF PARTS MAY IMPAIR INTRINSIC SAFETY. RETURN TO MANUFACTURER FOR ANY REPAIRS.
8. ADDITIONAL SUFFIXES AT (ALUMINUM TAG), COO (CERTIFICATE OF ORGIN), FC (FACTORY CALIBRATION CERTIFICATE), NIST (NIST TRACEABLE)

CD = CRITICAL DIMENSION
STANDARD TOLERANCES UNLESS NOTED:
ALL DECIMAL DIMENSIONS ± .005
ALL ANGLES ± 1°

F M C O N T R O L D R A W I N G

SCALE 1:1

NO.	CHANGES	BY/DATE
4	UPDATE TO ZONES PER DWK 06-11-14, ECR 35481	PFA 6-23-14
3	REVISED NOTE 3 TO ADD CANADIAN ELECTRICAL CODE PER ECR #25003	KAS 05-05-09
2	ADDED CLASS II AND III RATINGS PER ECR #23754	AJB 8-6-08
1	CLASS II AND CLASS III RATINGS REMOVED ITEM 6 PER ECR #22759	KAS 01-15-08

DATE 01-02-08
DWN BY KAS
CHKD CAR
APPD LRR

NAME: FM CONTROL DRAWING ISDP

ACAD2002

MATERIAL
FINISH

DWYER INSTRUMENTS, INC.
MICHIGAN CITY, INDIANA 46360 U.S.A.

FR. NO. 19-443480-50

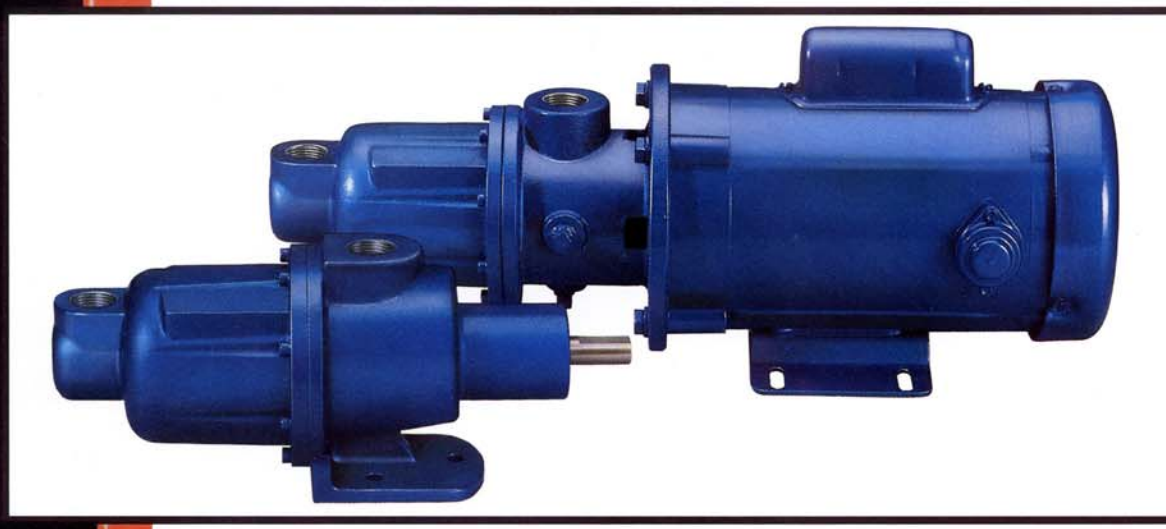
19-443480-50

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, IN 46360, U.S.A.
Phone: 219/879-8000 www.dwyer-inst.com
Fax: 219/872-9057 e-mail: info@dwyermail.com

Printed in U.S.A. 12/14
FR# 19-443480-00 Rev. 3

MOYNO® 500

Progressing Cavity Pumps



CERTIFICATE No. 101442

MOYNO

Always the Right Solution™

Moyno® 500 Pumps:
Outstanding Benefits for Unsurpassed Value!

Why choose Moyno 500 pumps over other pumps for commercial and general purpose industrial applications? The answer lies in the many benefits Moyno 500 pumps offer – an outstanding combination of performance enhancing advantages that other types of pumps simply cannot match. Here are just some of the benefits you can enjoy with Moyno 500 pumps:

- **Assure yourself of proven pump design.** Moyno 500 pumps are pre-engineered and thoroughly tested, with designs that have proven themselves in scores of applications year after year. With Moyno 500 pumps, you know up front that they will perform for you.

- **Match your pump precisely to its application.** Over 70 Moyno 500 pump models are available, in a variety of construction materials, with many pump options. This broad offering allows you to "tailor" a Moyno 500 pump to the specific needs of your application.

- **Place your pump where you need it the most.** Moyno 500 pumps combine high performance with efficient size. These compact, lightweight pumps fit in tight or difficult spaces, giving you more installation flexibility.

- **Use the pump drive source of your choice.** Moyno 500 pumps are available in both motorized models and non-motorized versions that work with various drive sources. You not only choose the pump you need, you also choose how to power it.

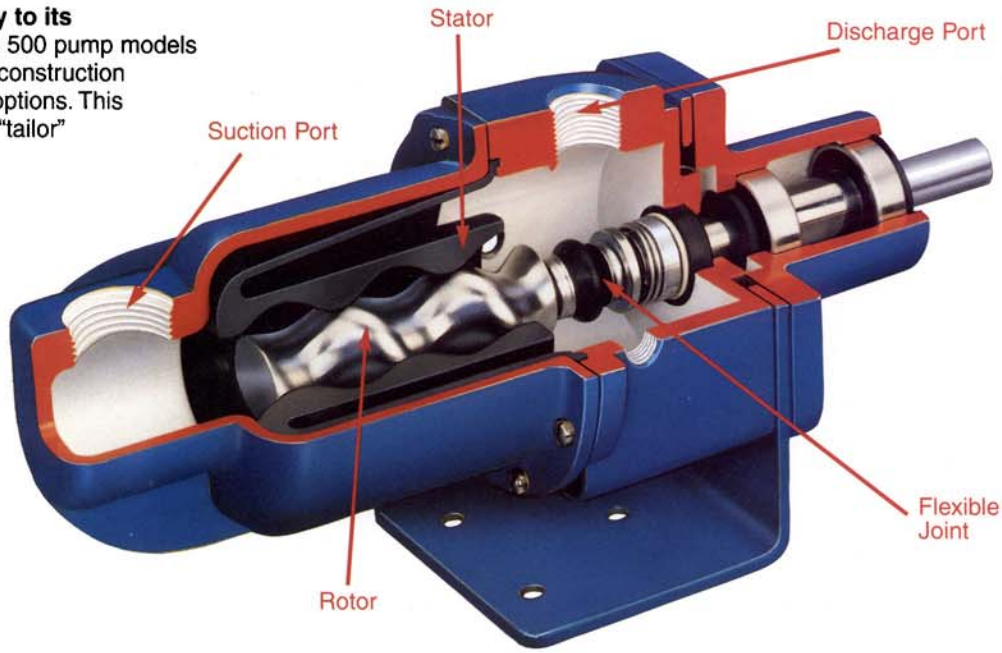
- **Eliminate priming.** As long as there is material in the suction line, Moyno 500 pumps are self priming.

- **Eliminate excessive operating noise.** Moyno 500 pumps operate quietly...the only sound you hear is the low hum of the drive motor. That makes it comfortable to work around a Moyno 500 pump installation. It also contributes to the overall quiet operation of OEM equipment into which the pump is installed.

- **Ensure steady, repeatable flow.** Moyno 500 pumps provide accurate, repeatable, non-pulsating, low-shear flow which remains steady even under wide variations in suction head.

- **Reduce pump maintenance.** With premium components, you rarely need to repair a Moyno 500 pump. When you do, design simplicity allows you to make the repairs quickly using standard tools. There are no valves to stick or wear out and no timing gears to align, saving you time and money.

- **Use the same pump for different applications.** For ultimate versatility, you can use the Moyno 500 pump in a wide variety of applications. Whether you are pumping clean, clear liquids or viscous, abrasive, corrosive or solids-laden fluids, the Moyno 500 pump can handle the job.



- **Access industry-leading technology.** Choosing Moyno 500 pumps means access to Moyno's state-of-the-art manufacturing and developmental lab facilities plus nearly 60 years of progressing cavity pump design innovation. The result is product performance reliability you can depend on time after time.

- **Receive full-service support from local stocking distributors.** Moyno maintains a worldwide network of stocking distributors ready to assist you with applications information, product knowledge and extensive pump and replacement parts inventories. You receive fast, accurate solutions to your pumping needs. Your Moyno 500 pump receives first-rate support, no matter where you are located.

The Moyno® 500 Pump Line

200 Series Pumps

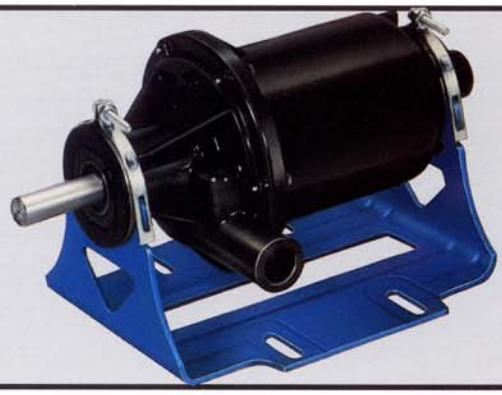
- Capacities to 5 GPM
- Pressures to 40 PSI
- Compact size
- Motorized and non-motorized models
- Dual, heavy-duty ball bearings, fully sealed and pre-lubricated
- Mechanical seal

300 Series Pumps

- Capacities to 15 GPM
- Pressures to 150 PSI
- Interchangeable rotors and stators
- Fluid temperature range to 210°F
- Packing gland or mechanical seals available
- Motorized and non-motorized models available

301 Series Pumps

- Capacities to 13 GPM
- Pressures to 25 PSI
- Phenolic housing and rotor for chemical corrosion resistance
- Reverse covered seal between rotor and shaft eliminates metal exposure to fluids
- Non-motorized with hose connections, resilient cushion and cradle mounting



356/367 Series Pumps

- Capacities to 50 GPM
- Pressures to 50 PSI
- Full range of elastomer materials
- Fluid temperatures to 240°F
- Packing and mechanical seals available
- Motorized and non-motorized models available

400 Series Grinder Pumps

- Capacities to 15 GPM
- Discharge to 100 PSI
- Cast iron cutter disk
- Replaceable carbide cutting tips
- Hardened tool-steel cutter ring

600 Series Pumps

- Capacities to 30 GPM
- High pressure and fluid viscosity capabilities
- Pressures to 600 PSI
- Reverse operation capability
- Packing or mechanical seals available

How Moyno 500 Pumps Work

The progressing cavity design forms a series of sealed cavities 180 degrees apart. These cavities contain the pumped fluid. As the rotor turns, the cavities "progress" from the suction to the discharge end of the pump, carrying the pumped fluid with them. As one cavity decreases and empties itself of fluid, the opposite cavity increases at exactly the same rate, filling with fluid. The result is a constant, uniform, non-pulsating flow that provides low shearing action for minimum degradation of shear-sensitive materials and low velocity capabilities for effective pumping of viscous fluids.

"Wobble" Stators

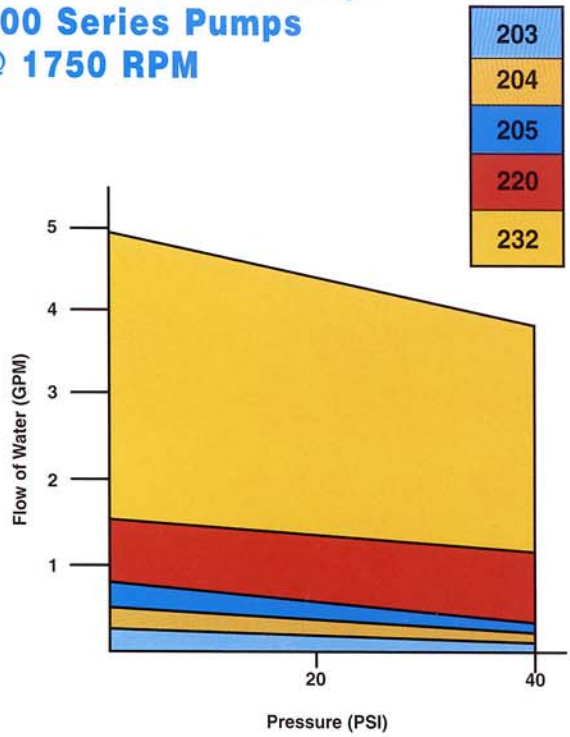
Most Moyno 500 pumps are equipped with an innovative "wobble" stator, a fully molded stator with an integral "skirt" separating the suction and discharge ends of the pump. This unique design actually increases the compression fit during operation between rotor and stator, for greater pumping performance. The wobble stator design can handle pressures to 150 PSI and is available on the Series 200, 300, 301, 356/367 and 400 pumps.

"Tube" Stators

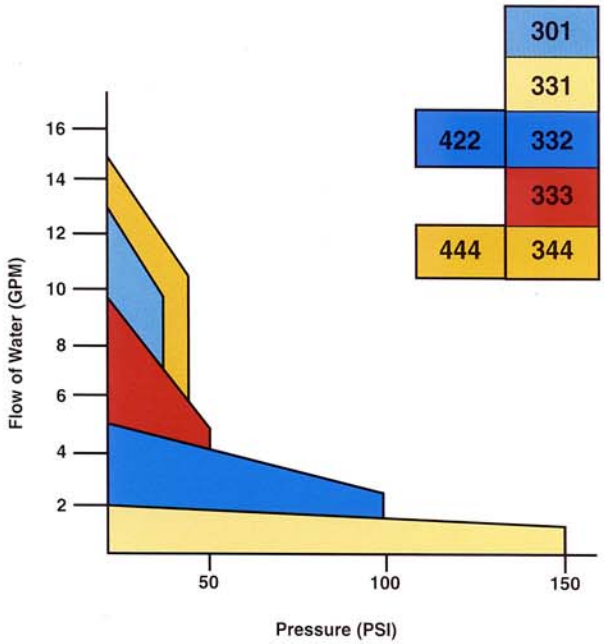
Moyno 500 pumps with a tube-type stator design can easily handle high-pressure pumping of heavy-duty industrial fluids. The tube-type design permits additional length to be added, increasing pressure capabilities for greater operating efficiencies. The tube stator design can handle pressures to 600 PSI, and is available on the Series 600 pumps.

Moyno® 500 Pump Performance

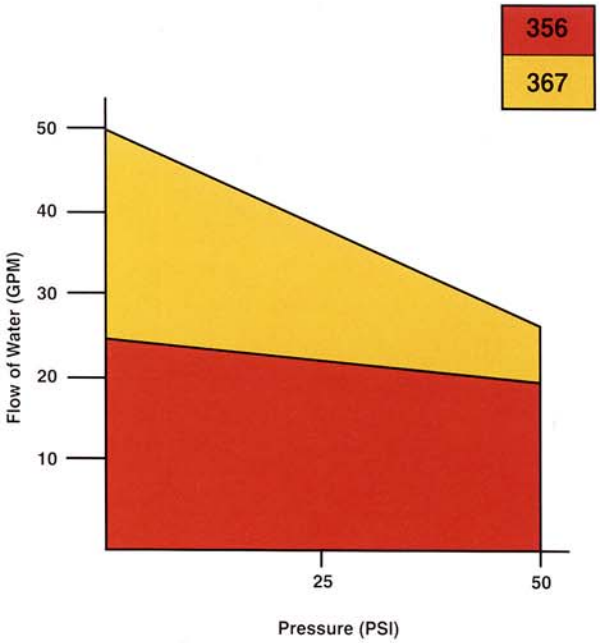
Performance Envelope 200 Series Pumps @ 1750 RPM



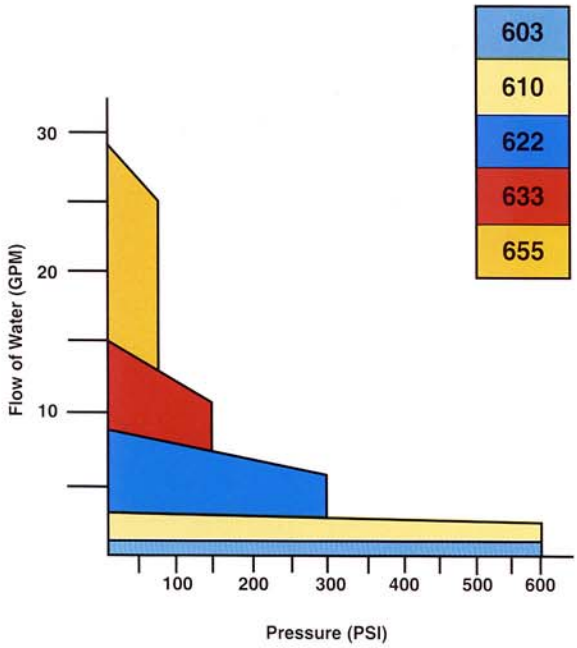
Performance Envelope 300/400 Series Pumps @ 1750 RPM



Performance Envelope 356/367 Series Pumps @ 1750 RPM



Performance Envelope 600 Series Pumps @ 1750 RPM



Application Versatility ... From A to Z

Versatile Moyno® 500 pumps are used in these and hundreds of other applications...

Abrasive chemicals and slurries
Agricultural spray wash systems
Airless paint sprayers
Anti-freeze lubricants
Asphalt transfer

Batching systems
Bilge pumps
Boat and barge duty
Boiler feed (low pressure)
Bridge deck flooding

Campground facilities
Caulking
Centrifugal priming, scavaging and seal flush systems
Closed loop cooling systems
Construction applications

Dairy applications
Dental suction
Dirty oil
Drainage
Drum transfer

EDM dielectric fluids
Effluent sampling
Emulsions
Emergency drainage
Explosives

Fabric coatings
Feed additives
Fiberboard manufacturing
Filtration systems
Fuel transfer

Garbage disposal
Glue
Grain mash slurries
Grout
Gum and wood chemicals

Heat pump supply
Heat exchanger service
Heavy crude
High-pressure feed/transfer systems
Home applications

Industrial circulation and transfer
Industrial waste and sewage sampling
Ink
Insecticides

Jet fuel

Kerosene
Kitchen waste
Knit fabric mills

Laboratory testing
Lime slurries
Liquid aluminum
Liquid manure
Lubricants

Machine tool coolants
Marine septic systems
Metered injection systems
Mining operations
Molasses based feeds

Nitric acid
Non-ferrous metal
Nutrient additives

OEM applications
Offshore drilling
Oil and sand
Oil scum
Oily water separators

Paint
Pilot and prototype systems design
Pit de-watering
Polymer treatment

Radar equipment
Raw and digested sewage
Recreational facilities
Reverse osmosis systems
Roofing compounds

Saline solution (hemodialysis machines)
Slurries (high solids content)
Spraying systems
Sump pump-out
Swimming pool drainage

Tank sump cleaning
Thickened underflow
Titanium dioxide
Toner
Transfer applications

Urine (agriculture)

Vehicle wash down

Waste management
Wastewater treatment
Water and sewage sampling

Zebra mussel removal

For information about Moyno products or for technical assistance, write or call:

Moyno, Inc.
P.O. Box 960
Springfield, OH 45501-0960
U.S.A.
Telephone: 1-877-4UMOYNO
Facsimile: 937-327-3572
Web site: www.moyno.com

Note: Information contained herein is subject to change without notice. Before making a final product selection, please contact a Moyno representative.

Your Moyno Authorized Distributor is:

Bulletin 90-M

MOYNO

Always the Right Solution™

Printed in U.S.A.
5M PPI 1201

MOYNO
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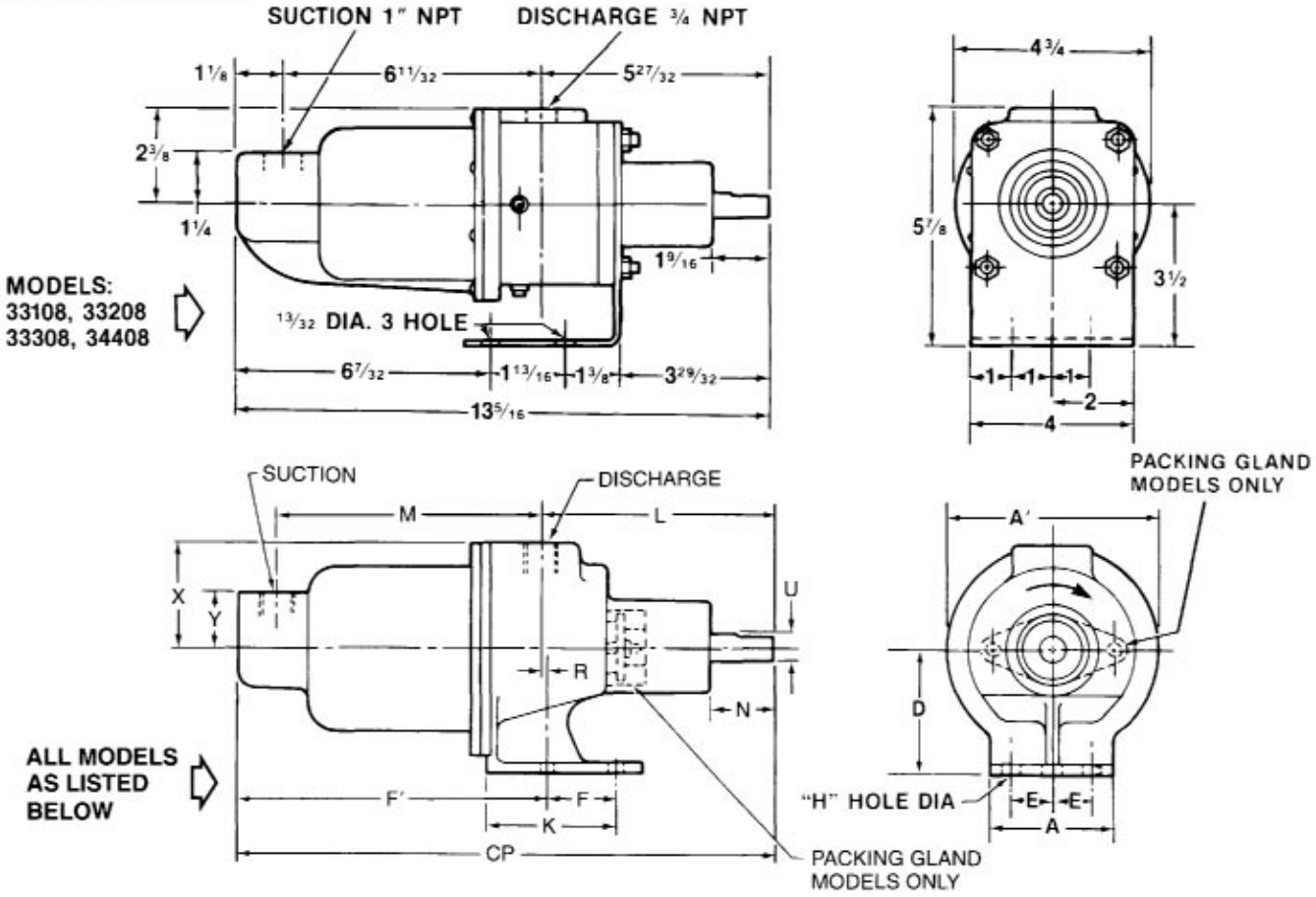
SPECIFICATION DATA

MOYNO® 500 PUMPS

300 SERIES
331, 332, 333, 344, 356 AND 367 MODELS

DIMENSIONS

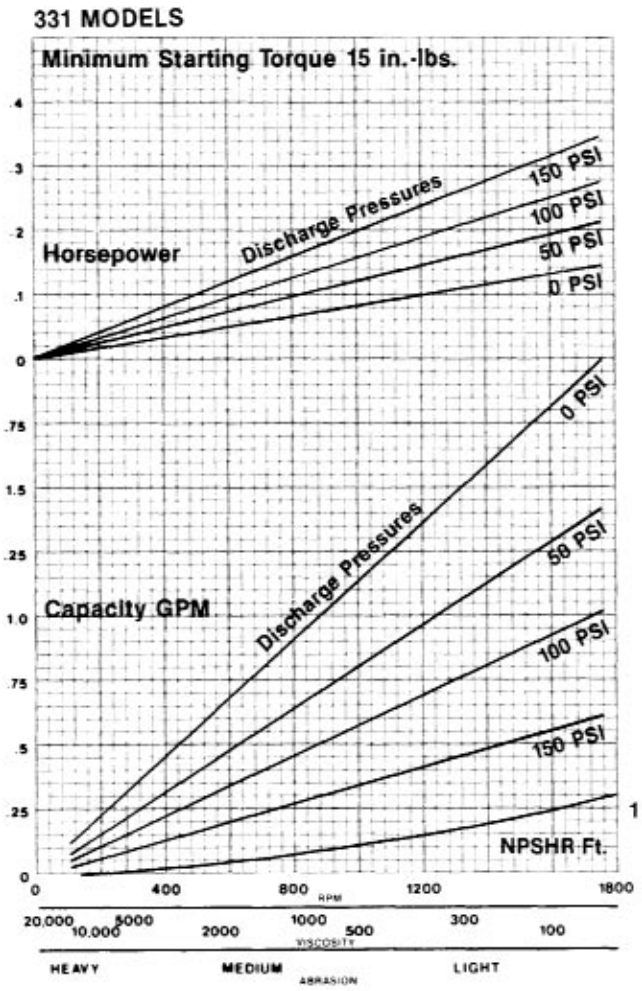


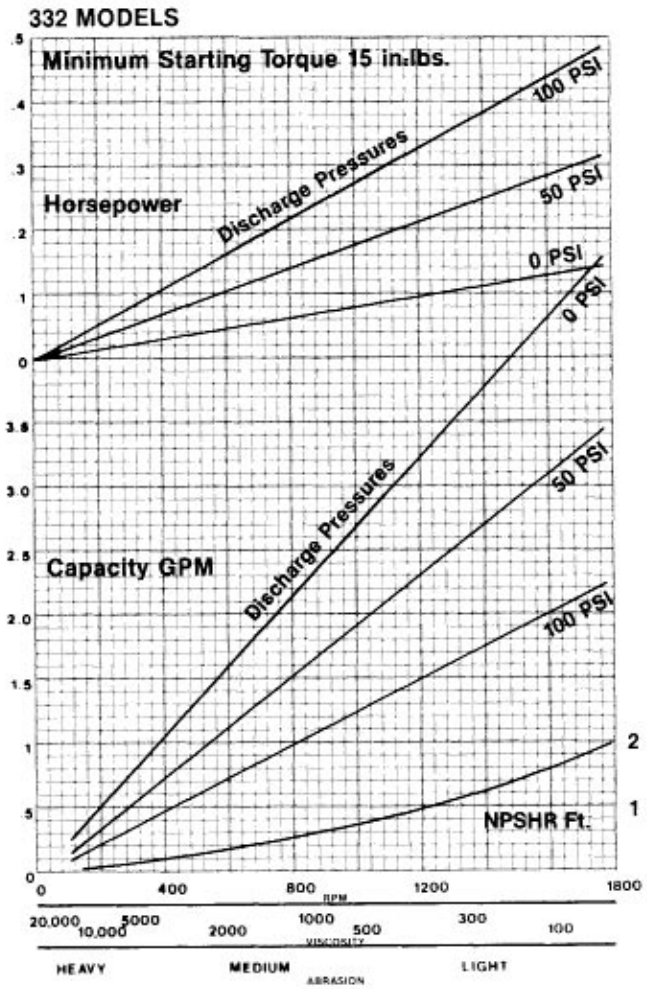
MODELS	CP	A	A[1]	D	E	F	F[1]	H	K	L	M	N	R	U	X	Y	SUCT (NPT)	DISCH (NPT)
33101, 33201 33301, 33104 33204, 33304 34401, 34404	12⅝	3⅛	4¾	2¾	1	1¹³⁄₁₆	6¹⁵⁄₁₆	¹³⁄₃₂	3¹⁄₃₂	5¹¹⁄₁₆	6¹⁄₁₆	1⁷⁄₁₆	—	⅝	2⅜	1¼	¾	¾

*Packing Gland Model

All dimensions are in inches. Specifications subject to change without notice.

~~331, 332, 333 and~~ 344 MODELS
PERFORMANCE (water at 70ºF)



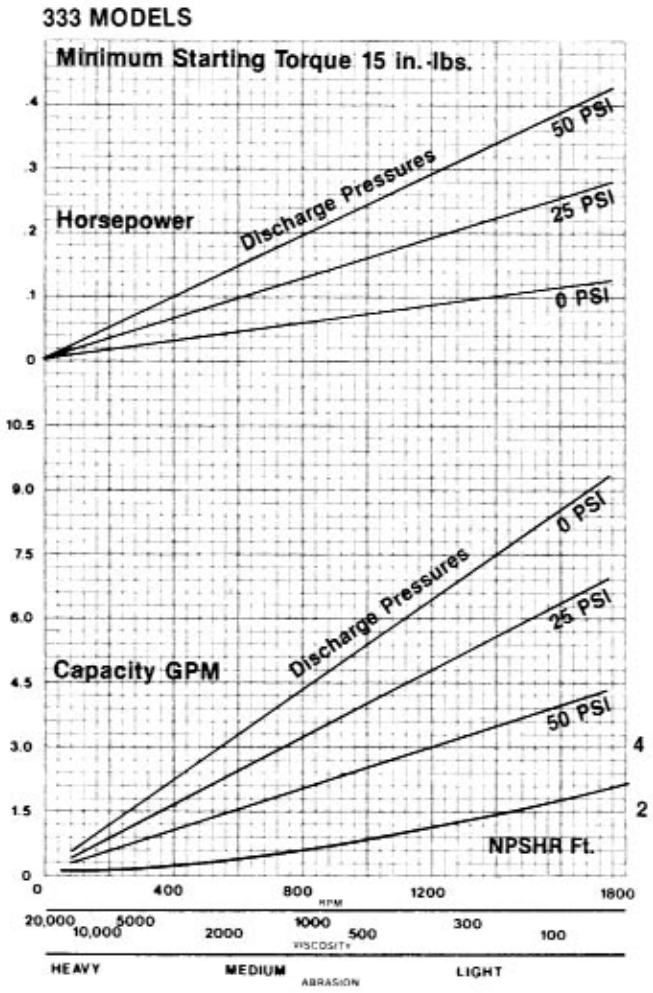


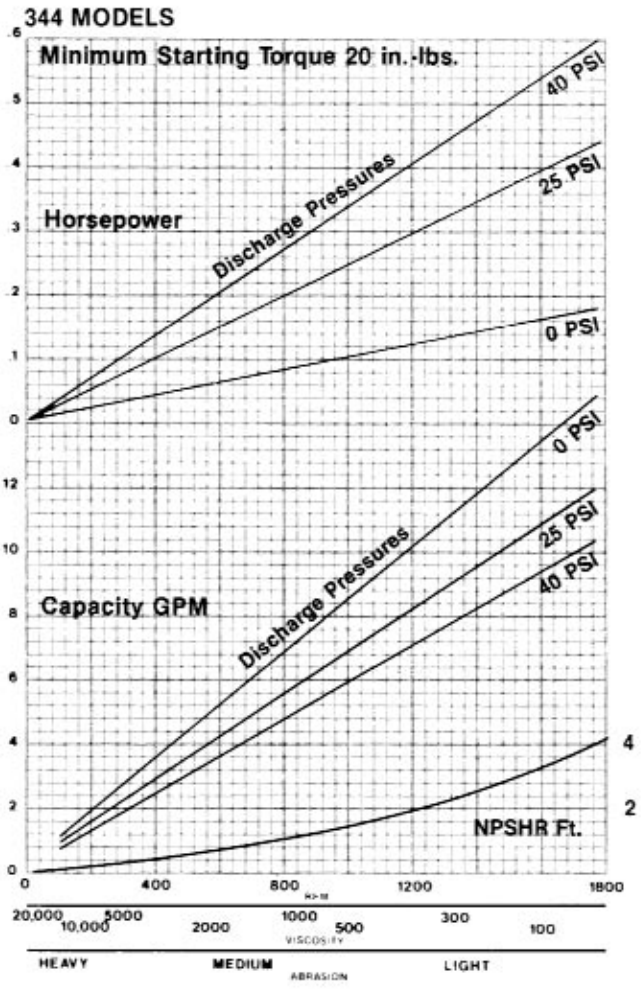
NOTE: For fluids with viscosity over 200 CP (1000 SSU), pump capacity is reduced by 20%.

MATERIALS OF CONSTRUCTION

COMPONENT	MODELS			
	33101, 33201 33301, 34401	33104, 33204 33304, 34404	33108, 33208 33308, 34408	*34411
Housing	Cast iron	316 SS	Nylon	Cast iron
Rotor	416 SS/CP	316 SS/CP	416 SS/CP	416 SS/CP
Stator	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)
Weight (lbs)	16	16	8	16

* Packing Gland Model
CP = Chrome plated





NOTE: For fluids with viscosity over 200 CP (1000 SSU), pump capacity is reduced by 20%.

Always the Right Solution™

SERVICE MANUAL

MOYNO® 500 PUMPS

300 SERIES
331, 332, 333, 344, 356 AND 367 MODELS

Mechanical Seal Models

Packing Gland Models

DESIGN FEATURES	MODELS				
	33101 34401 33201 35601 33301 36701	**33104 34404 33204 35604 33304 36704**	**33108 33308 33208 34408**	**34411 35611**	**35613**
Housing:	Cast Iron	AISI 316 SS	Nylon	Cast Iron	AISI 316 SS
Pump Rotor:	Chrome plated 416 SS	Chrome plated 316 SS	Chrome plated 416 SS	Chrome plated 416 SS	Chrome plated 316 SS
Pump Stator:	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)
Shaft:	416 SS	316 SS	416 SS	416 SS	316 SS
Flexible Joint:	Carbon steel/ NBR	316 SS/ NBR	Carbon steel/ NBR	Carbon steel/ NBR	316 SS/ NBR
Bearings:	Ball (sealed)	Ball (sealed)	Ball (sealed)	Ball (sealed)	Ball (sealed)
Mechanical Seal:	Carbon-ceramic	Carbon-ceramic	Carbon-ceramic	---	---
Packing:	---	---	---	Braided PTFE	Braided PTFE

Note: Alternate elastomers available. Refer to Repair/Conversion kit numbers, page 8.

INSTALLATION

Mounting Position. Pump may be mounted in any position. When mounting vertically, it is necessary to keep bearings above seals to prevent possible seal leakage into bearings.

Pre-Wetting. Prior to connecting pump, wet pump elements and mechanical seal or packing by adding fluid to be pumped into suction and discharge ports. Turn shaft over several times in a clockwise direction to work fluid into elements.

Piping. Piping to pump should be self-supporting to avoid excessive strain on pump housings. See Table 1 for suction and discharge port sizes of each pump model. Use pipe "dope" or tape to facilitate disassembly and to provide seal.

Drive. On belt driven units, adjust belt tension to point of non-slip. Do not overtighten.

On direct drive units, coupling components should be aligned and spaced at least 1/16" apart.

Pump rotation must be clockwise when facing shaft to prevent damage to pump. Check direction of rotation before startup.

Water Flush of Packing (356 Models Only). The packing may be either grease lubricated through a grease fitting in the stuffing box or have plumbing connected to the housing to allow a water flush.

Maximum speed is 1750 rpm.

When the material being pumped is abrasive in nature, it may be advantageous to flush the packing to prevent leakage under packing and excessive shaft wear.

Clean water can be injected through a 1/8" NPT tapped hole that normally houses the grease fitting for lubricating the packing. The water can be permitted to leak axially along the shaft in either direction or can be removed from the second tapped hole in the stuffing box. In both cases, the discharge from the stuffing box should be throttled slightly to maintain 10-15 PSI higher pressure in the stuffing box than is present in the discharge housing.

Table 1. Pump Data

Pump Models	331	332	333	344	356	367
Suction Port (NPT)	3/4*	*3/4**	*3/4**	3/4*	1-1/2	2
Discharge Port (NPT)	3/4	3/4	3/4	3/4	1-1/4	2
Discharge Pressure (psig)	150	100	50	40	50	50

*08 versions = 1" NPT

Table 2. Temperature Limits

Elastomer	Temperature Limits
*NBR	10°-160°F
*EPDM	10°-210°F
*FPM	10°-240°F

*NBR = Nitrile
*EPDM = Ethylene-Propylene-Diene Terpolymer
*FPM = Fluoroelastomer

OPERATION

Self-Priming. With wetted pumping elements, the pump is capable of 25 feet of suction lift when operating at 1750 rpm with pipe size equal to port size.

DO NOT RUN DRY. Unit depends on liquid pumped for lubrication. For proper lubrication, flow rate should be at least 10% of rated capacity.

Pressure and Temperature Limits. See Table 1 for maximum discharge pressure of each model. Unit is suitable for service at temperatures shown in Table 2.

Storage. Always drain pump for extended storage periods by removing suction housing bolts and loosening suction housing.

TROUBLE SHOOTING

WARNING: Before making adjustments, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.

Failure To Pump.

1. Belt or coupling slip: Adjust belt tension or tighten set screw on coupling.
2. Stator torn; possibly excessive pressure: Replace stator, check pressure at discharge port.
3. Wrong rotation: Rotation must be clockwise when facing shaft.
4. Threads in rotor or on shaft stripped: Replace part. Check for proper rotation.
5. Excessive suction lift or vacuum.

Pump Overloads.

1. Excessive discharge pressure: Check discharge pressure for maximum rating given in Table 1. Check for obstruction in discharge pipe.
2. Fluid viscosity too high: Limit fluid viscosity to 20,000 CP or 100,000 SSU.

Viscosity CP	Limit RPM
1-300	1750
300-1,000	1200
1,000-2,000	700
2,000-5,000	350
5,000-10,000	180
10,000-20,000	100

3. Insufficient motor HP: Check HP requirement.

Noisy Operation.

1. Starved suction: Check fluid supply, length of suction line, and obstructions in pipe.
2. Bearings worn: Replace parts; check alignment, belt tension, pressure at discharge port.
3. Broken flexible joint: Replace part, check pressure at discharge port.
4. Insufficient mounting: Mount to be secure to firm base. Vibration induced noise can be reduced by using mount pads and short sections of hose on suction and discharge ports.

Mechanical Seal Leakage (Mechanical Seal Models Only).

1. Leakage at startup: If leakage is slight, allow pump to run several hours to let faces run in.
2. Persistent seal leakage: Faces may be cracked from freezing or thermal shock. Replace seal.

Packing Leakage (Packing Models Only).

1. Leakage at startup: Adjust packing as outlined in maintenance instructions.

Note: Slight leakage is necessary for lubrication of packing.

2. Persistent leakage: Packing rings and/or shaft may be worn. Replace parts as required.

Pump Will Not Prime.

1. Air leak on suction side: Check pipe connections.

MAINTENANCE

General. These pumps have been designed for a minimum of maintenance, the extent of which is routine lubrication and adjustment of packing. The pump is one of the easiest to work on in that the main elements are very accessible and require few tools to disassemble.

Packing Lubrication (356 Models Only). The zerk fitting on the side of the suction housing leads to the lantern ring halves in the mid-section of the packings. At least once a week, inject a small quantity of good quality grease, such as MPG-2 Multi Purpose Grease (Du Bois Chemical), or equivalent, into the zerk fitting to lubricate the packings.

Note: For Model 34411, lubricate packing by applying a liberal amount of grease during assembly.

Packing Adjustment (Packing Models Only). Packing gland attaching nuts should be evenly adjusted so they are little more than finger tight. Over-tightening of the packing gland may result in premature packing failure and possible damage to the shaft and gland.

When the packing is new, frequent minor adjustments are recommended for the first few hours of operation in order to compress and seat the packing. Be sure to allow slight leakage for lubrication of packing.

When excessive leakage can no longer be regulated by tightening the gland nuts, remove and replace the packings in accordance with the DISASSEMBLY and REASSEMBLY instructions. The entire pump need not be disassembled to replace the packings.

Bearing Lubrication. The prelubricated, fully sealed bearings do not require additional lubrication.

PUMP DISASSEMBLY

WARNING: Before disassembling pump, disconnect power source and thoroughly bleed pressure from system. Failure to do so could result in electric shock or serious bodily harm.

To Disassemble Mechanical Seal Models:

1. Disconnect suction and discharge piping.
2. Remove screws (112) holding suction housing (2) to pump body (1). Remove suction housing and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning counter-clockwise (RH thread). Use 3/16 inch diameter punch to remove rotor pin (45) on Model 36701.
4. Flexible joint (24) can be removed from shaft (26) by using a 3/16 inch allen wrench in end of joint (1/4 inch wrench on 356 Models) and turn counter-clockwise. Use 3/16 inch diameter punch to remove shaft pin (46) on Model 36701.
5. Carefully slide mechanical seal (69) off shaft (26). Carefully pry seal seat out of pump body (1). If any parts of mechanical seal are worn or broken, the complete seal assembly should be replaced. Seal components are matched parts and are not interchangeable.
6. The bearings (29) and shaft (26) assembly can be removed from pump body (1) after snap ring (66) has been removed. To remove the assembly, lightly tap the shaft at threaded end using a block of wood to protect the threads. The bearings may be pressed off the shaft.

To Disassemble Packing Models:

1. Disconnect suction and discharge piping.
2. Remove screws (112) which hold suction housing (2) to pump body (1). Remove suction housing and stator (21).
3. Remove rotor (22) from flexible joint (24) by turning in a counter-clockwise direction (RH thread).
4. Flexible joint (24) can be removed by using a 3/16 inch allen wrench in end of joint (1/4 inch wrench on 356 Models) and turn in a counter-clockwise direction.
5. The packing (42) can be removed without removing the shaft (26) using the following procedure:
   a. Remove gland bolts (47).
   b. Slide gland (41) away from packing (42).
   c. Pull out packing (42) (and lantern ring halves (57) on 356 Models) using a packing removing tool.

   Note: Packing can be removed after shaft has been removed by pushing out from pump side of pump body after gland (41) has been detached.
6. The bearings (29) and shaft (26) assembly can be removed from pump body (1) after snap ring (66) has been removed. To remove the assembly, lightly tap the shaft at threaded end using a block of wood to protect the threads.
7. To disassemble shaft assembly, remove snap ring (66A) from shaft (26) and press bearings (29) and bearing spacer (33) off the shaft.

PUMP ASSEMBLY

To Assemble Mechanical Seal Models:

1. Press bearings (29) on shaft (26), and locate slinger ring (77) near bearing on threaded end of shaft.

Note: When replacing bearings, always press on the inner race when assembling to shaft, and on the outer race when pressing bearings into the housings.

2. Press shaft assembly into pump body (1) securing with snap ring (66).
3. Install mechanical seal (69) using the following procedure:
   a. Clean and oil sealing faces using a clean light oil (not grease).

Caution: Do not use oil on EPDM parts. Substitute glycerin or soap and water.

   b. Oil the outer surface of the seal seat, and push the assembly into the bore in the pump body (1), seating it firmly and squarely.
   c. After cleaning and oiling the shaft, slide the seal body along the shaft until it meets the seal seat.
   d. Install seal spring and spring retainer on shaft.
4. Thread flexible joint (24) into shaft (26) in a clockwise direction (RH thread). On 356 Models, install seal spacer (69A) and washer (116) before threading flexible joint onto shaft in a clockwise direction. On Model 36701, use shaft pin (46) to pin flexible joint (24) to shaft.
5. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread). On Model 36701, pin rotor (22) to joint using rotor pin (45).
6. Slide stator (21) on rotor (22). On 331 and 332 Models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
7. Secure stator (21) and suction housing (2), with suction port vertically up, to pump body (1) using screws (112).
8. Proceed as in installation instructions.

To Assemble Packing Models:

1. Press bearings (29), with bearing spacer (33) in between, on shaft (26) and secure in place using snap ring (66A).

Note: When replacing bearings, always press on the inner race when assembling to shaft, and on the outer race when pressing bearings into the housings.

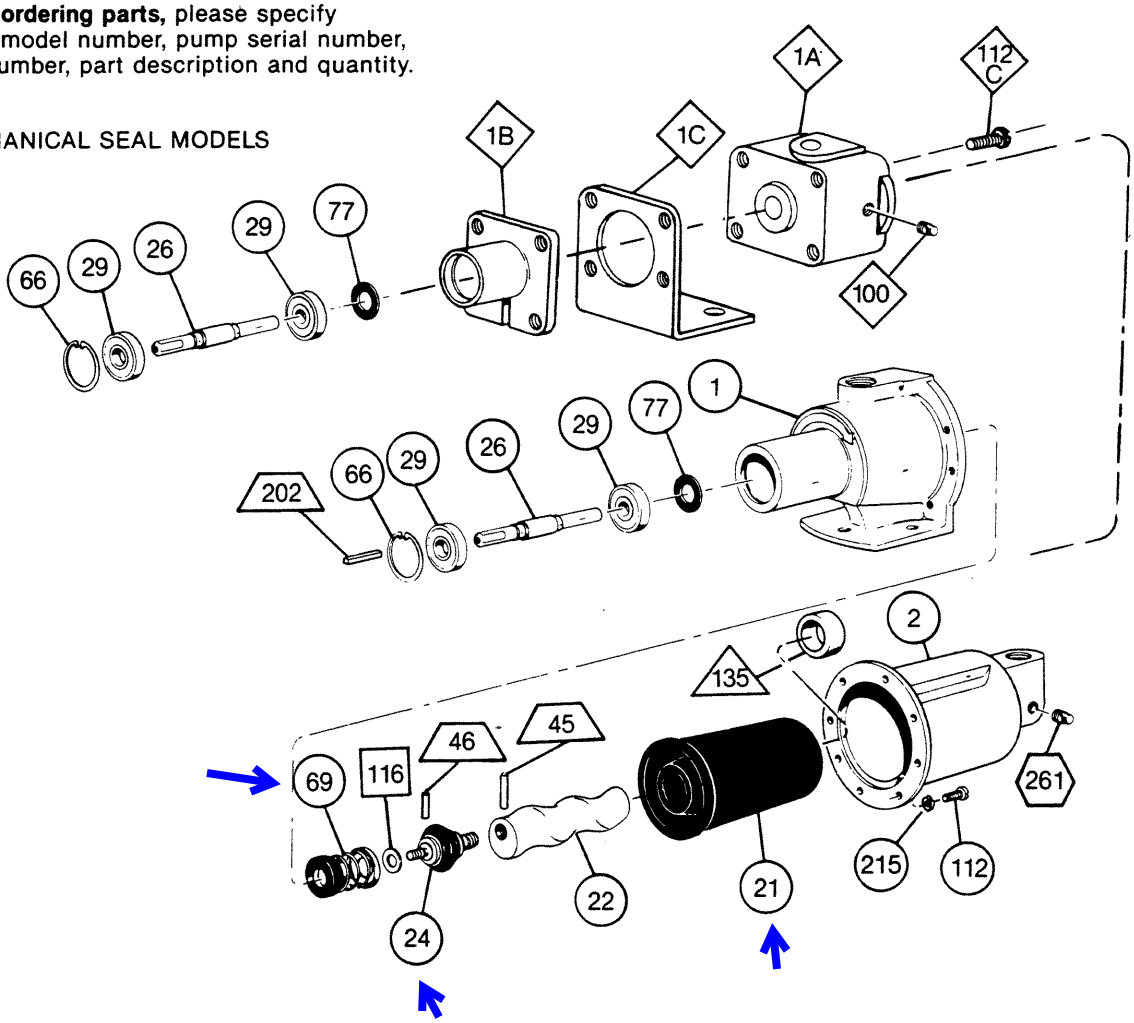
2. Install packing (42) before installing shaft assembly using the following procedure:
   a. Lubricate each individual ring of packing with a grease that is insoluble in the fluid being pumped.
   b. Individually assemble each ring of packing loosely in the packing chamber of the pump body (1). Stagger splits on rings. (Four rings, 3/16 inch square required on Model 34411; four rings, 1/4 inch square and two lantern ring halves (57) assembled between two rings on 356 Models).
   c. Loosely install packing gland (41) on pump body (1) using gland bolts (47).
3. Press shaft assembly into pump body (1) positioning slinger ring (77) between packing gland (41) and bearing end of pump body. Secure the shaft assembly with snap ring (66).
4. Thread flexible joint (24) into shaft (26) in a clockwise direction (RH thread).
5. Thread rotor (22) onto flexible joint (24) in a clockwise direction (RH thread).
6. Slide stator (21) on rotor (22). On 331 and 332 Models, insert rounded end of stator ring (135) into end of stator prior to installing stator on rotor.
7. Secure stator (21) and suction housing (2), with suction port vertically up, to pump body (1) using screws (112).
8. Proceed as in installation instructions.

Note: Adjust newly installed packing as described in maintenance procedure.

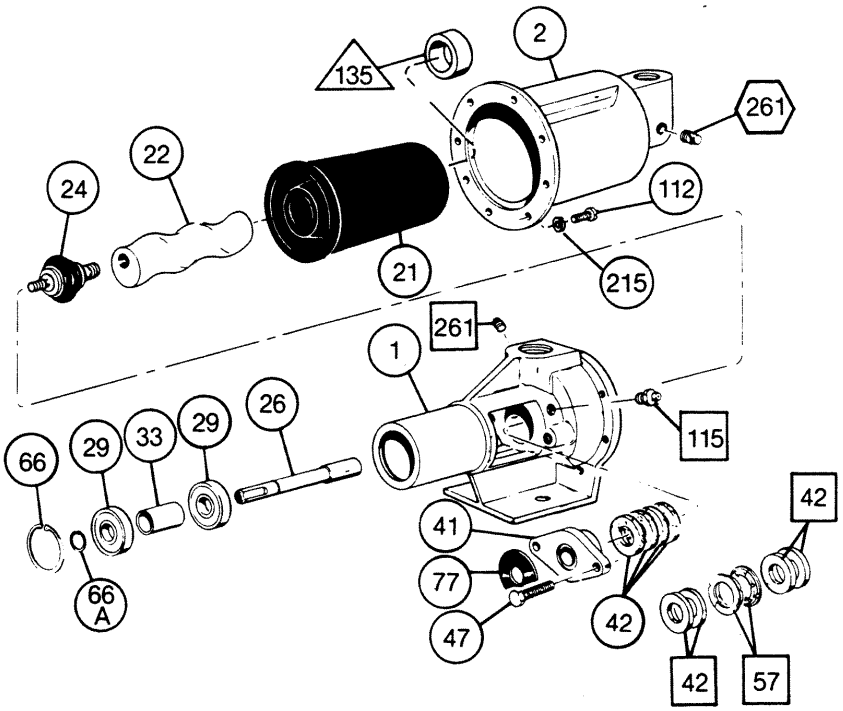
WARNING: Replace belt or coupling guards before reconnecting power.

When ordering parts, please specify pump model number, pump serial number, part number, part description and quantity.

MECHANICAL SEAL MODELS



PACKING MODELS



Used on 332 and 367 only.

Used on 356 only.

Used on 356 and 367 only.

Used on -08 only.

Used on 367 only.

PARTS LIST — 331, 332, 333, AND 344 MODELS

Item No.	Description	Mechanical Seal Models			Packing Gland Models
		33101 33201 33301 34401	33104 33204 33304 34404	33108 33208 33308 34408	34411
1	Pump Body	330-1065-002	330-1910-002		340-1000-001
1A	Discharge Housing			340-2362-000	
1B	Bearing Housing			330-4587-000	
1C	Pump Base			340-2369-000	
2	Suction Housing	330-1064-002	330-1911-002	330-4536-000	330-1064-002
*21	Stator	See Stator section below.			
*22	Rotor	See Rotor section below with circled numbers for each series.			
		(1)	(2)	(1)	(1)
24	Joint	Carbon Steel/NBR 320-1511-000	316 SS/NBR 320-3759-000	Carbon Steel/NBR 320-1511-000	
26	Drive Shaft	320-1499-000	320-2938-000	320-1499-000	320-2448-000
29	Bearing (2 req.)	630-0502-031			
33	Bearing Spacer				320-1900-000
41	Packing Gland				320-0101-004
42	Packing				340-3396-005
47	Gland Bolt				619-1520-161
66	Snap Ring	320-1506-000			
66A	Snap Ring				320-4182000
69	Mechanical Seal	320-2424-000			
77	Slinger Ring	320-6382-000			320-6384-000
100	Pipe Plug (3 req.)			610-0120-021	
112	Screws (8 req.)	619-1430-103	320-5968-000	619-0860-081	619-1430-103
112C	Screws (4 req.)			61 9-0890-281	
135	Stator Ring (331 -332 only)	320-7812-000			
215	Lock Washer (8 req.)	320-6464-000			

*Recommended spare parts.

STATORS		Models			
		331	332	333	344
21	Standard Stator, NBR All Models	340-3501-120	340-3502-120	340-3503-120	340-3504-120
21	EPDM Stator	340-3501-320	340-3502-320	340-3503-320	340-3504-320
21	FPM Stator	340-3501-520	340-3502-520	340-3503-520	340-3504-520
ROTORS					
22	(1) 416SS - All Models	320-2729-000	330-0906-000	320-1394-000	320-1841-000
22	(2) 316SS – All Models	320-2933-000	320-2942-000	320-2936-000	320-2934-000

See page 8 for Repair/Conversion Kits

PARTS LIST — 356 AND 367 MODELS

Item No.	Description	Mechanical Seal Models		Packing Gland Models		Mechanical Seal Model	
		35601	35604	35611	35613	36701	36704
1	Pump Body	Cast Iron 340-0636-000	316SS 340-1550-000	Cast Iron 350-0420-000	316SS 350-0491-000	Cast Iron 350-0423-000	316SS 350-0423-007
2	Suction Housing	350-0280-000	350-0489-000	350-0280-000	350-0489-000	350-0302-000	350-0302-007
*21	Stator	NBR 340-3505-120		NBR 340-3505-120		NBR 340-3506-120	
22	Rotor	416SS 320-2304-000	316SS 320-4431-000	416SS 320-2304-000	316SS 320-4431-000	416SS 330-2042-000	316SS 330-3077-000
24	Flex Joint	Carbon Steel 320-1583-000	316SS 320-4427-000	Carbon Steel 320-1583-000	316SS 320-4427-000	Carbon Steel 320-1749-000	316SS 320-4436-000
26	Drive Shaft	320-1759-000	320-4430-000	320-2765-000	320-4435-000	330-1805-000	330-1805-015
29	Bearing (2 req.)	630-0552-051				630-0552-061	
33	Bearing Spacer			320-2764-000			
41	Packing Gland			320-0003-004	320-0003-007		
*42	Packing			340-3396-008			
45	Rotor Pin					320-4439-002	
46	Shaft Pin					320-4439-001	
47	Gland Bolt			619-1530-241			
57	Lantern Ring Half**			320-6585-000			
66	Snap Ring	320-1758-000				320-2794-000	
66A	Snap Ring			320-3533-000			
*69	Mechanical Seal	320-3945-000				320-1750-000	
69A	Seal Spacer	320-4434-000					
77	Slinger Ring	320-6383-000		320-6385-000		320-6385-000	
112	Screws (6 req.)	619-1530-161				619-1530-161	
115	Zerk Fitting			320-2503-001			
135	Stator Spacer	330-7594-000					
202	Shaft Key					611-0040-240	
215	Lock Washer (6 req.)	623-0010-411					
261	Pipe Plug	610-0120-011	610-0420-010	610-0120-011	610-0420-010	610-0120-011	610-0420-010

*Recommended spare parts.
**2 Required

See page 8 for Repair/Conversion Kits

REPAIR/CONVERSION KIT NUMBERS

ELASTOMER REPAIR/CONVERSION KITS

Item No.	Description	331 Models			332 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9026-000	311-9025-000	311-9054-000	311-9027-000	311-9038-000	311-9055-000
21	• Stator	340-3501-120	340-3501-320	340-3501-520	340-3502-120	340-3502-320	340-3502-520
24	• Joint	320-1511-000‡	320-6367-000†	320-4670-000†	320-1511-000‡	320-6367-000†	320-4670-000†
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000
Item No.	**Description**	**333 Models**			**344 Models**		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No.	311-9029-000	311-9028-000	311-9056-000	311-9031-000	311-9030-000	311-9057-000
21	• Stator	340-3503-120	340-3503-320	340-3503-520	340-3504-120	340-3504320	340-3504520
24	• Joint	320-1511-000‡	320-6367-000†	320-4670-000†	320-1511-000‡	320-6367-000†	320-4670-000†
69	• Seal	320-2424-000	320-6379-000	320-6501-000	320-2424-000	320-6379-000	320-6501-000

t316SS/with appropriate elastomer.
‡Carbon steel. NBR kits are available only with carbon steel joints; a 316SS/NBR joint for 331-344 Models is available as 320-3759-000.

Item No.	Description	356 Models			367 Models		
		NBR	EPDM	FPM	NBR	EPDM	FPM
—	Kit No. (Mech. Seal Models)	311-9033-000	311-9032-000	311-9058-000	311-9060-000	311-9036-000	311-9124-000
21	• Stator	340-3505-120	340-3505-320	340-3505-520	340-3506-120	340-3506-320	340-3506-520
24	• Flex Joint	320-1583-000‡	320-6369-000†	320-4671-000†	320-1749-000‡	320-6378-000‡	3206515-000‡
69	• Seal	320-3945-000	320-6380-000	320-6510-000	320-1750-000	320-6390-000	320-6517-000
45	• Rotor Pins				320-4439-002	320-4439-002	320-4439-002
46	• Shaft Pin				320-4439-001	320-4439-001	320-4439-001
—	Kit No (Packing Gland Models)	311-9035-000	311-9034-000	311-9059-000			
21	• Stator	340-3505-120	340-3505-320	340-3505-520			
24	• Joint	320-1583-000‡	320-6369-000†	320-4671-000†			

†316SS/with appropriate elastomer.
‡Carbon steel. NBR kits are available only with carbon steel joints; a 316SS/NBR joint for Model 35604 and 35613 pumps is available as 320-4427-000; a 316SS/NBR joint for model 36704 is available as 320-4436-000.

ABRASION RESISTANT SEALS

Elastomer	Models		
	331-344	356	36701
NBR	3206460000	3206505000	3206511000
EPDM	3206502000	3206506000	3206512000
FPM	3206503000	3206507000	3206513000

NBR = Nitrile
EPDM = Ethylene-Propylene-Diene Terpolymer
FPM = Fluoroelastomer

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Product Information Packet

M3546

1HP,1725RPM,3PH,60HZ,56,3426M,TEFC,F1,N

Part Detail

Revision:	L	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	3426M	**Elec. Spec:**	34WGX269	**CD Diagram:**	CD0005
Enclosure:	TEFC	**Mfg Plant:**		**Mech. Spec:**	34G796	**Layout:**	34LYG796
Frame:	56	**Mounting:**	F1	**Poles:**	04	**Created Date:**	
Base:	RG	**Rotation:**	R	**Insulation:**	B	**Eff. Date:**	03-28-2011
Leads:	9#18					**Replaced By:**	
Literature:		**Elec. Diagram:**					

Nameplate NP1256L

CAT.NO.	M3546						
SPEC.	34G796X269						
HP	1						
VOLTS	208-230/460						
AMP	3.7-3.4/1.7						
RPM	1725						
FRAME	56	**HZ**	60	**PH**	3		
SER.F.	1.15	**CODE**	M	**DES**	B	**CLASS**	B
NEMA-NOM-EFF	78.5	**PF**	71				
RATING	40C AMB-CONT						
CC		**USABLE AT 208V**	3.7				
DE	6203	**ODE**	6203				
ENCL	TEFC	**SN**					

Parts List

Part Number	Description	Quantity
SA009422	SA 34G796X269	1.000 EA
RA005744	RA 34G796X269	1.000 EA
NS2512A01	INSULATOR, CONDUIT BOX X	1.000 EA
34CB3002A	CB CAST W/.88 DIA HOLE	1.000 EA
34GS1029A01	GASKET, CONDUIT BOX	1.000 EA
51XB1016A07	10-16 X 7/16 HXWSSLD SERTYB	2.000 EA
11XW1032G06	10-32 X .38, TAPTITE II, HEX WSHR SLTD U	1.000 EA
34EP3102A01SP	FR ENDPLATE, MACH	1.000 EA
HW5100A03SP	WAVY WASHER (W1543-017)	1.000 EA
34EP3102A02SP	FR/PU ENDPLATE, MACH	1.000 EA
XY1032A02	10-32 HEX NUT DIRECTIONAL SERRATION	4.000 EA
34FN3002A01SP	EXTERNAL FAN, PLASTIC, .637/.639 HUB W/	1.000 EA
34FH4002A01	IEC FH NO GREASER	1.000 EA
51XW1032A06	10-32 X .38, TAPTITE II, HEX WSHR SLTD S	3.000 EA
34CB4517	CB LID 4 MTG HOLES .22 DIA STAMPED, FOR	1.000 EA
34GS1031A01	GASKET, FLAT CONDUIT BOX LID (LEXIDE)	1.000 EA
51XW0832A07	8-32 X .44, TAPTITE II, HEX WSHR SLTD SE	4.000 EA
HW2501D13SP	KEY, 3/16 SQ X 1.375	1.000 EA
HA7000A04	KEY RETAINER 0.625 DIA SHAFTS	1.000 EA
MG1000G27	MED CHARCOAL METALLIC GREY	0.014 GA
10XF0440S02	04-40 X 1/8 TYPE F HEX HD STAINLESS STIC	2.000 EA
HA3100A44	THRUBOLT 10-32 X 8.000	4.000 EA
MN416A01	TAG-INSTAL-MAINT no wire. (100/bx) 8/12	1.000 EA
LB1125C01	STD (STOCK) CARTON LABEL BALDOR WITH FLA	1.000 EA

Parts List (continued)

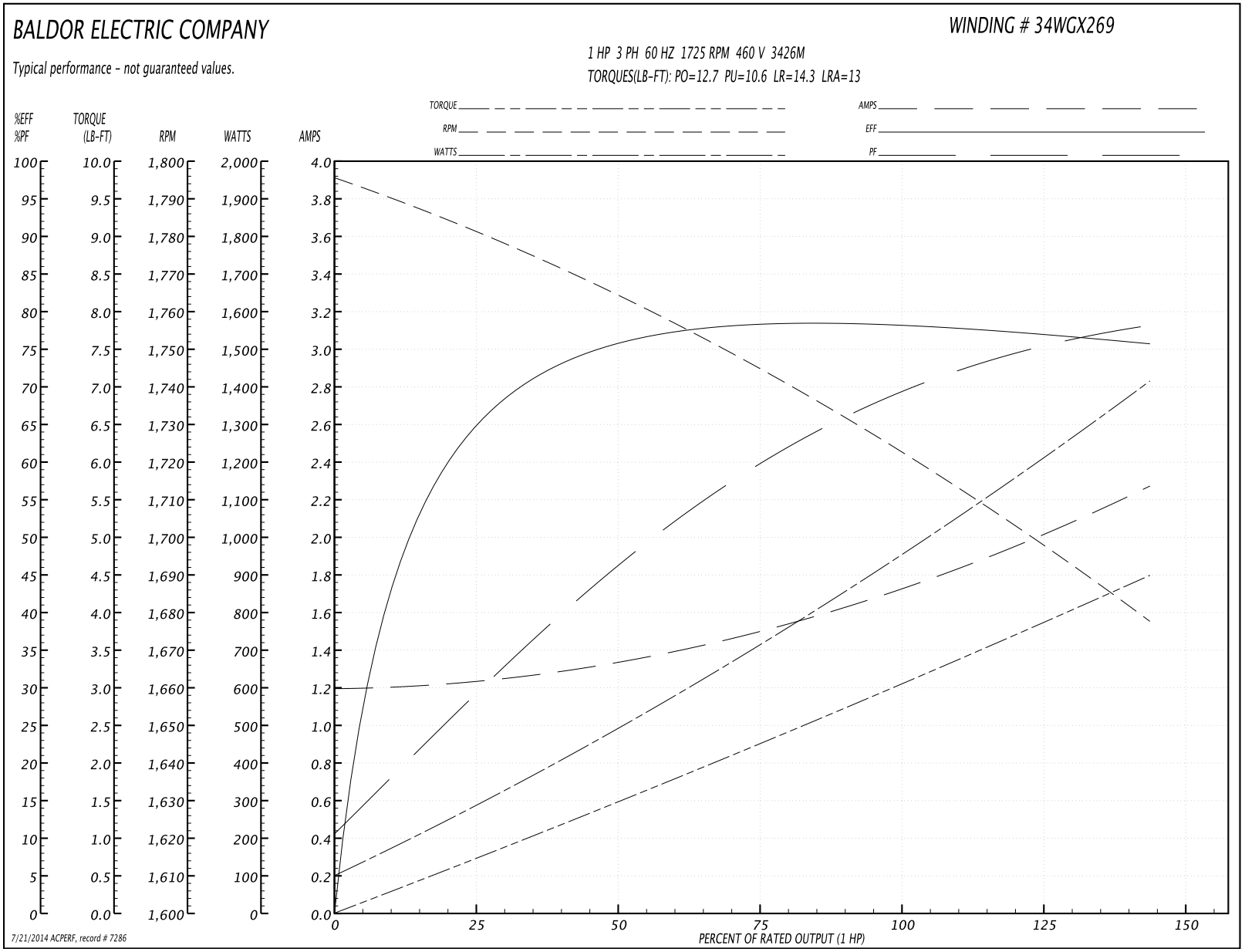
Part Number	Description	Quantity
LC0005E01	CONN.DIA./WARNING LABEL (LC0005/LB1119N)	1.000 EA
NP1256L	ALUM UL CSA CC	1.000 EA
34PA1005	PACKING GROUP, BALDOR	1.000 EA
LB1506	LABEL "AMERICAN MADE" 1.50 X 1.00	1.000 EA

Accessories

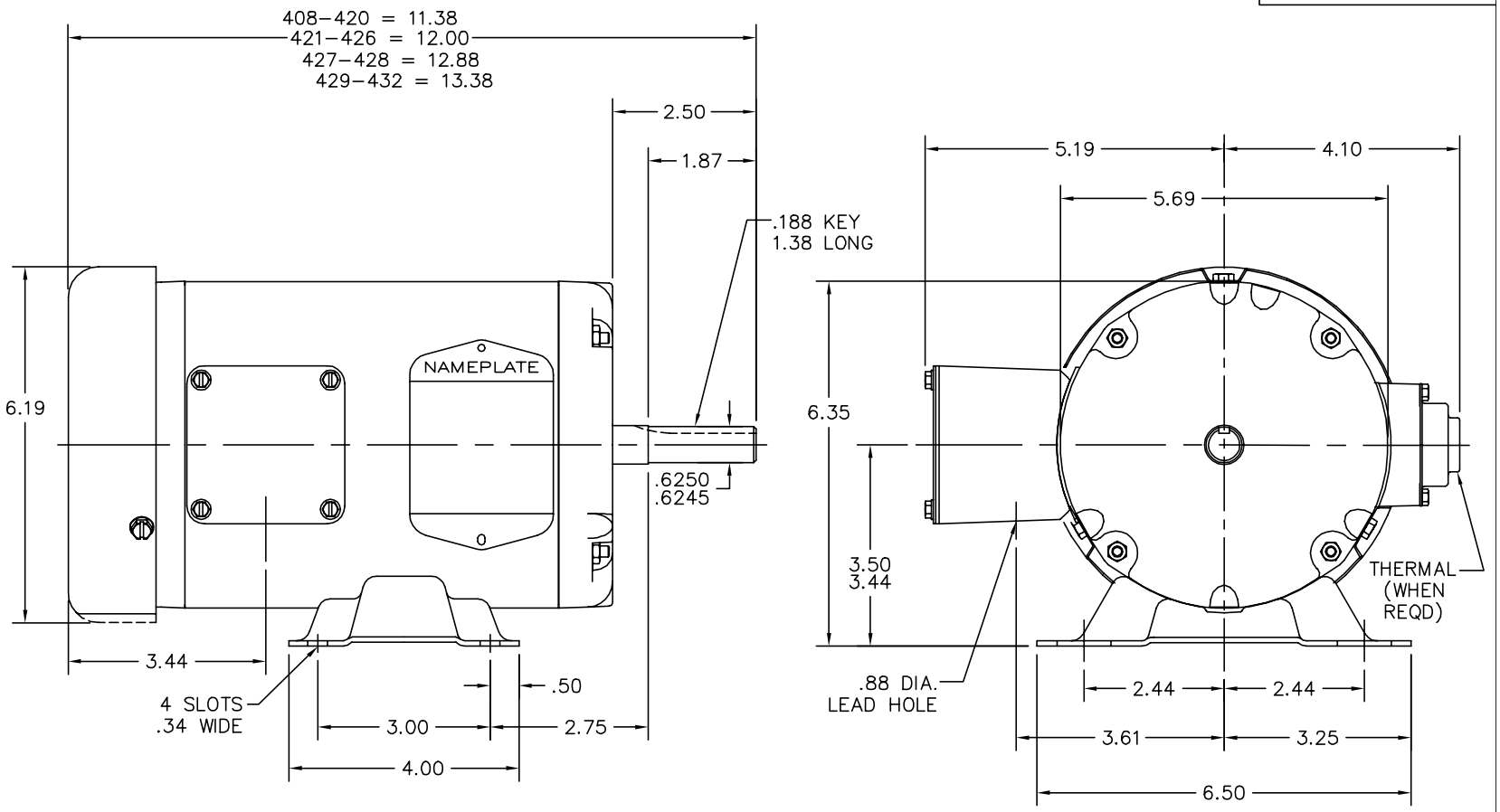
Part Number	Description	Multiplier
34-171	C FACE KIT	A8

Performance Data at 460V, 60Hz, 1.0HP (Typical performance - Not guaranteed values)							
General Characteristics							
Full Load Torque:	3.0 LB-FT			**Start Configuration:**		DOL	
No-Load Current:	1.2 Amps			**Break-Down Torque:**		12.7 LB-FT	
Line-line Res. @ 25°C.:	13.2 Ohms A Ph / 0.0 Ohms B Ph			**Pull-Up Torque:**		10.6 LB-FT	
Temp. Rise @ Rated Load:	79 C			**Locked-Rotor Torque:**		14.3 LB-FT	
Temp. Rise @ S.F. Load:	94 C			**Starting Current:**		13.0 Amps	
Load Characteristics							
% of Rated Load	**25**	**50**	**75**	**100**	**125**	**150**	**S.F.**
Power Factor:	30.0	47.0	60.0	68.0	75.0	79.0	72.0
Efficiency:	63.9	75.5	78.3	78.6	77.4	75.5	77.9
Speed:	1781.0	1763.0	1745.0	1725.0	1702.0	1677.0	1711.0
Line Amperes:	1.23	1.33	1.5	1.72	1.97	2.27	1.87

Performance Graph at 460V, 60Hz, 1.0HP Typical performance - Not guaranteed values



34LYG796



CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT MOTOR PERFORMANCE IS SUITABLE IN THE APPLICATION.

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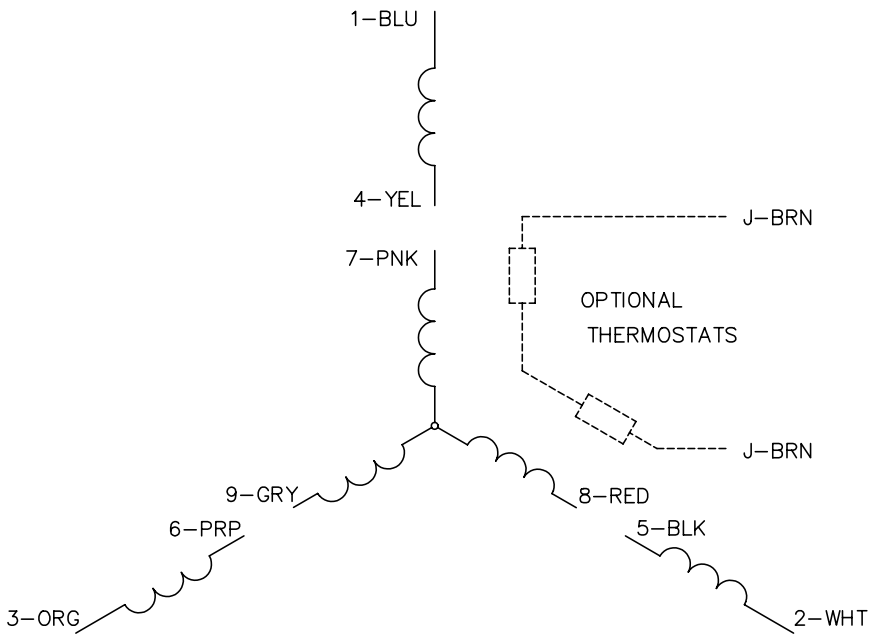
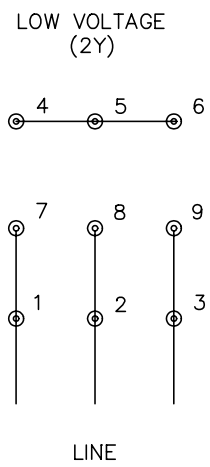
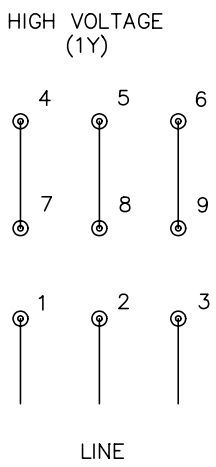
34LYG796	FILE: \AAA\00019\124	REVISED: 09:11:55 03/05/2007	HORZ MODEL 34M NEMA 56 TEFC W/SPL STACKING
	MTL: –	BY: ENROSTO	

34LYG796

CD0005







NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0005

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			BALDOR ELECTRIC Co.
REV. LTR: E	BY: JLP	REVISED: 01/19/99 10:15	TDR: 0171435
CD0005		FILE: AAA00005140	MDL: –
		MTL: –	3PH, DV, 9 LEADS

BALDOR • RELIANCE

Integral Horsepower
AC Induction Motors
ODP, WPI Enclosures
TENV, TEAO, TEFC Enclosure
Explosion Proof

7/14 Installation & Operating Manual MN408

Any trademarks used in this manual are the property of their respective owners.

Important:
Be sure to check www.baldor.com to download the latest version of this manual in Adobe Acrobat PDF format.

Table of Contents

Section 1

General Information

Overview

This manual contains general procedures that apply to Baldor Motor products. Be sure to read and understand the Safety Notice statements in this manual. For your protection, do not install, operate or attempt to perform maintenance procedures until you understand the Warning and Caution statements.
A Warning statement indicates a possible unsafe condition that can cause harm to personnel.
A Caution statement indicates a condition that can cause damage to equipment.

Important:

This instruction manual is not intended to include a comprehensive listing of all details for all procedures required for installation, operation and maintenance. This manual describes general guidelines that apply to most of the motor products shipped by Baldor. If you have a question about a procedure or are uncertain about any detail, Do Not Proceed. Please contact your Baldor distributor for more information or clarification.

Before you install, operate or perform maintenance, become familiar with the following:

- NEMA Publication MG-2, Safety Standard for Construction and guide for Selection, Installation and Use of Electric Motors and Generators.
- IEC 34–1 Electrical and IEC72–1 Mechanical specifications
- ANSI C51.5, the National Electrical Code (NEC) and local codes and practices.

Limited Warranty

www.baldor.com/support/warranty_standard.asp

Safety Notice: **This equipment contains high voltage! Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation and maintenance of electrical equipment. Be sure that you are completely familiar with NEMA publication MG-2, safety standards for construction and guide for selection, installation and use of electric motors and generators, the National Electrical Code and local codes and practices. Unsafe installation or use can cause conditions that lead to serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.**

WARNING: **Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.**

WARNING: **Disconnect all electrical power from the motor windings and accessory devices before disassembly of the motor. Electrical shock can cause serious or fatal injury.**

WARNING: **Be sure the system is properly grounded before applying power. Do not apply AC power before you ensure that all grounding instructions have been followed. Electrical shock can cause serious or fatal injury. National Electrical Code and Local codes must be carefully followed.**

WARNING: **Avoid extended exposure to machinery with high noise levels. Be sure to wear ear protective devices to reduce harmful effects to your hearing.**

WARNING: **Surface temperatures of motor enclosures may reach temperatures which can cause discomfort or injury to personnel accidentally coming into contact with hot surfaces. When installing, protection should be provided by the user to protect against accidental contact with hot surfaces. Failure to observe this precaution could result in bodily injury.**

WARNING: **This equipment may be connected to other machinery that has rotating parts or parts that are driven by this equipment. Improper use can cause serious or fatal injury. Only qualified personnel should attempt to install operate or maintain this equipment.**

WARNING: **Do not by-pass or disable protective devices or safety guards. Safety features are designed to prevent damage to personnel or equipment. These devices can only provide protection if they remain operative.**

WARNING: **Avoid the use of automatic reset devices if the automatic restarting of equipment can be hazardous to personnel or equipment.**

WARNING: **Be sure the load is properly coupled to the motor shaft before applying power. The shaft key must be fully captive by the load device. Improper coupling can cause harm to personnel or equipment if the load decouples from the shaft during operation.**

WARNING: **UL Listed motors must only be serviced by UL Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.**

WARNING: **Thermostat contacts automatically reset when the motor has slightly cooled down. To prevent injury or damage, the control circuit should be designed so that automatic starting of the motor is not possible when the thermostat resets.**

WARNING: **Use proper care and procedures that are safe during handling, lifting, installing, operating and maintaining operations. Improper methods may cause muscle strain or other harm.**

WARNING: **Pacemaker danger – Magnetic and electromagnetic fields in the vicinity of current carrying carrying conductors and permanent magnet motors can result result in a serious health hazard to persons with cardiac pacemakers, metal implants, and hearing aids. To avoid risk, stay way from the area surrounding a permanent magnet motor.**

WARNING: **Before performing any motor maintenance procedure, be sure that the equipment connected to the motor shaft cannot cause shaft rotation. If the load can cause shaft rotation, disconnect the load from the motor shaft before maintenance is performed. Unexpected mechanical rotation of the motor parts can cause injury or motor damage.**

Continued on next page.

Safety Notice Continued

WARNING: **Do not use non UL/CSA listed explosion proof motors in the presence of flammable or combustible vapors or dust. These motors are not designed for atmospheric conditions that require explosion proof operation.**

WARNING: **Motors that are to be used in flammable and/or explosive atmospheres must display the UL label on the nameplate along with CSA listed logo. Specific service conditions for these motors are defined in NFPA 70 (NEC) Article 500.**

WARNING: **Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.**

Caution: **To prevent premature equipment failure or damage, only qualified maintenance personnel should perform maintenance.**

Caution: **Do not over tension belts. Excess tension may damage the motor or driven equipment.**

Caution: **Do not over–lubricate motor as this may cause premature bearing failure.**

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

Caution: **If eye bolts are used for lifting a motor, be sure they are securely tightened. The lifting direction should not exceed a 20 ° angle from the shank of the eye bolt or lifting lug. Excessive lifting angles can cause damage.**

Caution: **To prevent equipment damage, be sure that the electrical service is not capable of delivering more than the maximum motor rated amps listed on the rating plate.**

Caution: **If a HI POT test (High Potential Insulation test) must be performed, follow the precautions and procedure in NEMA MG1 and MG2 standards to avoid equipment damage.**

Caution: **The space heaters are designed to operate at or below the maximum surface temperature stated on the nameplate. If the marked ambient and/or voltage are exceeded this maximum surface temperature can be exceeded and can damage the motor windings. If applied in a division 2 or zone 2 environment this excessive temperature may cause ignition of hazardous materials.**

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Section 3.**

If you have any questions or are uncertain about any statement or procedure, or if you require additional information please contact your Baldor distributor or an Authorized Baldor Service Center.

Receiving

Each Baldor Electric Motor is thoroughly tested at the factory and carefully packaged for shipment. When you receive your motor, there are several things you should do immediately.

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your motor.
2. Verify that the part number of the motor you received is the same as the part number listed on your purchase order.

Handling

The motor should be lifted using the lifting lugs or eye bolts provided.

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

1. Use the lugs or eye bolts provided to lift the motor. Never attempt to lift the motor and additional equipment connected to the motor by this method. The lugs or eye bolts provided are designed to lift only the motor. Never lift the motor by the motor shaft or the hood of a WPII motor.
2. To avoid condensation inside the motor, do not unpack until the motor has reached room temperature. (Room temperature is the temperature of the room in which it will be installed). The packing provides insulation from temperature changes during transportation.
3. When lifting a WPII (Weather Proof Type 2) motor, do not lift the motor by inserting lifting lugs into holes on top of the cooling hood. These lugs are to be used for hood removal only. A spreader bar should be used to lift the motor by the cast lifting lugs located on the motor frame.
4. If the motor must be mounted to a plate with the driven equipment such as pump, compressor etc., it may not be possible to lift the motor alone. For this case, the assembly should be lifted by a sling around the mounting base. The entire assembly can be lifted as an assembly for installation. Do not lift the assembly using the motor lugs or eye bolts provided. Lugs or eye bolts are designed to lift motor only. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting. If the load is unbalanced (as with couplings or additional attachments) additional slings or other means must be used to prevent tipping. In any event, the load must be secure before lifting.

Storage

Storage requirements for motors and generators that will not be placed in service for at least six months from date of shipment.

Improper motor storage will result in seriously reduced reliability and failure. An electric motor that does not experience regular usage while being exposed to normally humid atmospheric conditions is likely to develop rust in the bearings or rust particles from surrounding surfaces may contaminate the bearings. The electrical insulation may absorb an excessive amount of moisture leading to the motor winding failure.

A wooden crate "shell" should be constructed to secure the motor during storage. This is similar to an export box but the sides & top must be secured to the wooden base with lag bolts (not nailed as export boxes are) to allow opening and reclosing many times without damage to the "shell".

Minimum resistance of motor winding insulation is 5 Meg ohms or the calculated minimum, which ever is greater. Minimum resistance is calculated as follows: Rm = kV + 1

where: (Rm is minimum resistance to ground in Meg–Ohms and kV is rated nameplate voltage defined as Kilo–Volts.)

Example: For a 480VAC rated motor Rm =1.48 meg–ohms (use 5 M Ω).

For a 4160VAC rated motor Rm = 5.16 meg–ohms.

Preparation for Storage

1. Some motors have a shipping brace attached to the shaft to prevent damage during transportation. The shipping brace, if provided, must be removed and stored for future use. The brace must be reinstalled to hold the shaft firmly in place against the bearing before the motor is moved.
2. Store in a clean, dry, protected warehouse where control is maintained as follows:
   a. Shock or vibration must not exceed 2 mils maximum at 60 hertz, to prevent the bearings from brinelling. If shock or vibration exceeds this limit vibration isolation pads must be used.
   b. Storage temperatures of 10 ºC (50 ºF) to 49 ºC (120 ºF) must be maintained.
   c. Relative humidity must not exceed 60%.
   d. Motor space heaters (when present) are to be connected and energized whenever there is a possibility that the storage ambient conditions will reach the dew point. Space heaters are optional.

Note: Remove motor from containers when heaters are energized, reprotect if necessary.

3. Measure and record the resistance of the winding insulation (dielectric withstand) every 30 days of storage.
   a. If motor insulation resistance decreases below the minimum resistance, contact your Baldor District office.
   b. Place new desiccant inside the vapor bag and re–seal by taping it closed.
   c. If a zipper–closing type bag is used instead of the heat–sealed type bag, zip the bag closed instead of taping it. Be sure to place new desiccant inside bag after each monthly inspection.
   d. Place the shell over the motor and secure with lag bolts.
4. Where motors are mounted to machinery, the mounting must be such that the drains and breathers are fully operable and are at the lowest point of the motor. Vertical motors must be stored in the vertical position. Storage environment must be maintained as stated in step 2.
5. Motors with anti–friction bearings are to be greased at the time of going into extended storage with periodic service as follows:
   a. Motors marked "Do Not Lubricate" on the nameplate do not need to be greased before or during storage.
   b. Ball and roller bearing (anti–friction) motor shafts are to be rotated manually every 3 months and greased every 6 months in accordance with the Maintenance section of this manual.
   c. Sleeve bearing (oil lube) motors are drained of oil prior to shipment. The oil reservoirs must be refilled to the indicated level with the specified lubricant, (see Maintenance). The shaft should be rotated monthly by hand at least 10 to 15 revolutions to distribute oil to bearing surfaces.
   d. "Provisions for oil mist lubrication" – These motors are packed with grease. Storage procedures are the same as paragraph 5b.
   e. "Oil Mist Lubricated" – These bearings are protected for temporary storage by a corrosion inhibitor. If stored for greater than 3 months or outdoor storage is anticipated, connected to the oil mist system while in storage. If this is not possible, add the amount of grease indicated under "Standard Condition" in Section 3, then rotate the shaft 15 times by hand.

6. All breather drains are to be fully operable while in storage (drain plugs removed). The motors must be stored so that the drain is at the lowest point. All breathers and automatic “T” drains must be operable to allow breathing and draining at points other than through the bearings around the shaft. Vertical motors should be stored in a safe stable vertical position.
7. Coat all external machined surfaces with a rust preventing material.
   An acceptable product for this purpose is Exxon Rust Ban # 392.
8. Carbon brushes should be lifted and held in place in the holders, above the commutator, by the brush holder fingers. The commutator should be wrapped with a suitable material such as cardboard paper as a mechanical protection against damage.

Non–Regreaseable Motors

Non–regreasable motors with “Do Not Lubricate” on the nameplate should have the motor shaft rotated 15 times to redistribute the grease within the bearing every 3 months or more often.

All Other Motor Types

Before storage, the following procedure must be performed.

1. Remove the grease drain plug, if supplied, (opposite the grease fitting) on the bottom of each bracket prior to lubricating the motor.
2. The motor with regreasable bearing must be greased as instructed in Section 3 of this manual.
3. Replace the grease drain plug after greasing.
4. The motor shaft must be rotated a minimum of 15 times after greasing.
5. Motor Shafts are to be rotated at least 15 revolutions manually every 3 months and additional grease added every nine months (see Section 3) to each bearing.
6. Bearings are to be greased at the time of removal from storage.

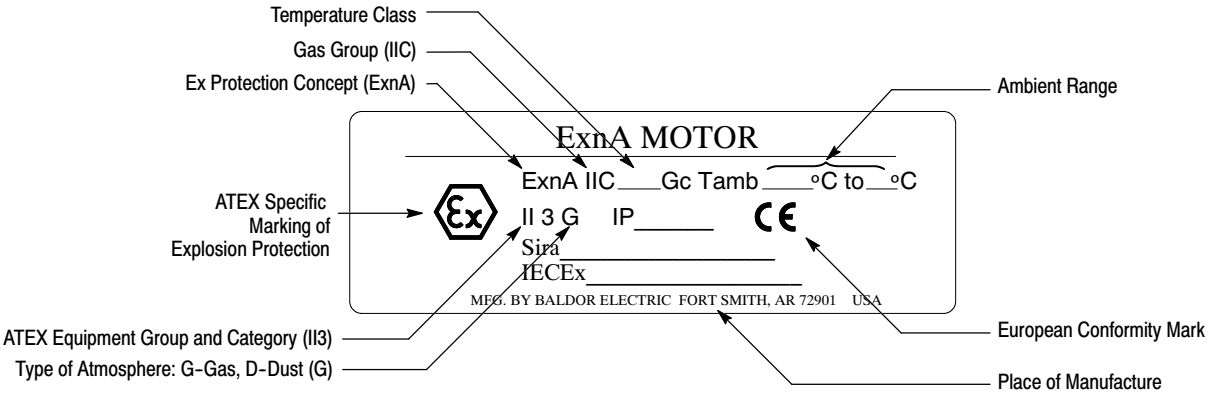
Removal From Storage

1. Remove all packing material.
2. Measure and record the electrical resistance of the winding insulation resistance meter at the time of removal from storage. The insulation resistance must not be less than 50% from the initial reading recorded when the motor was placed into storage. A decrease in resistance indicates moisture in the windings and necessitates electrical or mechanical drying before the motor can be placed into service. If resistance is low, contact your Baldor District office.
3. Regrease the bearings as instructed in Section 3 of this manual.
4. Reinstall the original shipping brace if motor is to be moved. This will hold the shaft firmly against the bearing and prevent damage during movement.

Equipment Marking for IEC Certified Product

IEC certified products have special markings that identify the protection concept and environment requirements. An example is shown in Figure 1-1.

Figure 1-1 IEC Certified Product Markings



Specific Conditions of Use:

If the motor certificate number is followed by the symbol "X", this indicates that the motor has specific conditions of use which are indicated on the certificate. It is necessary to review the product certification certificate in conjunction with this instruction manual.

Operation On Frequency Converters:

If the motor is evaluated for operation with an adjustable speed drive, the type of converter (for example PWM for Pulse Width Modulated) and safe speed ranges (for example 0- 120Hz) will be specified in the certification documents or on motor nameplates. It is necessary to consult the adjustable speed drive

manual for proper set up. IECEx Certificates are available online at www.iecex.com

Unit Conversions	
Inches to Millimeters	Inches x 25.4 = mm
Millimeters to Inches	mm x .03937 = Inches
Horsepower to Kilowatts	Hp x .746 = Kw
Kilowatts to Horsepower	Kw x 1.341 = Hp
Pounds to Kilograms	Lbs x .454 = Kg
Kilograms to Pounds	Kg x 2.205 = Lbs

EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC . These motors are commercial in design and not intended for residential use. When used with converters, please consult converter manufacturers literature regarding recommendations on cable types, cable shielding, cable shielding termination, connection recommendations and any filters which may be recommended for EMC compliance. For additional information, consult Baldor MN1383.

Section 2

Installation & Operation

Overview

Installation should conform to the National Electrical Code as well as local codes and practices. When other devices are coupled to the motor shaft, be sure to install protective devices to prevent future accidents. Some protective devices include, coupling, belt guard, chain guard, shaft covers etc. These protect against accidental contact with moving parts. Machinery that is accessible to personnel should provide further protection in the form of guard rails, screening, warning signs etc.

Location

It is important that motors be installed in locations that are compatible with motor enclosure and ambient conditions. Improper selection of the motor enclosure and ambient conditions can lead to reduced operating life of the motor.

Proper ventilation for the motor must be provided. Obstructed airflow can lead to reduction of motor life.

1. **Open Drip–Proof/WPI** motors are intended for use indoors where atmosphere is relatively clean, dry, well ventilated and non–corrosive.
2. **Totally Enclosed and WPII** motors may be installed where dirt, moisture or dust are present and in outdoor locations.

Severe Duty, IEEE 841 and Washdown Duty enclosed motors are designed for installations with high corrosion or excessive moisture conditions. These motors should not be placed into an environment where there is the presence of flammable or combustible vapors, dust or any combustible material, unless specifically designed for this type of service. IEEE841 motors are suitable for application in Class I Division 2 and Class I Zone 2 areas on sine wave power in accordance with the applicable codes and standards.

Hazardous Locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers, or flyings. Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code.

EMC Compliance Statement for European Union

The motors described in this instruction manual are designed to comply 2004/108/EC . These motors are commercial in design and not intended for residential use.

Mounting Location

The motor should be installed in a location compatible with the motor enclosure and specific ambient. To allow adequate air flow, the following clearances must be maintained between the motor and any obstruction:

Table 2-1 Enclosure Clearance

TEFC / TENV (IC0141) Enclosures	
Fan Cover Air Intake	180 – 210T Frame 1” (25mm)
Fan Cover Air Intake	250 – 449T Frame 4” (100mm)
	IEC 112 – 132 1” (25mm)
	IEC 160 – 280 4” (100mm)
Exhaust	Envelope equal to the P Dimension on the motor dimension sheet
OPEN/Protected Enclosures	
Bracket Intake	Same as TEFC
Frame Exhaust	Exhaust out the sides envelope A minimum of the P dimension plus 2” (50mm) Exhaust out the end same as intake.

The motor must be securely installed to a rigid foundation or mounting surface to minimize vibration and maintain alignment between the motor and shaft load. Failure to provide a proper mounting surface may cause vibration, misalignment and bearing damage.

Foundation caps and sole plates are designed to act as spacers for the equipment they support. If these devices are used, be sure that they are evenly supported by the foundation or mounting surface.

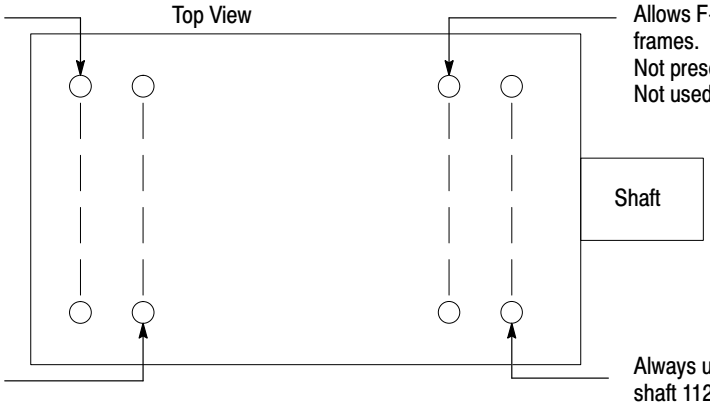
When installation is complete and accurate alignment of the motor and load is accomplished, the base should be grouted to the foundation to maintain this alignment.

The standard motor base is designed for horizontal or vertical mounting. Adjustable or sliding rails are designed for horizontal mounting only. Consult your Baldor distributor or authorized Baldor Service Center for further information.

Frame Mounting Holes

Some motors have standardized frames containing 6 or 8 mounting holes. 6 hole frames are not suitable for field reversal of mounting from F–1 to F–2, etc. Figure 2-1 indicates the proper mounting holes to use.

Figure 2-1 6 & 8 Hole Motor Frame Mounting



For short frame designations 182, 213, 254, 284, 324, 364, 404, 444 (NEMA)

Allows F-1 to F-2 Conversion on 8 hole frames.
Not present on 6 hole frames.
Not used on 8 hole frames.

For long frame designations 184, 215, 256, 286, 326, 365, 405, 445 (NEMA) (IEC) 112M, 132M, 160L, 200L, 225M, 250M, 280M

Always use these holes, closer to the shaft 112S, 132S, 160M, 180M, 200M, 225S, 250S, 280S, (IEC)

Caution: **Do not lift the motor and its driven load by the motor lifting hardware. The motor lifting hardware is adequate for lifting only the motor. Disconnect the load (gears, pumps, compressors, or other driven equipment) from the motor shaft before lifting the motor.**

In the case of assemblies on a common base, any lifting means provided on the motor should not be used to lift the assembly and base but, rather, the assembly should be lifted by a sling around the base or by other lifting means provided on the base. Assure lifting in the direction intended in the design of the lifting means. Likewise, precautions should be taken to prevent hazardous overloads due to deceleration, acceleration or shock forces.

Alignment

Accurate alignment of the motor with the driven equipment is extremely important. The pulley, sprocket, or gear used in the drive should be located on the shaft as close to the shaft shoulder as possible. It is recommended to heat the pulley, sprocket, or gear before installing on the motor shaft. Forcibly driving a unit on the motor shaft will damage the bearings.

1. Direct Coupling
   For direct drive, use flexible couplings if possible. Consult the drive or equipment manufacturer for more information. Mechanical vibration and roughness during operation may indicate poor alignment. Use dial indicators to check alignment. The space between coupling hubs should be maintained as recommended by the coupling manufacturer.
2. End-Play Adjustment
   The axial position of the motor frame with respect to its load is also extremely important. The standard motor bearings are not designed for excessive external axial thrust loads. Improper adjustment will cause failure.
3. Pulley Ratio
   The best practice is to not exceed an 8:1 pulley ratio.

Caution: **Do not over tension belts. Excess tension may damage the motor or driven equipment.**

4. Belt Drive
   Align sheaves carefully to minimize belt wear and axial bearing loads (see End-Play Adjustment). Belt tension should be sufficient to prevent belt slippage at rated speed and load. However, belt slippage may occur during starting.

Doweling & Bolting

After proper alignment is verified, dowel pins should be inserted through the motor feet into the foundation. This will maintain the correct motor position should motor removal be required. (Baldor•Reliance motors are designed for doweling.)

1. Drill dowel holes in diagonally opposite motor feet in the locations provided.
2. Drill corresponding holes in the foundation.
3. Ream all holes.
4. Install proper fitting dowels.
5. Mounting bolts must be carefully tightened to prevent changes in alignment.

Use a flat washer and lock washer under each nut or bolt head to hold the motor feet secure.

Flanged nuts or bolts may be used as an alternative to washers.

WARNING: **Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions, should be permanently guarded to prevent accidental contact by personnel. Accidental contact with body parts or clothing can cause serious or fatal injury.**

Guarding

Guards must be installed for rotating parts such as couplings, pulleys, external fans, and unused shaft extensions. This is particularly important where the parts have surface irregularities such as keys, key ways or set screws. Some satisfactory methods of guarding are:

1. Covering the machine and associated rotating parts with structural or decorative parts of the driven equipment.
2. Providing covers for the rotating parts. Covers should be sufficiently rigid to maintain adequate guarding during normal service.

Power Connection

Motor and control wiring, overload protection, disconnects, accessories and grounding should conform to the National Electrical Code and local codes and practices.

For ExnA hazardous location motors, it is a specific condition of use that all terminations in a conduit box be fully insulated. Fully insulated and lugged terminations must be bolted and provided with lock washer to prevent rotation. Flying leads must be insulated with two full wraps of electrical grade insulating tape or heat shrink tubing.

Grounding

In the USA consult the National Electrical Code, Article 430 for information on grounding of motors and generators, and Article 250 for general information on grounding. In making the ground connection, the installer should make certain that there is a solid and permanent metallic connection between the ground point, the motor or generator terminal housing, and the motor or generator frame. In non–USA locations consult the appropriate national or local code applicable.

Motors with resilient cushion rings usually must be provided with a bonding conductor across the resilient member. Some motors are supplied with the bonding conductor on the concealed side of the cushion ring to protect the bond from damage. Motors with bonded cushion rings should usually be grounded at the time of installation in accordance with the above recommendations for making ground connections. When motors with bonded cushion rings are used in multimotor installations employing group fusing or group protection, the bonding of the cushion ring should be checked to determine that it is adequate for the rating of the branch circuit over current protective device being used.

There are applications where grounding the exterior parts of a motor or generator may result in greater hazard by increasing the possibility of a person in the area simultaneously contacting ground and some other nearby live electrical parts of other ungrounded electrical equipment. In portable equipment it is difficult to be sure that a positive ground connection is maintained as the equipment is moved, and providing a grounding conductor may lead to a false sense of security.

Select a motor starter and over current protection suitable for this motor and its application. Consult motor starter application data as well as the National Electric Code and/or other applicable local codes.

For motors installed in compliance with IEC requirements, the following minimum cross sectional area of the protective conductors should be used:

Crosssectional area of phase conductors, S	Minimum crosssectional area of the corresponding protective conductor, S_p
mm^2	mm^2
$S < 16$	S
$16 < S \leq 35$	16
$S > 35$	$0{,}5\ S$

Equipotential bonding connection shall made using a conductor with a cross-sectional area of at least 4 mm^2.

Conduit Box

For ease of making connections, an oversize conduit box is provided. Most conduit boxes can be rotated 360 ° in 90 ° increments. Auxiliary conduit boxes are provided on some motors for accessories such as space heaters, RTD's etc.

AC Power

Motors with flying lead construction must be properly terminated and insulated.

Connect the motor leads as shown on the connection diagram located on the name plate or inside the cover on the conduit box. Be sure the following guidelines are met:

1. AC power is within ±10% of rated voltage with rated frequency. (See motor name plate for ratings).

OR

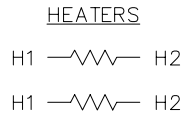
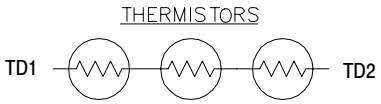
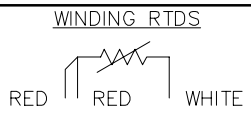
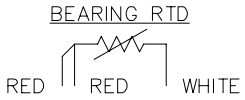
2. AC power is within ±5% of rated frequency with rated voltage.

OR

3. A combined variation in voltage and frequency of ±10% (sum of absolute values) of rated values, provided the frequency variation does not exceed ±5% of rated frequency.

Performance within these voltage and frequency variations are shown in Figure 2-3.

Figure 2-2 Accessory Connections

	One heater is installed in each end of motor. Leads for each heater are labeled H1 & H2. (Like numbers should be tied together).
	Three thermistors are installed in windings and tied in series. Leads are labeled TD1 & TD2.
	Winding RTDs are installed in windings (2) per phase. Each set of leads is labeled 1TD1, 1TD2, 1TD3, 2TD1, 2TD2, 2TD3 etc.
	* One bearing RTD is installed in Drive endplate (PUEP), leads are labeled RTDDE. * One bearing RTD is installed in Opposite Drive endplate (FREP), leads are labeled RTDODE. * Note RTD may have 2–Red/1–White leads; or 2–White/1–Red Lead.

Rotation

All three phase motors are reversible. To reverse the direction of rotation, disconnect and lock out power and interchange any two of the three line leads for three phase motors. For single phase motors, check the connection diagram to determine if the motor is reversible and follow the connection instructions for lead numbers to be interchanged. Not all single phase motors are reversible.

Adjustable Frequency Power Inverters used to supply adjustable frequency power to induction motors produce wave forms with lower order harmonics with voltage spikes superimposed. Turn–to–turn, phase–to–phase, and ground insulation of stator windings are subject to the resulting dielectric stresses. Suitable precautions should be taken in the design of these drive systems to minimize the magnitude of these voltage spikes. Consult the drive instructions for maximum acceptable motor lead lengths, and proper grounding.

Note: Main power leads for CE Marked Motors may be marked U,V,W – for standard configurations, please consult connection diagrams.

Caution: **The space heaters are designed to operate at or below the maximum surface temperature stated on the nameplate. If the marked ambient and/or voltage are exceeded this maximum surface temperature can be exceeded and can damage the motor windings. If applied in a division 2 or zone 2 environment this excessive temperature may cause ignition of hazardous materials.**

AC Motor Connection Diagram

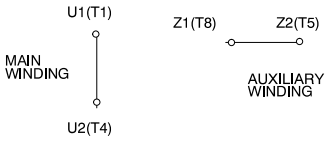
IEC VERSUS NEMA LEAD MARKING

EXAMPLE COMPARISIONS OF IEC AND NEMA LEADING MARKINGS FOR COMMON CONNECTION TYPES ARE SHOWN BELOW.

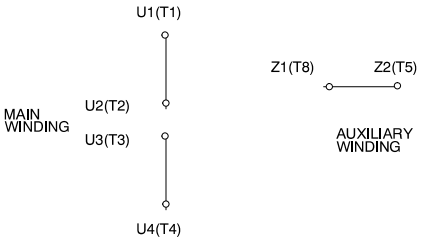
SINGLE PHASE MOTORS

SINGLE VOLTAGE NON REVERSIBLE

SINGLE VOLTAGE REVERSIBLE



DUAL VOLTAGE REVERSIBLE



AC Motor Connection Diagram

THREE PHASE

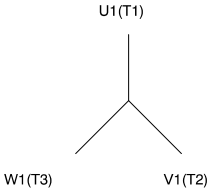
FOR SINGLE WINDING 3 PHASE MOTORS, LEAD MARKINGS CAN BE DIRECTLY TRANSLATED BETWEEN IEC AND NEMA DESIGNATIONS. FOR THESE MOTORS, THE LEAD MARKINGS ARE EQUIVALENT AS FOLLOWS:

U1=T1	U2=T4	U5=T7	U6=T10
V1=T2	V2=T5	V5=T8	V6=T11
W1=T3	W2=T6	W5=T9	W6=T12

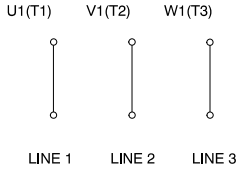
EXAMPLES OF COMMON CONNECTIONS ARE GIVEN BELOW.

THREE LEADS

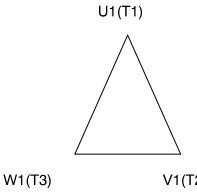
WYE CONNECT



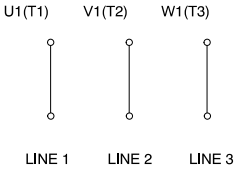
WIRING DIAGRAM



DELTA CONNECT



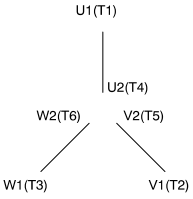
WIRING DIAGRAM



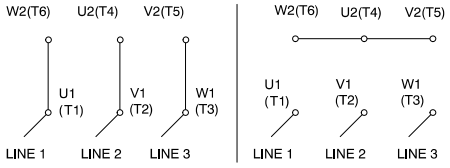
AC Motor Connection Diagram

SIX LEADS

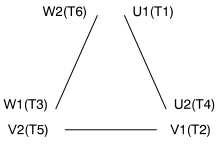
DELTA-WYE CONNECT



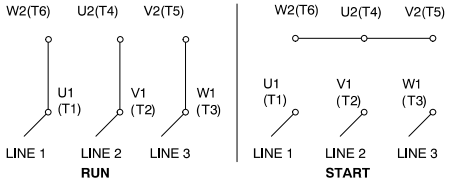
DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 1.73:1



WYE-DELTA CONNECT



WYE START-DELTA RUN SINGLE VOLTAGE

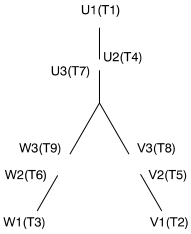


AC Motor Connection Diagram

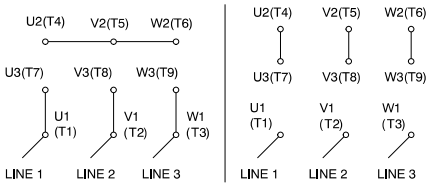
NINE LEADS

DUAL VOLTAGE-HIGH TO LOW VOLTAGE RATIO 2:1

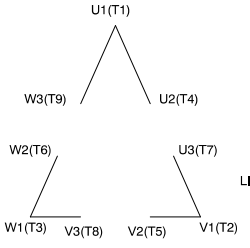
WYE CONNECT



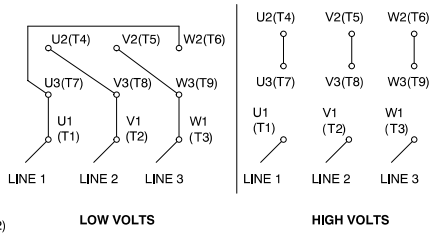
WIRING DIAGRAM



DELTA CONNECT



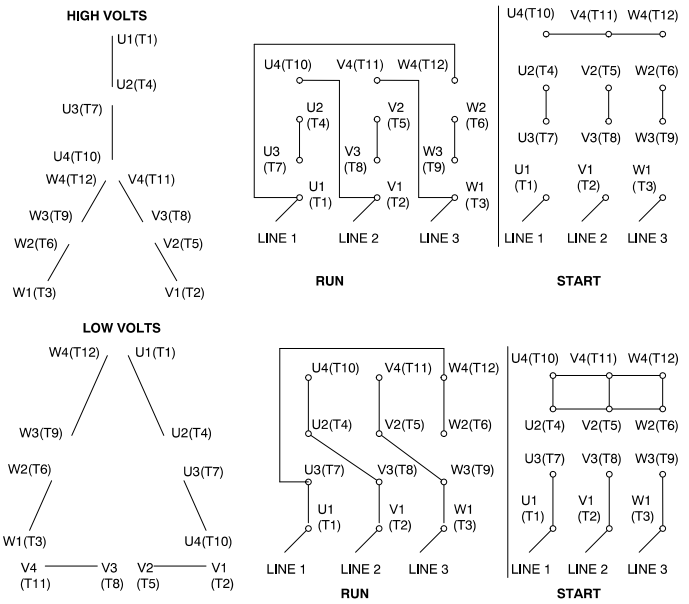
WIRING DIAGRAM



AC Motor Connection Diagram

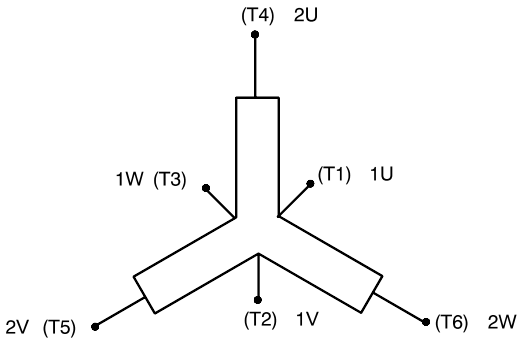
TWELVE LEADS

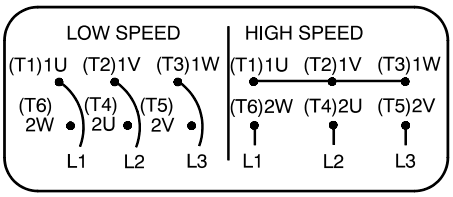
DUAL VOLTAGE WYE START – DELTA – RUN



AC Motor Connection Diagram

SINGLE WINDING MULTI-SPEEDS CONSTANT TORQUE

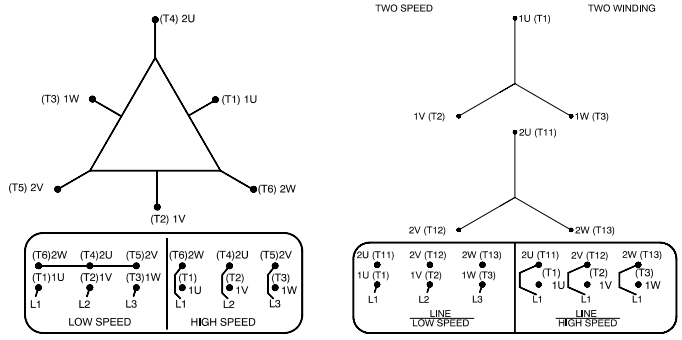




(N.P. 1634–DE)

AC Motor Connection Diagram

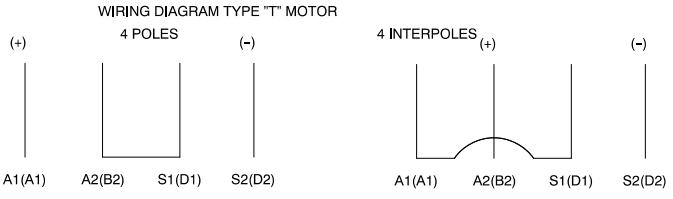
SINGLE WINDING MULTI-SPEEDS CONSTANT HP.



TWO SPEED TWO WINDING

DC Motor Connection Diagram

WIRING DIAGRAM TYPE "T" MOTOR



ROTATION – FACING COMMUTATOR END

COMPARISON OF IEC AND NEMA LEAD MARKINGS
FOR DIRECT CURRENT MOTORS

A1--A1
A2--B2
S1--D1

S2--D2

MOTOR WINDING THERMOSTATS

CONTACTS _____ @ _____ °C
FIGURE NUMBER _____

CONTACT RATING

VOLTS	CONTINUOUS AMPERES	INRUSH AMPERES
110 - 120	3.0	30
220 - 240	1.5	15
440 - 480	0.75	7.5
550 - 600	0.60	6.0

THERMOSTATS

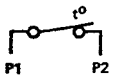
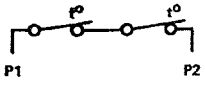
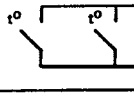
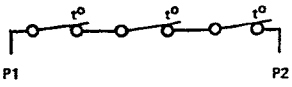
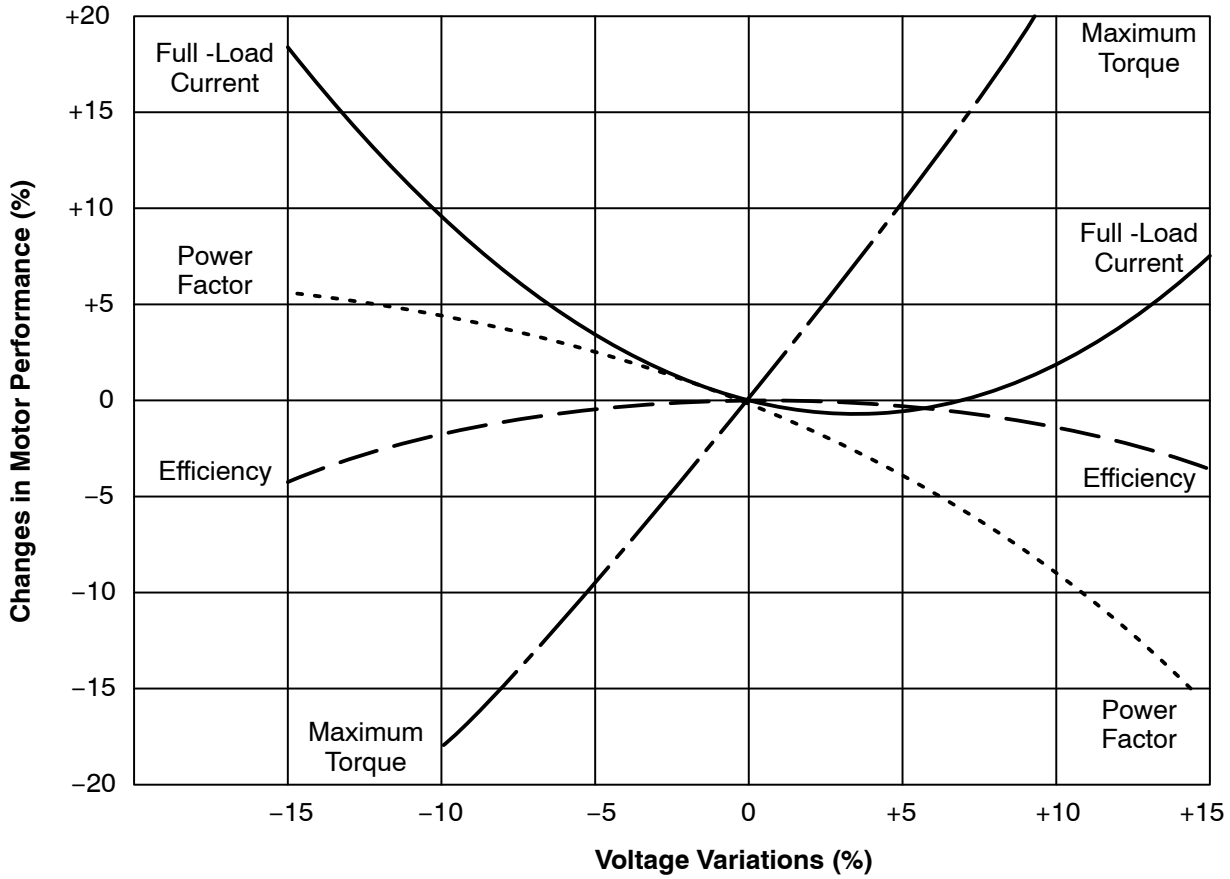
NORMALLY CLOSED	NORMALLY OPEN
FIGURE 1 	FIGURE 4 
FIGURE 2 	FIGURE 5 
FIGURE 3 	FIGURE 6 

Figure 2-3 Typical Motor Performance VS Voltage Variations



Initial Lubrication

Baldor•Reliance motors are shipped from the factory with the bearings properly packed with grease and ready to operate. Where the unit has been subjected to extended storage (6 months or more) the bearings should be relubricated (regreasable type) prior to starting. When motors are equipped for oil mist lubrication refer to the instruction manual for installation, operation, and maintenance of oil mist lubrication systems.

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Section 3.**

First Time Start Up

Be sure that all power to motor and accessories is off. Be sure the motor shaft is disconnected from the load and will not cause mechanical rotation of the motor shaft.

1. Make sure that the mechanical installation is secure. All bolts and nuts are tightened etc.
2. If motor has been in storage or idle for some time, check winding insulation integrity.
3. Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity.
4. Be sure all shipping materials and braces (if used) are removed from motor shaft.
5. Manually rotate the motor shaft to ensure that it rotates freely.
6. Replace all panels and covers that were removed during installation.
7. Momentarily apply power and check the direction of rotation of the motor shaft.
8. If motor rotation is wrong, be sure power is off and change the motor lead connections. Verify rotation direction before you continue.
9. Start the motor and ensure operation is smooth without excessive vibration or noise. If so, run the motor for 1 hour with no load connected.

10. After 1 hour of operation, disconnect power and connect the load to the motor shaft.
    Verify all coupling guards and protective devices are installed. Ensure motor is properly ventilated.
11. If motor is totally enclosed fan–cooled or non–ventilated it is recommended that condensation drain plugs, if present, be removed. These are located in the lower portion of the end–shields. Totally enclosed fan–cooled “XT” motors are normally equipped with automatic drains which may be left in place as received.

Coupled Start Up

This procedure assumes a coupled start up. Also, that the first time start up procedure was successful.

1. Check the coupling and ensure that all guards and protective devices are installed.
2. Check that the coupling is properly aligned and not binding.
3. The first coupled start up should be with no load. Apply power and verify that the load is not transmitting excessive vibration back to the motor though the coupling or the foundation.
   Vibration should be at an acceptable level.
4. Run for approximately 1 hour with the driven equipment in an unloaded condition.

The equipment can now be loaded and operated within specified limits. Do not exceed the name plate ratings for amperes for steady continuous loads.

Jogging and Repeated Starts

Repeated starts and/or jogs of induction motors generally reduce the life of the motor winding insulation. A much greater amount of heat is produced by each acceleration or jog than by the same motor under full load. If it is necessary to repeatedly start or jog the motor, it is advisable to check the application with your local Baldor distributor or Baldor Service Center.

Heating - Duty rating and maximum ambient temperature are stated on the motor name plate. Do not exceed these values. If there is any question regarding safe operation, contact your local Baldor distributor or Baldor Service Center.

Hazardous Locations

Hazardous locations are those where there is a risk of ignition or explosion due to the presence of combustible gases, vapors, dust, fibers or flyings.

Selection

Facilities requiring special equipment for hazardous locations are typically classified in accordance with local requirements. In the US market, guidance is provided by the National Electric Code. In international hazardous location areas, guidance for gas / vapor / mist classification is given in IEC60079–14, or for dust in IEC61241–14. This classification process lets the installer know what equipment is suitable for installation in that environment, and identifies what the maximum safe temperature or temperature class is required. It is the customer or users responsibility to determine the area classification and select proper equipment.

Areas are classified with respect to risk and exposure to the hazard. In the US market, areas are typically classified as follows Class, Division, Group and Temperature Class. In some newer installations in the US and in most international markets, areas are classified in Zones.

Protection Concepts

Class I Division 1 / Zone 1 [Equipment Group I (mining) or II (surface), Equipment Protection Level (EPL) Gb, Mb]

Baldor offers a range of motors suitable for installation in a Division 1 or Zone 1 environment. These motors are known as explosion proof or flameproof.
Motors that are explosion proof or flameproof use specially machined flameproof joints between the end bell or bracket and the frame, as well as along the rotating shaft and at connection box covers and entries. The fit of these flameproof joints are designed to contain the combustion or quench the flame of an explosive gas atmosphere prior to it exiting the motor. These flameproof joints have lengths and widths selected and tested based on the gas group present in the atmosphere. Baldor•Reliance motors are typically designed to meet Class I (Division 1) Group C and D (explosion proof) or Ex d IIB (flameproof).

An application note regarding equipment applied in accordance with the US National Electric Code (NFPA 70–2008) – according to Article 500.8(C) Marking, sub clause (2) in the fine print note, it is noted that Equipment not marked to indicate a division is suitable for both Division 1 and Division 2 locations. These motors are not gas tight. To the contrary, this protection concept assumes that due to the normal heating and cooling cycle of motor operation that any gas present will be drawn into the motor. Since flameproof or explosion proof motors are designed to contain the combustion and extinguish any flame transmission, for this protection concept, only external surface temperatures are of concern. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions.

If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device. The ATEX directive requires that motor shutdown on thermal trip be accomplished without an intermediate software command. Where intermediate circuitry is involved the circuit shall fall within the scope of a safety, controlling and regulating device as defined in article 1(2) of European Directive 94/9/EC, and shall be covered by an appropriate EC Type Examination Certificate.

Flameproof motors, internationally referred to as Ex d use a protection concept similar to that used in Class I Division 1 motors, with minor differences in the flameproof joints and cable entry designs. Flameproof and explosion proof motors are both type tested. Representative motors are connected to a reference gas and ignited in laboratory conditions to verify that the flame is not transmitted outside the motor enclosure and to determine the maximum internal pressure encountered.

Explosion proof and Flame proof motors shipped without a conduit box require use of a certified box of suitable dimensions and that is appropriate for the classification. Openings in connection boxes must be closed with suitably certified and dimensioned device.

Hazardous location motors equipped with NPT pipe nipples are designed and built such that the pipe nipple is securely attached to the motor frame. This is accomplished externally by interference between the threads as well as tack welding. The conduit box is securely attached to the pipe nipple at the factory per:

1. Standard Commercial NPT & Explosion Proof IEC/ATEX parts : L-1 gauging notch +/- 1 thread (ref. ANSI/ASME B1.20.1 and Clarification Sheet ExNB/98/06/010/CS) Note: Clarification Sheet ExNB/98/06/010/CS provides inspection criteria to meet (6 threads minimum per engineering part drawing for ATEX parts).
2. Explosion Proof UL conduit boxes & MSHA parts: L-1 gauging notch "+1 min to + 3 1/2 max threads. Note: Provides inspection criteria to meet (5 threads minimum per engineering part drawing for MSHA parts and meet UL 1203 requirement for L-1 gauging notch flush to + 3 1/2 max threads).

This allows the end user to position the conduit box according to the application then secure when in place. For obvious reasons having the conduit box snug prior to affixing to the pipe nipple is preferable. However, the guidance in numbers 1 and 2 above can be used in determining thread engagement.

Note: In the United States most non-mining applications have rigid conduit for cabling, therefore not tack welding the conduit box to the pipe nipple is standard. In markets outside the United States, flexible conduit/cabling are common and end users should take note to secure the conduit box to the pipe nipple once in position. Further, the flexible leads should be secured to inhibit forces acting on the conduit box.

Class I Division 2 / Zone 2 Ex nA, [Equipment Protection Level (EPL) Gc]

This protection concept relies on having no sources of ignition present such as arcing parts or hot surfaces. For this protection concept, internal temperatures as well as external temperatures are considered. In many cases, the internal temperatures are higher than the external temperatures and therefore become the limiting factor in determination of temperature code designation. In these applications, it is very important to use a motor that has been evaluated thermally for use with an inverter or converter, if variable speed operation is desired. Thermostats used for Class I Division 2 and Ex nA motors are used to protect the motor only. For motors using flying lead construction, it is important to use connection lugs and insulate with heat shrink tubing or a double wrap of insulation grade electrical tape to avoid the risk of spark or ignition.

Class II Division 1 / Zone 21 [Equipment Group III, Equipment Protection Level (EPL) Db]

This area classification is one where the risk of ignitable concentrations of dust is present at all or some of the time. The protection concepts used for Class II Division 1 is similar to flamepath, except with additional dust exclusion paths designed for the rotating shaft. In the international designations, this concept is referred to as dust ignition proof or Ex tD. External surface temperature remains the limiting factor. Thermal limiting devices such as thermostats, thermistors or RTDs may be provided on these motors to limit the external surface temperature during overload conditions. If thermostats are provided as a condition of certification, it is the installer's responsibility to make sure that these devices are properly connected to a suitable switching device.

Note: In the North American area classification system, Class III exists for fibers and flyings.
In the IEC designation, both dusts and flyings are absorbed into Group III.

Class II Division 2 / Zone 22 [Equipment Group III, Equipment Protection Level (EPL) Dc]

This area classification is one where the risk of exposure to ignitable concentrations of dust are not likely to occur under normal operating conditions and relies heavily on the housekeeping practices within the installation.

Sine Wave Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22 Hazardous Location.

These motors are designed to operate at or below the maximum surface temperature (or T–Code) stated on the nameplate. Failure to operate the motor properly can cause this maximum surface temperature to be exceeded. If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperatures above nameplate value
3. Voltages above or below nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Altitude above 3300 feet / 1000 meters
7. Severe duty cycles of repeated starts
8. Motor stall
9. Motor reversing
10. Single phase operation of polyphase equipment
11. Variable frequency operation

Variable Frequency Power Operation for Division 1 or 2 and Zone 1 or 2 and Zone 21 or 22

Hazardous Location (motors with maximum surface temperature listed on the nameplate).
Only motors with nameplates marked for use on inverter (variable frequency) power, and labeled for specific hazardous areas may be used in those hazardous areas on inverter power. The motor is designed to operate at or below the maximum surface temperature (or T−Code) stated on the nameplate.
Failure to operate the motor properly can cause this maximum surface temperature to be exceeded.

If applied in a Division 1 or 2 / Zone 1 or 2 and Zone 21 or 22 environment, this excessive temperature may cause ignition of hazardous materials. Operating the motor at any of the following conditions can cause the marked surface temperature to be exceeded.

1. Motor load exceeding service factor nameplate value
2. Ambient temperature above nameplate value
3. Voltage (at each operating frequency) above or below rated nameplate value
4. Unbalanced voltages
5. Loss of proper ventilation
6. Operation outside of the nameplate speed / frequency range
7. Altitudes above 3300 feet / 1000 meters
8. Single phase operation of polyphase equipment
9. Unstable current wave forms
10. Lower than name plate minimum carrier frequency

Thermal Limiting
Thermal limiting devices are temperature sensing control components installed inside the motor to limit the internal temperature of the motor frame by interrupting the circuit of the holding coil of the magnetic switch or contactor. They are required for most Division 1 and Zone 1 applications. For Division 2 or Zone 2 applications, motors should be selected that preclude running temperatures from exceeding the ignition temperatures for the designated hazardous material. In Division 2 or Zone 2 classified locations, thermal limiting devices should only be used for winding protection and not considered for limiting all internal motor temperatures to specific ignition temperatures.

Equipotential Bonding and Shaft Current Reduction
Larger motors (ie WP construction) may require proper bonding between motor enclosures and covers to avoid the risk of stray currents during start up. Fastening methods and bonding straps must not be modified. Bearing currents can exist in some motors for both line−fed and inverter−fed applications. Larger line−fed motors may require at least one insulated bearing to prevent a flow of current through the bearings. Do not defeat such insulation whether the motor is line−fed or inverter−fed applications. Inverter−fed motors may require additional bearing insulation or even a shaft brush. Do not defeat such features. When the motor and the coupled load are not on a common conductive baseplate, it may also be necessary to electrically bond together the stationary parts of the motor and the coupled equipment.

Repair of Motors used in Hazardous Locations

Repair of hazardous certified motors requires additional information, skill, and care. It is the customer's responsibility to select service shops with proper qualifications to repair hazardous location motors. Contact the manufacture for additional repair details. Use only original manufacturer's parts.

Repair of Explosion Proof or Flame Proof Motors Class I Division 1 and Zone 1

In the North American market, recertification programs are offered by Underwriters Laboratories and Canadian Standards Association which allow authorized service shops to mark the rebuilt motors as certified. In the international markets using IEC based requirements, repair should be undertaken only after consulting IEC60079–19 Explosive Atmospheres–Part 19 Equipment repair, overhaul and reclamation. If use of a certified repair facility is desired, consult the IECEX Repair Scheme at http://www.iecex.com/service_facilities.htm

Explosion proof and flameproof motors achieve their safety based on the mechanical construction – flameproof joints and bearing clearance, and the electrical design including any thermal limiting devices. If it is necessary to repair a flameproof or explosion proof motor, it is critical that the mechanical flameproof joints be maintained. Consult Baldor Electric Company for flameproof joint construction details.
Use only Baldor•Reliance supplied parts. Baldor does not recommend reclamation of parts.
Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present.

Repair of Dust Ignition Proof Motors – Class II Division 1 and 2, Zone 21 and 22.

For Dust Ignition Proof, proper sealing is required. Do not modify the motor construction to add any additional opening, and ensure that proper sealing is maintained in the connection box and at the shaft seal. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present

Repair of Class I Division 2 and Zone 2 motors

For Division 2 and Zone 2, the internal and external temperatures are of concern. Since this protection method also relies on temperature being maintained, make sure that any rewinding uses the original electrical designs, including any thermal protection that may be present. Use only Baldor replacement thermostats, if provided.

Section 3

Maintenance & Troubleshooting

WARNING: UL and EX Listed motors must only be serviced by UL or EX Approved Authorized Baldor Service Centers if these motors are to be returned to a hazardous and/or explosive atmosphere.

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Perform a dielectric with stand test periodically to ensure that the integrity of the winding insulation has been maintained. Record the readings. Immediately investigate any significant decrease in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Relubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease A high grade ball or roller bearing grease should be used. Baldor motors are pregreased, normally with Polyrex EM (Exxon Mobil) or as stated on the nameplate.
Do not mix greases unless compatibility has been checked and verified.

Ball Bearing Motors

Operating Temperature –25 ºC (–15 ºF) to 50 ºC (120 ºF)

EXXON	POLYREX EM (Standard on Baldor motors)
EXXON	UNIREX N2
EXXON	BEACON 325
CHEVRON OIL	SRI NO. 2 (Compatible with Polyrex EM)
CHEVRON OIL	BLACK PEARL
TEXACO, INC.	PREMIUM RB
TEXACO, INC.	POLYSTAR
AMOCO	RYKON # 2
PENNZOIL	PENNZLUBE EM–2
DARMEX	DARMEX 707
DARMEX	DARMEX 711
PETRO–CANADA	PEERLESS LLG
SHELL OIL	DOLIUM BRB

Minimum Starting Temperature –60 ºC (–76 ºF)

SHELL OIL CO.	AEROSHELL 7 (Standard on Baldor motors)
MOBIL	MOBIL 28
MOBIL	MOBILITH SHC 100 (Low Temperature – Arctic Duty)

Roller Bearing Motors

Operating Temperature –25 ºC (–15 ºF) to 50 ºC (120 ºF)

TEXACO, INC.	PREMIUM RB
MOBIL	MOBILITH SHC 220 (Standard on Baldor motors)
CHEVRON OIL	BLACK PEARL

Relubrication Intervals

Recommended relubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-2 are based on average use.

Refer to additional information contained in Tables 3-2, 3-3 and 3-4.

Table 3-1 Relubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	**6000**	**3600**	**1800**	**1200**	**900**
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)		**	* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 449 incl. (315)		**	*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Relubrication intervals are for ball bearings.
For vertically mounted motors and roller bearings, divide the relubrication interval by 2.

** For motors operating at speeds greater than 3600 RPM, contact Baldor for relubrication recommendations.

Table 3-2 Service Conditions

Severity of Service	Hours per day of Operation	Ambient Temperature Maximum	Atmospheric Contamination
Standard	8	40 ºC	Clean, Little Corrosion
Severe	16 Plus	50 ºC	Moderate dirt, Corrosion
Extreme	16 Plus	>50 ºC* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion, Heavy Shock or Vibration
Low Temperature		<–29 ºC **	

* Special high temperature grease is recommended (Dow Corning DC44). Note that Dow Corning DC44 grease does not mix with other grease types. Thoroughly clean bearing & cavity before adding grease.

** Special low temperature grease is recommended (Aeroshell 7).

Table 3-3 Relubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Some motor designs use different bearings on each motor end. This is normally indicated on the motor nameplate. In this case, the larger bearing is installed on the motor Drive endplate. For best relubrication results, only use the appropriate amount of grease for each bearing size (not the same for both).

Table 3-4 Bearings Sizes and Types

Frame Size NEMA (IEC)	Bearing Description (These are the "Large" bearings (Shaft End) in each frame size)			
	Bearing	Weight of Grease to add * oz (Grams)	Volume of grease to be added	
			in^3	teaspoon
56 to 140 (90)	6203	0.08 (2.4)	0.15	0.5
140 (90)	6205	0.15 (3.9)	0.2	0.8
180 (100–112)	6206	0.19 (5.0)	0.3	1.0
210 (132)	6307	0.30 (8.4)	0.6	2.0
250 (160)	6309	0.47 (12.5)	0.7	2.5
280 (180)	6311	0.61 (17)	1.2	3.9
320 (200)	6312	0.76 (20.1)	1.2	4.0
360 (225)	6313	0.81 (23)	1.5	5.2
400 (250)	6316	1.25 (33)	2.0	6.6
440 (280)	6318	1.52(40)	2.5	8.2
440 (280)	6319	2.12 (60)	4.1	13.4
5000 to 5800 (315–355)	6328	4.70 (130)	9.2	30.0
5000 to 5800 (315–355)	NU328	4.70 (130)	9.2	30.0
360 to 449 (225–280)	NU319	2.12 (60)	4.1	13.4
AC Induction Servo				
76 Frame 180 (112)	6207	0.22 (6.1)	0.44	1.4
77 Frame 210 (132)	6210	0.32 (9.0)	0.64	2.1
80 Frame 250(160)	6213	0.49 (14.0)	0.99	3.3

* Weight in grams = .005 DB of grease to be added

Note: Not all bearing sizes are listed. For intermediate bearing sizes, use the grease volume for the next larger size bearing.

Caution: **To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact your Baldor distributor or an authorized Baldor Service Center for additional information.**

Relubrication Procedure Be sure that the grease you are adding to the motor is compatible with the grease already in the motor. Consult your Baldor distributor or an authorized service center if a grease other than the recommended type is to be used.

Caution: **Do not over–lubricate motor as this may cause premature bearing failure.**

With Grease Outlet Plug

1. With the motor stopped, clean all grease fittings with a clean cloth.
2. Remove grease outlet plug.

Caution: **Over–lubricating can cause excessive bearing temperatures, premature lubrication breakdown and bearing failure.**

3. Add the recommended amount of grease.
4. Operate the motor for 15 minutes with grease plug removed. This allows excess grease to purge.
5. Re-install grease outlet plug.

Without Grease Provisions

Note: Only a Baldor authorized and UL or CSA certified service center can disassemble a UL/CSA listed explosion proof motor to maintain it's UL/CSA listing.

1. Disassemble the motor.
2. Add recommended amount of grease to bearing and bearing cavity. (Bearing should be about 1/3 full of grease and outboard bearing cavity should be about 1/2 full of grease.)
3. Assemble the motor.

Sample Relubrication Determination

Assume - NEMA 286T (IEC 180), 1750 RPM motor driving an exhaust fan in an ambient temperature of 43 °C and the atmosphere is moderately corrosive.

1. Table 3-2 list 9500 hours for standard conditions.
2. Table 3-3 classifies severity of service as "Severe".
3. Table 3-5 shows that 1.2 in^3 or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.

Shaker Duty Motors only

Caution: **Shaker Duty motors must be properly lubricated prior to Start Up to prevent damage. See Table 3-6.**

Lubrication should be performed before Start Up and at regular maintenance intervals. Follow these recommendations to ensure proper lubrication.

Recommended Lubricant

For ambient temperatures between –15 °F to 120 °F the following lubricants are recommended: Mobil PolyrexEM, Texaco Premium RB, Exxon Unirex N–2.

Do not mix greases unless compatibility has been checked and verified.

Table 3-5 Lubrication Volume

NEMA Frame Size	Volume in Cubic Inches					
	Normal Duty		Severe Duty		Extreme Duty	
	Start Up	Relub	Start Up	Relub	Start Up	Relub
184TY	1.4	0.5	1.4	0.5	2.7	0.5
215TY	1.6	0.5	1.6	0.5	4.5	1
256TY	7	1			11	2
286TY	9	1			15	3

Lubrication Frequency

Normal Duty 8 hours per day (16 hours per day in a clean environment). Lubricate every 2 months.

Severe Duty 16 hours per day or more in a dirty environment (corrosive atmosphere, chemical fumes, acids, alkalies or extreme high humidity). Lubricate every month or 700 hours of operation.

Extreme Duty operation in extremely dirty or dusty environments and high ambient temperatures exceeding 104 °F (40 °C). Lubricate twice a month or 350 hours of operation.

Lubrication Procedure

1. Locate the grease inlet and outlet. Clean the areas.
2. Remove the plug(s) and install a grease fitting in the inlet if grease fitting is not already installed.
3. Add the recommended amount of lubricant.
4. Run the motor for two hours with the outlet plug removed.
5. Install outlet plug.

Note: To loosen hardened grease it may be necessary to insert a rod or wire into the grease inlet and outlet holes.

Table 3-6 Troubleshooting Chart

Symptom	Possible Causes	Possible Solutions
Motor will not start	Usually caused by line trouble, such as, single phasing at the starter.	Check source of power. Check overloads, fuses, controls, etc.
Excessive humming	High Voltage. Eccentric air gap.	Check input line connections. Have motor serviced at local Baldor service center.
Motor Over Heating	Overload. Compare actual amps (measured) with nameplate rating.	Locate and remove source of excessive friction in motor or load. Reduce load or replace with motor of greater capacity.
	Single Phasing.	Check current at all phases (should be approximately equal) to isolate and correct the problem.
	Improper ventilation.	Check external cooling fan to be sure air is moving properly across cooling fins. Excessive dirt build-up on motor. Clean motor.
	Unbalanced voltage.	Check voltage at all phases (should be approximately equal) to isolate and correct the problem.
	Rotor rubbing on stator.	Check air gap clearance and bearings. Tighten “Thru Bolts”.
	Over voltage or under voltage.	Check input voltage at each phase to motor.
	Open stator winding.	Check stator resistance at all three phases for balance.
	Grounded winding.	Perform dielectric test and repair as required.
	Improper connections.	Inspect all electrical connections for proper termination, clearance, mechanical strength and electrical continuity. Refer to motor lead connection diagram.
Bearing Over Heating	Misalignment.	Check and align motor and driven equipment.
	Excessive belt tension.	Reduce belt tension to proper point for load.
	Excessive end thrust.	Reduce the end thrust from driven machine.
	Excessive grease in bearing.	Remove grease until cavity is approximately 3/4 filled.
	Insufficient grease in bearing.	Add grease until cavity is approximately 3/4 filled.
	Dirt in bearing.	Clean bearing cavity and bearing. Repack with correct grease until cavity is approximately 3/4 filled.
Vibration	Misalignment.	Check and align motor and driven equipment.
	Rubbing between rotating parts and stationary parts.	Isolate and eliminate cause of rubbing.
	Rotor out of balance.	Have rotor balance checked are repaired at your Baldor Service Center.
	Resonance.	Tune system or contact your Baldor Service Center for assistance.
Noise	Foreign material in air gap or ventilation openings.	Remove rotor and foreign material. Reinstall rotor. Check insulation integrity. Clean ventilation openings.
Growling or whining	Bad bearing.	Replace bearing. Clean all grease from cavity and new bearing. Repack with correct grease until cavity is approximately 3/4 filled.

Suggested bearing and winding RTD setting guidelines for Non–Hazardous Locations ONLY

Most large frame AC Baldor motors with a 1.15 service factor are designed to operate below a Class B (80 ºC) temperature rise at rated load and are built with a Class H winding insulation system. Based on this low temperature rise, RTD (Resistance Temperature Detectors) settings for Class B rise should be used as a starting point. Some motors with 1.0 service factor have Class F temperature rise.

The following tables show the suggested alarm and trip settings for RTDs. Proper bearing and winding RTD alarm and trip settings should be selected based on these tables unless otherwise specified for specific applications.

If the driven load is found to operate well below the initial temperature settings under normal conditions, the alarm and trip settings may be reduced so that an abnormal machine load will be identified.

The temperature limits are based on the installation of the winding RTDs imbedded in the winding as specified by NEMA. Bearing RTDs should be installed so they are in contact with the outer race on ball or roller bearings or in direct contact with the sleeve bearing shell.

Table 3-7 Winding RTDs – Temperature Limit In ºC (40 ºC Maximum Ambient)

Motor Load (Typical Design)	Class B Temp Rise ≤ 80 ºC		Class F Temp Rise ≤ 105 ºC		Class H Temp Rise ≤ 125 ºC	
	Alarm	Trip	Alarm	Trip	Alarm	Trip
≤ Rated Load	130	140	155	165	175	185
Rated Load to 1.15 S.F.	140	150	160	165	180	185

Note: • Winding RTDs are factory production installed, not from Mod–Express.

When Class H temperatures are used, consider bearing temperatures and relubrication requirements.

Table 3-8 Bearing RTDs – Temperature Limit In oC (40 ºC Maximum Ambient)

Bearing Type Oil or Grease	Anti–Friction		Sleeve	
	Alarm	Trip	Alarm	Trip
Standard*	95	100	85	95
High Temperature**	110	115	105	110

Notes: * Bearing temperature limits are for standard design motors operating at Class B temperature rise.

** High temperature lubricants include some special synthetic oils and greases.

Greases that may be substituted that are compatible with Polyrex EM (but considered as “standard” lubricants include the following:

– Texaco Polystar – Rykon Premium #2 – Chevron SRI #2

– Mobilith SHC–100 – Pennzoil Pennzlube EM–2 – Chevron Black Pearl

– Darmex 707 – Darmex 711 – Petro–Canada Peerless LLG

See the motor nameplate for replacement grease or oil recommendation.

Contact Baldor application engineering for special lubricants or further clarifications.

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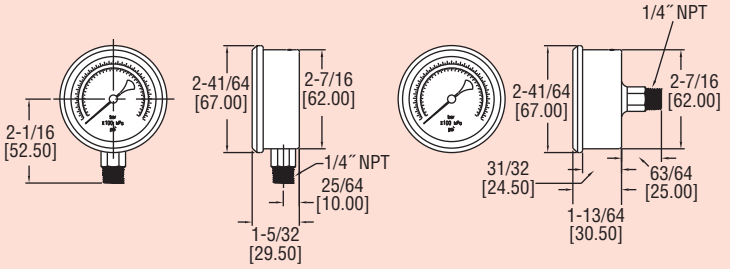
MN408
7/14

Series SGY 2.5″ Stainless Steel Industrial Pressure Gage

1.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales

SGY Bottom

SGY Back with Accessory Pointers



The Series SGY Gages have dual psi and bar (x100 kPa) scales with ±1.5% full-scale accuracy. The Series SGY gages are designed with 304 SS housings and brass wetted parts for excellent chemical compatibility. These gages cover a wide variety of ranges from full vacuum to 1,000 psi and are available in both bottom or back connections. Series SGY gages employ an easy-open breather plug on top, which allows liquid filled units to breathe, relieving any built up internal pressures. Plug easily pops open and does not need to be entirely removed or cut like a typical gages' rubber plug grommet.

APPLICATIONS

- Vacuums in pneumatic conveying lines
- Positive pressure in compressed air headers

Model	Range	Model	Range
SGY-D10122N	30″ Hg to 0	SGY-D10722N	0 to 200 psi
SGY-D10322N	0 to 30 psi	SGY-D11022N	0 to 300 psi
SGY-D10422N	0 to 60 psi	SGY-D11122N	0 to 500 psi
SGY-D10522N	0 to 100 psi	SGY-D11222N	0 to 1000 psi
SGY-D10622N	0 to 160 psi		

Note: To order with glycerin fill add - GF to the end of the model
For back connect, change ending from 22N to 42N

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Brass connection, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±1.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Weight: 4.9 oz (139 g) bottom, 5.8 oz (164 g) back. Add 2.8 oz (78 g) for fill.

ACCESSORIES

A-445D, U-Bracket Mounting Kit for 2.5″ Gage
A-499R, Red Sliding Color Pointer
A-499Y, Yellow Sliding Color Pointer
A-499G, Green Sliding Color Pointer

GRAINGER® FOR THE ONES WHO GET IT DONE GRAINGER INTERNATIONAL, INC. GLOBAL SOURCING DIVISION	-- GGS TECHNICAL SPECIFICATION --			
	SPECIFICATION NUMBER: 1NFY8_TSRev1.doc	AUTHOR: Hoskinson	TITLE: ENG	REL. DATE: 5/25/07
	GGS MODEL NUMBER(s): 1NFY8	DESCRIPTION: Industrial thermometer	REVISION #: 1	REV. DATE: 8/10/07

1.0 BRAND:	No brand
2.0 PRODUCT DESCRIPTION:	Bimetal Industrial Thermometer

3.0 PRODUCT PHOTO(S):

4.0 PRODUCT REQUIREMENTS:

4.1 Features & Performance	Requirement
Temperature scale(s)	°F: -20 to 120 °C: -30 to 50
Connection location/type	Back; 1/2 inch NPT
Dial size (inches)	3
Stem length (inches)	4
Stem diameter (inches)	1/4 In
Rotated degrees	N/A
Angled degrees	N/A
Full scale accuracy	≤80°F: ±1% ≥81°F: ±1.5%
Calibration	External Adjustment

4.2 Materials & Construction	Requirement
Case	Stainless Steel Hermetically Sealed to Prevent Icing/Fogging Inside
Stem	Stainless Steel
Coil dampening	Silicone for Superior Time Response and Vibration Dampening
Dial face	Glass

4.3 Finish / Color	Requirement
All Surface Finishes	a) Surface finishes must be uniform and continuous. The surface finish must not exhibit any visual defects such as blisters, rust, corrosion, scratches, peeling, bubbles, and/or cracking. b) All exposed surfaces must be free of burrs and sharp edges. c) All applied finishes must adhere to the surface and show no signs of delamination or peeling.
Finish	Stainless Steel

SECTION 6 - 300 SERIES PROCESS EQUIPMENT - SVE BLOWER

VACUUM INDICATOR - DWYER MODEL LPG4-D7722N

DILUTION FILTER/SILENCER - SOLBERG MODEL FS-235P-400

INLINE PARTICULATE FILTER - SOLBERG MODEL CT-275P-600C

VACUUM SWITCH - DWYER MODEL 1950P-8-2F

VACUUM RELIEF VALVE - FPZ MODEL VRL9

REGENERATIVE BLOWER, 30 HP, 460 VAC, 3PH, TEFC - FPZ MODEL SCL K10-TS-GOR-C-30-3

REGENERATIVE BLOWER MOTOR - BALDOR MODEL 0107485397-000010

PRESSURE INDICATOR - DWYER MODEL LPG4-D8622N

PRESSURE SWITCH - DWYER MODEL 1950P-2-2F

TEMPERATURE INDICATOR - AV MODEL 1NFY4

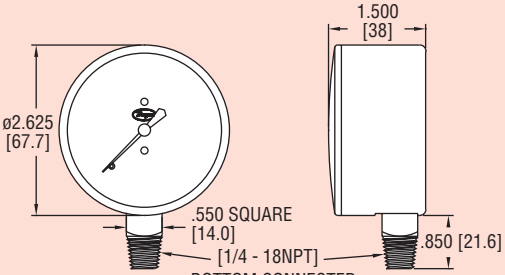
FLOW INDICATOR (MAGNEHELIC) - DWYER MODEL 2005

FLOW ELEMENT PITOT TUBE - DWYER MODEL DS-300-6

Series LPG4

2.5" Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2" Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5" (63 mm).
Process Connections: 1/4" male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)

Model	Range
LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

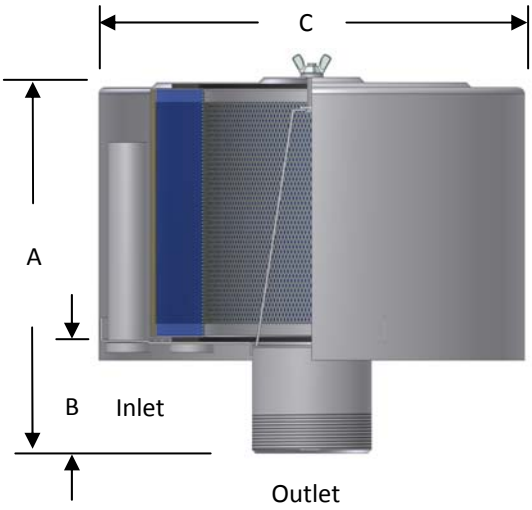
OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

Compact Filter Silencers
FS Series 1/2” - 6” MPT, Flange

Features

- Fully drawn weatherhood - no welds to rust or vibrate apart
- Tubular silencing design - tubes are positioned to maximize attenuation and air flow while minimizing pressure drop
- Durable carbon steel construction with baked enamel finish & powder coated weatherhood



Technical Specifications

- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 15-20” H2O over initial Δ P
- Pressure drop graphs available upon request
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

- 1/8” tap holes available for 3” and larger connections
- Pressure drop indicator (See page 3-11)
- Various media for different environments
- Stainless steel construction
- Epoxy coated finish
- Special connections
- Side Access Silencer Filters (LQB Series) for space restricted enclosures (select models)

Tidbit: Charlie Solberg Sr. “Senior” designed our first filter silencer in 1966. The FS-15 size filter was created for small air compressors.

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Outlet Connections

MPT Outlet	Assembly SCFM Rating	Assembly Part Number Polyester	Assembly Part Number Paper	Dimensions - inches A	B	C	No. of Silencing Tubes	Approx. Wt. lbs	Replacement Element Part No. Polyester	Replacement Element Part No. Paper	Element SCFM Rating
1/2"	10	FS-15-050	FS-14-050	4	1 1/2	6	1	2	15	14	35
3/4"	25	FS-15-075	FS-14-075	4	1 1/2	6	2	2	15	14	35
1"	35	FS-15-100	FS-14-100	4	1 1/2	6	3	2	15	14	35
1"	55	FS-19P-100	FS-18P-100	6 5/8	1 5/8	6	3	3	19P	18P	100
1 1/4"	70	FS-19P-125	FS-18P-125	6 5/8	1 5/8	6	5	3	19P	18P	100
1 1/2"	85	FS-19P-150	FS-18P-150	6 5/8	1 5/8	6	5	4	19P	18P	100
2"	135	FS-31P-200	FS-30P-200	7 1/4	2 1/4	10	5	8	31P	30P	195
2"	135	FS-231P-200	FS-230P-200	12 1/4	2 1/4	10	5	14	231P	230P	300
2 1/2"	195	FS-31P-250	FS-30P-250	7 1/2	2 1/2	10	5	8	31P	31P	195
2 1/2"	195	FS-231P-250	FS-230P-250	12 1/2	2 1/2	10	9	15	231P	230P	300
3"	300	FS-231P-300	FS-230P-300	13	3	10	9	15	231P	230P	300
3"	300	FS-235P-300	FS-234P-300	13	3	16	9	29	235P	234P	570
3"	300	FS-275P-300	FS-274P-300	13	3	16	9	33	275P	274P	1100
4"	520	FS-235P-400	FS-234P-400	14	4	16	9	30	235P	234P	570
4"	520	FS-275P-400	FS-274P-400	14	4	16	9	34	275P	274P	1100
5"	800	FS-245P-500	FS-244P-500	14	4	16	14	33	245P	244P	880
5"	800	FS-275P-500	FS-274P-500	14	4	16	14	36	275P	274P	1100
6"	1100	FS-275P-600	FS-274P-600	15	5	16	18	38	275P	274P	1100

See Filter Silencer Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

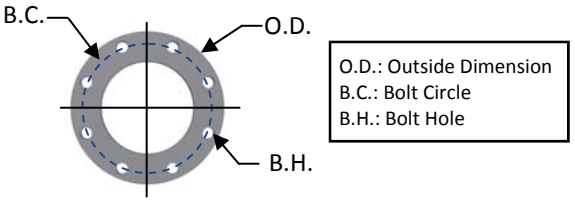
Flange Outlet Connections

Flange Outlet	Assembly SCFM Rating	Assembly Part Number Polyester	Assembly Part Number Paper	Dimensions - inches A	B	C	No. of Silencing Tubes	Approx. Wt. lbs	Replacement Element Part No. Polyester	Replacement Element Part No. Paper	Element SCFM Rating
4"	520	FS-235P-400F	FS-234P-400F	14	4	16	9	33	235P	234P	570
4"	520	FS-275P-400F	FS-274P-400F	14	4	16	9	39	275P	274P	1100
5"	800	FS-245P-500F	FS-244P-500F	14	4	16	14	38	245P	244P	880
5"	800	FS-275P-500F	FS-274P-500F	14	4	16	14	41	275P	274P	1100
6"	1100	FS-275P-600F	FS-274P-600F	15	5	16	18	42	275P	274P	1100

See Filter Silencer Technical Data section for sizing guidelines.

Dimension tolerance ± 1/4"

125/150# Pattern Flg	Dimensions - inches O.D.	B.C.	B.H.	No. of Holes	Flange Thickness
4"	9	7 1/2	0.75	8	0.38
5"	10	8 1/2	0.88	8	0.38
6"	11	9 1/2	0.88	8	0.38



O.D.: Outside Dimension
B.C.: Bolt Circle
B.H.: Bolt Hole

Note: Model offerings and design parameters may change without notice. See www.solbergmfg.com for most current offering.

SOLBERG

Filter Silencers and Inlet Filters Maintenance Manual

www.solbergmfg.com

Note: Please read the maintenance instructions given by the OEM for the machinery first. The OEM's manual should be adhered to in order to protect the equipment. So berg Manufacturing, Inc has made every effort to make sure that these instructions are accurate but is not responsible for any typos, slight variations or for human errors that may occur.

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Maintenance Manual

Solberg Air Inlet Filters and Filter Silencers

CONTENTS

**For Further Information Please Call: 630-773-1363*

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SOLBERG

Section A

INTRODUCTION

The purpose of this manual is instruction on the proper assembly and care of Solberg inlet air filters.

WARNING

This manual must be read and thoroughly understood before using and caring for this air filter. Failure to comply could result in explosion, product/system contamination or personal injury.

This manual should be used as a supplement to the user's understanding of the proper care needed to maintain a safe and dependable air filter. It is the responsibility of the user to interpret and explain all instructions to persons who do not read or understand English BEFORE they are allowed to maintain and use this filter.

This manual should be readily available to all operators responsible for operation and maintenance of the inlet air filters.

We thank you for selecting products from Solberg Manufacturing, Inc. We are confident that our superior filter designs will meet your application requirements.

Section B

GENERAL INFORMATION

1. Identification of Solberg Inlet Air Filters.

All Solberg inlet air filters should have an identification label/nameplate that gives the following information:

Assembly Model #
Replacement Element #

(The exception is OEM supplied units. In this case, please enter the OEM part numbers below.)
Fill in the actual nameplate data from your new Solberg inlet filter(s):

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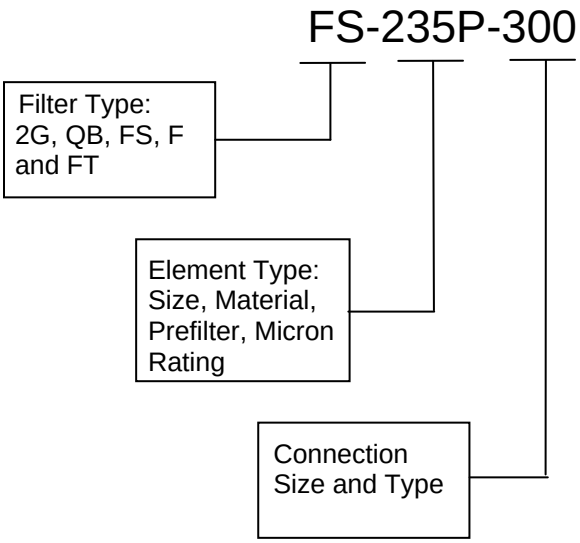
No.	Filter Model Number	Replacement Element	Initial Delta P Readings
1			
2			
3			
4			
5			

Table 1

The model number designates the filter type, the original element configuration and housing connection size. For example, the following part number identifies the filter as being a 'FS' design filter with a 235 element with prefilter and 3" MPT connection size:



2. Filtration Rules of Thumb

General: For peak output performance from a compressor, blower, vacuum pump, engine, or any other machine that consumes air, one must have clean, unrestricted air. Proper filtration can help stabilize the working environment within rotating equipment even when the external conditions may be quite severe. A critical component in creating the right working conditions is filter sizing. With the properly sized filter, equipment will run smoothly over its entire expected operating life.

A major factor in filtration and filter sizing is air velocity through the filter media. Generally, the slower the velocity of air through a media the higher the filter efficiency and, conversely, the lower the pressure drop. Therefore, the primary

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goal in filter sizing is to optimize the velocity of air through the media (sometimes called face velocity).

Rule of Thumb #1: Always begin with the filter cartridge requirements when sizing a filter. Once the appropriate element has been selected then move on to the housing requirements.

Rule of Thumb #2: Always ask or specify a filter based on a micron rating ***with filtration efficiencies***. As an example, stating a requirement for a 1-micron filter is misleading because no efficiency rating has been specified. A 1-micron filter at 95% efficiency may be less efficient than a 5-micron filter at 99% efficiency. For proper air system performance in light and industrial duty environments, a filter with a minimum of 99% filtration efficiency at 5 microns is required.

Rule of Thumb #3: Size your filter correctly by understanding the impact air velocity through a media has on efficiency and pressure drop. Maintain the suggested Air-to-Media ratios listed below based on the external environment listings and Filtration efficiency needs.

Filtration Efficiency Requirements (99%+ efficiency)	**Environmental Conditions**	**Air to Media Ratio**	
Industrial Grade 2-micron **Paper**	Industrial Duty (clean, office/warehouse-like)	30 CFM/ft^2	(51m^3/h)/cm^2
	Severe Duty (workshop, factory-like)	15 CFM/ft^2	(25.5m^3/h)/cm^2
	Extreme Duty (Foundry, Construction-like)	10 CFM/ft^2	(17m^3/h)/cm^2
Industrial Grade 5-micron **Polyester**	Industrial Duty (clean, office/warehouse-like)	50 CFM/ft^2	(85m^3/h)/cm^2
	Severe Duty (workshop, factory-like)	40 CFM/ft^2	(68m^3/h)/cm^2
	Extreme Duty (Foundry, Construction-like)	25 CFM/ft^2	(42.5m^3/h)/cm^2
Industrial Grade 1-micron **Polyester**	Severe Duty (Foundry, Construction-like)	10 CFM/ft^2	(17m^3/h)/cm^2
Industrial Grade 0.3-micron **HEPA** Glass @ 99.97% Efficiency	Industrial Duty (Pre-filtered Applications)	10 CFM/ft^2	(17m^3/h)/cm^2
	Severe Duty (workshop, factory-like)	7 CFM/ft^2	(12m^3/h)/cm^2
	Extreme Duty (Foundry, Construction-like)	5 CFM/ft^2	(8.5m^3/h)/cm^2

Table 2

Rule of Thumb #4: Pressure drop is also caused by the dirt holding capacity of the element. As the element fills up with dirt, the pressure drop increases. It is

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important to document the pressure drop across a given filter when it is new and then clean or replace it when the pressure drop increases by 10” to 15” / 250-280mm H_2O over the original reading.

Rule of Thumb #5: The inlet connection greatly influences the overall pressure drop of the filter system. To minimize the restriction contributed by an inlet filter, a velocity of 6,000 ft/min (10200m^3/h) or less is suggested through the outlet pipe. The table below lists the suggested flows based on pipe size:

Pipe Size (inches)	Max Airflow		Pipe Size (inches)	Max Airflow		Pipe Size (inches)	Airflow	
1/4"	6 CFM	10m^3/h	1 ¼"	60 CFM	102m^3/h	6"	1,100 CFM	1870m^3/h
3/8"	8 CFM	14m^3/h	1 ½"	80 CFM	136m^3/h	8"	1,800 CFM	3060m^3/h
1/2"	10 CFM	17m^3/h	2"	135 CFM	230m^3/h	10"	3,300 CFM	5610m^3/h
3/4"	20 CFM	34m^3/h	2 ½"	195 CFM	332m^3/h	12"	4,700 CFM	7990m^3/h
1"	35 CFM	60m^3/h	3"	300 CFM	510m^3/h	14"	6,000 CFM	10200m^3/h
			4"	520 CFM	884m^3/h			
			5"	800 CFM	1360m^3/h			

Table 3 **Note: This information is for general use only. A qualified engineer must properly design each system.*

3. Element Specifications

Temperature Range: -15° to 220°F / -26° to 105°C
Filter Change-Out Differential: 10” to 15” / 250-380mm H_2O Over Initial Delta P

Media	Micron Rating
Standard Paper	99+% @ 2 micron
Standard Polyester	99+% @ 5 micron
“S” Series Wire Mesh	Epoxy Coated Wire Mesh
“Z” Series Polyester	99+% @ 1 micron
“HE” Series HEPA	99.97% @ 0.3 microns
“U” Series Polyester	99+% @ 25 micron
“W” Series Polyester	99+% @ 100 micron
“S2” Series	Stainless Steel Wire Mesh
“AC” & “ACP” Series	N/A
“Y” Series Polypropylene	99+% @ 5 micron

Table 4

Temperature Range: -15° to 385°F / -26° to 196°C
Filter Change-Out Differential**:** 10” to 15”/ 250-380mm H_2O Over Initial Delta P

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Media	Micron Rating
“MX” & “MXD” Series – Nomex Cloth	99+% @ 5 micron

Table 5

4. **Element Cleaning - Inlet Filtration**

Solberg elements should be cleaned or replaced, once the pressure drop reaches 15 to 20-inches water column (380 - 500mm WC) above the initial pressure drop of the installation.

The decision to clean the element rather than replace it is left to the discretion of the operator. Any damage which results from by-pass or additional pressure drop created by element cleaning is the sole responsibility of the operator.

WARNING

The overall performance of a filter element is altered once cleaned.

The initial pressure drop after cleaning will be greater than the original, clean pressure drop of the element.

After each subsequent cleaning, the initial pressure drop will continue to increase.

Under all circumstances, the initial pressure drop of the element needs to be maintained at less than 20-inches water column (500mm WC).

Cleaned elements that exceed 20-inches water column (500mm WC) at start-up should be replaced with new elements.

With many types of equipment, the maximum pressure drop allowed will be dictated by the ability of the equipment to perform to its rated capacity. Under all circumstances, the operator should avoid exceeding the manufacturer’s recommended maximum pressure drop for their specific equipment.

A. ***Polyester Element***: The polyester element may be washed in warm soapy water, vacuumed, gently blown out or replaced. The element

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should be dry before reinstallation. The element should be replaced after a maximum of three cleanings.

B. ***Paper Element***: The paper element may be lightly blown with low pressure air. It is disposable and in most cases should be replaced with a new element.
C. ***Polyurethane Prefilter***: The prefilter may be washed as a sponge or replaced to give the element a longer service life.
D. ***Epoxy Coated Wire Mesh and Stainless Steel Wire Mesh Elements***: Cleaning instructions similar to polyester, except mild solvents may be used.
E. ***Activated Carbon Element***: Not cleanable
F. ***Polypropylene Element***: Cleaning instructions similar to polyester
G. ***Nomex Cloth Element***: Cleaning instructions similar to polyester

If you are not confident that the integrity of the element was maintained during cleaning, it is recommended that a new element be installed. Also, spare parts such as gaskets, wing nuts and washers can be supplied upon request.

Section C

PROCEDURES

1. Installation.

A. Maximum operating temperature for most Solberg inlet air filter products is 220°F / 105°C. Temperatures in excess of this could cause damage to elements, media and elastomers. High temperature products are available.

B. Direction of flow is typically from the outside of the element to the inside of the element. Most products have arrows indicating direction of flow on the inlet and outlet ports.

C. Ensure that pipe/flange connections are adequately sealed so the potential for leaks is reduced to a minimum.

2. Disconnecting canister top from canister base.

A. FS-04-06-10 *(or 05-07-11):* Twist top housing to open. Use care to support bottom housing while removing top housing. Fitting damage can occur if fitting is torqued in the wrong direction.

B. Small QB/FS/F/FT*:* Remove weather hood or top plate by loosening hex nut or wing nut and lifting off.

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C. Large 2Q/QB/FS/F/FT: Remove cover by loosening hex nut or wing nut and lifting off.

3. Removing element for service/maintenance.

A. Carefully remove retaining hex head/wing-nut and washer over top plate, and then remove element. Note: Model “04-06-10” elements should be free when housing tops are removed.

B. Clean sealing surfaces of housing, top plates and element endcaps so that they are free of dirt or any other particulate.

WARNING

Failure to comply with these instructions may result in system or equipment contamination.

4. Securing Element.

A. Place new or cleaned element evenly on base plate. Be sure element seats properly on base and there is no dirt or particulate present on sealing surfaces. With multiple element stacks place elements in line with base element and ensure elements seat properly.

B. Place top plate (if necessary) on element by centering on tap bolt.

C. Secure washer and wing nut to end cap (or top plate) and tap bolt. Element must be tightly secured. Note: Do NOT over tighten!

WARNING

Defective installation may cause system or pump contamination. Use only genuine Solberg replacement parts.

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5. **Securing canister top to canister base.**

   A. Make sure all surfaces are free from dust and other particulate.

   B. Small QB/FS/F/FT: Replace top plate and/or weather hood if necessary. Feed threaded rod into corresponding bolthole and tighten. Note: Do NOT over tighten!

   C. Large 2G/QB/FS/F/FT: Replace cover. Feed threaded rod into corresponding bolt hole(s) and tighten. Note: Do NOT over tighten!

   D. FS-04-06-10 (or 05-07-11): Reassemble top housing to bottom housing by aligning tabs and turning into place.

6. **Equipment Startup.**

   A. Be sure to read the instructions on installation or element replacement as listed above before starting equipment.

WARNING

If at any time the operator is unable to verify the integrity of the element or any housing feature, the factory or a regional representative should be contacted prior to start-up.

   B. Please check the listed steps prior to startup.

      1. Check element to make sure it is seated properly on element base or sealing surface.

WARNING

Failure to seat the element properly may result in contaminant by-pass resulting in damage to equipment.

      2. Check element top plate or cover to make sure it is seated properly on element.

      3. Check housing cover (if applicable) that it is installed correctly onto housing.

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4. Be sure all fasteners and hardware (if applicable) have been tightened.

WARNING

If the air flow is reversed through a Solberg filter unit, be sure to check the element and housing internals for damage. Failure to do so may result in damage to equipment.

Section D

MAINTENANCE RECOMMENDATIONS

1. Pressure drop readings are recommended to have an effective air filter. Always document initial pressure drop during start-up when element is clean. Replacement cartridge is needed when system experiences 10" to 15" / 250-380mm H^2O above drop above the initial reading. Refer to page 4 for initial values.

2. Always check replacement cartridge gaskets to insure they are adhered uniformly along the end caps during handling. If not, contact Solberg Manufacturing, Inc. immediately. Do not modify or change!

3. Always check inlets/outlets, element base and its components when replacing element to insure cleanliness. Wipe clean if necessary.

4. Operate only when a proper seal exists.

SPARE PARTS LIST:

Contact your Solberg Representative for spare part model numbers.

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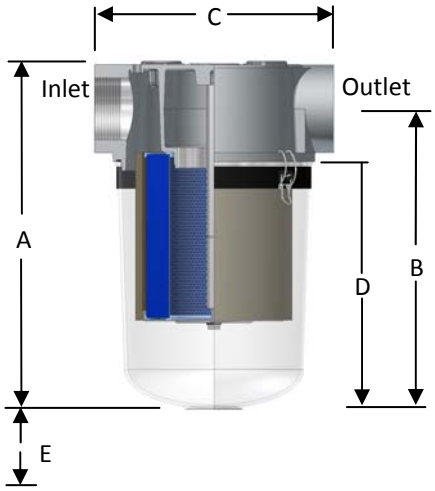
”T” Style Vacuum Filters
ST/CT Series 1” – 6” FPT



General Features

- Compact design for space restrictions; min. service area
- Inlet above element for extended element life & maintenance intervals
- Cast, corrosion resistant aluminum top with machined connections: - Integrated baffle design
  - 4 M12 taps for mounting brackets: 2” to 6”
- ”T” style design minimizes piping requirements
- 1/4” differential gauge ports: 2” to 6”

ST Series Specifications

- See-through bucket made from polycarbonate material
- Bucket has a high tensile strength for dimensional stability
- Temp ratings: - Complete assembly max: 220°F (104°C)
  - See-through bucket only max: 257°F (125°C)
- Increased holding capacity

Technical Specifications

- Vacuum Rating: Gas tight seal
- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 15-20” H2O over initial Δ P
- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron

Options

- Swing bolts for heavy duty environments
- 1” to 1-1/2” housings have dimples for optional gauge ports & mounting bracket taps
- Epoxy coated housings
- Drain ports
- Spool piece extender on select models
- ISO flange connections: NW25, NW40 (select models)

FPT Inlet & Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches				Suggested Service HT.	Approx. Weight	Replacement Element Part No.		Element SCFM Rating
		Polyester	Paper	A	B	C	D	E	lbs.	Polyester	Paper	
1"	40	ST-897-100C	ST-896-100C	13 3/8	11 15/16	7	10 3/8	9	11	897	896	115
1-1/4"	60	ST-897-125C	ST-896-125C	13 3/8	11 15/16	7	10 3/8	9	11	897	896	115
1-1/2"	80	ST-897-150C	ST-896-150C	13 3/8	11 15/16	7	10 3/8	9	10	897	896	115
2"	175	ST-851/1-200C	ST-850/1-200C	16 1/4	14 1/4	9	12 1/2	9	15	851/1	850/1	290
2-1/2"	210	ST-851/1-250C	ST-850/1-250C	16 1/4	14 1/4	9	12 1/2	9	14	851/1	850/1	290
3"	300	ST-235P-300C	ST-234P-300C	19 3/4	17	13 1/2	14	9	29	235P	234P	570
4"	520	ST-235P-400C	ST-234P-400C	19 3/4	17	13 1/2	14	9	25	235P	234P	570

Dimension tolerance ± 1/4”

CT Series Specifications

- Carbon steel black enamel drop down bucket
- Swing bolts standard on 6” housings

FPT Inlet & Outlet	Assembly SCFM Rating	Assembly Part Number		Dimensions - inches				Suggested Service HT.	Approx. Weight	Replacement Element Part No.		Element SCFM Rating
		Polyester	Paper	A	B	C	D	E	lbs.	Polyester	Paper	
1"	40	CT-897-100C	CT-896-100C	13 3/8	11 13/16	7	10 3/8	9	12	897	896	115
1-1/4"	60	CT-897-125C	CT-896-125C	13 3/8	11 13/16	7	10 3/8	9	12	897	896	115
1-1/2"	80	CT-897-150C	CT-896-150C	13 3/8	11 13/16	7	10 3/8	9	11	897	896	115
2"	175	CT-851-200C	CT-850-200C	13	10 7/8	9	9	9	16	851	850	290
2-1/2"	210	CT-851-250C	CT-850-250C	13	10 7/8	9	9	9	15	851	850	290
3"	300	CT-235P-300C	CT-234P-300C	18 5/8	16 1/8	13 1/2	13	9	30	235P	234P	570
4"	520	CT-235P-400C	CT-234P-400C	18 5/8	16 1/8	13 1/2	13	9	26	235P	234P	570
6"	1100	CT-275P-600C	CT-274P-600C	18 1/4	14 1/2	19	9 7/8	10	45	275P	274P	1100

Note CT 2” & 2-1/2” models: Element seals on the base of the housing.

See Vacuum Filter Technical Data section for sizing guidelines.

Note: Model offerings and design parameters may change without notice. See www.solbergmfg.com for most current offering.

SOLBERG

Inlet Vacuum Filters
Maintenance Manual

www.solbergmfg.com

Solberg Manufacturing, Inc., 1151 Ardmore Itasca, IL 60143 USA
Ph: 630.773.1363 Fax: 630.773.0727 Email: sales@solbergmfg.com Web: www.solbergmfg.com
Rev: MMVF-910

Note: Please read the maintenance instructions given by the OEM for the machinery first. The OEM's manual should be adhered to in order to protect the equipment. Solberg Manufacturing, Inc has made every effort to make sure that these instructions are accurate but is not responsible for any typos, slight variations or for human errors that may occur.

Maintenance Manual

SOLBERG Inlet Vacuum Filters

CONTENTS

**For Further Information Please Call: 630-773-1363*

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Rev: MMVF-910

Section A

INTRODUCTION

The purpose of this manual is instruction on the proper assembly and care of Solberg inlet vacuum filters.

WARNING

This manual must be read and thoroughly understood before using and caring for this air filter. Failure to comply could result in explosion, product/system contamination or personal injury.

This manual should be used as a supplement to the user's understanding of the proper care needed to maintain a safe and dependable air filter. It is the responsibility of the user to interpret and explain all instructions to persons who do not read or understand English BEFORE they are allowed to maintain and use this filter.

This manual should be readily available to all operators responsible for operation and maintenance of the vacuum inlet filters.

We thank you for selecting products from Solberg Manufacturing, Inc. We are confident that our superior filter designs will exceed your application requirements.

Section B

GENERAL INFORMATION

1. Identification of Solberg Vacuum Inlet Filters.

All Solberg inlet vacuum air filters should have an identification label/nameplate that gives the following information:

Assembly Model #
Replacement Element #

(The exception is OEM supplied units. In this case please enter the OEM part numbers below.)

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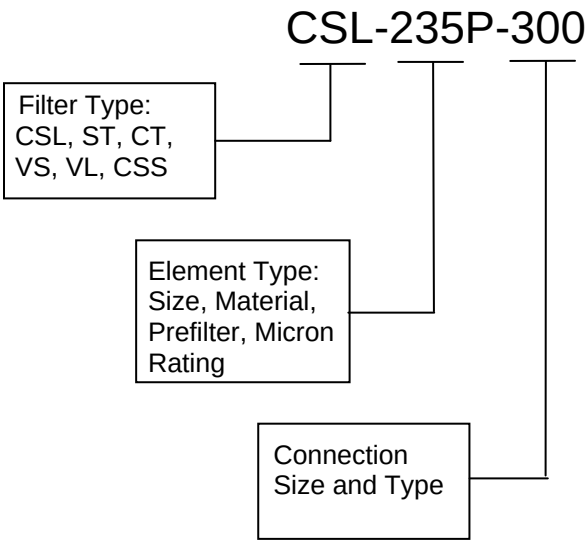
Fill in the actual nameplate data from your new Solberg inlet filter(s):

No.	Filter Model Number	Replacement Element
1		
2		
3		
4		
5		

Table 1

The model number designates the filter type, the original element configuration and housing connection size. For example, the following part number identifies the filter as being a 'CSL' design filter with a 235 element with prefilter and 3" MPT connection size:



2. Filtration Rules of Thumb

General: For peak output performance from a compressor, blower, vacuum pump, engine, or any other machine that consumes air, one must have clean, unrestricted air. Proper filtration can help stabilize the working environment within rotating equipment even when the external conditions may be quite severe. A critical component in creating the right working conditions is filter sizing. With the properly sized filter, equipment will run smoothly over its entire expected operating life.

A major factor in filtration and filter sizing is air velocity through the filter media. Generally, the slower the velocity of air through a media the higher the filter efficiency and, conversely, the lower the pressure drop. Therefore, the primary

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goal in filter sizing is to optimize the velocity of air through the media (sometimes called face velocity).

Rule of Thumb #1: Always begin with the filter cartridge requirements when sizing a filter. Once the appropriate element has been selected then move on to the housing requirements.

Rule of Thumb #2: Always ask or specify a filter based on a micron rating **with** filtration efficiencies. As an example, stating a requirement for a 1-micron filter is misleading because no efficiency rating has been specified. A 1-micron filter at 95-% efficiency may be less efficient than a 5-micron filter at 99% efficiency. For proper air system performance in light and industrial duty environments, a filter with a minimum of 99% filtration efficiency at 5 microns is required.

Rule of Thumb #3: Size your filter correctly by understanding the impact air velocity through a media has on efficiency and pressure drop. Maintain the suggested Air-to-Media ratios listed below based on the external environment listings and Filtration efficiency needs.

Filtration Efficiency Requirements (99+% efficiency)	**Environmental Conditions**	**Air to Media Ratio**	
Industrial Grade 2-micron **Paper**	Industrial Duty (clean, office/warehouse-like)	30 CFM/ft^2	$(51m^3/h)/cm^2$
	Severe Duty (workshop, factory-like)	15 CFM/ft^2	$(25.5m^3/h)/cm^2$
	Extreme Duty (Foundry, Construction-like)	10 CFM/ft^2	$(17m^3/h)/cm^2$
Industrial Grade 5-micron **Polyester**	Industrial Duty (clean, office/warehouse-like)	50 CFM/ft^2	$(85m^3/h)/cm^2$
	Severe Duty (workshop, factory-like)	40 CFM/ft^2	$(68m^3/h)/cm^2$
	Extreme Duty (Foundry, Construction-like)	25 CFM/ft^2	$(42.5m^3/h)/cm^2$
Industrial Grade 1-micron **Polyester**	Severe Duty (Foundry, Construction-like)	10 CFM/ft^2	$(17m^3/h)/cm^2$
Industrial Grade 0.3-micron **HEPA** Glass @ 99.97% efficiency	Industrial Duty (clean office/warehouse-like)	10 CFM/ft^2	$(17m^3/h)/cm^2$
	Severe Duty (workshop, factory-like)	7 CFM/ft^2	$(12m^3/h)/cm^2$
	Extreme Duty (Foundry, Construction-like)	5 CFM/ft^2	$(8.5m^3/h)/cm^2$

Table 2

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Rule of Thumb #4: Pressure drop is also caused by the dirt holding capacity of the element. As the element fills up with dirt, the pressure drop increases. It is important to document the pressure drop across a given filter when it is new and then clean or replace it when the pressure drop increases by 10" to 15" / 250-380mm H_2O from the original reading.

Rule of Thumb #5: The inlet connection greatly influences the overall pressure drop of the filter system. To minimize the restriction contributed by an inlet filter, a velocity of 6,000 ft/min (10200m^3/h) or less is suggested through the outlet pipe. The table below lists the suggested flows based on pipe size:

Pipe Size (inches)	Max Airflow		Pipe Size (inches)	Max Airflow		Pipe Size (inches)	Airflow	
1/4"	6 CFM	10m^3/h	1 ¼"	60 CFM	102m^3/h	6"	1,100 CFM	1870m^3/h
3/8"	8 CFM	14m^3/h	1 ½"	80 CFM	136m^3/h	8"	1,800 CFM	3060m^3/h
1/2"	10 CFM	17m^3/h	2"	135 CFM	230m^3/h	10"	3,300 CFM	5610m^3/h
3/4"	20 CFM	34m^3/h	2 ½"	195 CFM	332m^3/h	12"	4,700 CFM	7990m^3/h
1"	35 CFM	60m^3/h	3"	300 CFM	510m^3/h	14"	6,000 CFM	10200m^3/h
			4"	520 CFM	884m^3/h			
			5"	800 CFM	1360m^3/h			

Table 3 **Note: This information is for general use only. A qualified engineer must properly design each system.*

3. Element Specifications

Temperature Range: -15° to 220°F / -26° to 105°C
Filter Change-Out Differential: 10" to 15" / 250-380mm H_2O Over Initial Delta P

Media	Micron Rating
Standard Paper	99+% @ 2 micron
Standard Polyester	99+% @ 5 micron
"S" Series Wire Mesh	Epoxy Coated Wire Mesh
"Z" Series Polyester	99+% @ 1 micron
"HE" Series HEPA	99.97% @ 0.3 microns
"U" Series Polyester	99+% @ 25 micron
"W" Series Polyester	99+% @ 100 micron
"S2" Series	Stainless Steel Wire Mesh
"AC" & "ACP" Series	N/A
"Y" Series Polypropylene	99+% @ 5 micron

Table 4

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SOLBERG

Temperature Range: -15° to 385°F / -26° to 196°C
Filter Change-Out Differential: 10” to 15” / 250-380mm H_2O Over Initial Delta P

Media	Micron Rating
“MX” & “MXD” Series – Nomex Cloth	99+% @ 5 micron

Table 5

4. **Element Cleaning - Inlet Filtration**

Solberg elements should be cleaned or replaced, once the pressure drop reaches 15 to 20-inches water column (380 - 500mm WC) above the initial pressure drop of the installation.

The decision to clean the element rather than replace it is left to the discretion of the operator. Any damage which results from by-pass or additional pressure drop created by element cleaning is the sole responsibility of the operator.

WARNING

The overall performance of a filter element is altered once cleaned.

The initial pressure drop after cleaning will be greater than the original, clean pressure drop of the element.

After each subsequent cleaning, the initial pressure drop will continue to increase.

Under all circumstances, the initial pressure drop of the element needs to be maintained at less than 20-inches water column (500mm WC).

Cleaned elements that exceed 20-inches water column (500mm WC) at start-up should be replaced with new elements.

With many types of equipment, the maximum pressure drop allowed will be dictated by the ability of the equipment to perform to its rated capacity. Under all

circumstances, the operator should avoid exceeding the manufacturer's recommended maximum pressure drop for their specific equipment.

A. ***Polyester Element***: The polyester element may be washed in warm soapy water, vacuumed, gently blown out or replaced. The element should be dry before reinstallation. The element should be replaced after a maximum of three cleanings.
B. ***Paper Element***: The paper element may be lightly blown with low pressure air. It is disposable and in most cases should be replaced with a new element.
C. ***Polyurethane Prefilter***: The prefilter may be washed as a sponge or replaced to give the element a longer service life.
D. ***Epoxy Coated Wire Mesh and Stainless Steel Wire Mesh Elements***: Cleaning instructions similar to polyester, except mild solvents may be used.
E. ***Activated Carbon Element***: Not cleanable
F. ***Polypropylene Element***: Cleaning instructions similar to polyester
G. ***Nomex Cloth Element***: Cleaning instructions similar to polyester

If you are not confident that the integrity of the element was maintained during cleaning, it is recommended that a new element be installed. Also, spare parts such as gaskets, wing nuts and washers can be supplied upon request.

Section C

PROCEDURES

1. Installation.

A. Maximum inlet gas stream temperature for most Solberg inlet vacuum filter products is 220°F / 105°C. Temperatures in excess of this could cause damage to elements, media and elastomers.

B. Direction of flow is typically from the outside of the element to the inside of the element. Most products have arrows indicating direction of flow on inlet and outlet ports.

C. Ensure that pipe/flange connections are adequately sealed so the potential for leaks is reduced to a minimum.

2. Disconnecting canister top from canister base.

A. ST/CT/Small CSL: Release wire-form clips or loosen wing nut on "claw" bolts.

B. Large CSL: Loosen wing nut or hex head on T-bolts.

C. CSS: Twist upper housing to release.

D. VS/VL: Remove V-clamp by loosening Hex Nut or T-bolt and releasing.

E. Lift off canister top.

3. Removing element for service/maintenance.

A. Remove retaining hex head/wing-nut and washer carefully, and then remove element. Some elements will have a top plate that should also be removed.

B. Clean sealing surfaces of housing, top & base plates, and element endcaps so that they are free of dirt or any other particulate.

WARNING

Failure to comply with these instructions may result in system or pump contamination.

4. Securing Element.

A. Place new or cleaned element evenly on base plate. Be sure element seats properly on base and there is no dirt or particulate present on sealing surfaces.

B. Place top plate (if necessary) on element by centering on tap bolt.

C. Secure washer and wing nut to end cap (or top plate) and tap bolt. Element must be tightly secured. Note: DO NOT over tighten!

WARNING

Defective installation may cause system or pump contamination. Use only genuine Solberg replacement parts.

5. Securing canister top to canister base.

A. Make sure all surfaces are free from dust and other particulate.

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B. Hemisphere o-ring must rest evenly along canister/casting base o-ring groove.

C. ST/CT/Small CSL: Hold canister housing against o-ring or sealing ring on main filter head. Re-fasten wire-form clips or “claw” bolts.

D. Large CSL: Replace housing top plate. Feed T-bolts into corresponding slots and tighten evenly around perimeter. Note: Do NOT over tighten!

E. VS/VL: Secure V-clamp by disconnecting hex nut or T-bolt portion and placing V-clamp along the diameter of canister o-ring groove. Fasten T-bolt and secure tightly. V-CLAMP LEGS MUST REST UNIFORMLY ALONG ENTIRE O-RING GROOVE.

F. CSS: Reassemble top housing to bottom housing by aligning tabs and turning into place.

Section D

MAINTENANCE RECOMMENDATIONS

1. Pressure drop readings are recommended to have an effective air filter. Always document initial pressure drop during start-up when element is clean. Replacement cartridge is needed when system experiences 10” to 15” / 250-380mm H_2O higher pressure drop above the initial reading. Refer to page 4 for instructions.

2. Always check replacement cartridge gaskets to insure they are adhered uniformly along the end caps during handling. If not, contact Solberg Manufacturing, Inc. immediately. Do not modify or change from Solberg specified parts!

3. Always check inlets/outlets, element base and its components when replacing element to insure cleanliness. Wipe clean if necessary.

4. Operate only when a proper seal exists.

5. VS/VL: Never operate without absolute assurance that V-clamp is secured correctly along entire diameter of canisters. Check along V-clamp for wear. Replace if any distortion occurs due to handling and usage.

SPARE PARTS

Contact your Solberg Representative for spare part model numbers.

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Rev: MMVF-910

Series 1950 Explosion-Proof Differential Pressure Switches

Specifications - Installation and Operating Instructions

Series 1950 Explosion-Proof Differential Pressure Switches combine the best features of the Series 1900 Pressure Switch with an integral explosion-proof and weather-proof housing. Each unit is UL & CSA listed; FM approved for use in Class I, Groups C & D; Class II, Groups E, F, & G; and Class III atmospheres (NEMA 7 & 9). They are totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches w.c. and from .5 to 50 psi (3.4 to 345 kPa).

Easy access to the SPDT switch for electrical hook-up is provided by removing the top plate of the three-part aluminum housing. Adjustment to the set point of the switch can be made without disassembling the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

CAUTION
For use only with air or compatible gases. Use of the Model 1950 switch with explosive media connected to the Low pressure port (including differential pressure applications in such media) is not recommended. Switch contact arcing can cause an explosion inside the switch housing which, while contained, may render the switch inoperative. If switch is being used to sense a single positive pressure relative to atmosphere, run a line from the low pressure port to a non-hazardous area free of combustible gases. This may increase response time on -0 and -00 models.

Note: The last number-letter combination in the model number identifies the switch's electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In case of special models, a number 1 rating is the same as 2; a number 3 or 4 rating is 10A 125, 250, 480 VAC; 1/8 H.P. 125 VAC; 1/4 H.P. 250 VAC; a number 5 or 6 rating is 1A 125 VAC. Letter B indicates a Buna-N diaphragm; N = Neoprene; S = Silicone; and V = Viton®.

UL and CSA Listed, FM Approved For
CL. I GR. C, D - CL. II GR. E, F, G - CL. III

Series 1950 Switches
Operating ranges and deadbands

To order specify Model Number	Operating Range: Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-02-2S	0.03 to 0.10	0.025	0.05
1950-00-2F	0.07 to 0.15	0.04	0.05
1950-0-2F	0.15 to 0.5	0.10	0.15
1950-1-2F	0.4 to 1.6	0.15	0.20
1950-5-2F	1.4 to 5.5	0.3	0.4
1950-10-2F	3.0 to 11.0	0.4	0.5
1950-20-2F	4.0 to 20.0	0.4	0.6
Model Number	Operating Range: PSI	Approximate Dead Band	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2.0	0.3 psi	0.3 psi
1950P-8-2F	1.5 to 8.0	1.0 psi	1.0 psi
1950P-15-2F	3.0 to 15.0	0.9 psi	0.9 psi
1950P-25-2F	4.0 to 25.0	0.7 psi	0.7 psi
1950P-50-2F	15.0 to 50	1.0 psi	1.5 psi

SPECIFICATIONS
Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits:
Continuous: 1950's - 45″ w.c. (0.11 bar);
1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar).
Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: IP54, NEMA 3, 7 and 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8″ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, UL, CSA, FM.

RESPONSE TIME: Because of restrictive effect of flame arrestors, switch response time may be as much as 10-25 seconds where applied pressures are near set point.

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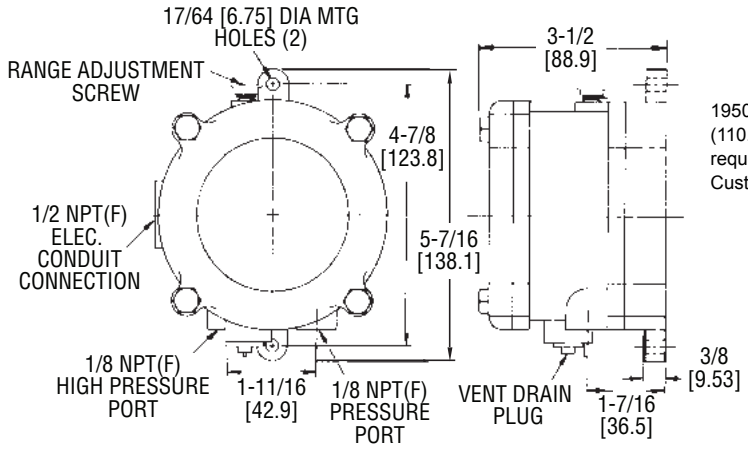

1950-02: 7-3/4″ (196.9) dia. x 4-11/32″ (110.3) depth. For complete dimensions request drawing 28-700175-00 from our Customer Service Department

1950 Switch Outline Dimensions

INSTALLATION

1. Select a location free from excess vibration and corrosive atmospheres where temperatures will be within the limits noted under Specifications on reverse. Switch may be installed outdoors or in areas where the hazard of explosion exists. See reverse for specific types of hazardous service.

2. Mount standard switches with the diaphragm in a vertical plane and with switch lettering and nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical.

3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4″ O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8″ female NPT pressure ports as noted below:

A. Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HIGH PRESS, and from source of lower pressure to low pressure port marked LOW PRESS.

B. Pressure only (above atmospheric pressure) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.

C. Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.

4. To make electrical connections, remove the three hex head screws from the cover and after loosening the fourth captive screw, swing the cover aside. Electrical connections to the standard single pole, double throw snap switch are provided by means of terminals marked “COM” (common), “NO” (norm open), “NC” (norm closed). The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point. Switch loads for standard models should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with an increase in ambient temperature, load inductance, or cycling rate. Whenever an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

ADJUSTMENT: To Change the Set point

1. Remove the plastic cap and turn the slotted Adjust-ment Screw at the top of the housing clockwise to raise the set point pressure and counterclockwise to lower the set point. After calibration, replace the plastic cap and re-check the set point.

2. The recommended procedure for calibrating or checking calibration is to use a “T” assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.

3. For highly critical applications check the set point adjustment and if necessary, reset it as noted in step A.

MAINTENANCE

The moving parts of these switches need no maintenance or lubrication. The only adjustment is that of the set point. Care should be taken to keep the switch reasonably clean. Periodically the vent drain plug should be rotated, then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch. The Series 1950 Explosion-Proof Differential Pressure Switch is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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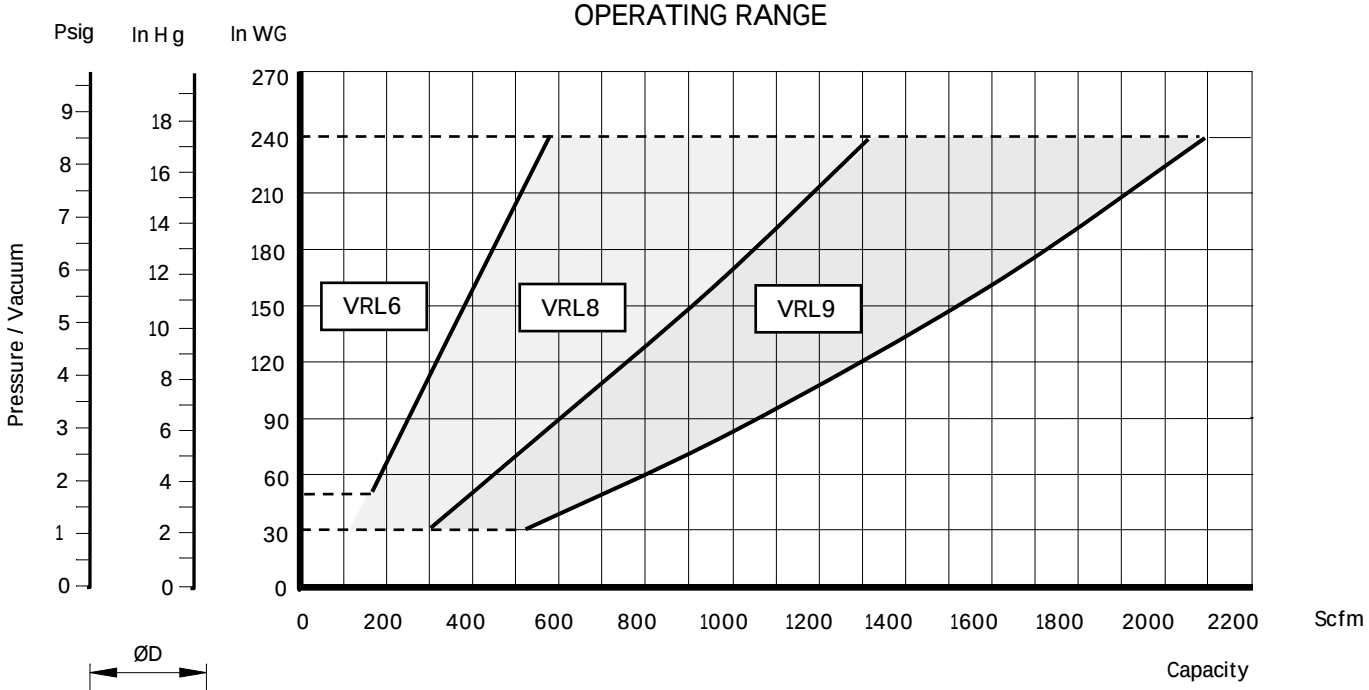
Safety Valves

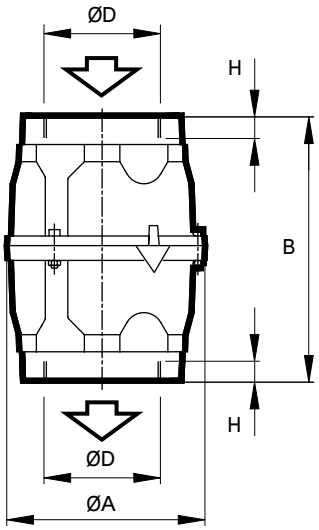
SN 1733 -5 1/1

The VRL valves are designed to protect blowers and / or motors from over pressurization or excess vacuum. When there is over pressurization, the valve opens and discharges to the outside. When there is excess in vacuum, the valve opens and takes flow from outside.
The valves have been designed for low pressure / low vacuum, with minimal difference between the initial value at which the valve begins to open and its fully opened position. The valves are supplied with 2 different springs to maximize their efficiency.
These compact valves, made of aluminum alloy, are both easy to install and calibrate. The valves are designed to operate in a wide range of capacities. The VRL can be plumbed to divert excess primary flow through a secondary external outlet when working in pressure conditions or to pipe in a secondary flow when working in vacuum.
Maximum efficiency is achieved by keeping operating values (flow versus pressure or vacuum) within the operating range (shaded area on graph). Capacity refers to air having a density equal to 0.075 lbs./cu.ft .

VRL6 VRL8 VRL9

OPERATING RANGE





OVERALL DIMENSIONS

TYPE	ND	D	A	B	H	WEIGHT (Lbs)
VRL6	2”	2” NPT	4.02	6.90	0.47	1.9
VRL8	3”	3” NPT	5.31	7.48	0.59	4.2
VRL9	4”	4” NPT	6.30	8.11	0.71	5.7

- Dimensions in inches.
- Specifications subject to change without prior notice.

® **FPZ S.p.A.**
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Fax +39 039 60 41 296
www.fpz.com

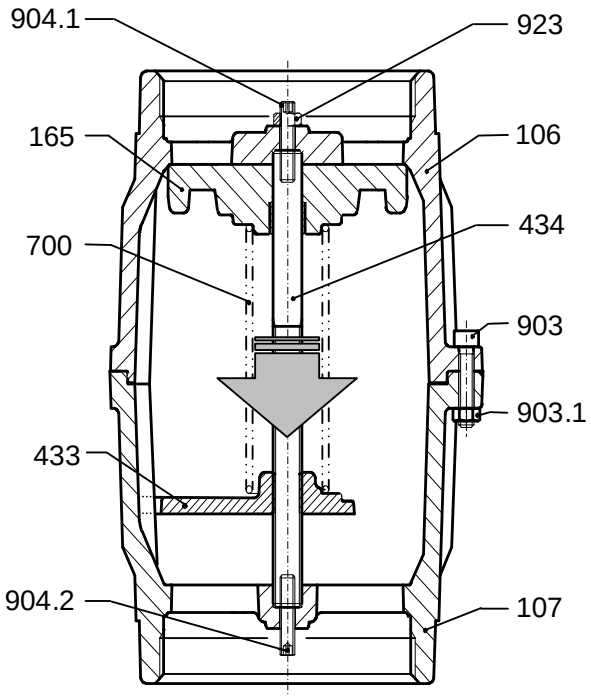
I – GB – F – D – E **SN 1701-7**

VALVOLA DI SICUREZZA VRL
SAFETY VALVE VRL
SOUPAPE DE SECURITE VRL
SICHERHEITSVENTIL VRL
VALVULA DE SEGURIDAD VRL

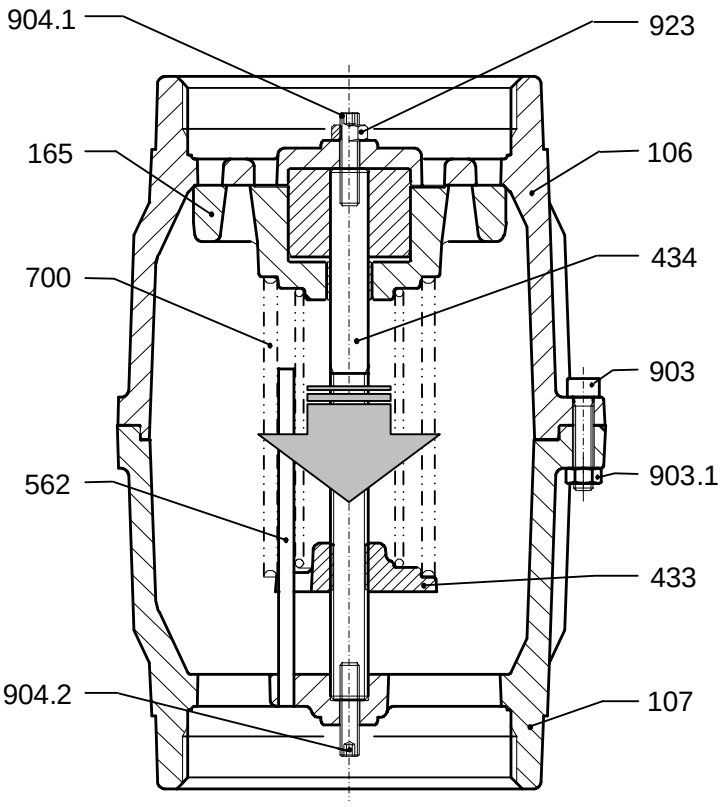
ISTRUZIONI D'USO
USE INSTRUCTIONS
INSTRUCTIONS D'UTILISATION
ANWENDUNGSHINWEISE
INSTRUCCIONES PARA EL USO

ATTENZIONE! LA VALVOLA E' FORNITA NON TARATA
CAUTION! THE VALVE IS SUPPLIED NOT CALIBRATED
ATTENTION ! LA SOUPAPE EST FOURNIE NON TAREE
ACHTUNG ! DAS VENTIL IST WERKSEITIG NICHT GEEICHT
ATENCION ! LA VALVULA NO ESTA GRADUADA

LEGGERE ATTENTAMENTE TUTTE LE ISTRUZIONI E CONSERVARLE
PLEASE READ CAREFULLY ALL INSTRUCTIONS AND KEEP THEM FOR FUTURE REFERENCE
LIRE ATTENTIVEMENT TOUTES LES INSTRUCTIONS ET LES CONSERVER
ALLE ANLEITUNGEN SIND SORGFÄLTIG ZU LESEN UND AUFZUBEWAHREN!
LEER ATENTAMENTE LAS INSTRUCCIONES Y CONSERVARLAS



VRL6
Fig. 1a



VRL8 - VRL9
Fig. 1b

ITEM	**Denominazione - *Description* - Désignation - *Description* - Descripciòn**
106	Corpo - *Housing* - Corps supérieur - *Gehäuse* - Cuerpo
107	Coperchio - *Cover* - Couvercle - *Abdeckung* - Cubierta
165	Otturatore - *Shutter* - Obturateur - *Verschluss* - Obturador
433	Piattello guida molla - *Spring guide disc* - Guide ressort - *Federführungsscheibe* - Disco guìa muelle
434	Asta - *Shutter guide* - Tige - *Schließführung* - Vastago
562	Spina cilindrica - Dowel pin -Goupille cylindrique - *Führungsstift* - Pin
700	Molla - *Spring* - Ressort - *Feder* - Muelle
903	Vite - *Screw* - Vis - *Schraube* - Tornillo
903.1	Dado - *Nut* - Ecrou - *Schraubenmutter* - Tuerca
904.1	Grano superiore - *Upper grub screw* - Tige de réglage supérieure – *Obere Einstellschraube* - Espàrrago superior
904.2	Grano inferiore - *Lower grub screw* - Tige de réglage inférieure - *Untere Einstellschraube* - Espàrrago inferior
923	Dado di fermo - *Nut* - Ecrou de blocage -*Schraubenmutter* - Contratuerca

I CONDIZIONI D'UTILIZZO

- **LE VALVOLE VRL SONO ADATTE AL CONVOGLIAMENTO DI ARIA E GAS NON ESPLOSIVI, NON INFIAMMABILI, NON AGGRESSIVI, IN ATMOSFERA NON ESPLOSIVA. LA TEMPERATURA DEL FLUIDO CONVOGLIATO È AMMESSA NEL CAMPO DI -15 A +160 °C.**
- **VALVOLE PROGETTATE E FABBRICATE PER LA LIMITAZIONE NEL CAMPO DELLE BASSE PRESSIONI / DEPRESSIONI, PER UN UTILIZZO SPECIFICO SU SOFFIANTI, ASPIRATORI E COMPRESSORI A BASSE PRESSIONI;**
- **NON SOPPORTANO PRESSIONI INTERNE ELEVATE, COMUNQUE NON SUPERIORI A 2.8 bar A;**
- **SONO SOGGETTE A PICCOLE PERDITE DEL FLUIDO CONVOGLIATO;**
- **CORPI SOLIDI ANCHE DI PICCOLE DIMENSIONI E SPORCIZIA POSSONO PROVOCARE GRAVI DANNI, VANNO QUINDI SEPARATI DAL FLUSSO MEDIANTE ADEGUATI FILTRI IN ASPIRAZIONE.**

GB *CONDITIONS OF USE*

- ***THE VRL VALVES ARE DESIGNED FOR THE HANDLING OF AIR OR NON-EXPLOSIVE, NON-HAZARDOUS AND NON-FLAMMABLE GASES IN NON-EXPLOSIVE ENVIRONMENTS. THE GAS INLET TEMPERATURE MUST BE IN THE RANGE OF -15 TO +160 °C.***
- ***RELIEF VALVES ARE DESIGNED AND MANUFACTURED TO LIMIT THE OPERATING PRESSURE IN LOW PRESSURE/VACUUM APPLICATIONS. THEY ARE FOR USE SPECIFICALLY ON LOW PRESSURE BLOWERS AND VACUUM PUMPS ONLY;***
- ***THE VALVE CANNOT WITHSTAND HIGH INTERNAL PRESSURE, DESIGN MAXIMUM OF 2.8 bar A;***
- ***THERE IS SMALL LOSS OF THE AIR/GAS BEING HANDLED;***
- ***SOLID PARTICULES, HOWEVER SMALL, INCLUDING DIRT CAN CAUSE SERIOUS DAMAGE; THEREFORE IT IS ESSENTIAL THAT SUCH SUBSTANCES SHOULD BE REMOVED FROM THE GAS BY SUITABLE FILTERS UPSTREAM OF THE INLET.***

F CONDITIONS D'UTILISATION

- **LES SOUPAPES VRL SONT ADAPTÉS À L'ACHEMINEMENT D'AIR ET DE GAZ NON EXPLOSIFS, ININFLAMMABLES, NON AGRESSIFS, DANS UNE ATMOSPHÈRE NON EXPLOSIVE. LA TEMPÉRATURE DU FLUIDE ACHEMINÉ EST ADMISE DANS UN ÉVENTAIL DE -15 À +160 °C.**
- **CES SOUPAPES ONT ETÉ DÉVELOPPÉES ET CONSTRUITES AFIN DE LIMITER LES VALEURS MAXIMALES VIDE/PRESSION ET LEUR UTILISATION EST SPÉCIFIQUEMENT RESERVÉE AUX ASPIRATEURS ET COMPRESSEURS BASSES PRESSION;**
- **NE SUPPORTENT PAS DES PRESSIONS INTERNES ÉLEVÉES, C'EST-À-DIRE DES PRESSIONS SUPÉRIEURES À 2.8 bar A;**
- **SONT SUJETTES À DE PETITES PERTES DU FLUIDE ACHEMINÉ;**
- **DES CORPS SOLIDES MÊME DE PETITES DIMENSIONS ET LÉGÈREMENT SALES PEUVENT PROVOQUER DE GRAVES DOMMAGES, ILS SONT PAR CONSÉQUENT SÉPARÉS DU FLUX PAR DES FILTRES ADÉQUANTS EN ASPIRATION.**

D *EINSATZBEDINGUNGEN*

- ***DIE VENTILE DER SERIE VRL SIND FÜR DEN DAUERBETRIEB IN NICHT-EXPLOSIVER UMGEBUNG ZUM ANSAUGEN UND VERDICHTEN VON LUFT ODER NICHT-EXPLOSIVEN, NICHT-BRENNBAREN UND NICHT-AGGRESSIVEN GASEN GEEIGNET. DIE ZULÄSSIGE ANSAUGTEMPERATUREN LIEGT ZWISCHEN -15 BIS +160 °C.***
- ***DIE SPEZIELL FÜR DEN NIEDERDRUCK- BZW. NIEDERVAKUUMBEREICH ENTWICKELTEN VENTILE SIND FÜR DIE SPEZIFISCHE ANWENDUNG IN VAKUUMPUMPEN UND KOMPRESSOREN GEEIGNET;***
- ***DIE GEHÄUSE WIDERSTEHEN KEINEN HOHEN INNENDRÜCKEN. UNTER KEINEN UMSTÄNDEN DARF DER MAX. BETRIEBSDRUCK VON 2.8 bar A ÜBERSCHRITTEN WERDEN;***
- ***DIE VENTILE SIND NICHT VOLLSTÄNDIG GASDICHT;***
- ***FREMDKÖRPER, AUCH GERINGER GRÖßE, UND VERUNREINIGUNGER KÖNNEN SCHWERE SCHÄDEN VERURSACHEN. SIE MÜSSEN DAHER AUS DEM FÖRDERMEDIUM MIT GEEIGNETEN ANSAUGFILTERN ENTFERNT WERDEN.***

E CONDICONES DE USO

- **LAS VALVULAS VRL SON ADAPTAS PARA EL MOVIMIENO DE AIRE O GASES NO EXPLOSIVOS, NO PELIGROSOS Y NO INFLAMABLES Y PARA SERVICIO EN AMBIENTES NO EXPLOSIVOS. LA TEMPERATURA DE ENTRADA DEL GAS DEBE ESTAR ENTRE LOS –15 Y +160 °C.**
- **VALVULAS PROYECTADAS Y FABRICADAS PARA LA LIMITACION EN EL SECTOR DE LAS BAJAS PRESIONES / VACIOS, PARA UN UTILIZO SOBRE ASPIRADORES, COMPRESORES A BAJAS PRESIONES.**
- **LA VALVULA NO PUEDE CONTENER PRESIONES INTERNAS ALTAS, NO MAYORES QUE 2.8 bar A;**
- **HAY UNA PECHEÑA PERDIDA DE FLUIDO MANEJADO;**
- **LAS PARTICULAS SOLIDAS, AUNQUE PEQUEÑAS, INCLUIDO EL POLVO, PUEDEN CAUSAR SERIOS DAÑOS. POR LO TANTO ES ESENCIAL QUE DICHAS SUSTANCIAS SEAN ELIMINADAS DEL GAS MEDIANTE FILTROS APROPIADOS ANTES DE LA ENTRADA.**

DIAGRAMMA DI SELEZIONE - *SELECTION DIAGRAM*
SCHÉMA DE SÉLECTION – AUSWAHLDIAGRAMM
DIAGRAMA DE SELECCION

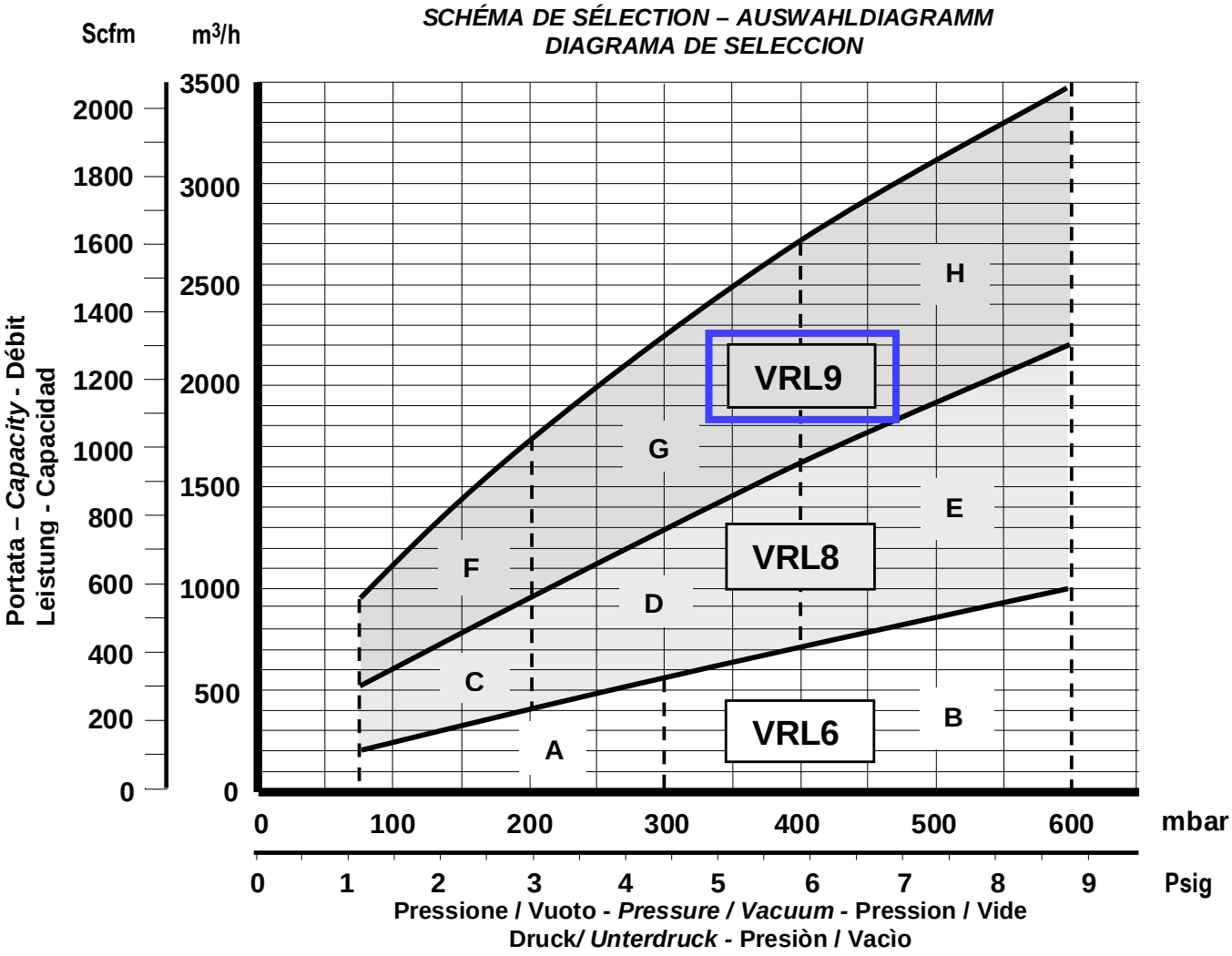


TABELLA DI SELEZIONE MOLLA - *SPRING SELECTION CHART* - TABLEAU DE SÉLECTION RESSORT
UEBERSICHTSTABELLE FEDERN - TABLA DE SELECCION MUELLE

RANGE	MOLLA *SPRING* RESSORT *FEDER* MUELLE N°	Pressione / Vuoto *Pressure / Vacuum* Pression / Vide *Druck / Underdruck* Presiòn / Vacìo MIN [mbar]	MIN [psig]	Pressione / Vuoto *Pressure / Vacuum* Pression / Vide *Druck / Underdruck* Presiòn / Vacìo MAX [mbar]	MAX [psig]	Colore di identificazione *Colour of identification* Couleur d' identification *Farbidentifizierung* Color de identificaciòn
VRL6						
A	I	75	1.102	300	4.408	-
B	II	300	4.408	600	8,820	VERDE - *GREEN* - VERT - *GRÜN* - VERDE
VRL8						
C	I	75	1.102	200	2.940	-
D	II	200	2.940	400	5.880	VERDE – *GREEN* VERT - *GRÜN* - VERDE
E	I + II	400	5.880	600	8,820	-
VRL9						
F	I	75	1.102	200	2.940	VERDE - *GREEN* - VERT - *GRÜN* - VERDE
G	II	200	2.940	400	5.880	-
H	I + II	400	5.880	600	8,820	-

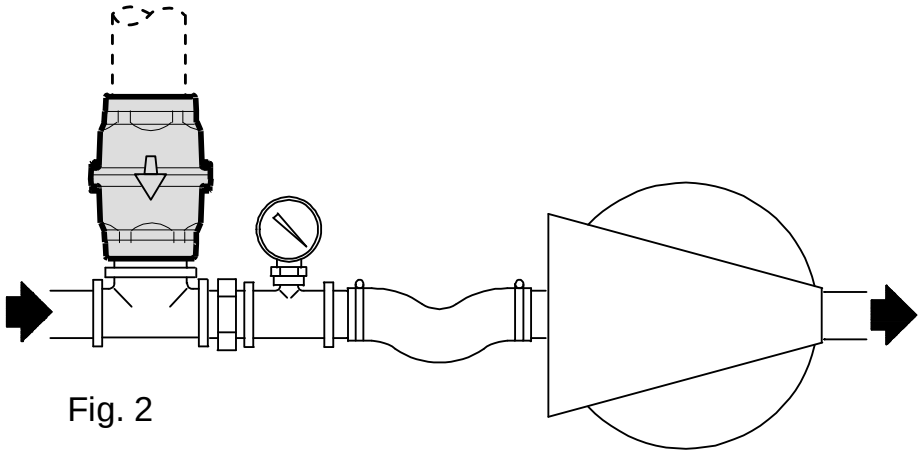


Fig. 2

SCHEMA DI INSTALLAZIONE – VALVOLA LIMITATRICE DI VUOTO
INSTALLATION SKETCH – VACUUM RELIEF VALVE
INSTALLATIONSSCHEMA – VAKUUMVENTIL
SCHÉMA DE INSTALLATION – SOUPAPE CASSE VIDE
ESQUEMA DE INSTALATIÒN – VALVULA LIMITADORA DE VACIO

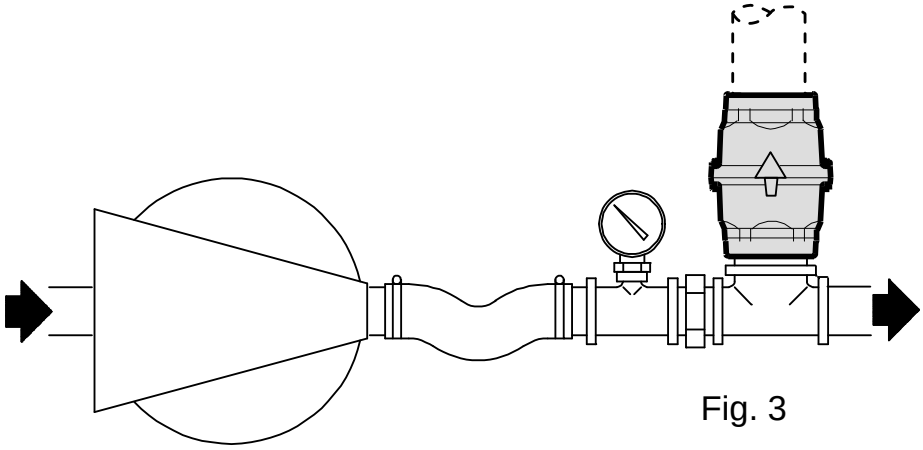


Fig. 3

SCHEMA DI INSTALLAZIONE – VALVOLA LIMITATRICE DI PRESSIONE
INSTALLATION SKETCH – PRESSURE RELIEF VALVE
INSTALLATIONSSCHEMA – DRUCKVENTIL
SCHÉMA DE INSTALLATION – SOUPAPE DE SÉCURITÉ
ESQUEMA DE INSTALATIÒN – VALVULA LIMITADORA DE PRESION

1. CHOICE OF SPRING

The valve is supplied with 2 different springs; each spring is to be used within a specific pressure-vacuum operating range. For the VRL8 and VRL9 there is the possibility to use both springs working in parallel.
Referring to the SELECTION DIAGRAM, check that the valve is correctly sized and depending where the operating point (area A, B,…H) is located, choose one or two springs according to SPRING SELECTION CHART.
The valve is supplied with spring # I installed. If spring needs to be replaced or a supplementary spring is needed to be added (for VRL8 / VRL9), proceed to point # 2 otherwise, adjust valve as per point #3.

2. INSTRUCTIONS FOR SPRING REPLACEMENT (OR MOUNTING ADITIONAL SPRING FOR VRL8 / VRL9)

- Remove the two plastic caps on valve.
- **Ensure stop-nut 923 is locked on the upper housing 106.**
- Unscrew screw 903 from nut 903.1.
- Remove cover 107 from housing 106.
- Unscrew spring guide disc 433 taking it out from shutter guide 434.
- Remove spring 700 (only in case of replacement).
- Install the appropriate spring into shutter 165.
- Compress spring and screw spring guide disc 433 on shutter guide 434 for at least 20 full thread terms.
- Check that both ends of the spring are properly positioned within their seats.
- Install the cover 107 on the housing 106 inserting:
  - for VRL6: the sliding guide on the slot in spring guide disc 433.
  - for VRL8 and VRL9: dowel pin 562 on the slot in spring guide disc 433.
- Tighten screw 903 on nut 903.1.

3. VALVE SETTING

A) Setting-up at allowed vacuum level

- Remove the two plastic caps on valve, if any.
- Position valve on the suction by-pass and connect a vacuum gage as close as possible to the exhauster inlet (Fig. 2).
- Unscrew nut 923.
- Relieve spring tension by backing off upper grub screw 904.1 with the fit key.
- Turn on exhauster. Induce highest attainable vacuum by throttling air intake upstream relief valve (normally reducing throttle to fully-closed).
- Adjust upper grub screw 904.1 until maximum allowable vacuum level is reached.
- Tighten nut 923 keeping blocked upper grub screw 904.1.
- Open suction line.

Double-check vacuum gauge to ensure no additional losses are induced by pipes or filters installed upstream relief valve.

B) Setting-up at allowed pressure level

- Remove the two plastic caps on valve, if any.
- Remove nut 923 from upper grub screw 904.1 and place it on to the lower grub screw 904.2. Do not tighten.
- Position valve on the discharge by-pass and connect a pressure gage as close as possible to the blower outlet (Fig. 3).
- Relieve spring tension by backing on lower grub screw 904.2 with the fit key.
- Turn on blower. Induce highest attainable pressure by throttling air discharge downstream of the valve (normally reducing throttle to fully-closed).
- Unscrew lower grub screw 904.2 until maximum allowable pressure level is reached.
- Tighten nut 923 keeping blocked lower grub screw 904.2.
- Open discharge line.

Double-check pressure gauge to ensure no additional losses are induced by pipes or filters installed downstream the valve

FPZ BLOWER TECHNOLOGY

REGENERATIVE BLOWERS - VACUUM

SCL K07 / K08 / K09 / K10 / K11 / K12

TS SERIES - GOR/GVR RANGE

SN 2165-4 1/2

TECHNICAL CHARACTERISTICS

- Aluminium alloy construction
- Smooth operation
- High efficiency impeller
- Maintenance free
- Mountable in any position
- G1/8" female thread on both suction and discharge silencer port flanges

OPTIONS

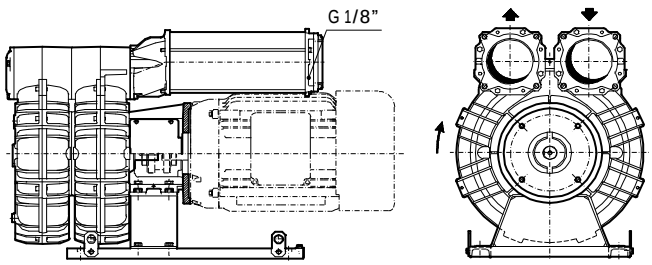
- Special voltages (IEC 38)
- Surface treatments

ACCESSORIES

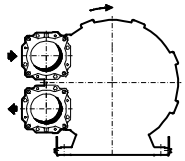
- Inlet and/or inline filters
- Additional inlet/outlet silencers
- Safety valves
- Flow converting device
- Optional connectors

For dimensions, please refer to drw:
GOR range: SI 1879
GVR range: SI 1880

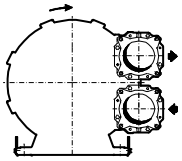
GOR RANGE



SCL Kxx-TS GOR-C

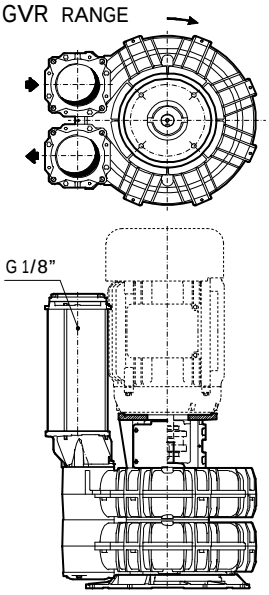


SCL Kxx-TS GOR-A



SCL Kxx-TS GOR-B

GVR RANGE



Model	Maximum flow cfm		Installed power	Size	Maximum differential pressure Δp (In Hg)		Noise level Lp dB (A) (1)		Weight (2)
	60 Hz 3500 rpm	50 Hz 2900 rpm	Hp		60 Hz 3500 rpm	50 Hz 2900 rpm	60 Hz 3500 rpm	50 Hz 2900 rpm	Lbs
K07-TS	588	487	7 ½	NEMA 182-4TC	2.6	4.4	84.5	82.5	160.90
				NEMA 213-5TC	2.6	4.4	84.5	82.5	160.90
			10	NEMA 213-5TC	4.4	6.6	84.8	82.8	160.90
			15	NEMA 213-5TC	8.1	8.1	85.4	83.4	160.90
				NEMA 254-6TC (3)	8.1	8.1	85.4	83.4	167.60
			20	NEMA 254-6TC (3)	8.8	8.1	85.9	83.4	167.60
K08-TS	715	592	10	NEMA 213-5TC	2.7	4.7	81.2	79.2	172.00
			15	NEMA 213-5TC	5.5	7.7	82.9	80.9	172.00
				NEMA 254-6TC (3)	5.5	7.7	82.9	80.9	180.80
			20	NEMA 254-6TC (3)	7.4	8.8	84.8	80.8	180.80
			25	NEMA 284-6TSC (3)	9.6	8.8	87.0	80.8	174.20
K09-TS	941	780	15	NEMA 213-5TC	3.8	5.5	82.2	80.2	202.80
				NEMA 254-6TC (3)	3.8	5.5	82.2	80.2	208.30
			20	NEMA 254-6TC (3)	5.9	7.9	84.1	82.1	208.30
			25	NEMA 284-6TSC (3)	8.1	8.8	86.1	84.1	205.00
			30	NEMA 284-6TSC (3)	8.8	8.8	88.1	84.1	205.00
			40	NEMA 324-6TSC (3)	9.6	8.8	90.1	84.1	220.50
K10-TS	1093	906	15	NEMA 213-5TC	3.0	4.7	89.1	87.1	209.40
				NEMA 254-6TC (3)	3.0	4.7	89.1	87.1	216.10
			20	NEMA 254-6TC (3)	4.8	6.6	89.4	87.4	216.10
			25	NEMA 284-6TSC (3)	5.9	8.1	89.7	87.7	211.60
			30	NEMA 284-6TSC (3)	7.4	9.6	90.0	88.0	211.60
			40	NEMA 324-6TSC (3)	10.3	9.6	90.3	88.0	227.10
K11-TS	1254	1039	25	NEMA 284-6TSC	3.7	6.5	90.7	88.7	251.30
			30	NEMA 284-6TSC	5.1	8.1	91.3	89.3	251.30
			40	NEMA 324-6TSC (3)	7.4	9.6	91.9	89.9	269.00
			50	NEMA 324-6TSC (3)	10.3	9.6	92.5	89.9	269.00
K12-TS	1410	1168	30	NEMA 284-6TSC	3.3	5.9	91.9	89.9	249.10
			40	NEMA 324-6TSC (3)	5.2	8.8	92.5	90.5	266.80
			50	NEMA 324-6TSC (3)	8.1	-	93.1	-	266.80

(1) Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744.
(2) Value is refered to weight of the machine without electric motor
(3) Not applicable on SCL Kxx - GVR
- For proper use, the blower should be equipped with inlet filter and safety valve; other accessories available on request.

- Specifications subject to change without notice.
- Ambient temperature from +5°to +104°F.

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FPZ BLOWER TECHNOLOGY

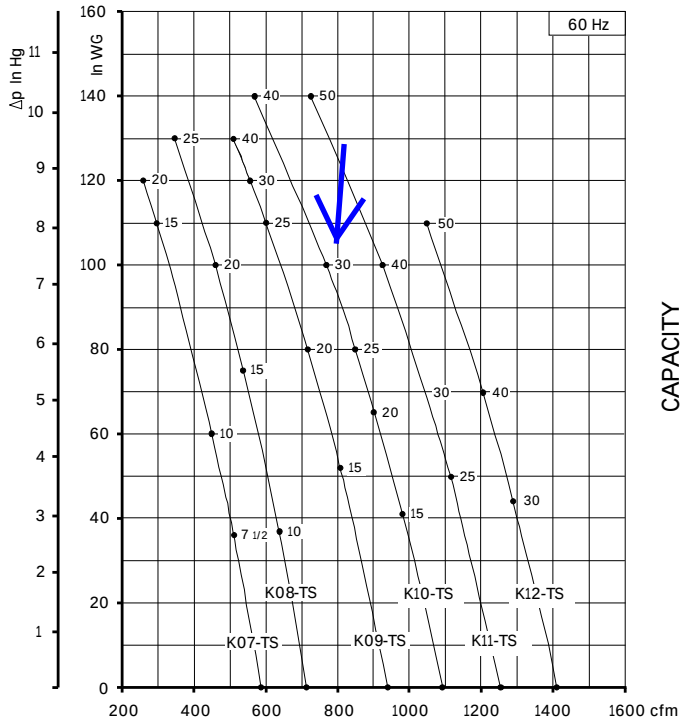
REGENERATIVE BLOWERS - VACUUM

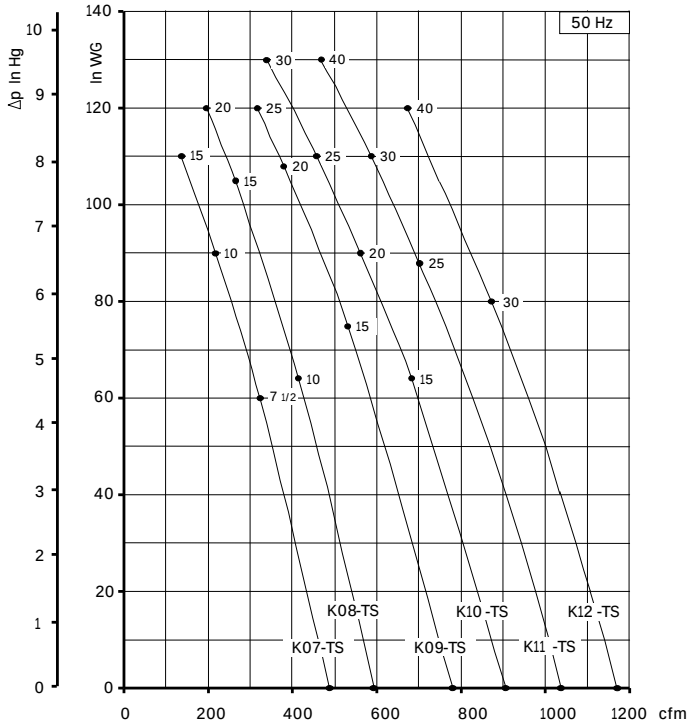
SCL K07 / K08 / K09 / K10 / K11 / K12

TS SERIES - GOR/GVR RANGE

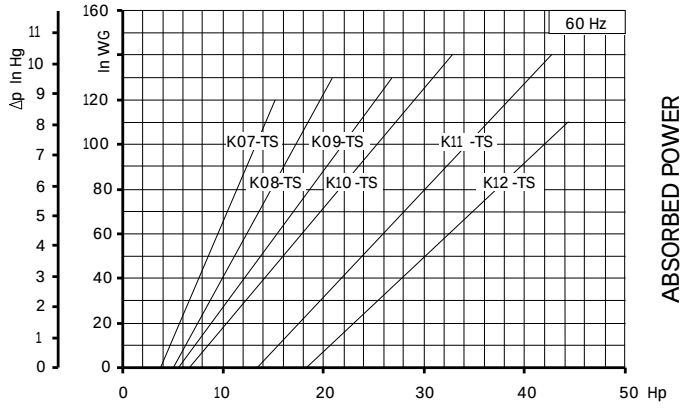
SN 2165-4 2/2

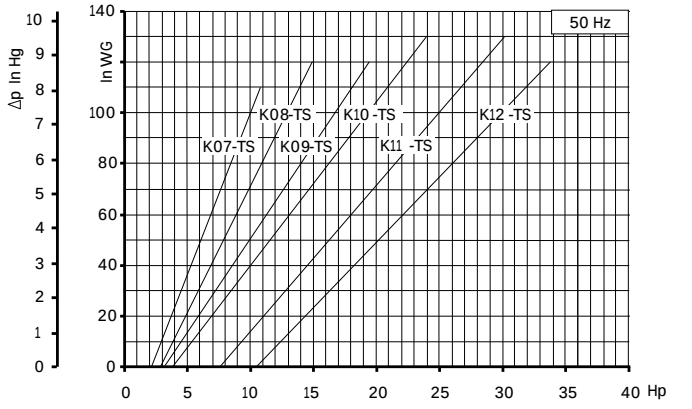
CAPACITY



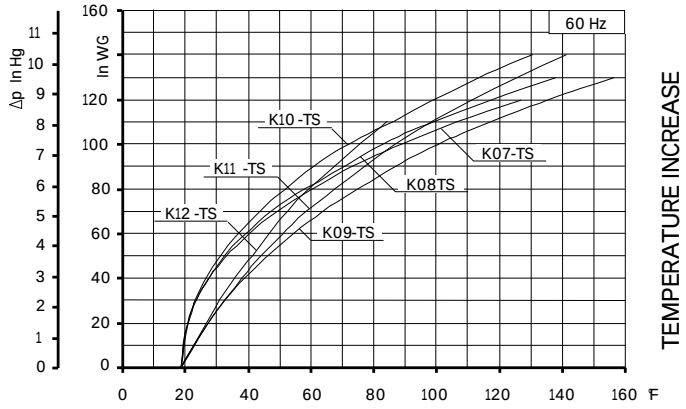


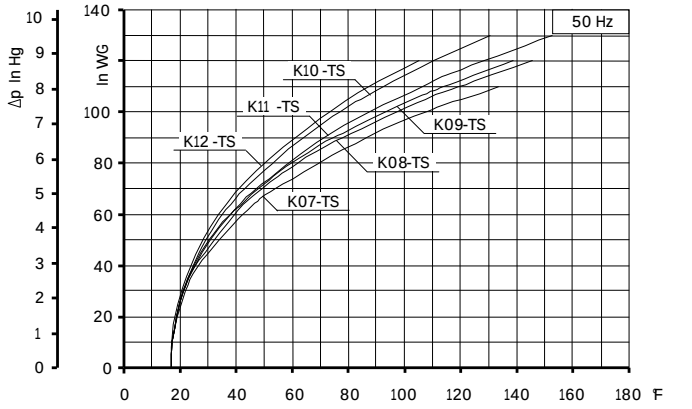
ABSORBED POWER





TEMPERATURE INCREASE





Curves refer to air at 68°F temperature, measuredat inlet port and 29.92 In Hg atmospheric backpressure (abs).
Values for flow, power consumption and temperature rise: +/-10% tolerance.
Data subject to change without notice.

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CE

COMPRESSORI - ASPIRATORI A CANALE LATERALE	**ISTRUZIONI I**
LATERAL CHANNEL BLOWERS – EXHAUSTERS	**INSTRUCTIONS GB**
COMPRESSEURS - ASPIRATEURS A CANAL LATERAL	**INSTRUCTIONS F**
SEITENKANALVERDICHTER - VAKUUMPUMPEN BAUREIHE	**BETRIEBSANLEITUNG D**
COMPRESORES - ASPIRADORES DE CANAL LATERAL	**INSTRUCCIONES E**

LEGGERE ATTENTAMENTE TUTTE LE ISTRUZIONI E CONSERVARLE I

PLEASE READ CAREFULLY ALL INSTRUCTIONS AND KEEP THEM FOR FUTURE REFERENCE GB

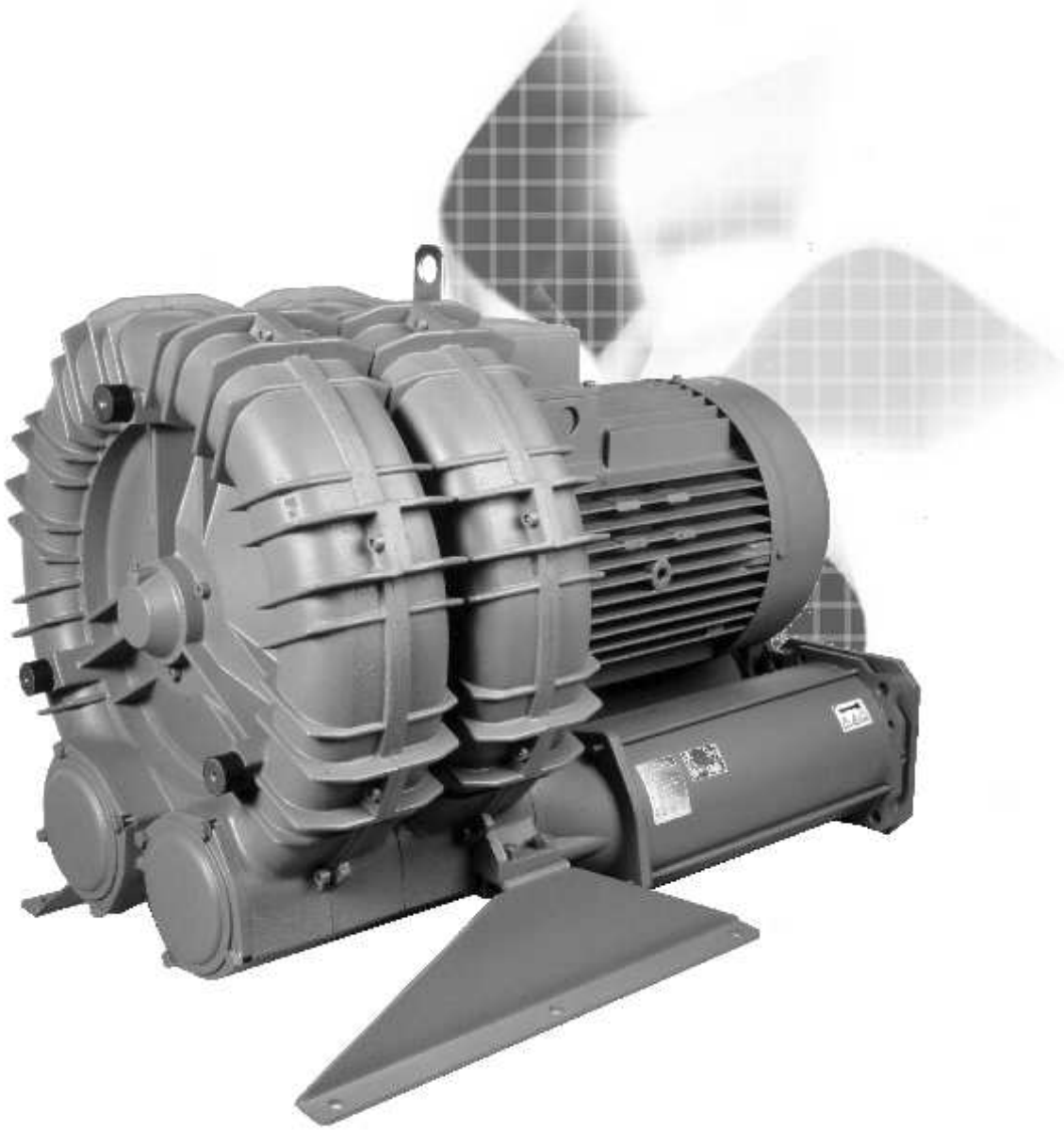
LIRE ATTENTIVEMENT TOUTES LES INSTRUCTIONS ET LES CONSERVER F

ALLE ANLEITUNGEN SIND SORGFÄLTIG ZU LESEN UND AUFZUBEWAHREN! D

SIRVASE LEER CUIDADOSAMENTE TODAS LAS INSTRUCCIONES Y CONSERVARLAS PARA FUTURA REFERENCIA E

SN 1975-3

SCL K07 / K08 / K09 / K10 / K11 / K12
TS - MOR



AZIENDA CON SISTEMA DI GESTIONE PER LA QUALITÀ CERTIFICATO DA DNV
=UNI EN ISO 9001:2000=

DICHIARAZIONE DI CONFORMITÁ ALLA DIRETTIVA MACCHINE
DECLARATION OF CONFORMITY TO THE MACHINERY DIRECTIVE

Unità tipo - *Unit type*

SCL K07-TS MOR	**SCL K09-TS MOR**	**SCL K11-TS MOR**
SCL K08-TS MOR	**SCL K10-TS MOR**	**SCL K12-TS MOR**

1. L'unità è in conformità con:
   - DIRETTIVA MACCHINE CE 2006/42;
   - DIRETTIVA COMPATIBILITA' ELETTROMAGNETICA (EMC) CE 2004/108;
   - DIRETTIVA BASSA TENSIONE 2006/95/CE;

   È tuttavia vietata la messa in servizio prima che la macchina in cui sarà incorporata sia dichiarata conforme con le citate Direttive.
2. Sottoposta a collaudo funzionale è risultata conforme alle caratteristiche richieste.
3. Il Fascicolo tecnico elaborato secondo Allegato VII della direttiva CE 2006/42 viene conservato presso la sede della società FPZ SpA a Concorezzo (MB), via F.lli Cervi 16.

1. *The unit conforms to the:*
   - *MACHINERY DIRECTIVE CE 2006/42;*
   - *ELECTROMAGNETIC COMPATIBILITY (EMC) DIRECTIVE CE 2004/108;*
   - *LOW VOLTAGE DIRECTIVE 2006/95/CE;*

   Nevertheless it is forbidden to put the unit in service before the machine in which will be incorporated is declared in conformity with the above Directives.
2. *The unit has been tested and meets its operating performances.*
3. *FPZ SpA in Concorezzo (ITALY), Via F.lli Cervi 16, store the Technical Files developed according Annex VII of Machinery Directive CE 2006/42*

Concorezzo (MB), *data 19.04.2010*

Amministratore Delegato
Managing Director

Sergio Ferigo

Direttore Tecnico
Technical Manager

Luis Sagastegui

DATI CARATTERISTICI I
PERFORMANCE TABLE GB
CARACTÉRISTIQUES TECHNIQUES F
LEISTUNGDATEN D
DATOS CARACTERISTICOS E

SI - Unità / Units / Unités / Einheiten / Unidades

Modello Model Modèle Modell Modelo	Potenza installata Installed power Puissance installé Installierte Motorleistung Potencia instalada		Pressione massima differenziale Maximum differential pressure Pression différentielle maxi Druckdifferenz Presión diferencial máxima		Rumorosità massima Max noise level Max niveau sonore Max Schalldruckpegel Rumorosidad máxima		Pressione massima assoluta Maximum absolute pressure Pression absolute maxi Maximal absoluter druck Presión absoluta máxima	Massa Weight Masse Gewicht Peso
	kW		**hPa** (mbar)		**Lp / Lw** (1) **dB (A)**		**Ps** max A	**M**
	50 Hz *2900 min^{-1}*	*60 Hz* *3500 min^{-1}*	*50 Hz* *2900 min^{-1}*	*60 Hz* *3500 min^{-1}*	*50 Hz* *2900 min^{-1}*	*60 Hz* *3500 min^{-1}*	**MPa** (bar)	**kg**
SCL K07-TS	**5.5**	**6.3**	**- 150 / + 150**	**- 110 / + 110**	**81.9**	**83.9**	**0.28 (2.8)**	**88.0**
	7.5	**8.7**	**- 225 / + 225**	**- 200 / + 200**	**82.2**	**84.2**	**0.28 (2.8)**	**93.0**
	9.2	**10.6**	**- 275 / + 275**	**- 250 / + 250**	**82.5**	**84.5**	**0.28 (2.8)**	**102.5**
	11.0	**12.7**	**- 300 / + 350**	**- 300 / + 300**	**82.8**	**84.8**	**0.28 (2.8)**	**103.5**
	-	**17.4**	**- / -**	**- 350 / + 450**	**-**	**85.1**	**0.28 (2.8)**	**109.5**
SCL K08-TS	**5.5**	**6.3**	**- 100 / + 100**	**- 60 / + 60**	**78.8**	**80.8**	**0.28 (2.8)**	**91.5**
	7.5	**8.7**	**- 160 / + 160**	**- 120 / + 120**	**78.9**	**80.9**	**0.28 (2.8)**	**96.5**
	9.2	**10.6**	**- 210 / + 210**	**- 170 / + 170**	**80.1**	**82.1**	**0.28 (2.8)**	**106.0**
	11.0	**12.7**	**- 260 / + 260**	**- 220 / + 220**	**81.3**	**83.3**	**0.28 (2.8)**	**107.0**
	15.0	**17.4**	**- 325 / + 380**	**- 325 / + 325**	**82.5**	**84.5**	**0.28 (2.8)**	**113.0**
SCL K09-TS	**9.2**	**10.6**	**- 145 / + 145**	**- 110 / + 110**	**79.0**	**81.0**	**0.28 (2.8)**	**116.0**
	11.0	**12.7**	**- 190 / + 190**	**- 150 / + 150**	**81.0**	**83.0**	**0.28 (2.8)**	**117.0**
	15.0	**17.4**	**- 270 / + 270**	**- 240 / + 240**	**83.0**	**85.0**	**0.28 (2.8)**	**128.0**
	18.5	**21.5**	**- 325 / + 360**	**- 275 / + 275**	**85.0**	**87.0**	**0.28 (2.8)**	**158.0**
SCL K10-TS	**11.0**	**12.7**	**- 160 / + 160**	**- 125 / + 125**	**85.8**	**87.8**	**0.28 (2.8)**	**122.0**
	15.0	**17.4**	**- 225 / + 225**	**- 180 / + 180**	**86.1**	**88.1**	**0.28 (2.8)**	**133.0**
	18.5	**21.5**	**- 275 / + 275**	**- 260 / + 260**	**86.4**	**88.4**	**0.28 (2.8)**	**163.0**
SCL K11-TS	**11.0**	**-**	**- 100 / + 100**	**- / -**	**86.0**	**-**	**0.28 (2.8)**	**135.0**
	15.0	**17.4**	**- 160 / + 160**	**- 105 / + 105**	**86.7**	**88.7**	**0.28 (2.8)**	**146.0**
	18.5	**21.5**	**- 220 / + 220**	**- 165 / + 165**	**87.4**	**89.4**	**0.28 (2.8)**	**176.0**
	22.0	**25.5**	**- 275 / + 275**	**- 220 / + 220**	**88.0**	**90.0**	**0.28 (2.8)**	**186.5**
SCL K12-TS	**18.5**	**-**	**- 150 / + 150**	**-**	**88.0**	**-**	**0.28 (2.8)**	**175.0**
	22.0	**25.5**	**- 200 / + 200**	**- 140 / + 140**	**88.6**	**90.6**	**0.28 (2.8)**	**185.5**

(1) Rumorosità misurata alla distanza di 1 m con aspirazione e mandata canalizzate, secondo la Normativa ISO 3744.
(1) Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744.
(1) Niveau de bruit mesuré a 1 m de distance, conduits d'aspiration et refoulement raccordés selon la norme ISO 3744.
(1) Schalldruckpegel, mit angeschlossener Schlauchleitung am Ein- und Auslass, im Abstand von 1 m gemäß ISO 3744 gemessen.
(1) Rumorosidad medida a la distancia de 1 m con vías de acceso de aspiración e impulsión canalizadas, según la Normativa ISO 3744.

DATI CARATTERISTICI I
PERFORMANCE TABLE GB
CARACTÉRISTIQUES TECHNIQUES F
LEISTUNGDATEN D
DATOS CARACTERISTICOS E

US - Unità / Units / Unités / Einheiten / Unidades

Modello Model Modèle Modell Modelo	Potenza installata Installed power Puissance installé Installierte Motorleistung Potencia instalada		Pressione massima differenziale Maximum differential pressure Pression différentielle maxi Druckdifferenz Presión diferencial máxima		Rumorosità massima Max noise level Max niveau sonore Max Schalldruckpegel Rumorosidad máxima		Pressione massima assoluta Maximum absolute pressure Pression absolute maxi Maximal absoluter druck Presión absoluta máxima	Massa Weight Masse Gewicht Peso
	Hp		**In Hg / In WG**		**Lp / Lw** (1) **dB (A)**		**Ps** max	**M**
	60 Hz *3500 rpm*	*50 Hz* *2900 rpm*	*60 Hz* *3500 rpm*	*50 Hz* *2900 rpm*	*60 Hz* *3500 rpm*	*50 Hz* *2900 rpm*	**In Hg**	**Lbs**
SCL K07- TS	**7 ½**	**7 ½**	**- 2.6 / + 36**	**- 3.5 / + 48**	**84.5**	**82.5**	**82.7**	**197.31**
	10	**10**	**- 4.4 / + 60**	**- 5.2 / + 71**	**84.8**	**82.8**	**82.7**	**206.13**
	15	**15**	**- 8.1 / + 110**	**- 8.9 / + 121**	**85.4**	**83.4**	**82.7**	**223.77**
SCL K08-TS	**7 ½**	**7 ½**	**- 1.3 / + 18**	**- 2.2 / + 30**	**80.9**	**78.9**	**82.7**	**205.47**
	10	**10**	**- 2.7 / + 37**	**- 3.7 / + 50**	**81.2**	**79.2**	**82.7**	**214.29**
	15	**15**	**- 5.5 / + 75**	**- 6.4 / + 87**	**83.3**	**81.3**	**82.7**	**231.92**
SCL K09-TS	**15**	**15**	**- 3.8 / + 52**	**- 4.5 / + 62**	**83.0**	**81.0**	**82.7**	**270.06**
	20	**20**	**- 5.9 / + 80**	**- 6.6 / + 90**	**85.0**	**83.0**	**82.7**	**350.53**
	25	**25**	**- 8.1 / + 110**	**- 8.8 / + 120**	**87.0**	**85.0**	**82.7**	**383.60**
SCL K10-TS	**15**	**15**	**- 3.0 / + 41**	**- 3.6 / + 51**	**89.1**	**87.1**	**82.7**	**274.47**
	20	**20**	**- 4.8 / + 65**	**- 5.5 / + 75**	**89.4**	**87.4**	**82.7**	**354.94**
	25	**25**	**- 5.9 / + 80**	**- 7.0 / + 95**	**89.7**	**87.7**	**82.7**	**388.01**
SCL K11-TS	**25**	**25**	**- 3.7 / + 50**	**- 5.0 / + 69**	**90.7**	**88.7**	**82.7**	**429.02**
	30	**30**	**- 5.1 / + 70**	**- 6.6 / + 90**	**91.3**	**89.3**	**82.7**	**434.53**
SCL K12-TS	**30**	**30**	**- 3.3 / + 45**	**- 5.9 / + 80**	**91.9**	**89.9**	**82.7**	**436.75**

(1) Rumorosità misurata alla distanza di 1 m con aspirazione e mandata canalizzate, secondo la Normativa ISO 3744.
(1) Noise measured at 1 m distance with inlet and outlet ports piped, in accordance to ISO 3744.
(1) Niveau de bruit mesuré a 1 m de distance, conduits d'aspiration et refoulement raccordés selon la norme ISO 3744.
(1) Schalldruckpegel, mit angeschlossener Schlauchleitung am Ein- und Auslass, im Abstand von 1 m gemäß ISO 3744 gemessen.
(1) Rumorosidad medida a la distancia de 1 m con vías de acceso de aspiración e impulsión canalizadas, seg+ún la Normativa ISO 3744.

1 SAFETY STANDARDS

This operating manual:

- Applies to “K” series side channel compressors/suction pumps in an “MOR” single block version.
- Contains instructions for transporting, installation, commissioning, operating, storing, and maintenance of “K” series side channel compressors/suction pumps in an “MOR” format.
- Must be read carefully and understood fully before doing any work using the unit.
- Must be complied with fully.
- Must be to hand at all times at the workstation at which the unit is used.

Failure to comply with the safety standards may result in serious injury to people – even with fatal consequences – as well as damage to materials and the environment.

1.1 NOTES FOR THE USER’S SAFETY

The safety standards referred to in this operating manual are marked by a danger symbol. Next to this symbol there is wording indicating the seriousness of the danger. You are kindly requested to fully comply with the procedures described in order to avoid any danger to people or property!

This **Danger** symbol indicates dangers that may result in **injury to people** with consequences including **death or serious injury** if the necessary precautions are not taken.

The term “**WARNING**” indicates dangers that may result in **damage to property**.

“**USER’S NOTES**” are intended to allow the unit to be used in the best way to achieve best performance, in safety and respecting the environment.

1.2 GENERAL SAFETY WARNINGS

WARNING!

The “K” series of side channel compressors / suction pumps in an “MOR” format are designed and built for use in industrial plants are fitted with three-phase electric motors of an asynchronous bipolar type, in compliance with IEC 34-1.

Any use other than the intended use of the unit may cause serious injury and even death!

- The unit may only be started:
  In conformity with the use, transport, and handling purposes indicated in “INTENDED USE”.
  According to the values indicated in the “CHARACTERISTIC DATA” table on page 3/4.
- All transportation, assembly, installation, starting up, and maintenance operations are only to be carried out by qualified personnel, that is, personnel whose training, instruction, experience, knowledge of standards, regulations, accident prevention procedures, and operating and service conditions, makes them capable of carrying out all the works necessary, while being aware of and avoiding any possible danger and/or damage.

When the unit us working there is a danger of injury due to shearing, crushing, entanglement, and burns!

Transportation, assembly, installation, starting up, and maintenance operations are to be carried out wearing adequate **personal protective clothing** (protective gloves and safety glasses, safety shoes, and a hardhat).

Do not wear loose-fitting garments, long laces, or other items that may get entangled in the machine.

Long hair must be gathered up.

Electrical danger!

Inappropriate behaviour may result in serious injury and even death!

Work on electrical equipment (installation and maintenance) is only to be done by qualified, authorised electricians!

Before starting to work on the unit or plant, the following precautions must be taken:

Switch off the mains power supply.

Adopt measures to prevent it being switched on again.

Only open the terminal board box after checking that the power is off altogether!

Danger due to rotating components (cooling fan for the electric motor, impeller, and shaft): Cutting or shearing of limbs, entanglement or trapping of hair or clothing.

Danger due to excess pressure and vacuum: Sudden ejection of process fluids (injury to the skin and eyes), and sudden sucking in of hair and clothing!

Danger due to process fluids that come out and cause burns!

- The unit may only be started and operated under the following conditions:

  The unit must be fully assembled and whole (not damaged).

  Piping must be connected to the silencers using fixings, connections, pipes, pipe fittings, and tanks that are watertight and sufficiently strong to withstand the pressures that develop.

  Connections to the suction and delivery silencers must not be closed, clogged, or dirty.

  Regularly check that the seatings for fixings, connections, piping, pipe fittings, and tanks are firmly secured!
- Before starting maintenance work on the unit, the following safety precautions must be taken:

  Put the unit out of order and ensure that it cannot be switched on again.

  Put a sign on the plant’s controls and on the control units that reads: “DANGER! Maintenance work on the compressor / suction pump in progress! Do not switch on!”

  Wait until the unit has stopped completely, that is, until the impeller has stopped rotating.

  Allow the unit to cool down!

  Make sure that there is no pressure or vacuum in the unit or in the piping to be disconnected.

  Make sure that no fluid can flow out of the unit and/or plant!

Danger due to rotating impeller: Cutting or shearing of limbs!

The impeller can be accessed while it is rotating by opening the suction and delivery silencers!

Never put your hands or any item into these openings.

Fit the suction and/or delivery silencers with additional silencers or additional pipes sufficiently long to prevent access to the impeller.

Danger due to burns caused by contact with hot surfaces on the unit!

When operating in compliance with the values indicated in the “CHARACTERISTIC DATA” table on page 3/4 the compressors / suction pumps can reach high surface temperatures of up to 160°C (+320°F).

Fit the unit with adequate protection against the risks of involuntary contact with hot surfaces.

Do not touch the unit’s surfaces on purpose when it is running!

Before doing any work after having switched off the unit, allow it to cool!

Danger resulting from the impeller seizing due to the performance values being exceeded: Vacuum and/or pressure exceeding the declared values!

Do not allow the unit to operate with the suction and/or delivery openings obscured for any reason.

Install a safety valve that can prevent excessive vacuum and/or pressure, and that makes it possible to comply with the values indicated among the “CHARACTERISTIC DATA” given on page 3/4 of this manual.

In order to limit the formation of layers of dust on the surfaces, which may compromise natural exchanging of heat between the unit and the environment, regularly clean and remove all dust using suitable equipment.

Suction and/or delivery piping must not be dirty or clogged!

If any anomalous noises are heard, which may be a warning that the impeller is about to seize, switch off the unit and move away from it immediately.

Danger due to the impeller seizing due to use in an unsuitable place and/or due to conveying fluids that are not suitable: Unsuitable ambient and suction temperatures!

Check that the ambient and suction temperatures for the gas conveyed are between: -15°C (+5°F) and +40°C (+104 °F).

Check that good ventilation is provided for the unit.

Use a filter on the suction side with a maximum filtration of 25 µm, which will make it possible to limit the entry of any solids into the unit, thereby avoiding possible breakage of the impeller blades, making the fragments projected out of the delivery opening dangerous!

During installation and when the unit is running, check for load losses due to the use of this filter: The maximum load loss allowed is 30 mbar. This value must be subtracted from the maximum admissible pressure indicated in the “CHARACTERISTIC DATA” table on page 3/4 of this manual.

If any anomalous noises are heard, which may be a warning that the impeller is about to seize, switch off the unit and move away from it immediately.

1.3 RESIDUAL RISKS

Danger due to rotating components: Cooling fan for the electric motor!

There is an immediate danger of hair and clothing becoming entangled in the cooling fan in the electric motor’s cowling via the cowling itself!

Protective steps to be taken:

Do not wear loose-fitting garments, long laces, or other items that may get entangled in the machine.

Long hair must be gathered up.

Danger due to hot surfaces – up to 160°C (+320°F)!

Under operating conditions there is a possibility of burns due to contact with the unit’s surfaces.

Protective steps to be taken:

Fit the unit with adequate protection against the risks of involuntary contact with hot surfaces.

Do not touch the unit’s surfaces on purpose when it is running!

Before starting with any work, wait for the unit to cool down after switching it off!

Danger due to noise emitted by the unit!

When the compressors / suction pumps are running they emit noise that may exceed 80 dB(A)!

Protective steps to be taken:

Mark the area around the unit using warning signs.

Wear personal protective equipment for hearing.

If necessary, fit additional silencers on the suction and/or delivery silencers.

From time to time use noise tests to check the efficiency of the soundproofing panels in the suction and delivery silencers. The reference values are indicated in the “CHARACTERISTIC DATA” table on page 3/4 of this manual.

2 INTENDED USE

The “K” series of side channel compressors / suction pumps in an “MOR” format are made to generate vacuums and pressures, and for conveying air and gas that is not explosive, not inflammable, not poisonous, and not aggressive, for continuous operation in a non-explosive environment.

The “K” series of side channel compressors / suction pumps in an “MOR” format are designed and built for use in industrial plants are fitted with three-phase electric motors of an asynchronous bipolar type, in compliance with IEC 34-1.

2.1 REASONABLY FORESEEABLE INCORRECT USE

Any use other than the intended use of the unit may cause serious injury and even death!

Failure to comply with the prohibitions / obligations indicated may result in technical faults, damage to the plant, or injury!

Danger of very serious injury!

THE FOLLOWING ARE STRICTLY FORBIDDEN:

- Using the unit in non-industrial installations, unless all the necessary precautions or protective measures have been taken (e.g. protection against contact to safeguard children).
- Using the unit in places in which there are explosive dust and/or gas or where these may form.
- Sucking up and conveying explosive, inflammable, aggressive, corrosive, and/or harmful fluids.
- Using the unit under conditions that differ from those indicated in the “CHARACTERISTIC DATA” table on page 3/4.
- Using the unit without having installed a suction filter.
- Operating with the suction and/or delivery openings closed.

- Making modifications to the unit or transforming it, or making repairs or doing maintenance based on your own initiative. Maintenance works are only to be carried out as described in this operating manual by qualified personnel, that is, personnel whose training, instruction, experience, knowledge of standards, regulations, accident prevention procedures, and operating and service conditions, makes them capable of carrying out all the works necessary, while being aware of and avoiding any possible danger and/or damage.
- Starting the unit up again after a fault, unless it has been repaired by qualified personnel.

THE FOLLOWING ARE OBLIGATORY:

- Doing maintenance work as indicated in chapter 6.
- Carrying out preliminary and periodic checks as indicated in the "STARTING UP" chapter.

3 STORAGE AND TRANSPORT

Danger due to loads that fall over or fall down!

Heavy loads that fall over or down may cause crushing, resulting in injuries to people and even death!

Do not put loads on top of the packing.

Danger due to lifting heavy loads!

Heavy loads that fall over or down may cause crushing, resulting in injuries to people and even death!

Before undertaking handling operations (lifting, moving, transporting, and putting down) look at the unit's mass (M) shown in the "CHARACTERISTIC DATA" table on page 3/4 and determine the best way to work in maximum safety.

In this regard all the prevention measures must be applied, including any local and/or specific regulations that make it possible to carry out the handling operations:

Using qualified personnel that have specific skills and adequate training.

With the help of suitable equipment.

Organising the work in such a way that it poses the least risk possible and is done under safe, healthy, conditions.

Using safe, stable support surfaces.

Use of suitable working clothes and adequate personal protective equipment (protective gloves and safety glasses, safety shoes and a hardhat).

Working in an area with sufficient space, even floors, no obstructions.

Avoiding impacts, jolting, and shaking.

Units with a mass that exceeds 25 kg (55 lbs) are fitted with lugs to be used for handling.

WARNING!

Lifting the unit is any way other than that indicated is strictly forbidden. Use the lug provided on the blower unit or motor.

Store in a dry place, keeping the packing if possible. Do not remove the covers over the openings.

4 INSTALLATION

4.1 SCL K COMPRESSOR – SUCTION PUMP

Any use other than the intended use of the unit may cause serious injury and even death!

- This operating manual:

  MUST be read carefully and understood fully before doing any work using the unit.

  MUST be complied with fully.

  MUST be to hand at all times at the workstation at which the unit is used.

- Remember that installation operations are only to be carried out by qualified personnel, that is, personnel whose training, instruction, experience, knowledge of standards, regulations, accident prevention procedures, and operating and service conditions, makes them capable of carrying out all the works necessary, while being aware of and avoiding any possible danger and/or damage.

Danger due to a lack of a clear view of the place in which the unit is installed!

Make sure that the unit installed is always under control when doing anything in the installation area.

The controls must be positioned in such a way as to be able to see the unit installed.

Danger of very serious injury!

WARNING!

If the flow rate has to be reduced, use a draw-off valve rather than throttling back the suction or delivery lines.

4.1.1 WORKING CONDITIONS

The "K" series of side channel compressors / suction pumps in an "MOR" format are made to generate vacuums and pressures, and for conveying air and gas that is not explosive, not inflammable, not poisonous, and not aggressive, for continuous operation in a non-explosive environment.

If installed outdoors, protect the unit against exposure to sunlight.

The maximum pressure differentials allowed are indicated in the "CHARACTERISTIC DATA" table on page 3 of this manual and must never be exceeded. Only the following conditions are valid:

As a compressor:
Gas intake temperature 20°C (+68°F) and atmospheric pressure 1013 mbar (abs) (29,92 in Hg) measured at the suction opening.

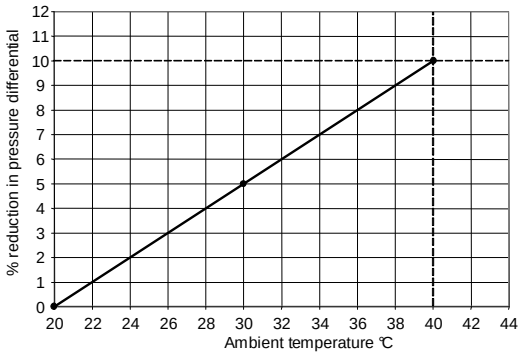
As a suction pump:
Gas intake temperature 20°C (+68°F) measured at the suction opening and atmospheric back pressure 1013 mbar (abs) (29,92 in Hg).

The ambient temperature and the intake temperature of the gas conveyed is allowed within the -15°C (+5°F) to + 40 °C (+104°F) range, with the following provisions:

- If the ambient temperature is +30°C (+86°F) **reduce** the maximum pressure differentials indicated in the "CHARACTERISTIC DATA" table on page 3/4 by 5%.

- If the ambient temperature is +40°C (+104°F) **reduce** the maximum pressure differentials indicated in the "CHARACTERISTIC DATA" table on page 3/4 by 10%.

The graph to be used to reduce the maximum pressure differentials when the ambient temperature is between +21°C (+70°F) and +40°C (+104°F) is given below.



4.1.2 INSTALLATION CONDITIONS

It is important that this unit be installed at an altitude not exceeding 1000 m above sea level. For installations at higher altitudes, contact FPZ for assistance.

The support surfaces for the unit must be flat, strong, stable, and as level as possible.

It is important that the unit be installed on a structure that does not transmit significant vibrations to the same.

Under all conditions, do not install units on structures that can transmit or amplify noise (tanks, steel plating, etc.).

The unit must always be installed using anti-vibration supports.

Danger due to vibrations!

Regularly check that the points at which the unit is fixed to the support structure are tight.

Excess vibration of the unit can cause damage to balance, resulting in injury to people and even death!

The unit must be installed in such a way that the motor's ventilation is not impeded by obstacles put in the immediate vicinity.
To this end a minimum gap must be kept between the motor's fan guard and any other structure of at least 50 mm.

WARNING!

To guarantee that the unit is well ventilated after installation, proceed as follows:
The air intake on the motor's fan guard must be kept free.

Air affected by other systems must NOT be sucked in again!

If the unit is installed in a closed space, guarantee a good flow of cooling air by using an extractor / fan and correct air intake for cooling the motor.

Any use other than the intended use of the unit may cause serious injury and even death!

To avoid overloading due to pressure fluctuations, fit a safety valve on the suction pipe if used as a suction pump and on the delivery pipe if used as a compressor.

Danger due to foreign bodies and dirt getting into the unit!

Any foreign bodies, even very small in size, getting into the unit causes serious damage and probable breakage of the impeller, and a danger that broken bits may be projected outwards!

Foreign bodies include: Dust, sand, lime scale, impurities in the pipes, cutting or threading burrs, welding drops or slag, metal burrs or residue of sealing products used when connecting up the pipework.

Protect the suction pipe using a suitable filter with a maximum degree if filtration of 25µm and a maximum load loss of ΔP=20mbar.

Replace filters regularly!

WARNING!

Size piping and choose accessories that cause the minimum load losses, and so:

Do not fit pipes of a diameter smaller than that of the machine's openings.

When installing a number of machines in parallel, size the manifold and main line accordingly.

Do not use elbows, but large radius bends.

Do not fit valves with a passage smaller than the nominal size and non-return valves with a spring-loaded shutter (the non-return valve that causes the smallest load loss is one with a lightened shutter).

When using for oxygenation, choose diffusers with a low passage resistance (low load loss) and do not forget that the spark plugs and porous sieves increase load losses over time due to gradual clogging.

WARNING!

Avoid the possibility of water stagnating, especially when installing the unit with its axis vertical.

See the INSTALLATION DIAGRAMS in chapter 8.

4.1.3 HORIZONTAL INSTALLATION

The unit is ready for installation in a horizontal position, suitably fixed to the foot/feet.

The foot has fixing holes. Use all the holes and suitable bolt types.

See point 4.1.2 for the INSTALLATION CONDITIONS.

Remove the covers over the openings before checking the direction of rotation and before final connection.

WARNING!

Check the direction of rotation in the motor.

(See point 4.2.3 ROTATION DIRECTION)

When connecting the unit cabin to the ducting, do so using the flanges on the silencer housings and form suitable connections using flexible hoses. Avoid rigid connections that may impose loads and give rise to harmful vibrations.

Fit the flanges on the silencer housings complete with gaskets again, and tighten.

4.1.4 INSTRUCTIONS FOR REPOSITIONING THE SILENCER HOUSINGS

Danger due to rotating components: Impeller!

There may be a danger of shearing due to the impeller rotating even when the machine is switched off, if it is started manually.

Suitable working clothes and personal protective equipment must therefore be used.

The SCL K-TS series is designed to provide maximum flexibility in positioning the silencer housings, to allow for various installation configurations.

The blower comes with the silencers positioned as shown in fig.1.

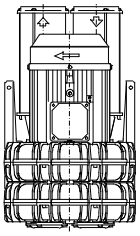


fig. 1

If this layout has to be modified, proceed to identify the layout of the silencer housings required.
The possible solutions are shown in fig 2, fig 3, and fig 4 below.

fig 2

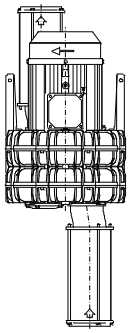


fig 2 with 90° manifold

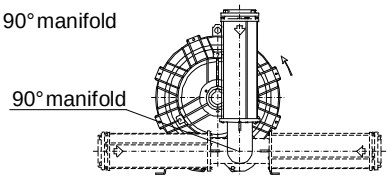


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fig 3

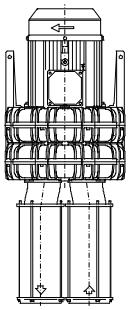


fig 3 with 90° manifolds

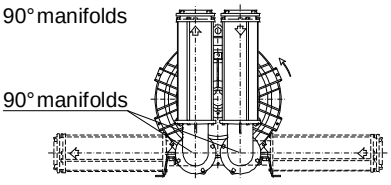


fig 4

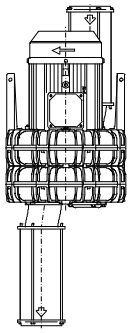
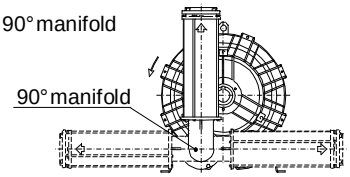


fig 4 with 90° manifold



Position the unit in a horizontal position with the feet on a flat, stable surface.

4.1.4.1 INSTRUCTIONS FOR SCL K07-TS / K08-TS

Disassembling the silencer housing: (see figure below)

- Remove the (904) screws, taking away the (706) manifold and the (424) gasket.

Fitting the blank (730) flange: (see figure below)

- Remove the (909) screws and the (730) flange with the (427) O-Ring.

Reassemble by proceeding in reverse order-do not forget the (424) and (427) gaskets.

4.1.4.2 INSTRUCTIONS FOR SCL K09-TS / K10-TS / K11-TS

Disassembling the silencer housing: (see figure below)

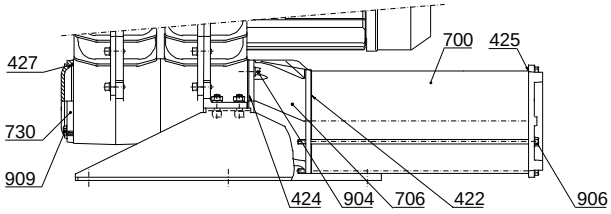
- Remove the (906) bolts
- Take away the silencer housing from the unit, along with (422) gasket
- Remove the (904) screws, taking away the (706) manifold and the (424) gasket

Fitting the blank (730) flange: (see figure below)

- Remove the (909) screws and the (730) flange with the (427) O-Ring.

Reassemble by proceeding in reverse order-do not forget the (422), (424) and (427) gaskets

If needed, reconstruct (425) seal using Loctite 5970 or similar, after cleaning the sealing surfaces of any existing sealant.



4.1.4.3 USING THE (accessory) CK TYPE 90° MANIFOLD KIT

The CK type 90° manifold kit comprises:

N°1 manifold
N°1 (422) gasket and
N°4 M8x25 UNI 5739 screws

To assemble the 90° manifold proceed as follows:

- Remove the silencer housing as described before.
- Put the gasket between the manifold (706) and the 90° manifold, and tighten the M8x25 UNI 5739 bolts.
- Assemble the silencer housing, following the instructions in reverse order and not forgetting (424) and (427) gasket.

4.1.5 VERTICAL INSTALLATION ON THE COVER

For installing in a vertical position, fit the anti-vibration supports supplied with the unit on the cover, and then fix the whole structure to the support.

See point 4.1.2 for the INSTALLATION CONDITIONS.

Any use other than the intended use of the unit may cause serious injury and even death!

When installing vertically DO NOT use the foot supplied with the unit as this is only suitable for horizontal installations.

Remove the covers over the openings before checking the direction of rotation and before final connection.

NOTE FOR THE USER

A foot for fitting the unit in a vertical position on the cover is available as an accessory.

The foot has fixing holes. Use all the holes and suitable bolt types.

WARNING!

Check the direction of rotation in the motor.

(See point 4.2.1 ROTATION DIRECTION)

When connecting the unit cabin to the ducting, do so using the flanges on the silencer housings and form suitable connections using flexible hoses. Avoid rigid connections that may impose loads and give rise to harmful vibrations.

Fit the flanges on the silencer housings complete with gaskets again, and tighten.

4.2 ELECTRIC MOTOR

Electrical danger!

- Inappropriate behaviour may result in serious injury and even death!
- Work on electrical equipment (installation and maintenance) is only to be done by qualified, authorised electricians!
- Before starting to work on the unit or plant, the following precautions must be taken:

  Make sure that the line is NOT switched on.

  Adopt measures to prevent it being switched on again.

  Only open the terminal board box after checking that the power is off altogether!
- The terminal board box must not contain:

  Foreign bodies

  Impurities

  Moisture.

Close the cover on the terminal board box and seal the openings in the cable glands in order to prevent dust, water, and moisture to penetrate.

Check the seals periodically.

- Should you touch a defective unit there may be a danger of electric shock!

  Fit a motor trip-switch.

  Have the unit's electrical system checked by an electrician on a regular basis.

The electric motor is sized to work at an ambient temperature between -15°C (+5°F) and +40°C (+104°F), and a maximum altitude of 1000 m above sea level.

Under other conditions the motor cannot be used at full load and so difficulties may arise for starting.

WARNING!

A maximum of n° 6 evenly distributed starts per hour, is allowed.

Failure to comply with this may seriously damage the unit.

4.2.1 CONNECTION

WARNING!

Connecting the motor incorrectly may seriously damage the unit.

The power supply for the motor and any auxiliary equipment must be provided using cables of suitable section to avoid abnormal overheating and great voltage drops.

Check that the details on the nameplate are compatible with the line voltage and frequency.

A voltage tolerance of ±10% compared to the nominal value is admissible.

Connect the motor's earth cable to the relevant terminal marked with this symbol ⏚ always before connecting to the mains supply and check the dispersion capacity.

The earth cable can be recognised by its colour (yellow/green).

This connection to the main supply must be formed as shown in the wiring diagram contained in the terminal board box.

Use the cable gland openings to allow power supply cables to pass into the terminal board box.

Proceed to tighten the power supply cables, taking the section of the electrical cables into account each time.

The terminal boards for the electrical connections must be tightened properly to avoid high contact resistances and resulting overheating.

Check that the insulation gaps between the various conductors are kept in the air and between surfaces, as indicated in the standards.

All the screws used to close the terminal board must be tightened properly. Damaged screws must be replaced immediately, using screws of the same or better quality.

The connection must guarantee:

- Long-lasting safety.
- That no wire ends are sticking out.

Fuses do not constitute protection for the motor, but merely protect against short-circuits.

Size the fuses according to the peak currents, especially when using direct starting.

Protection with a (thermal or amperometric) trip switches is essential to deal with risks of overloading, a loss of one phase in the mains supply, excessive voltage fluctuations, or the rotor getting stuck.

Set the motor trip switch using the current value shown on the nameplate as a maximum.

4.2.2 INVERTER POWERED ELECTRIC MOTOR

WARNING!

A maximum of n° 6 evenly distributed starts per hour, is allowed.

Failure to comply with this may seriously damage the unit.

WARNING!

The unit's nominal pressure or vacuum characteristics for service at mains frequency cannot be maintained if the unit is powered via an inverter.

If an inverter is used for the power supply the installer is responsible for the checks and any steps necessary to comply with the immunity and emission limits laid down by the standards.

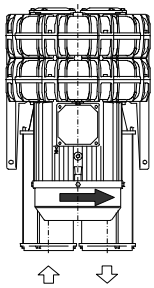
When using the unit with a motor powered via an inverter, follow the wiring instructions supplied by the inverter manufacturer carefully.

WARNING!

The performance of the unit powered via an inverter is shown in the relevant tables that can be requested from FPZ's assistance service.

4.2.3 ROTATION DIRECTION

The SCL K compressors – suction pumps must be used with the rotation direction shown by the arrow on the fan guard for the electric motor (see figure below).



To check the direction of rotation, switch on the motor very briefly. If the rotation direction is incorrect, switch the position of two of the three power supply conductors on the terminals.

5 STARTING UP

Any use other than the intended use of the unit may cause serious injury and even death!

The unit may only be started:

After having carefully read, fully understood, and complied with this operating manual ("SAFETY STANDARDS" and "INSTALLATION").

In conformity with the purposes laid down under "INTENDED USE".

According to the values indicated in the "CHARACTERISTIC DATA" table on page 3/4.

Danger due to rotating components (electric motor fan, impeller, and shaft): Cutting or shearing of limbs, entanglement or trapping of hair or clothing!

Danger due to excess pressure or vacuum: Sudden ejection of process fluids (injury to the skin and eyes), and sudden sucking in of hair and clothing!

Danger due to process fluids that come out and cause burns!

Danger due to burns caused by contact with hot surfaces on the unit!

Electrical danger!

Danger due to the impeller seizing due to use in an unsuitable place and/or due to conveying fluids that are not suitable: Unsuitable ambient and suction temperatures!

Danger resulting from the impeller seizing due to the performance values being exceeded: Vacuum and/or pressure exceeding the declared values and/or openings closed!

Danger due to noise emitted by the unit!

- CHECK THAT ALL THE SAFETY GUARDS HAVE BEEN FITTED CORRECTLY.

WARNING!

A maximum of n° 6 evenly distributed starts per hour, is allowed.

Failure to comply with this may seriously damage the unit.

5.1 PRELIMINARY CHECKS

Before finally starting up, carry out the following preliminary checks:

- If a lot of time has passed since the unit was last started up, check its condition and check for and if necessary remove dust deposited on the external surfaces.
- Deactivate/open any closing elements on the piping (closing valves, solenoid valves, etc.) before starting the unit.

  Do not allow the unit to be started and operate with the suction and/or delivery openings obscured for any reason!
- Check that the ambient and suction temperatures for the gas conveyed are between: -15°C (+5°F) and +40°C (+104°F).
- Check the rotation direction as indicated previously in the "INSTALLATION" chapter.
- Check that the setting for the motor trip switch corresponds to the motor's nominal current shown on the nameplate.
- Check that the safety valve is working correctly.

5.2 OPERATION

Having carried out all the preliminary checks, you can start with final starting of the unit.

Start the unit by switching on the power supply to the electric motor.

Check the operating pressure or vacuum and compare them to the values indicated in the "CHARACTERISTIC DATA" table on page 3/4. Load losses on the pipes are often underestimated but are determining factors for the operating pressure differential.

Measure the motor's absorption and check against the nameplate value.

Any use other than the intended use of the unit may cause serious injury and even death!

The unit may only be used:

- After having carefully read, fully understood, and complied with this operating manual ("SAFETY STANDARDS" and "INSTALLATION").
- In conformity with the purposes laid down under "INTENDED USE".
- According to the values indicated in the "CHARACTERISTIC DATA" table on page 3/4.

5.2.1 ROUTINE CHECKS

It is important that the units be checked routinely while running by qualified personnel, using inspections to avoid faults that may cause damage directly or indirectly.

When the unit is running, routinely carry out the following checks:

- Delivery temperature
- Operating pressure and/or vacuum
- Electric motor current absorption
- Vibrations
- State of the filter and related load loss.

Variations in normal working conditions (increases in power absorbed, anomalous noise, vibrations, excess overheating of the service fluid) indicate that the unit is not working correctly.

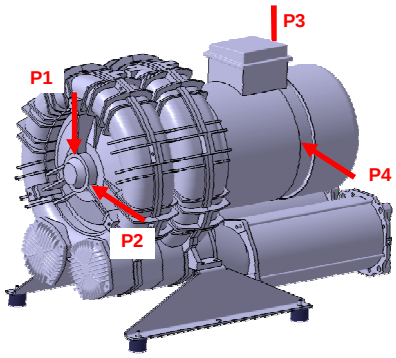
Also compare the values measured with those indicated in the "CHARACTERISTIC DATA" table on page 3/4.

See chapter 9 "TROUBLESHOOTING" for preventing possible breakage or faults.

Measuring vibrations

Measurements to determine vibration speed [mm/s] must be carried out using an electronic vibration meter at the points indicated below (see the figure below).

- **Points P1** and **P2 (front bearing):** The vibration meter must be put on the cover near the bearing seating, and the highest value must be recorded.
- **Points P3** and **P4 (back bearing):** The vibration meter must be put on the electric motor casing near the bearing seating (not on the fan guard), and the highest value must be recorded.



The results must be evaluated by comparing the maximum speed value measured with the limits laid down for the zones (A, B) shown in the table below, in compliance with ISO 14694.

Effective vibration speed value [mm/s]	***Class I*** (≤ 15kW)
1.8	***A***
4.5	***B***

Effective vibration speed value [mm/s]	***Class II*** (> 15kW)
2.8	***A***
7.1	***B***

Legend:

Machine classification:

Class I = SCL with electric motor power ≤ 15 kW
Class II = SCL with electric motor power > 15 kW

Evaluation zones:

Zone A = SCL with vibrations within this zone are considered acceptable for long-term service.

Zone B = SCL with vibrations within this zone are considered unsuitable for continuous long-term service. Under these conditions the machine can be operated for a limited period, until the opportunity arises for suitable corrective work to be done.

Danger resulting from the impeller seizing due to excessive vibrations!

Vibration values exceeding zone B (table of effective vibration speed values) are considered NOT admissible and may cause damage to the machine and resulting serious injury and even death!

- If any anomalous noises and/or vibrations are detected, these may be a warning that the impeller is about to seize, switch off the unit and move away from it immediately.

When the unit is stopped, routinely carry out the following checks:

- Dust deposits: Check and , if necessary, use suitable equipment to remove deposits on the external surfaces of the unit that may impede correct heat exchanging.
- Suction filter: Every 8-10 days check and if necessary clean or replace the filter cartridge. In very dusty environments, change the filter more frequently. A dirty cartridge creates extensive resistance at the suction, resulting in an increase in: the pressure differential, the power absorbed, and the operating temperature. The load loss must not exceed 30 mbar.

Electrical danger!

- Before doing anything else, make sure that the power supply is NOT switched on.

Danger due to burns caused by contact with hot surfaces on the unit!

When operating the compressors / suction pumps can reach high surface temperatures of up to 160°C (+320°F).

- Before starting with any work, wait for the unit to cool down after switching it off!

6 MAINTENANCE

Any use other than the intended use of the unit may cause serious injury and even death!

Maintenance may only be carried out on the unit:

If the maintenance instructions, parts list, and section/exploded view of the relevant unit are available.

After having carefully read, fully understood, and complied with this operating manual ("SAFETY STANDARDS" "STORAGE AND TRANSPORT" and "INSTALLATION").

In conformity with the purposes laid down under "INTENDED USE".

By qualified personnel, that is, personnel whose training, instruction, experience, knowledge of standards, regulations, accident prevention procedures, and operating and service conditions, makes them capable of carrying out all the works necessary, while being aware of and avoiding any possible danger and/or damage.

Danger due to burns caused by contact with hot surfaces on the unit!

When operating the compressors / suction pumps can reach high surface temperatures of up to 160°C (+320°F).

- Before starting with any work, wait for the unit to cool down after switching it off!

Electrical danger!

- Before doing anything else, make sure that the power supply is NOT switched on.

Any use other than the intended use of the unit may cause serious injury and even death!

The user is not authorised to make repairs or do maintenance work that involves restoring seized surfaces.

In these cases contact FPZ's assistance service or an authorised dealer.

After seizing the components involved may undergo deformation that makes the components unsuitable for being used again. Seized components must be analysed by FPZ before being reused or replaced.

- **Using unsuitable components may cause the impeller blades to break, giving rise to dangerous ejected fragments.**

Danger due to rotating components: Impeller!

There may be a danger of shearing due to the impeller rotating even when the machine is switched off, if it is started manually.

- **Suitable working clothes and personal protective equipment must therefore be used.**

6.1 INTERNAL CLEANING

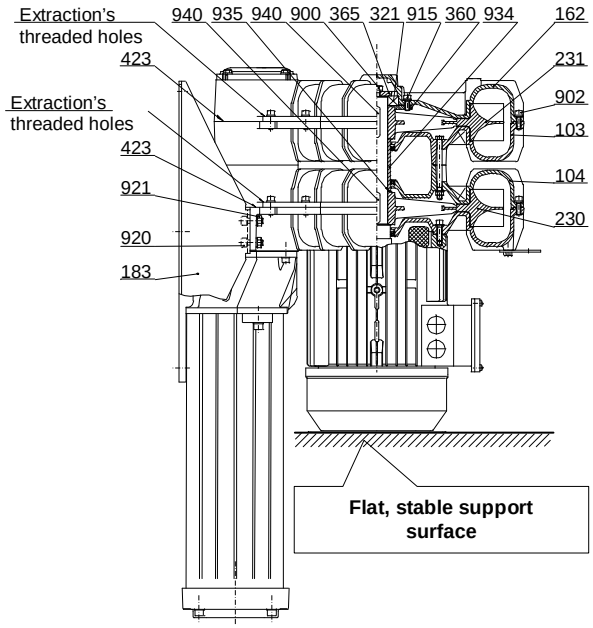
Should it be necessary to clean the inside of the unit, proceed as follows:

6.1.1 INSTRUCTIONS FOR K07-TS / K08-TS

1. Position the unit in a vertical position with the fan guard cowling on a flat, stable surface.
2. Remove the (183) mounting feet by removing (920) screws and (921) nuts.
3. Remove (915) and (902) screws in order from the (162) cover.
4. Remove the (162) cover by using the two threaded holes placed on cover itself.
5. Remove the (900) screw and (365) washer.
6. Remove the (321) bearing and (360) bearing cover working through the extractor.
7. Remove the (231) impeller through the extractor if necessary and (940) key.
8. Remove (902) screws from the (104) intermediate cover.
9. Remove components (103) and (104) and place them together, by using the two threaded holes placed on (104) intermediate cover.
10. Remove the (934) spacer.
11. Remove the (935) shims-be careful not to misplace.
12. Remove the (230) impeller through the extractor if necessary and (940) key.

Clean and reassemble following the instructions in reverse order, and forming the (423) seal using Loctite 5970 or a similar product after having carefully cleaned the surfaces previously sealed.

It's important not to reverse the position of the (230) and (231) impellers.

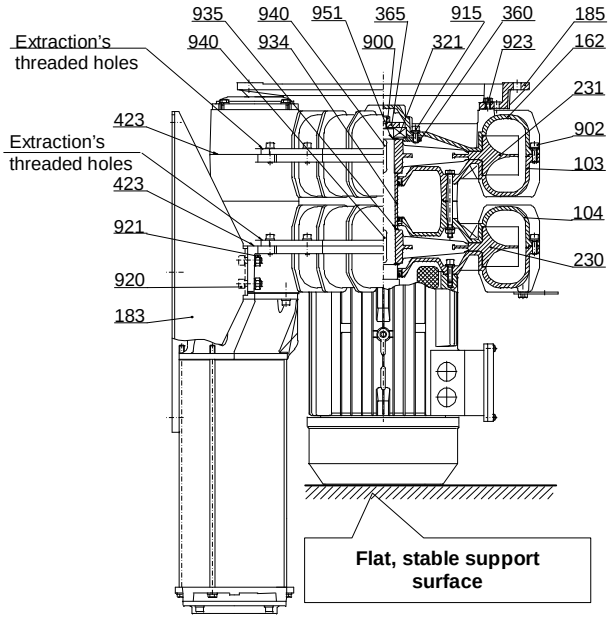


6.1.2 INSTRUCTIONS FOR K09-TS / K10-TS / K11-TS

1. Position the unit in a vertical position with the fan guard cowling on a flat, stable surface.
2. If present, remove the (185) mounting feet by removing (923) screws.
3. Remove the (183) mounting feet by removing (920) screws and (921) nuts.
4. Remove (915) and (902) screws in order from the (162) cover.
5. Remove the (162) cover by using the two threaded holes placed on cover itself.
6. Remove the (900) screw and (365) washer.
7. Remove the (321) bearing and (360) bearing cover working through the extractor.
8. Remove the (951) spacer ring.
9. Remove the (231) impeller through the extractor if necessary and (940) key.
10. Remove (902) screws from the (104) intermediate cover.
11. Remove components (103) and (104) and place them together, by using the two threaded holes placed on (104) intermediate cover.
12. Remove the (934) spacer.
13. Remove the (935) shims-be careful not to misplace.
14. Remove the (230) impeller through the extractor if necessary and (940) key.

Clean and reassemble following the instructions in reverse order, and forming the (423) seal using Loctite 5970 or a similar product after having carefully cleaned the surfaces previously sealed.

It's important not to reverse the position of the (230) and (231) impellers.

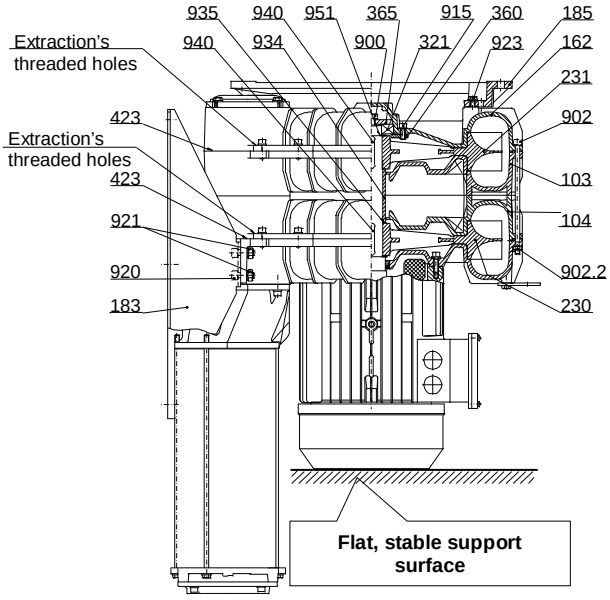


6.1.3 INSTRUCTIONS FOR K12-TS

1. Position the unit in a vertical position with the fan guard cowling on a flat, stable surface.
2. If present, remove the (185) mounting feet by removing (923) screws.
3. Remove the (183) mounting feet by removing (920) screws and (921) nuts.
4. Remove the (915) screws.
5. Remove the (902.2) nuts.
6. Remove (902) screws from the (162) cover.
7. Remove the (162) cover by using the two threaded holes placed on cover itself.
8. Remove the (900) screw and (365) washer.
9. Remove the (321) bearing and (360) bearing cover working through the extractor.
10. Remove the (951) spacer ring.
11. Remove the (231) impeller through the extractor if necessary and (940) key.
12. Remove components (103) and (104) and place them together, by using the two threaded holes placed on (104) intermediate cover.
13. Remove the (934) spacer.
14. Remove the (935) shims-be careful not to misplace.
15. Remove the (230) impeller through the extractor if necessary and (940) key.

Clean and reassemble following the instructions in reverse order, and forming the (423) seal using Loctite 5970 or a similar product after having carefully cleaned the surfaces previously sealed.

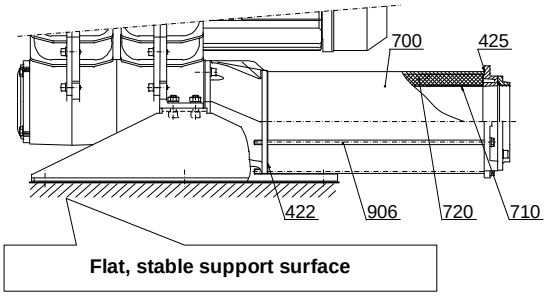
It's important not to reverse the position of the (230) and (231) impellers



6.2 REPLACEMENT SOUND-ABSORBING PANELS

If needed, replace the foam sound-absorbing panels, proceed as follows

1. Position the unit in a horizontal position with its foot on a flat, stable surface.
2. Remove the bolts (906).
3. Remove the silencers (700) from the unit, being careful not to lose the gaskets (422).
4. Remove the soundproofing (720) from the silencer housings.
5. Retrieve the support mesh (710).
6. Replace and reassemble-proceeding in reverse order, remembering to include the (422) gaskets.



6.3 LIFESPAN OF BEARINGS

Under normal operating conditions (values shown in CHARACTERISTIC DATA – page 3/4) the machine's bearings have to be replaced after a maximum of 25,000 working hours or not more than 4 years.

Any use other than the intended use of the unit may cause serious injury and even death!

The bearings may only be replaced:

If the instructions, parts list, and section/exploded view of the relevant unit are available.

After having carefully read, fully understood, and complied with this operating manual ("SAFETY STANDARDS" "STORAGE AND TRANSPORT" and "INSTALLATION").

In conformity with the purposes laid down under "INTENDED USE".

By qualified personnel, that is, personnel whose training, instruction, experience, knowledge of standards, regulations, accident prevention procedures, and operating and service conditions, makes them capable of carrying out all the works necessary, while being aware of and avoiding any possible danger and/or damage.

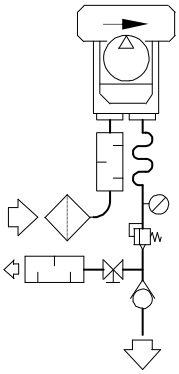
7 COMMERCIAL CONDITIONS

All undertakings, agreements, or legal relations are governed by the relevant sales contract. These are in no way limited by the contents of this manual.

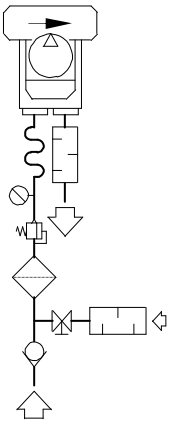
The quality of the materials and workmanship is guaranteed, as indicated in the general sales conditions. Guarantees are regulated by the general conditions of sale

8. INSTALLATION DIAGRAMS

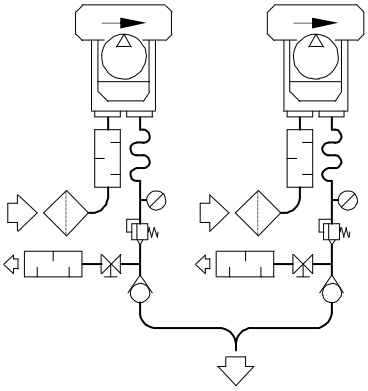
8.1 PRESSURE SERVICE



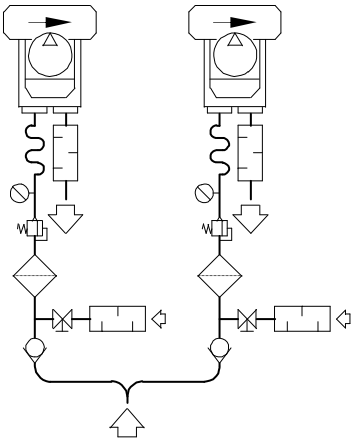
8.3 VACUUM SERVICE



8.2 PARALLEL PRESSURE SERVICE



8.4 PARALLEL VACUUM SERVICE



8.5 LIST ACCESSORIES

Item		Denomination	Item		Denomination
1		Filter – Inline filter	5		Safety valve
(2)		Silencer	6		Non return valve
3		Flexible coupling	7		Valve
4		Pressure – Vacuum gauge	(x) IF NECESSARY		

9 TROUBLESHOOTING

Problem	Cause	Solution
The unit does not start	Electrical wiring incorrect	Get the operator to check the electrical connection against the wiring diagram contained in the terminal board box.
	Power supply voltage unsuitable	Check that the power supply voltage, measured at the motor's terminals, is within +/- 10% of the nominal voltage.
	The impeller is stuck	Get the operator to repair the unit
No or insufficient air flow	The suction filter is clogged	Get the operator to clean or replace the cartridge
	Frequency wrong (for units powered via an inverter)	Correct the frequency
	Profile of the impeller blades modified (due to deposits on the profile)	Get the operator to clean the impeller, check if it is worn and, if necessary, replace it.
No or insufficient pressure differential	Incorrect rotation direction	Get the operator to invert the rotation direction by switching two of the electrical power supply conductors.
	Leaks in the plant	Identify the leak and seal
Current absorption exceeding the admissible value	Electrical wiring incorrect	Get the operator to check the electrical connection against the wiring diagram contained in the terminal board box.
	Drop in mains supply voltage	Get the operator to reinstate the power supply voltage at the terminals at the admissible values
	The suction filter is clogged	Get the operator to clean or replace the cartridge
	The unit has accumulated deposits inside	Get the operator to clean the inside of the unit
	The unit is operating at a pressure and/or vacuum that exceeds the admissible value	Adjust the system and/or the regulating valve to lower pressure differentials.
High delivery air temperature	The unit is operating at a pressure and/or vacuum that exceeds the admissible value	Adjust the system and/or the regulating valve to lower pressure differentials.
	The suction filter is clogged	Get the operator to clean or replace the cartridge
	The unit has accumulated deposits inside	Get the operator to clean the inside of the unit
	Suction and/or delivery piping obstructed.	Get the operator to remove any obstructions
	Suction air temperature exceeds 40°C (+104°F)	Use heat exchangers to reduce the suction air temperature
Anomalous noise	The soundproofing is damaged	Get the operator to replace the soundproofing
	The impeller scrapes against the casing. - The unit is operating at a pressure and/or vacuum that exceeds the admissible value	Reduce the pressure differentials in the plant
	- Reduction of assembly play due to internal deposits (dust, impurities in the pipes, process residues, etc.)	Get the operator to clean the inside of the plant
	Bearing worn	Get the operator to replace the bearing
	Unit's installation position unsuitable	Do not fit structures (tanks, steel plating, etc.) on the unit that can transmit or amplify noise
Abnormal vibrations	The impeller is damaged	Get the operator to replace the impeller
	The impeller has accumulated deposits	e uniGet the operator to clean the inside of th t
	Unit fixing without anti-vibration supports	Get the operator to fix the unit with anti-vibration supports
	Rigid connection to the plant	Get the operator to fit flexible hoses between the unit and the piping
	Bearing on the blower or motor side defective	Get the operator to replace the bearing
Leaks in the unit	Defective silencer gaskets	Get the operator to clean or replace the gaskets
	Defective cover gaskets	Get the operator to clean or replace the gaskets

The term "operator" means: A qualified person appointed to install, operate, set, clean, repair or move a unit or to carry out maintenance work on it.

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Product Information Packet

CEM4108T

30HP,3520RPM,3PH,60HZ,284TSC,1042M,TEFC

Part Detail							
Revision:	F	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	1042M	**Elec. Spec:**	10WGY806	**CD Diagram:**	CD0180
Enclosure:	TEFC	**Mfg Plant:**		**Mech. Spec:**	10E346	**Layout:**	10LYE346
Frame:	286TSC	**Mounting:**	F1	**Poles:**	02	**Created Date:**	08-25-2010
Base:	RG	**Rotation:**	R	**Insulation:**	F	**Eff. Date:**	08-28-2014
Leads:	9#10					**Replaced By:**	
Literature:		**Elec. Diagram:**					

Nameplate NP2138L							
CAT.NO.	CEM4108T	P/N		ENCLOSURE	TEFC		
SPEC.	10E346Y806G1	CC	010A	FRAME	286TSC	S/N	
HP	30	CLASS	F	HZ	60		
RPM	3520	PH	3	DES	B		
VOLT	208-230/460	KVA-CODE	G	ODE BRG	6309	DE BRG	6311
AMP	72-66/33	USABLE AT 208V					
RATING	40C AMB-CONT	GREASE	POLYREX EM				
NEMA-NOM-EFF	91.7	PF	90	SER.F.	1.15		
HTR-VOLTS		HTR-AMPS		MAX. SPACE HEATER TEMP.			

Parts List

Part Number	Description	Quantity
SA202069	SA 10E346Y806G1	1.000 EA
RA189355	RA 10E346Y806G1	1.000 EA
37FN3002C03	EXFN, PLASTIC, 6.00 OD, 1.690 ID	1.000 EA
S/P107-000-004	SUPER-E(284 FR. & UP)-CL PLANT,POLYREX E	1.000 EA
10CB3000SP	STD KO BOX MODEL 310,312,314 MTRS W/2.00	1.000 EA
10XN3118K12	5/16-18 X .75 GRADE 5, ZINC PLATED	4.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	4.000 EA
WD1000B16	T&B CX70TN TERMINAL	1.000 EA
51XF2520A08	SCREW, HEX SER SLT HD, ZN 1/4-20 X .50 L	1.000 EA
10EP1106A01	FR ENDPLATE, MACH	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
10XN3816K28	3/8-16 X 1.75 HEX HD CAP SCREW, GRADE 5	4.000 EA
HW1001A38	LOCKWASHER 3/8, ZINC PLT .688 OD, .382 I	4.000 EA
HW5100A11	W3917-042 WVY WSHR (WB)	1.000 EA
10EP1305A01	PU ENDPLATE, MACH	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
10XN2520K32	1/4-20 X 2.00 HX HD SCRW GRADE 5, ZINC P	2.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	2.000 EA
10XN3118K40	5/16-18 X 2.50" HEX HD, GRADE 5	4.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	4.000 EA
10XN3816K28	3/8-16 X 1.75 HEX HD CAP SCREW, GRADE 5	4.000 EA
HW1001A38	LOCKWASHER 3/8, ZINC PLT .688 OD, .382 I	4.000 EA
10FH4000SP	310 FAN HOUSING STAMPED	1.000 EA
51XF2520A08	SCREW, HEX SER SLT HD, ZN 1/4-20 X .50 L	4.000 EA

Parts List (continued)

Part Number	Description	Quantity
HW4600B40	V-RING SLINGER 2.000 X 2.680 X 0.280	1.000 EA
10CB3500	CONDUIT BOX LID, CAST	1.000 EA
51XW2520A12	.25-20 X .75, TAPTITE II, HEX WSHR SLTD	4.000 EA
HW2501G17	KEY, 3/8 SQ X 1.875	1.000 EA
LB1115N	LABEL,LIFTING DEVICE (ON ROLLS)	1.000 EA
12GS1000SP	GASKET	1.000 EA
HW4500A21	1618BALEMITE FITTING 825 UNIVERSAL	1.000 EA
HA4017A01	1/8 X 4 GREASE EXT (F/S)	1.000 EA
HW4500A17	317400 ALEMITE GREASE RELIEF	1.000 EA
HA4054	SHORT T-DRAIN FITTING, .125" N.P.T.	1.000 EA
MJ1000A75	GREASE, POLYREX EM EXXON (USe 4824-15A)	0.130 LB
HW4500A03	GREASE FITTING, .125 NPT 1610(ALEMITE) 8	1.000 EA
HW4500A17	317400 ALEMITE GREASE RELIEF	1.000 EA
HA4054	SHORT T-DRAIN FITTING, .125" N.P.T.	1.000 EA
HW2500A25	WOODRUFF KEY USA #1008 #BLOW CARBON STEE	1.000 EA
51XB1214A20	12-14X1.25 HXWSSLD SERTYB	1.000 EA
10GS1000	GASKET, CONDUIT BOX LID	1.000 EA
MG1000Y03	MUNSELL 2.53Y 6.70/ 4.60, GLOSS 20,	0.070 GA
85XU0407A04	#4-7 X 1/4 DRIVE PIN	4.000 EA
MN416A01	TAG-INSTAL-MAINT no wire. (100/bx) 8/12	1.000 EA
LB1119N	WARNING LABEL	1.000 EA
LB1125C02	SUPER-E (STOCK CTN LABEL SUPER-E WITH FL	4.000 EA
LC0181	CONNECTION LABEL	1.000 EA
NP2138L	ALUM SUPER-E UL CSA-EEV PREM CC (300	1.000 EA

Parts List (continued)

Part Number	Description	Quantity
10PA1000	PACKAGING GROUP COMBINED PRINT PK1023A06	1.000 EA
LB1506	LABEL "AMERICAN MADE" 1.50 X 1.00	1.000 EA

AC Induction Motor Performance Data

Record # 32211 - Typical performance - not guaranteed values

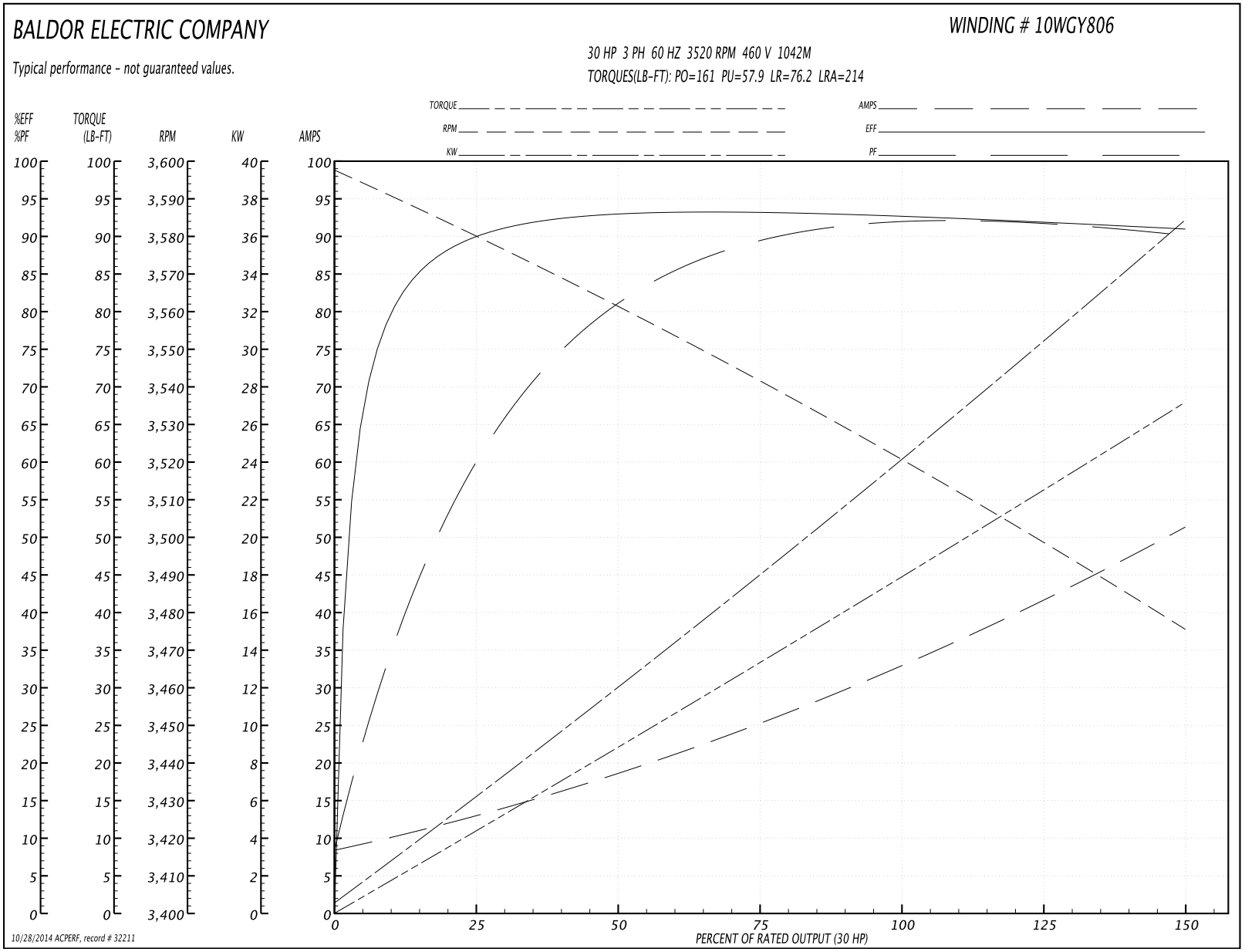
Winding: 10WGY806-R001	**Type:** 1042M	**Enclosure:** TEFC

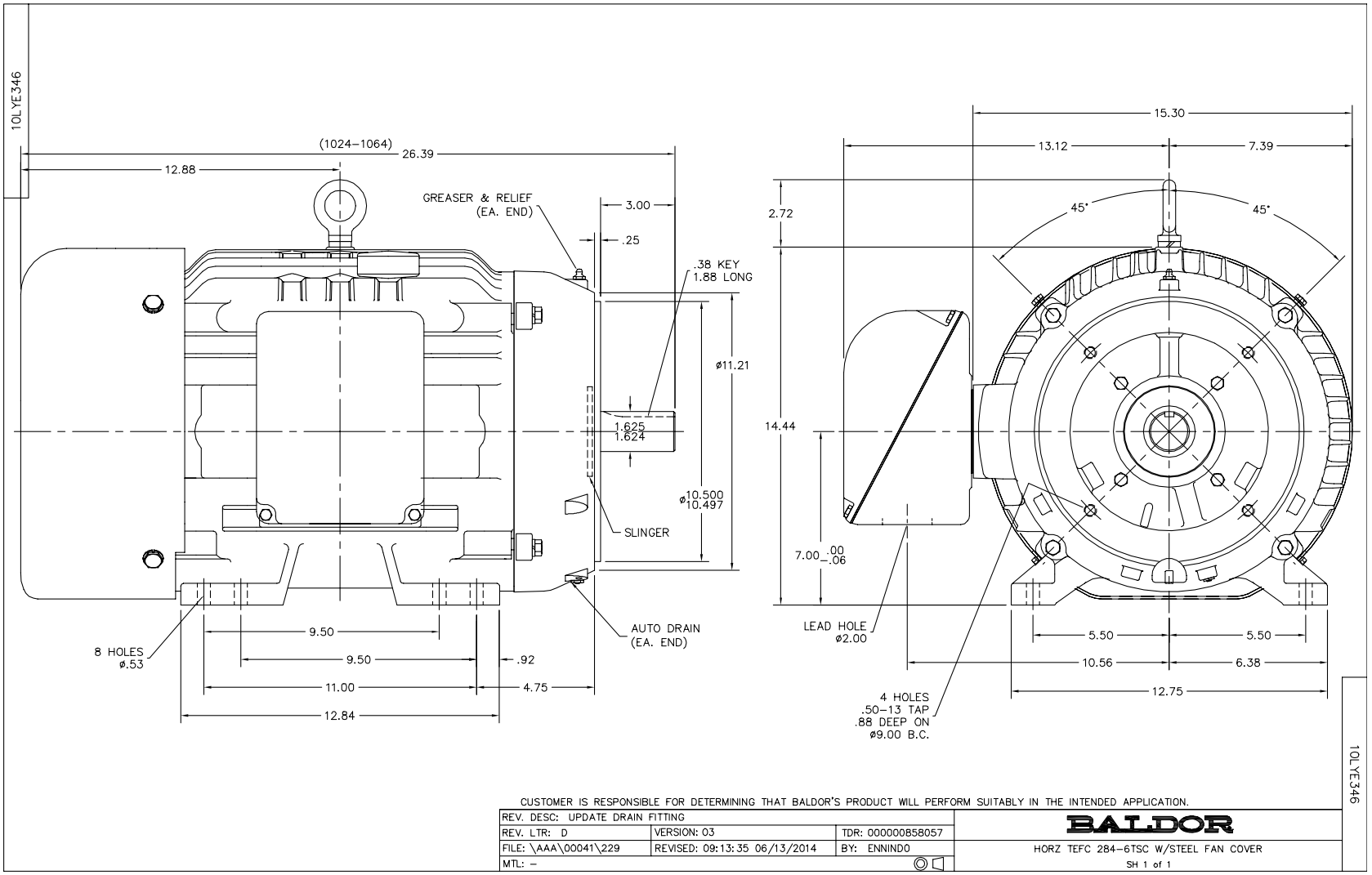
Nameplate Data				460 V, 60 Hz: High Voltage Connection	
Rated Output (HP)	30			Full Load Torque	44.5 LB-FT
Volts	208-230/460			Start Configuration	direct on line
Full Load Amps	72-66/33			Breakdown Torque	161 LB-FT
R.P.M.	3520			Pull-up Torque	57.9 LB-FT
Hz	60	Phase	3	Locked-rotor Torque	76.2 LB-FT
NEMA Design Code	B	KVA Code	G	Starting Current	214 A
Service Factor (S.F.)	1.15			No-load Current	9.03 A
NEMA Nom. Eff.	91.7	Power Factor	90	Line-line Res. @ 25ºC	0.255 Ω
Rating - Duty	40C AMB-CONT			Temp. Rise @ Rated Load	62°C
S.F. Amps				Temp. Rise @ S.F. Load	77°C
				Rotor inertia	1.8 LF²

Load Characteristics 460 V, 60 Hz, 30 HP

% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor	64	83	89	91	91	91	91
Efficiency	89.6	92.8	93.2	92.3	92.2	90.8	92.4
Speed	3579	3560	3542	3522	3500	3474	3509
Line amperes	12	18.4	25.4	33.3	41.9	51.1	38.5

Performance Graph at 460V, 60Hz, 30.0HP Typical performance - Not guaranteed values





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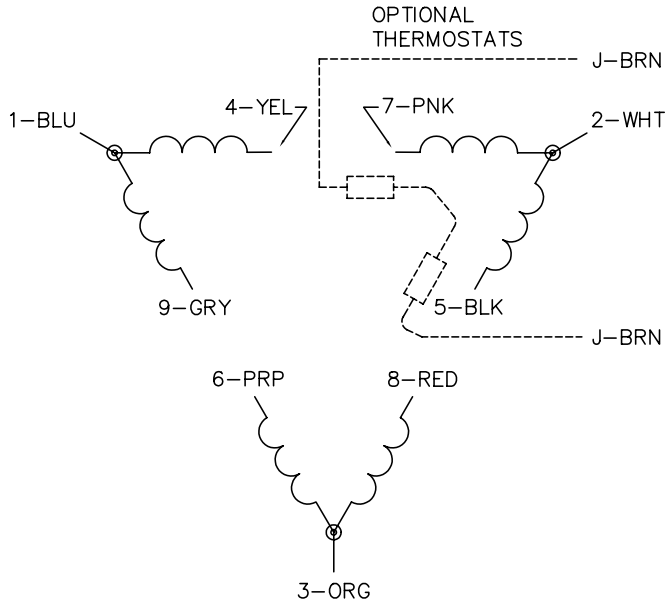
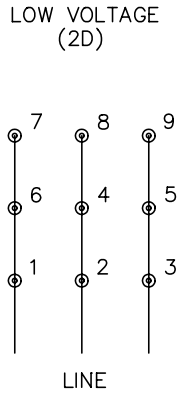
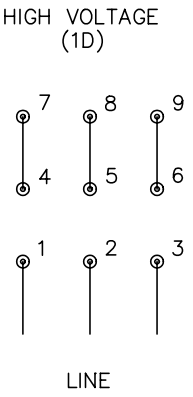






NOTES:

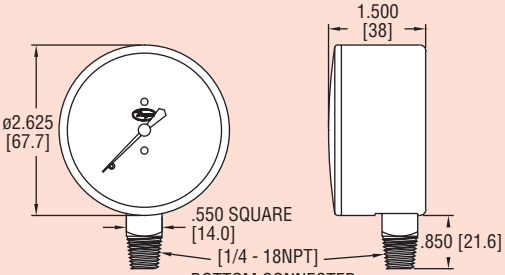
1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0180

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			BALDOR ELECTRIC Co.
REV. LTR: C	BY: JLP	REVISED: 01/21/99 2:28	TDR: 0171435
CD0180		FILE: AAA00005148	MDL: –
		MTL: –	3PH, DV, 9 LEADS, DELTA CONNECTION

Series LPG4 2.5″ Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2″ Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range	Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)	LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)	LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)	LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)	LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)	LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)	LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)	LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)	LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)	LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)	LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)	LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)	LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

OPTION
For NIST traceable calibration certificate, use order code NISTCAL-PG1.

Series 1950 Explosion-Proof Differential Pressure Switches

Specifications - Installation and Operating Instructions

Series 1950 Explosion-Proof Differential Pressure Switches combine the best features of the Series 1900 Pressure Switch with an integral explosion-proof and weather-proof housing. Each unit is UL & CSA listed; FM approved for use in Class I, Groups C & D; Class II, Groups E, F, & G; and Class III atmospheres (NEMA 7 & 9). They are totally rain-tight for outdoor installations. Twelve models allow set-points from .03 to 20 inches w.c. and from .5 to 50 psi (3.4 to 345 kPa).

Easy access to the SPDT switch for electrical hook-up is provided by removing the top plate of the three-part aluminum housing. Adjustment to the set point of the switch can be made without disassembling the housing. The unit is very compact, about half the weight and bulk of equivalent conventional explosion-proof switches.

CAUTION
For use only with air or compatible gases. Use of the Model 1950 switch with explosive media connected to the Low pressure port (including differential pressure applications in such media) is not recommended. Switch contact arcing can cause an explosion inside the switch housing which, while contained, may render the switch inoperative. If switch is being used to sense a single positive pressure relative to atmosphere, run a line from the low pressure port to a non-hazardous area free of combustible gases. This may increase response time on -0 and -00 models.

Note: The last number-letter combination in the model number identifies the switch's electrical rating (number) and diaphragm material (letter). The 2F combination is standard as described in the physical data above. In case of special models, a number 1 rating is the same as 2; a number 3 or 4 rating is 10A 125, 250, 480 VAC; 1/8 H.P. 125 VAC; 1/4 H.P. 250 VAC; a number 5 or 6 rating is 1A 125 VAC. Letter B indicates a Buna-N diaphragm; N = Neoprene; S = Silicone; and V = Viton®.

UL and CSA Listed, FM Approved For
CL. I GR. C, D - CL. II GR. E, F, G - CL. III

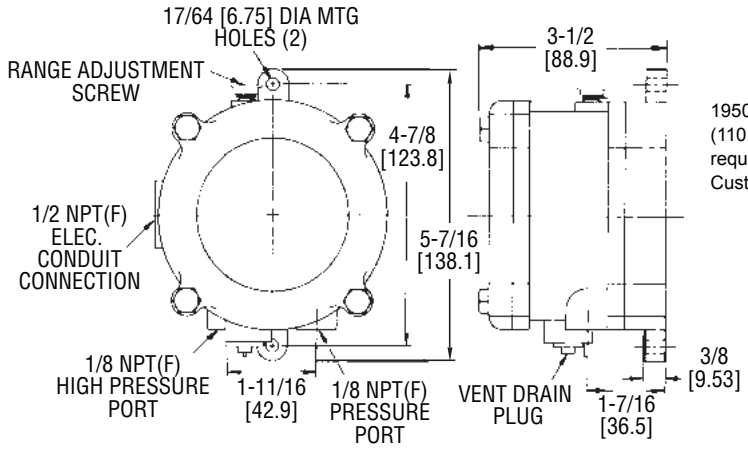
Series 1950 Switches
Operating ranges and deadbands

To order specify Model Number	Operating Range: Inches, W.C.	Approximate Dead Band	
		At Min. Set Point	At Max. Set Point
1950-02-2S	0.03 to 0.10	0.025	0.05
1950-00-2F	0.07 to 0.15	0.04	0.05
1950-0-2F	0.15 to 0.5	0.10	0.15
1950-1-2F	0.4 to 1.6	0.15	0.20
1950-5-2F	1.4 to 5.5	0.3	0.4
1950-10-2F	3.0 to 11.0	0.4	0.5
1950-20-2F	4.0 to 20.0	0.4	0.6
Model Number	Operating Range: PSI	Approximate Dead Band	
		Min. Set Point	Max. Set Point
1950P-2-2F	0.5 to 2.0	0.3 psi	0.3 psi
1950P-8-2F	1.5 to 8.0	1.0 psi	1.0 psi
1950P-15-2F	3.0 to 15.0	0.9 psi	0.9 psi
1950P-25-2F	4.0 to 25.0	0.7 psi	0.7 psi
1950P-50-2F	15.0 to 50	1.0 psi	1.5 psi

SPECIFICATIONS
Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits:
Continuous: 1950's - 45″ w.c. (0.11 bar);
1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar).
Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: IP54, NEMA 3, 7 and 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8″ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, UL, CSA, FM.

RESPONSE TIME: Because of restrictive effect of flame arrestors, switch response time may be as much as 10-25 seconds where applied pressures are near set point.

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**



1950-02: 7-3/4″ (196.9) dia. x 4-11/32″ (110.3) depth. For complete dimensions request drawing 28-700175-00 from our Customer Service Department

1950 Switch Outline Dimensions

INSTALLATION

1. Select a location free from excess vibration and corrosive atmospheres where temperatures will be within the limits noted under Specifications on reverse. Switch may be installed outdoors or in areas where the hazard of explosion exists. See reverse for specific types of hazardous service.

2. Mount standard switches with the diaphragm in a vertical plane and with switch lettering and nameplate in an upright position. Some switches are position sensitive and may not reset properly unless they are mounted with the diaphragm vertical.

3. Connect switch to source of pressure, vacuum or differential pressure. Metal tubing with 1/4″ O.D. is recommended, but any tubing which will not restrict the air flow can be used. Connect to the two 1/8″ female NPT pressure ports as noted below:

A. Differential pressures - connect pipes or tubes from source of greater pressure to high pressure port marked HIGH PRESS, and from source of lower pressure to low pressure port marked LOW PRESS.

B. Pressure only (above atmospheric pressure) - connect tube from source of pressure to high pressure port. The low pressure port is left open to atmosphere.

C. Vacuum only (below atmospheric pressure) - connect tube from source of vacuum to low pressure port. The high pressure port is left open to atmosphere.

4. To make electrical connections, remove the three hex head screws from the cover and after loosening the fourth captive screw, swing the cover aside. Electrical connections to the standard single pole, double throw snap switch are provided by means of terminals marked “COM” (common), “NO” (norm open), “NC” (norm closed). The normally open contacts close and the normally closed contacts open when pressure increases beyond the set point. Switch loads for standard models should not exceed the maximum specified current rating of 15 amps resistive. Switch capabilities decrease with an increase in ambient temperature, load inductance, or cycling rate. Whenever an application involves one or more of these factors, the user may find it desirable to limit the switched current to 10 amps or less in the interest of prolonging switch life.

ADJUSTMENT: To Change the Set point

1. Remove the plastic cap and turn the slotted Adjust-ment Screw at the top of the housing clockwise to raise the set point pressure and counterclockwise to lower the set point. After calibration, replace the plastic cap and re-check the set point.

2. The recommended procedure for calibrating or checking calibration is to use a “T” assembly with three rubber tubing leads, all as short as possible and the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc. Be certain the switch is checked in the position it will assume in use, i.e. with diaphragm in a vertical plane and switch lettering and Dwyer nameplate in an upright position.

3. For highly critical applications check the set point adjustment and if necessary, reset it as noted in step A.

MAINTENANCE

The moving parts of these switches need no maintenance or lubrication. The only adjustment is that of the set point. Care should be taken to keep the switch reasonably clean. Periodically the vent drain plug should be rotated, then returned to its original position. This will dislodge deposits which could accumulate in applications where there is excessive condensation within the switch. The Series 1950 Explosion-Proof Differential Pressure Switch is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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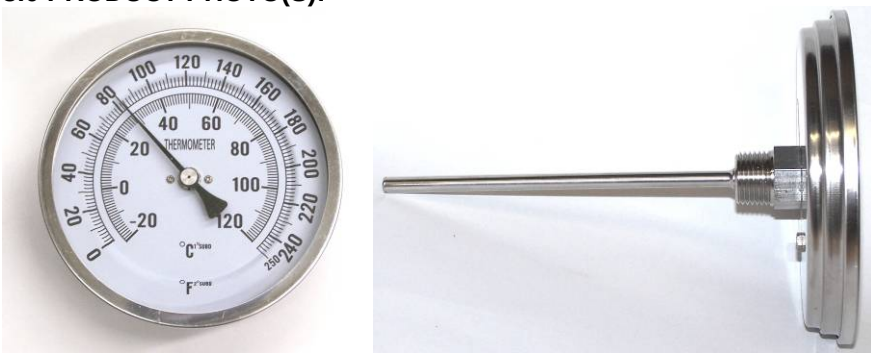
GRAINGER® FOR THE ONES WHO GET IT DONE GRAINGER INTERNATIONAL, INC. GLOBAL SOURCING DIVISION	-- GGS TECHNICAL SPECIFICATION --			
	SPECIFICATION NUMBER: 1NFY4_TSRev1.doc	AUTHOR: Hoskinson	TITLE: ENG	REL. DATE: 5/25/07
	GGS MODEL NUMBER(s): 1NFY4	DESCRIPTION: Industrial thermometer	REVISION #: 1	REV. DATE: 8/10/07

1.0 BRAND:	No brand
2.0 PRODUCT DESCRIPTION:	Bimetal Industrial Thermometer

3.0 PRODUCT PHOTO(S):



4.0 PRODUCT REQUIREMENTS:

4.1 Features & Performance	Requirement
Temperature scale(s)	°F: 0 to 250 °C: -20 to 120
Connection location/type	Back; 1/2 inch NPT
Dial size (inches)	3
Stem length (inches)	2 1/2
Stem diameter (inches)	1/4 In
Rotated degrees	N/A
Angled degrees	N/A
Full scale accuracy	≤40°F: ±1.5% 41 to 200°F: ±1% ≥201°F: ±1.5%
Calibration	External Adjustment

4.2 Materials & Construction	Requirement
Case	Stainless Steel Hermetically Sealed to Prevent Icing/Fogging Inside
Stem	Stainless Steel
Coil dampening	Silicone for Superior Time Response and Vibration Dampening
Dial face	Glass

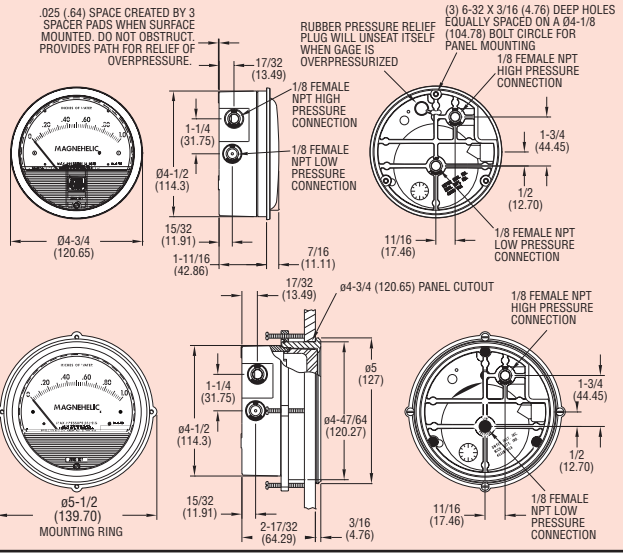
4.3 Finish / Color	Requirement
All Surface Finishes	a) Surface finishes must be uniform and continuous. The surface finish must not exhibit any visual defects such as blisters, rust, corrosion, scratches, peeling, bubbles, and/or cracking. b) All exposed surfaces must be free of burrs and sharp edges. c) All applied finishes must adhere to the surface and show no signs of delamination or peeling.
Finish	Stainless Steel

Series 2000

Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%

RoHS



Select the Dwyer® Magnehelic® gage for high accuracy – guaranteed within 2% of full-scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® gage movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

The Magnehelic® gage is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Mounting

A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. Although calibrated for vertical position, many ranges above 1″ may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4-9/16″ hole is required for flush panel mounting. Complete mounting and connection fittings, plus instructions, are furnished with each instrument. See pages 6 and 7 for more information on mounting accessories.

Flush, Surface or Pipe Mounted

Enclosure Mounted

SPECIFICATIONS

Service: Air and non-combustible, compatible gases (natural gas option available).
Note: May be used with hydrogen. Order a Buna-N diaphragm. Pressures must be less than 35 psi.
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of FS (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on - 00, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20 in Hg to 15 psig† (-0.677 to 1.034 bar); MP option: 35 psig (2.41 bar); HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. See Overpressure Protection Note on next page.
Temperature Limits: 20 to 140°F*
(-6.67 to 60°C). -20°F (-28°C) with low temperature option.
Size: 4″ (101.6 mm) diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Standard Accessories: Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapter, and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for three adapters in MP & HP gage accessories.)
Agency Approval: RoHS. **Note:** -SP models not RoHS approved.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

ACCESSORIES

Model A-432 Portable Kit
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft (2.7 m) of 3/16″ ID rubber tubing, standhang bracket and terminal tube with holder.

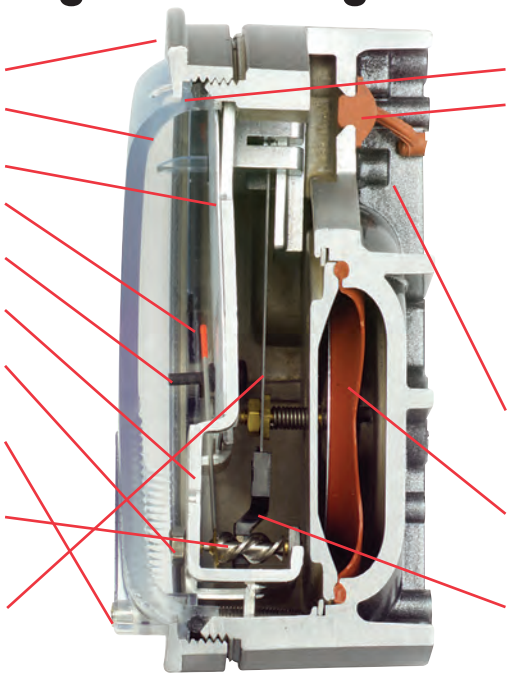
Model A-605 Air Filter Gage Accessory Kit
Adapts any standard Magnehelic® gage for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft (1.5 m) lengths of 1/4″ aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

A-605B Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two 4″ steel static tips, plastic tubing and mounting flange

A-605C Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two plastic static tips, plastic tubing and mounting flange

Series 2000

Magnehelic® Gage Models & Ranges



Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

O-ring seal for cover assures pressure integrity of case.

OVERPRESSURE PROTECTION
Blowout plug is comprised of a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (1.7 bar). To provide a free path for pressure relief, there are four spacer pads which maintain 0.023″ clearance when gage is surface mounted. Do not obstruct the gap created by these pads. The blowout plug is not used on models above 180″ of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm. The blowout plug should not be used as a system overpressure control. High supply pressures may still cause the gage to fail due to over pressurization, resulting in property damage or serious injury. Good engineering practices should be utilized to prevent your system from exceeding the ratings or any component.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

Model	Range Inches of Water
2000-00N†••	.05-0-.2
2000-00†••	0-.25
2000-0†•	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2012	0-12
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2120	0-120
2150	0-150
2160	0-160
2180*	0-180
2250*	0-250
Zero Center Ranges	
2300-00†••	0.125-0-0.125
2300-0†•	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model	Range PSI
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

Model	Range, CM of Water
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300
Zero Center Ranges	
2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

†These ranges calibrated for vertical scale position.
• Accuracy +/-3%
• • Accuracy +/-4%
*MP option standard
**HP option standard

Model	Range MM of Water
2000-6MM†••	0-6
2000-10MM†•	0-10
2000-15MM	0-15
2000-25MM	0-25
2000-30MM	0-30
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100
2000-125MM	0-125
2000-150MM	0-150
2000-200MM	0-200
2000-250MM	0-250
2000-300MM	0-300
Zero Center Ranges	
2300-6MM†••	3-0-3
2300-10MM†•	5-0-5
2300-20MM†•	10-0-10

Model	Range, Pa
2000-60NPA†••	10-0-50
2000-60PA†••	0-60
2000-100PA†•	0-100
2000-125PA†•	0-125
2000-250PA	0-250
2000-300PA	0-300
2000-500PA	0-500
2000-750PA	0-750
2000-1000PA	0-1000
Zero Center Ranges	
2300-60PA†••	30-0-30
2300-100PA†•	50-0-50
2300-120PA	60-0-60
2300-200PA	100-0-100
2300-250PA	125-0-125
2300-300PA	150-0-150
2300-500PA	250-0-250
2300-1000PA	500-0-500

Model	Range, kPa
2000-0.5KPA	0-0.5
2000-1KPA	0-1
2000-1.5KPA	0-1.5
2000-2KPA	0-2
2000-2.5KPA	0-2.5
2000-3KPA	0-3
2000-4KPA	0-4
2000-5KPA	0-5
2000-8KPA	0-8
2000-10KPA	0-10
2000-15KPA	0-15
2000-20KPA	0-20
2000-25KPA	0-25
2000-30KPA	0-30
Zero Center Ranges	
2300-1KPA	.5-0-.5
2300-2KPA	1-0-1
2300-2.5KPA	1.25-0-1.25
2300-3KPA	1.5-0-1.5

Dual Scale Air Velocity Units
For use with pitot tube

Model	Range in W.C./ Velocity F.P.M.
2000-00AV†••	0-.25/300-2000
2000-0AV†•	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2005AV	0-5.0/2000-8800
2010AV	0-10/2000-12500

Dual Scale English/Metric Models

Model	Range, in w.c.	Range, Pa or kPa
2000-00D†••	0-.25	0-62 Pa
2000-0D†•	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
2002D	0-2.0	0-500 Pa
2003D	0-3.0	0-750 Pa
2004D	0-4.0	0-1.0 kPa
2005D	0-5.0	0-1.25 kPa
2006D	0-6.0	0-1.5 kPa
2008D	0-8.0	0-2.0 kPa
2010D	0-10	0-2.5 kPa
2015D	0-15	0-3.7 kPa
2020D	0-20	0-5 kPa
2025D	0-25	0-6.2 kPa
2050D	0-50	0-12.4 kPa
2060D	0-60	0-15 kPa

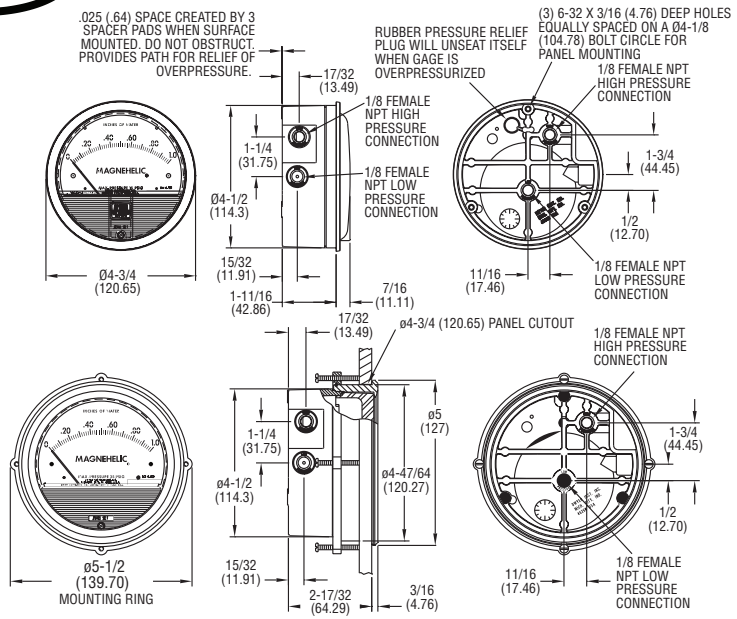
VELOCITY AND VOLUMETRIC FLOW UNITS
Scales are available on the Magnehelic® that read in velocity units (FPM, m/s) or volumetric flow units (SCFM, m^3/s, m^3/h). Stocked velocity units with dual range scales in inches w.c. and feet per minute are shown above. For other ranges contact the factory.
When ordering volumetric flow scales please specify the maximum flow rate and its corresponding pressure. Example: 0.5 in w.c. = 16,000 CFM.

ACCESSORIES
A-321, Safety Relief Valve
A-448, 3-piece magnet kit for mounting Magnehelic® gage directly to magnetic surface
A-135, Rubber gasket for panel mounting

A-310A 3-Way Vent Valves
In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

Bulletin A-27

Magnehelic® Differential Pressure Gage



**The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.*

STANDARD GAGE ACCESSORIES: Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapters and three flush mounting adapters with screws.

MP AND HP GAGE ACCESSORIES: Mounting ring and snap ring retainer substituted for 3 adaptors, 1/4" compression fittings replace 1/8" pipe thread to rubber tubing adaptors.

OVERPRESSURE PROTECTION: Standard Magnehelic® Differential Pressure Gages are rated for a maximum pressure of 15 psig and should not be used where that limit could be exceeded. Models employ a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (excludes MP and HP models). To provide a free path for pressure relief, there are four spacer pads which maintain .023″ clearance when gage is surface mounted. Do not obstruct the gap created by these pads.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. (MP model has polycarbonate cover).
Accuracy: ±2% of full scale (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on -00, - 00N, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20″ Hg to 15 psig.† (-0.677 bar to 1.034 bar); MP option: 35 psig (2.41 bar), HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.
Temperature Limits: 20 to 140°F (-6.67 to 60°C). *Low temperature models available as special option.
Size: 4″ (101.6 mm) diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Agency Approvals: RoHS.

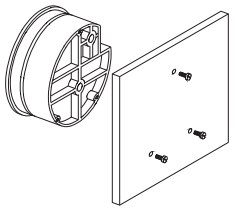
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options.

Note: May be used with hydrogen when ordering Buna-N diaphragm. Pressure must be less than 35 psi.

INSTALLATION

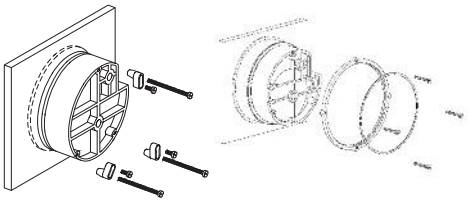
Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F (60°C). Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.
All standard Magnehelic® Differential Pressure Gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range models of 0.5" w.c. plus 0.25" w.c. and metric equivalents must be used in the vertical position only.

SURFACE MOUNTING



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

FLUSH MOUNTING



Provide a 4-9/16" dia. (116 mm) opening in panel. Provide a 4-3/4" dia. (120 mm) opening for MP and HP models. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adapters, firmly secured in place.

PIPE MOUNTING

To mount gage on 1-1/4" - 2" pipe, order optional A-610 pipe mounting kit.

TO ZERO GAGE AFTER INSTALLATION

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

OPERATION

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.
Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.
Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.
When one side of the gage is vented in dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

A. For portable use of temporary installation use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with flexible rubber or vinyl tubing.
B. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended.

MAINTENANCE

No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves should be used in permanent installations. The Series 2000 is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

WARNING

Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended.

TROUBLE SHOOTING TIPS

Gage won't indicate or is sluggish.

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O"ring damaged, missing.
5. Pressure sensor, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F (-7°C), order gage with low temperature, (LT) option.

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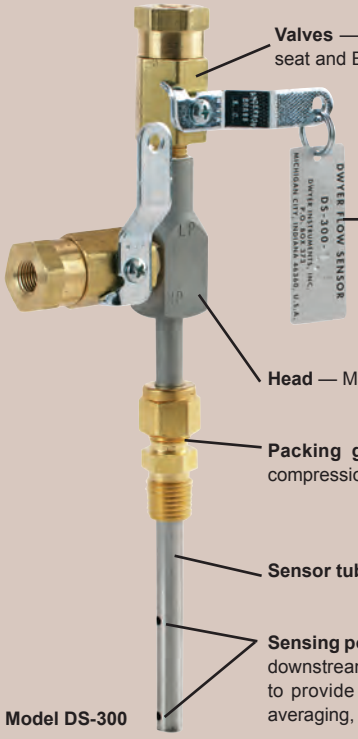
Series DS

In-Line Flow Sensors

Use with the Dwyer® Differential Pressure Gages or Transmitters



Valves — Standard, brass with TFE seat and Buna-N O-ring

Nameplate — Stainless steel permanently attached with split ring. Includes complete size and model information.

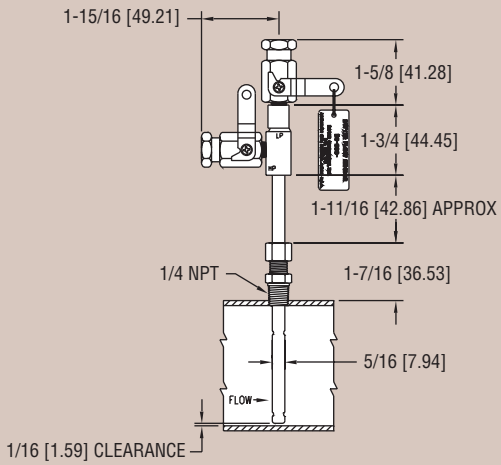
Head — Machined stainless steel.

Packing gland — Parker CPI brass compression fitting.

Sensor tube — 304 SS.

Sensing ports — Multiple upstream and downstream ports sized and positioned to provide effective accurate pressure averaging, even at lower velocities.

Model DS-300



In-Line Flow Sensors are averaging Pitot tubes that provide accurate and convenient flow rate sensing for schedule 40 pipe. When purchased with a Dwyer® Capsuhelic® differential pressure gage of appropriate range, the result is a flow indicating system delivered off the shelf at an economical price.

Pitot tubes have been used in flow measurement for years. Conventional pitot tubes sense velocity pressure at only one point in the flowing stream. Therefore, a series of measurements must be taken across the stream to obtain a meaningful average flow rate. The Dwyer® flow sensor eliminates the need for "traversing" the flowing stream because of its multiple sensing points and built-in averaging capability.

The Series DS-300 flow sensors are designed to be inserted in the pipeline through a compression fitting. They are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® gage kit. Standard valves are rated at 200 psig (13.7 bar) and 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 flow sensors are available for pipe sizes from 1″ to 10″.

DS-400 Averaging Flow Sensors are quality constructed from extra strong 3/4″ dia. stainless steel to resist increased forces encountered at higher flow rates with both air and water. This extra strength also allows them to be made in longer insertion lengths up to 24 inches (61 cm). All models include convenient and quick-acting quarter-turn ball valves to isolate the sensor for zeroing. Process connections to the valve assembly are 1/8″ female NPT. A pair of 1/8″ NPT X 1/4″ SAE 45° flared adapters are included, compatible with hoses used in the Model A-471 Portable Capsuhelic® Gage Kit. Supplied solid brass mounting adapter has a 3/4″ dia. compression fitting to lock in required insertion length and a 3/4″ male NPT thread for mounting in a Threaded Branch Connection.

Select model with suffix which matches pipe size

Model DS-300-1″
Model DS-300-1-1/4″
Model DS-300-1-1/2″
Model DS-300-2″
Model DS-300-2-1/2″
Model DS-300-3″
Model DS-300-4″
Model DS-300-6″
Model DS-300-8″
Model DS-300-10″

Model DS-400-6″
Model DS-400-8″
Model DS-400-10″
Model DS-400-12″
Model DS-400-14″
Model DS-400-16″
Model DS-400-18″
Model DS-400-20″
Model DS-400-24″

OPTIONS & ACCESSORIES

DS-300 or DS-400 Less Valves. To order, add suffix **-LV**

A-160, Threaded Branch Connection, 3/8″ NPT, forged steel, 3000 psi

A-161, Brass Bushing, 1/4″ x 3/8″

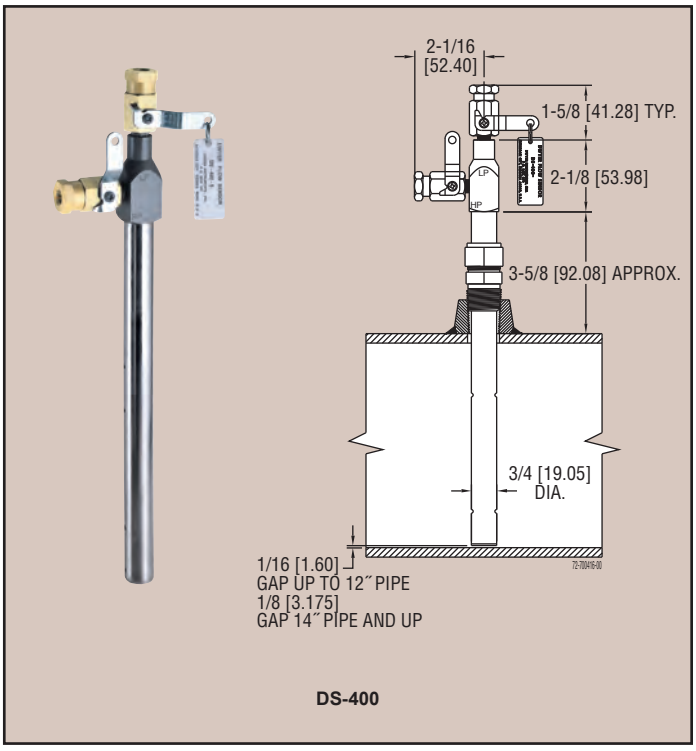
How To Order

Merely determine the pipe size into which the flow sensor will be mounted and designate the size as a suffix to Model DS-300. For example, a flow sensor to be mounted in a 2″ pipe would be a Model No. DS-300-2″.

For non-critical water and air flow monitoring applications, the chart below can be utilized for ordering a stock Capsuhelic® differential pressure gage for use with the DS-300 flow sensor. Simply locate the maximum flow rate for the media being measured under the appropriate pipe size and read the Capsuhelic® gage range in inches of water column to the left. The DS-300 sensor is supplied with installation and operating instructions, Bulletin F-50. It also includes complete flow conversion information for the three media conditions shown in the chart below. This information enables the user to create a complete differential pressure to flow rate conversion table for the sensor and differential pressure gage employed. Both the Dwyer® Capsuhelic® gage and flow sensor feature excellent repeatability so, once the desired flow rate is determined, deviation from that flow in quantitative measure can be easily determined. You may wish to order the adjustable signal flag option for the Capsuhelic® gage to provide an easily identified reference point for the proper flow.

Capsuhelic® gages with special ranges and/or direct reading scales in appropriate flow units are available on special order for more critical applications. Customer supplied data for the full scale flow (quantity and units) is required along with the differential pressure reading at that full flow figure. Prior to ordering a special Capsuhelic® differential pressure gage for flow read-out, we recommend you request Bulletin F-50 to obtain complete data on converting flow rates of various media to the sensor differential pressure output. With this bulletin and after making a few simple calculations, the exact range gage required can easily be determined.

Large 3/4 Inch Diameter for Extra Strength in Lengths to 24 Inches



DS-400

Gage Range (in w.c.)	Media @ 70°F	Full Range Flows by Pipe Size (Approximate)									
		1″	1-1/4″	1-1/2″	2″	2-1/2″	3″	4″	6″	8″	10″
2	Water (GPM)	4.8	8.3	11.5	20.5	30	49	86	205	350	560
	Air @ 14.7 PSIA (SCFM)	19.0	33.0	42.0	65.0	113	183	330	760	1340	2130
	Air @ 100 PSIG (SCFM)	50.0	90.5	120.0	210.0	325	510	920	2050	3600	6000
5	Water (GPM)	7.7	14.0	18.0	34.0	47	78	138	320	560	890
	Air @ 14.7 PSIA (SCFM)	30.0	51.0	66.0	118.0	178	289	510	1200	2150	3400
	Air @ 100 PSIG (SCFM)	83.0	142.0	190.0	340.0	610	820	1600	3300	5700	10000
10	Water (GPM)	11.0	19.0	25.5	45.5	67	110	195	450	800	1260
	Air @ 14.7 PSIA (SCFM)	41.0	72.0	93.0	163.0	250	410	725	1690	3040	4860
	Air @ 100 PSIG (SCFM)	120.0	205.0	275.0	470.0	740	1100	2000	4600	8100	15000
25	Water (GPM)	18.0	32.0	40.5	72.0	108	173	310	720	1250	2000
	Air @ 14.7 PSIA (SCFM)	63.0	112.0	155.0	255.0	390	640	1130	2630	4860	7700
	Air @ 100 PSIG (SCFM)	185.0	325.0	430.0	760.0	1200	1800	3300	7200	13000	22000
50	Water (GPM)	25.0	44.0	57.5	100.0	152	247	435	1000	1800	
	Air @ 14.7 PSIA (SCFM)	90.0	161.0	205.0	360.0	560	900	1600	3700	6400	
	Air @ 100 PSIG (SCFM)	260.0	460.0	620.0	1050.0	1700	2600	4600	10000	18500	
100	Water (GPM)	36.5	62.0	82.0	142.0	220	350	620	1500		
	Air @ 14.7 PSIA (SCFM)	135.0	230.0	300.0	505.0	800	1290	2290	5000		
	Air @ 100 PSIG (SCFM)	370.0	660.0	870.0	1500.0	2300	3600	6500	15000		

Model A-471 Portable Kit

For portable operation, the A-471 Capsuhelic® Portable Gage Kit is available complete with tough polypropylene carrying case, mounting bracket, 3-way manifold valve, two 10' high pressure hoses, and all necessary fittings.

See page 16 for complete information on the Capsuhelic® gage

Capsuhelic® Gage Shown Installed In A-471 Portable Kit

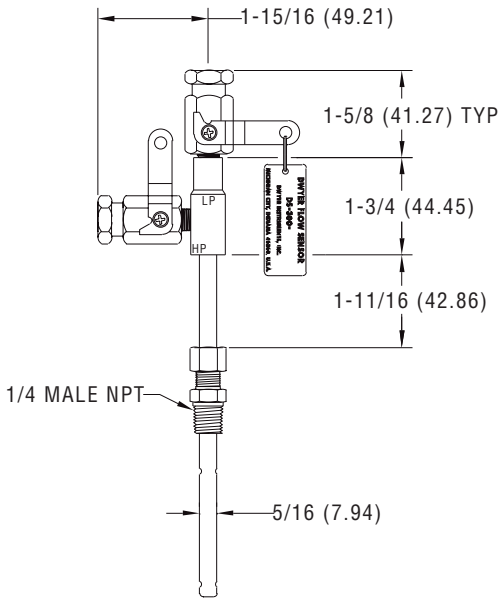
Series 631B Capsuhelic® Wet/Wet Differential Pressure Transmitter

Low pressure transmitter for use with DS-300/400 flow sensors. Use Series 631B Capsuhelic® Wet/Wet Differential Pressure Transmitter.

See page 65 for additional details.

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations



Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

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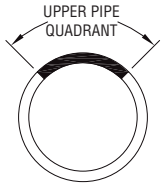
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

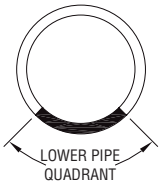
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

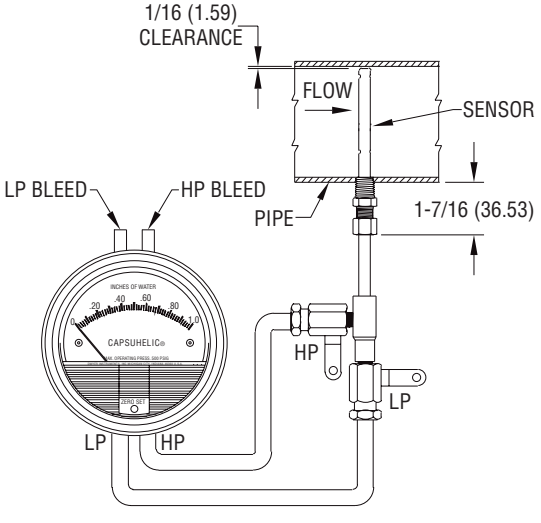
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

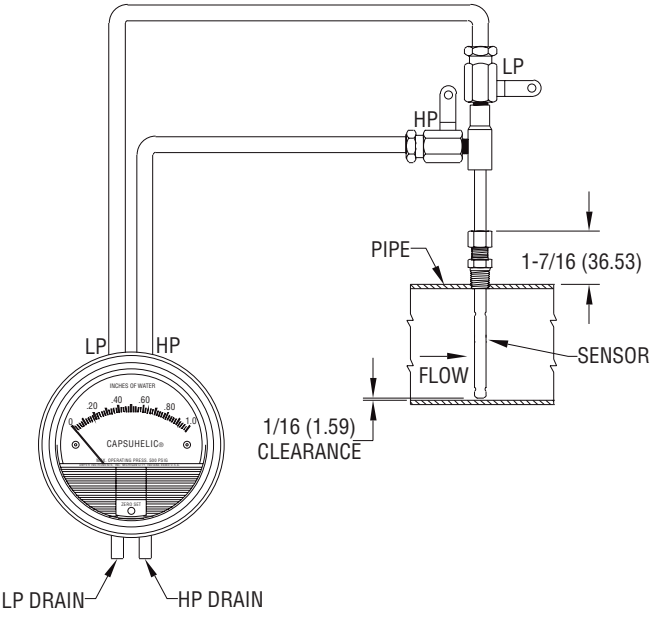
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

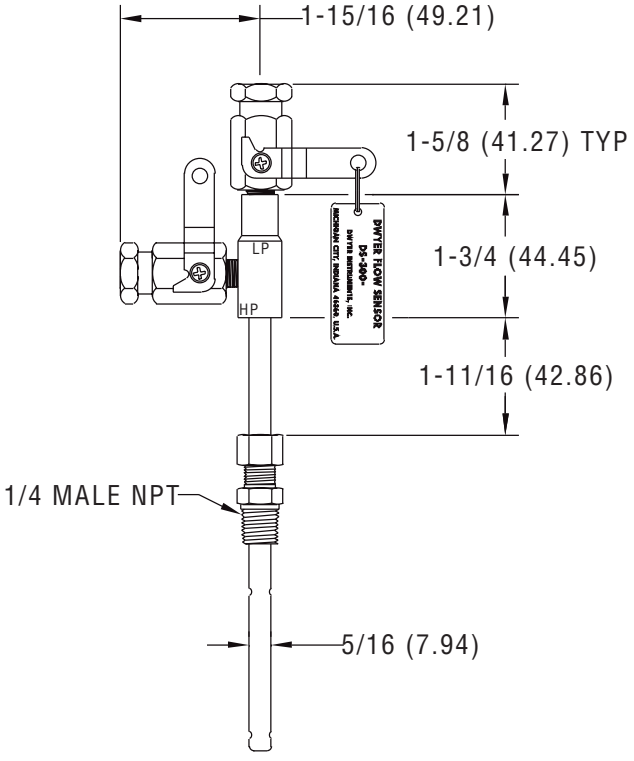
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 “Flow of Fluids Through Valves, Fittings and Pipe.” It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient “K”	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Water @ 70°F (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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SECTION 7 - 400 SERIES PROCESS EQUIPMENT - SVE DISCHARGE HEAT EXCHANGER

PRESSURE INDICATOR - DWYER MODEL LPG4-D8422N

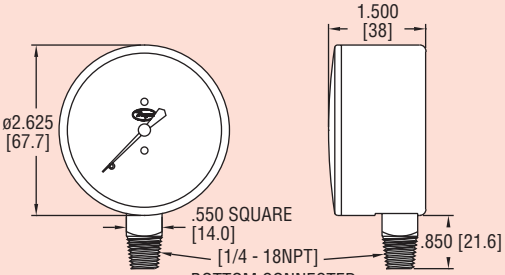
TEMPERATURE INDICATOR - AV MODEL 1NFY4

TEMPERATURE SWITCH - UNITED ELECTRIC MODEL B400-120

Series LPG4

2.5" Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2" Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5" (63 mm).
Process Connections: 1/4" male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)

Model	Range
LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

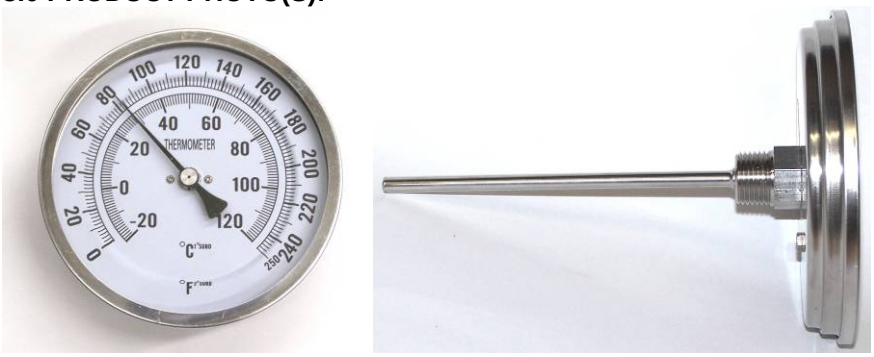
OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

GRAINGER® FOR THE ONES WHO GET IT DONE GRAINGER INTERNATIONAL, INC. GLOBAL SOURCING DIVISION	-- GGS TECHNICAL SPECIFICATION --			
	SPECIFICATION NUMBER: 1NFY4_TSRev1.doc	AUTHOR: Hoskinson	TITLE: ENG	REL. DATE: 5/25/07
	GGS MODEL NUMBER(s): 1NFY4	DESCR PTION: Industrial thermometer	REVISION #: 1	REV. DATE: 8/10/07

1.0 BRAND:	No brand
2.0 PRODUCT DESCRIPTION:	Bimetal Industrial Thermometer

3.0 PRODUCT PHOTO(S):



4.0 PRODUCT REQUIREMENTS:

4.1 Features & Performance	Requirement
Temperature scale(s)	°F: 0 to 250 °C: -20 to 120
Connection location/type	Back; 1/2 inch NPT
Dial size (inches)	3
Stem length (inches)	2 1/2
Stem diameter (inches)	1/4 In
Rotated degrees	N/A
Angled degrees	N/A
Full scale accuracy	≤40°F: ±1.5% 41 to 200°F: ±1% ≥201°F: ±1.5%
Calibration	External Adjustment

4.2 Materials & Construction	Requirement
Case	Stainless Steel Hermetically Sealed to Prevent Icing/Fogging Inside
Stem	Stainless Steel
Coil dampening	Silicone for Superior Time Response and Vibration Dampening
Dial face	Glass

4.3 Finish / Color	Requirement
All Surface Finishes	a) Surface finishes must be uniform and continuous. The surface finish must not exhibit any visual defects such as blisters, rust, corrosion, scratches, peeling, bubbles, and/or cracking. b) All exposed surfaces must be free of burrs and sharp edges. c) All applied finishes must adhere to the surface and show no signs of delamination or peeling.
Finish	Stainless Steel

400 Series

PRESSURE, VACUUM, DIFFERENTIAL PRESSURE AND TEMPERATURE SWITCHES

FEATURES

- 1, 2 & 3 switch outputs
- Epoxy-coated enclosure designed to meet enclosure type 4X
- Wide variety of pressure sensors and materials
- Setting via reference dial or hex screw adjustment
- FM approved
- Adjustable Ranges:

  "WC ranges: 300 "wc vacuum to 250 "wc pressure (-746,7 to 622,3 mbar)

  Pressure: 30 "Hg Vac to 6000 psi (-1,0 to 413,7 bar)

  Differential pressure: 1"wcd to 200 psid (2.5 mbar to 13,8 bar)

  Temperature: -180 to 650 °F (-117.8 to 343.3 °C)

ISO 9001 CERTIFIED COMPANY

UNITED ELECTRIC CONTROLS

OVERVIEW

The 400 Series is a versatile family of vacuum, pressure, differential pressure and temperature switches for applications that require single or multiple switching capabilities. Dual and triple switch versions provide multi-output for alarm and shutdown, pre-alarm and alarm, high/low limit or level staging functions.

A wide variety of microswitch and process connection options, along with a weather-tight enclosure, make the 400 Series an ideal choice for most ordinary location applications. Its worldwide use is assured with approvals and certifications to agency standards.

Widely used throughout the process industries, the 400 Series provides threshold protection and control for many critical functions. Typical installations are found in industrial gas production, energy generation including pumps, turbines and compressors, pulp and paper, and water and wastewater treatment.

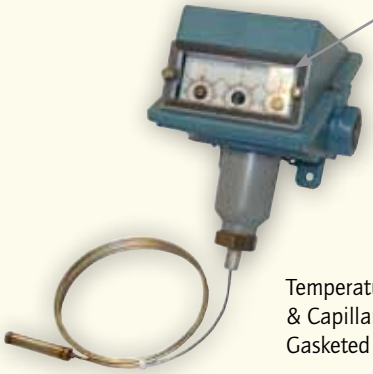
FEATURES

- UL listed and cUL certified. FM approved.
- CE compliant to low voltage directive and pressure equipment directive.
- Optional ATEX or GOST intrinsic safety compliance.
- One, two or three switch outputs may be separated up to 100% of range.
- Wide variety of available options and pressure sensor modules.
- Most models available for immediate delivery.

Reference scale, for types B, E & H with option M321

Enlarged View

Differential Pressure Model with M210 Option - Dial Indication



Temperature Model with Remote Bulb & Capillary and M321 option - Gasketed Lexan Window

Dual Switch, Low Water Column Differential Pressure Model

SPECIFICATIONS

STORAGE TEMPERATURE	-65 to 160°F (-54 to 71°C)
AMBIENT TEMPERATURE LIMITS	-40 to 160°F (-40 to 71°C); set point typically shifts less than 1% of range for a 50°F (28°C) ambient temperature change
SET POINT REPEATABILITY	Temperature models: ± 2% of full scale range Pressure: models 126-376, 520-535, 540-547, 570-572, S126B-S164B: ± 2% of full scale range; models 440-457, 550-559: ± 1% of full scale range; models 610-614: ± 3% of full scale range
SHOCK	Set point repeats after 15 G, 10 millisecond duration
VIBRATION	Set point repeats after 2.5 G, 5-500 Hz
ENCLOSURE	Die cast aluminum, epoxy powder coated, gasketed, captive cover screws
ENCLOSURE CLASSIFICATION	Designed to meet enclosure type 4X requirements
SWITCH OUTPUT	One, two or three SPDT switches, may be separated up to 100% of range except models 521-524, 531-534: 50%; models 520, 525, 530, 535, 570-572: 30%; switches may be wired "normally open" or "normally closed"
ELECTRICAL RATING	15 A 125/250/480 VAC resistive. Electrical switches have limited DC capabilities. Consult factory for additional information.
WEIGHT	Approx. 3 to 7.5 lbs.; varies with model
ELECTRICAL CONNECTION	One 3/4" NPT and two 7/8" diameter knockouts
PRESSURE CONNECTION	All models 1/4" NPT (female) except models S126B-S164B, 520-535: 1/2" NPT (female); models 540-547: 1/8" NPT (female)
TEMPERATURE ASSEMBLY	'E' types use the same assemblies as 'F' types, however, range spans are limited due to use of reference dials Bulb and capillary: 6 feet 304 stainless steel Immersion stem: models 120 &121: nickel-plated brass; optional 316L stainless steel available
FILL	Temperature Models: Model 1BS: solvent filled; models 2-8: non-toxic oil filled
TEMPERATURE DEADBAND	Type F typically 1% and type E, B & C typically 2% of range under laboratory conditions (70°F ambient circulating bath at rate of 1/2°F per minute change)
DIFFERENTIAL PRESSURE INDICATOR (OPTION M210)	Differential pressure indication available J400K, J402K models 147-S157B; accuracy approximately 1-1/2% mid 50% of range, 3% at ends; window is plexiglass and gasketed; indicator may be field adjusted for approximately ±1% accuracy at any set point within range

APPROVALS

UNITED STATES AND CANADA
Type 400 & 402
UL Listed, cUL Certified
Pressure: UL 508; CSA C22.2 No. 14, file # E42272
Temperature: UL 873; CSA C22.2 No. 24, file # E10667

Type 403
UL Recognized, cUL Recognized
Pressure: UL 508; CSA C22.2 No. 14, file # E42272
Temperature: UL 873; CSA C22.2 No. 24, file # E10667

All Types
FM Approved
Pressure: Class 3510
Temperature: Class 3545

EUROPE
ATEX Directive (94/9/EC)
II 1 G EEx ia IIC T6 **(OPTIONAL – code M405)**
Tamb = -50°C to +60°C
UL International DEMKO A/S (N.B.# 0539)
Certificate # DEMKO 03 ATEX 0335063
EN 50014, 50020 & 50284

Low Voltage Directive (LVD) (73/23/EC & 93/68/EEC)
Compliant to LVD
Products rated lower than 50 VAC and 75 VDC are outside of the scope of the LVD

Pressure Equipment Directive (PED) (97/23/EC)
Compliant to PED
Products rated below 7.5 PSI are outside the scope of PED

RUSSIA
Gosgortechnadzor Permit **(OPTIONAL – code M406)**
0ExiaIICT6
Tamb = -50˚C to +60˚C
NANIO CCVE Certification Center
Certificate # ROSS US.GB05.Bo2933
GOST R 51330.0, 51330.1, 51330.10 & 51330.14

TEMPERATURE MODEL CHART

Type B400, single switch output, immersion stem, internal adjustment via reference dial
Type B402, dual switch output, immersion stem, internal adjustment via reference dial
Type B403, triple switch output, immersion stem, internal adjustment via reference dial
Type C400, single switch output, immersion stem, internal hex screw adjustment
Type C402, dual switch output, immersion stem, internal hex screw adjustment
Type C403, triple switch output, immersion stem, internal hex screw adjustment
Type E400, single switch output, bulb & capillary***, internal adjustment via reference dial
Type E402, dual switch output, bulb & capillary***, internal adjustment via reference dial
Type E403, triple switch output, bulb & capillary***, internal adjustment via reference dial
Type F400, single switch output, bulb & capillary***, internal hex screw adjustment
Type F402, dual switch output, bulb & capillary***, internal hex screw adjustment
Type F403, triple switch output, bulb & capillary***, internal hex screw adjustment

Model	Adjustable Set Point Range		Max. Temp.		Scale Division††		Stem or Bulb Size*/Finish**
	°F	°C	°F	°C	°F	°C	OD x Length
Type B400, B402, B403, single, dual, or triple switch output, immersion stem, internal adjustment via reference dial. Type C400, C402, C403, single, dual, or triple switch output, immersion stem, internal hex screw adjustment							
120	0 to 225	-17.8 to 107.2	275	135	5	5	9/16" x 1-7/8" nickel-plated brass
121	200 to 425	93.3 to 218.3	475	246.1	5	5	9/16" x 1-7/8" nickel-plated brass
Type E400, E402, E403, single, dual, or triple switch output, bulb & capillary***, internal adjustment via reference dial							
2BSA	-120 to 100	-84.4 to 37.8	150	65.6	10	5	3/8 x 2-5/8"
2BSB	30 to 250	-1.1 to 121.1	300	148.9	10	5	3/8 x 2-5/8"
3BS	100 to 400	37.8 to 204.4	450	232.2	10	10	3/8 x 2-1/8"
4BS	25 to 100	-3.9 to 37.8	150	65.6	5	2	3/8 x 6-3/4"
5BS	-20 to 80	-28.9 to 26.7	130	54.4	5	2	3/8 x 5"
8BS	350 to 640	176.7 to 337.8	690	365.6	10	10	3/8 x 3-1/4"
Type F400, F402, F403, single, dual, or triple switch output, bulb & capillary***, internal hex screw adjustment							
1BS†	-180 to 120	-117.8 to 48.9	170	76.7	N/A		3/8 x 3-3/4"
2BS	-125 to 350	-87.2 to 176.7	400	204.4	N/A		3/8 x 2-5/8"
3BS	-125 to 500	-87.2 to 260	550	287.8	N/A		3/8 x 2-1/8"
4BS	-40 to 120	-40 to 48.9	170	76.7	N/A		3/8 x 6-3/4"
5BS	-40 to 180	-40 to 82.2	230	110	N/A		3/8 x 5"
6BS	0 to 250	-17.8 to 121.1	300	148.9	N/A		3/8 x 4-1/2"
7BS	0 to 400	-17.8 to 204.4	450	232.2	N/A		3/8 x 3"
8BS	50 to 650	10 to 343.3	700	371.1	N/A		3/8 x 3-1/4"

† Model not available on type F403
†† Only applies to types B400, B402, B403, E400, E402 and E403
* **Optional immersion** stem lengths and **capillary** lengths are available
** **Optional** stainless steel **immersion** stem and **capillary** covering available
*** **Standard capillary** lengths are 6ft

HOW TO ORDER

BUILDING A PART NUMBER

Select a **Type**

Refer to the "Type" section below.

Determine type number based on switch output, enclosure, adjustment and reference.

Fill in the type portion of your part number with the corresponding number.

Select a **Model**

Refer to the "Model Charts".

Determine model based on adjustable range, deadband and proof pressure.

Fill in the model portion of your part number with the corresponding number.

Select an **Option**

Refer to the "Options" section.

Determine option number based on switch output, optional materials or other product enhancements.

Fill in the option portion of your part number with the corresponding number.

Leave "option" portion blank if no options are needed.

FOR MULTIPLE OPTIONS: Call United Electric Controls.

TYPE	DESCRIPTION
PRESSURE	Type J400 - One SPDT output; internal hex screw adjustment
	Type J402 - Two SPDT outputs; internal hex screw adjustment
	Type J403 - Three SPDT outputs; internal hex screw adjustment
	Type H400 - One SPDT output; internal adjustment with reference dial
	Type H402 - Two SPDT outputs; internal adjustment with reference dial
	Type H403 - Three SPDT outputs; internal adjustment with reference dial
DIFFERENTIAL PRESSURE	Type J400K - One SPDT output; internal hex screw adjustment
	Type J402K - Two SPDT outputs; internal hex screw adjustment
	Type H400K - One SPDT output; internal adjustment with reference dial
	Type H402K - Two SPDT outputs; internal adjustment with reference dial
TEMPERATURE	Type B400 - Immersion stem; one SPDT output; internal adjustment with reference dial
	Type B402 - Immersion stem; two SPDT outputs; internal adjustment with reference dial
	Type B403 - Immersion stem; three SPDT outputs; internal adjustment with reference dial
	Type C400 - Immersion stem; one SPDT output; internal hex screw adjustment
	Type C402 - Immersion stem; two SPDT outputs; internal hex screw adjustment
	Type C403 - Immersion stem; three SPDT outputs; internal hex screw adjustment
	Type E400 - Bulb and capillary; one SPDT output; internal adjustment with reference dial
	Type E402 - Bulb and capillary; two SPDT outputs; internal adjustment with reference dial
	Type E403 - Bulb and capillary; three SPDT outputs; internal adjustment with reference dial
	Type F400 - Bulb and capillary; one SPDT output; internal hex screw adjustment
	Type F402 - Bulb and capillary; two SPDT outputs; internal hex screw adjustment
	Type F403 - Bulb and capillary; three SPDT outputs; internal hex screw adjustment

HOW TO ORDER OPTIONS

SWITCH OPTIONS*	DESCRIPTION
0140	Gold contacts, 1 A 125 VAC resistive. NOT AVAILABLE MODELS 440-443
0500	Close deadband, 5 A 125/250 VAC resistive. NOT AVAILABLE MODELS 440-443
1010	DPDT switch, 10 A 125/250 VAC resistive; deadband and minimum set point will increase. NOT AVAILABLE TEMPERATURE VERSIONS, TYPE J403, TYPE H403 AND MODELS 440-449, 520-535, 540-547, 570-572
1070	10 A 125 VDC resistive; deadband and minimum set point will increase. NOT AVAILABLE TYPES B, E AND MODELS 440-449, 520-535, 540-547, 570-572
1520	Adjustable deadband, 15 A 125/250/480 VAC resistive. Adjustment wheel changes rise setting only if adjustment on fall setting is required, use primary adjustment. NOTE: NOT AVAILABLE ON MIDDLE SWITCH FOR TYPE J403, C403 AND F403. NOT AVAILABLE TYPES B, E, H, OR MODELS 440-443, 520-535, 540-547, 570-572, 610-614
1530	External manual reset, 15 A 125/250/480 VAC resistive, latches on rise only. NOT AVAILABLE TRIPLE SWITCH VERSIONS, OR MODELS 440-443, 520-535, 570-572
1535	High ambient, 15 A 125/250/480 VAC resistive; temperatures up to 250°F/145°C. NOT AVAILABLE MODELS 440-443, 520-535
1537	Vapor-sealed 15 A 125/250 VAC resistive. NOT AVAILABLE MODELS 440-443, 520-535
1539	Fungus resistant case, 15 A 125/250 VAC resistive. NOT AVAILABLE MODELS 440-443, 520-535
2000	20 A 125/250/480 VAC resistive. NOT AVAILABLE MODELS 440-443, 520-535, 540-547, 570-572
OTHER OPTIONS	
M020	Red status light, 115 VAC only. Specify whether light goes on or off with increasing or decreasing pressure or temperature. NOT AVAILABLE J400K, H400K, J402K, H402K OR MODELS 440-443
M201	Factory set one switch; specify set point on increasing or decreasing pressure, differential pressure or temperature. NOT AVAILABLE DUAL OR TRIPLE SWITCH VERSIONS
M202	Factory set two switches; specify set points on increasing or decreasing pressure, differential pressure or temperature. NOT AVAILABLE SINGLE OR TRIPLE SWITCH VERSIONS
M203	Factory set three switches; note: the third or middle switch must always be set to highest pressure or temperature when switches are set apart; specify set points on increasing or decreasing pressure, differential pressure or temperature. NOT AVAILABLE SINGLE OR DUAL SWITCH VERSIONS
M210	Differential pressure indication. AVAILABLE J400K AND J402K, MODELS 147, S147B, 157 & S157B
M277	Range indicated on nameplate in kPa or MPa, factory selected. NOT AVAILABLE TEMPERATURE VERSIONS
M278	Range indicated on nameplate in Kg/cm^2. NOT AVAILABLE TEMPERATURE VERSIONS
M321	Gasketed Lexan® window. NOT AVAILABLE ON J, C, F TYPES
M405	Intrinsic safety compliance for European Union per ATEX standards
M406	Intrinsic safety compliance for Russia per Gosgortechnadzor standards
M444	Paper ID tag
M446	Stainless steel ID tag & wire attachment
M449	Mounting bracket kit. Required for models 520-535 when surface mounting. Use kit part number 6361-704 for other models
M504	316L Stainless steel immersion temperature stem. AVAILABLE TEMPERATURE MODELS 120, 121 ONLY
M540	Viton® wetted parts with standard connection material. Deadbands and low end of range may increase. AVAILABLE MODELS 448-454 and 540-547. MODELS 455-457 (Viton® sealing diaphragms and o-rings with Teflon® main diaphragm). MODELS 610-614 (o-ring only)
M550	Oxygen service cleaning; alcohol cleaning to remove residue from the process connection. NOT AVAILABLE ON MODELS 440-443
M900	Watertight conduit fitting; converts 7/8" hole to 1/2" NPT fitting. Required for product to meet NEMA 4X if using knockout holes for wiring
M913	1/4" NPT (female) stainless steel pressure connection. AVAILABLE MODELS S126B-S146B, S156B, S164B ONLY
M914	1/2" NPT (female) stainless steel pressure connection. AVAILABLE MODELS 358-376
M921	1/4" NPT (female) brass pressure connection. AVAILABLE MODELS 610-614, TYPE J402 ONLY
6361-704	Surface and Pipe Mounting Hardware (required for models 520-535, 540-547 when surface mounting)
OPTIONAL MATERIAL FOR "WC SENSORS: (AVAILABLE MODELS 520-525)	
XC001	Aluminum pressure connection, Viton® diaphragm, Viton® O-Ring
XC002	Aluminum pressure connection, Kapton® diaphragm, Buna-N O-Ring
XC003	Aluminum pressure connection, Kapton® diaphragm, Viton® O-Ring
XC004	316L stainless steel pressure connection, 316L stainless steel diaphragm, Viton® O-Ring (Over range pressure is limited to 100 psi)
XC005	316L stainless steel pressure connection, Viton® diaphragm, Viton® O-Ring
XC007	316L stainless steel pressure connection, Teflon® diaphragm, Viton® O-Ring

Lexan® is a registered trademark of Sabic Innovative Plastics.
*All switches have limited DC capabilities. Consult factory for details.

OPTIONS FOR TEMPERATURE MODELS

UNION CONNECTORS**
For all bulb & capillary switches, types E and F

Option	Replacement Number	Description
	Brass	
W027	SD6213-27	1/2" NPT w/ 3/4" bushing
W045	SD6213-45	3/4" NPT
W051	SD6213-51	1/2" NPT
	304 Stainless Steel	
W028	SD6213-28	1/2" NPT w/ 3/4" bushing
W046	SD6213-46	3/4" NPT
W050	SD6213-50	1/2" NPT

THERMOWELLS**
For all bulb & capillary switches, types E and F

	Brass	
W075	SD6225-75	1/2" NPT with 3/4" NPT adapter bushing, 4" BT
W191	SD6225-191	1/2" NPT, 4" BT
W118	SD6225-118	1/2" NPT with 3/4" NPT adapter bushing, 7" BT
W192	SD6225-192	1/2" NPT, 7" BT
	316 Stainless Steel	
W076	SD6225-76	3/4" NPT, 4.5" BT
W193	SD6225-193	1/2" NPT, 4.5" BT
W119	SD6225-119	3/4" NPT, 7.5" BT
W177	SD6225-177	1/2" NPT, 7.5" BT

For all immersion stem switches; types B and C

W139	SD6225-139	3/4" NPT X 1-23/32" BT, BRASS
W140	SD6225-140	3/4" NPT X 1-23/32" BT, 316 ST/ST

W000 IMMERSION STEM AND THERMOWELLS
Note: Option W000 is a special Immersion Stem construction that has no external thread. This option fits inside a special thermowell and is secured with a set-screw. Available on types B and C only.

Option	Description
W000	Immersion stem only, brass
W097	Immersion stem and thermowell. Includes W000 stem and 1/2" NPT x 1-23/32" BT brass thermowell
W099	Immersion stem and thermowell. Includes W000 stem and 1/2" NPT x 1-23/32" BT 316 st/st thermowell.

OPTIONAL LENGTHS:
Optional immersion stem lengths to 15" available in brass, with or without 316 st/st thermowell. Consult UE for additional information. Optional capillary length to *50' available in copper or 304 st/st. Armor or Teflon® capillary protection available to lengths less than or equal to capillary length. Consult UE for additional information.

* Consult UE regarding repeatability and ambient effects on capillary lengths over 30'.
** Dimensional drawings for union connectors and thermowells may be found at www.ueonline.com

DIMENSIONAL DRAWINGS

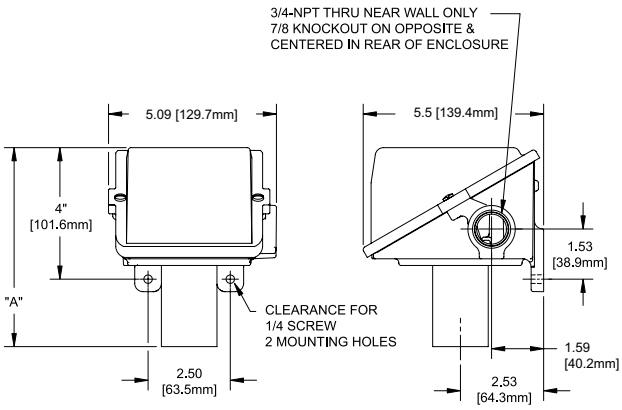
Dimensional drawings for all models may be found at www.ueonline.com

Internal Hex Screw Set Point Adjustment

Types J400, J402, J403, J400K, J402K, C400, C402, C403, F400, F402, F403

Set Point Adjustment via Reference Dial

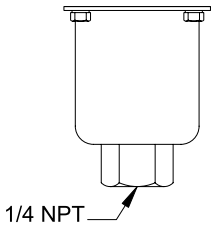
Types H400, H402, H403, H400K, H402K, B400, B402, B403, E400, E402, E403



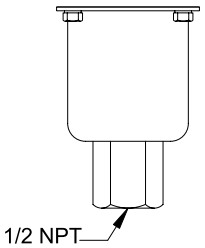
Dimension A			
Models	**Inches**	**mm**	**NPT**
PRESSURE			
126-164	5.91	150.0	1/4
S126B-S164B	6.31	160.3	1/2
270-376	5.50	139.7	1/4
440-443, 449			
451, 453, 454	4.28	108.7	1/4
448, 450, 452	5.03	127.8	1/4
520-525	8.25	209.6	1/2
530-535	8.13	206.5	1/2
551, 553-555	4.56	115.8	1/4
550, 552	5.03	127.8	1/4
570-572	4.56	115.8	1/4
610-614	6.31	160.3	1/4
DIFFERENTIAL PRESSURE			
147-157	6.13	155.7	1/4
S147B-S157B	6.13	155.7	1/2
455-559	7.00	177.8	1/4
540-543	7.97	202.4	1/8
544-547	8.03	204.0	1/8
TEMPERATURE			
120, 121	7.38	187.3	Immersion Stem
1BS-8BS	6.72	170.7	Bulb & Capillary

Pressure Sensors *All dimensions stated in inches (millimeters)*

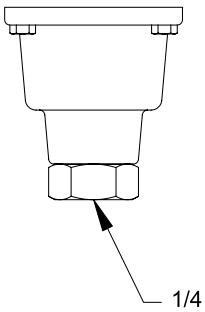
Models 126-164



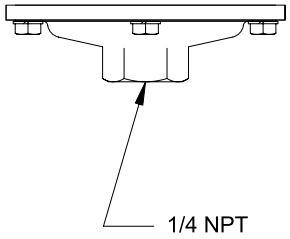
Models S126B-S164B



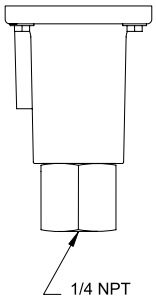
Models 270-376



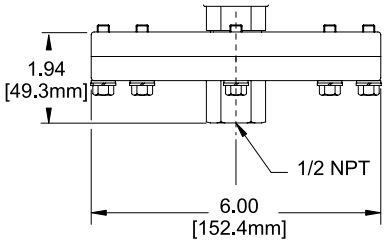
Models 440-454, 550-555, 570-572



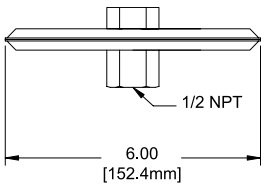
Models 610-614



Models 520-525



Models 530-535

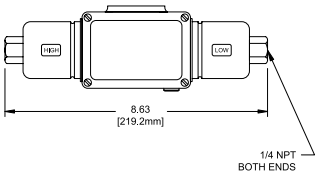


DIMENSIONAL DRAWINGS

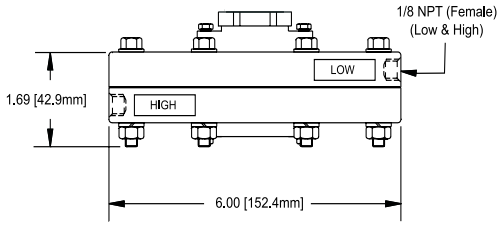
Dimensional drawings for all models may be found at www.ueonline.com

Differential Pressure Sensors

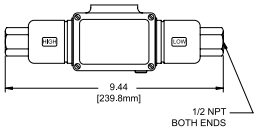
Models 147-157



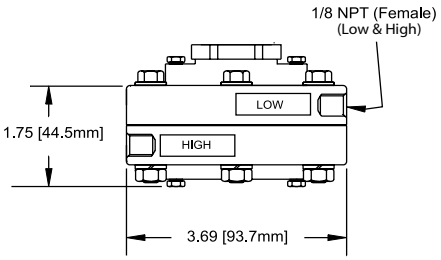
Models 540-543



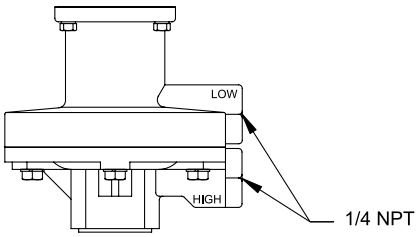
Models S147B-S157B



Models 544-547

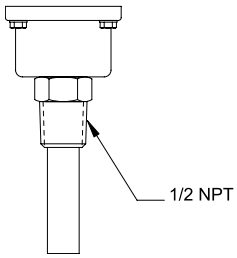


Models 455-457, 559



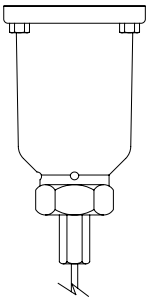
Temperature Sensors

Models 120-121



Local mount temperature version

Models 1BS-8BS



Remote mount temperature version

RECOMMENDED PRACTICES AND WARNINGS

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the Installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and maximum temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to maximum pressure or temperature is acceptable on a limited basis (e.g., start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at maximum pressure or temperature limits could reduce sensor life.
- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where a dangerous runaway condition could result.
- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.
- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. When applicable, orient unit so that moisture does not enter the enclosure via the electrical connection. When appropriate, this entry point should be sealed to prevent moisture entry.
- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.
- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point or faulty display. Check unit immediately.
- Preventative maintenance and periodic testing is necessary for critical applications where damage could endanger property or personnel.
- Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, even on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.
- Do not mount unit in ambient temp. exceeding published limits.

LIMITED WARRANTY

Seller warrants that the product hereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by Seller (Ex-works, Factory, Watertown, Massachusetts. INCOTERMS); provided, however, that this warranty applies only to equipment found to be so defective within a period of 24 months from the date of manufacture by the Seller. Seller shall not be obligated under this warranty for alleged defects which examination discloses are due to tampering, misuse, neglect, improper storage, and in any case where products are disassembled by anyone other than authorized Seller's representatives. EXCEPT FOR THE LIMITED WARRANTY OF REPAIR AND REPLACEMENT STATED ABOVE, SELLER DISCLAIMS ALL WARRANTIES WHATSOEVER WITH RESPECT TO THE PRODUCT, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF SELLER'S LIABILITY

SELLER'S LIABILITY TO BUYER FOR ANY LOSS OR CLAIM, INCLUDING LIABILITY INCURRED IN CONNECTION WITH (I) BREACH OF ANY WARRANTY WHATSOEVER, EXPRESSED OR IMPLIED, (II) A BREACH OF CONTRACT, (III) A NEGLIGENT ACT OR ACTS (OR NEGLIGENT FAILURE TO ACT) COMMITTED BY SELLER, OR (IV) AN ACT FOR WHICH STRICT LIABILITY WILL BE INPUTTED TO SELLER, IS LIMITED TO THE "LIMITED WARRANTY" OF REPAIR AND/OR REPLACEMENT AS SO STATED IN OUR WARRANTY OF PRODUCT. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY SPECIAL, INDIRECT, CONSEQUENTIAL OR OTHER DAMAGES OF A LIKE GENERAL NATURE, INCLUDING, WITHOUT LIMITATION, LOSS OF PROFITS OR PRODUCTION, OR LOSS OR EXPENSES OF ANY NATURE INCURRED BY THE BUYER OR ANY THIRD PARTY.

UE specifications subject to change without notice.

U.S. SALES OFFICES

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email: midwestsales@ueonline.com

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email: southeastsales@ueonline.com

United Electric Controls
5829 Grazing Court
Mason, OH 45040
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email: midatlanticsales@ueonline.com

United Electric Controls
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Clayton, CA 94517
Phone: 925-408-5997
email: westcoastsales@ueonline.com

United Electric Controls
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Sparta, NJ 07871
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United Electric Controls
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Fulshear, TX 77441
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EASTERN
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UNITED ELECTRIC CONTROLS

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CP03111000

SECTION 8 - 500 SERIES PROCESS EQUIPMENT - VAPOR TREATMENT

VAPOR CARBON VESSEL, 4X10 VIRGIN MEDIA - TETRASOLV MODEL VF-2000

6% POTASSIUM PERMANGANATE IMPREGNATED ZEOLITE - TETRASOLV MODEL VF-1000

PRESSURE INDICATOR - DWYER MODEL LPG4-D8422N

PRESSURE INDICATOR - DWYER MODEL LPG4-D8322N

PRESSURE INDICATOR - DWYER MODEL LPG4-D8222N

tetraSOLV FILTRATION

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www.tetrasolv.com

REGIONAL OFFICE
717 Van Patten
Truth or Consequences, NM 87901
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jbarbour@tetrasolv.com

4x10 VIRGIN CARBON

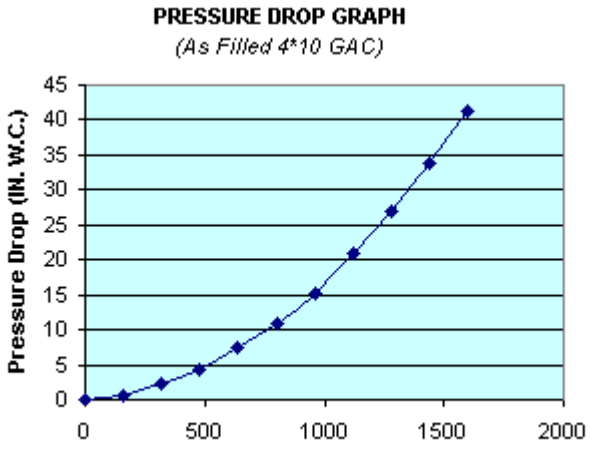
GENERAL DESCRIPTION

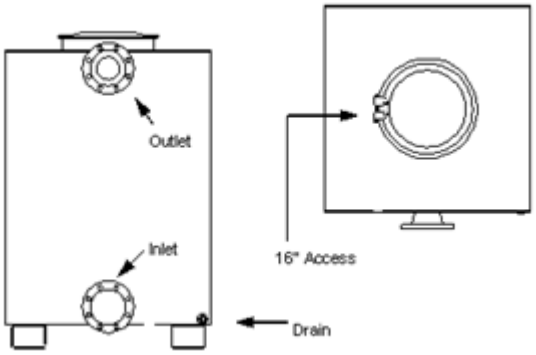
Select virgin carbon is quality screened during our purchasing process for activity, density and fines. The use of virgin carbon is recommended where drinking water quality is necessary. All carbon either sold by itself or installed in our filtration units is traced by lot number to the installation or sale.

4*10 (Vapor Phase) Standard Specifications:	Standard	Value
Carbon Tetrachloride Activity Level	ASTM D-3467	60 Minimum
Moisture Content	ASTM D-2867	5% Maximum (as packed)
Particle Size	ASTM D-2862	4x10 US Mesh
Ash		10% Maximum
Total Surface Area (N2BET)		1050 Minimum
Pore Volume (cc/g)		0.75

VF-2000

Low Pressure Drop Vapor Phase Filter





VF-2000 SPECIFICATIONS			
Overall Height	6'8"	Vessel/Internal Piping Materials	Polypropylene
Footprint	4' x 4'	Internal Coating	Polyamide (2-Part) Epoxy Resin
Inlet / Outlet (150# FLNG)	6"	External Coating	Epoxy Mastic (Light Grey)
Drain / Vent (FNPT)	1/2"	Maximum Pressure / Temp	3 PSIG / 250° F
GAC Fill (lbs)	2000	Cross Sectional Bed Area	16 FT^2
Shipping / Operational Weight (lbs)	2,650/3,200	Bed Depth/Volume	4.5 FT / 71 FT^3

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www.tetrasolv.com

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Truth or Consequences, NM 87901
508-448-0256 Fax
jbarbour@tetrasolv.com

HS-600

6% potassium permanganate impregnated media. The number one method for removing acid gasses and other air born pollutants.

The Environmental Remediation Heavyweight

HS-600 is a major breakthrough in oxidation of acid gases, fumes and odors. HS-600, a unique molecular sieve impregnated with potassium permanganate, was created in our laboratories to oxidize gaseous pollutants such as hydrogen sulfide, sulfur dioxide, formaldehyde, ethylene, mercaptans, and various aldehydes and alcohols.

The potassium permanganate impregnated media shall have no less than 3.6 pounds of potassium permanganate per cubic foot, a bulk density of no less than 60 pounds per cubic foot, a moisture content of 12-15% by weight and shall not dust. The media shall have an irregular particle size of 4 x 8 mesh.

The performance characteristics of the air filtration media shall meet or exceed a service life of no less than 72 hours for breakthrough of hydrogen sulfide at the following test conditions:

Media Bed Volume: 76.00 cubic centimeters
Bed Configuration: 2.54 cm (id) x 15.00 cm
Flow Rate: 3000 (+/- 100) ml/minute
Relative Humidity: 70%
Challenge Gas: hydrogen sulfide
Challenge Gas Concentration: 10 (+/- 0.25) PPM

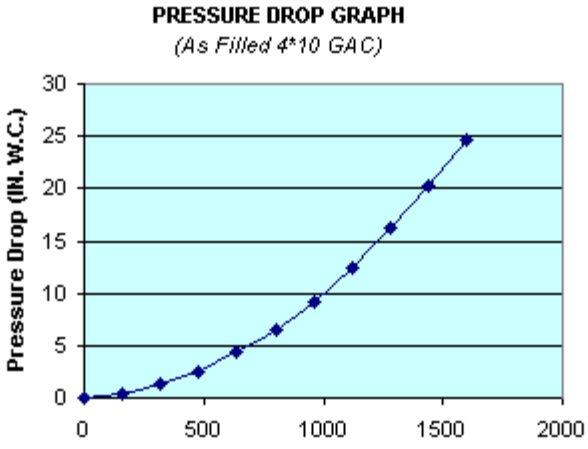
Removes

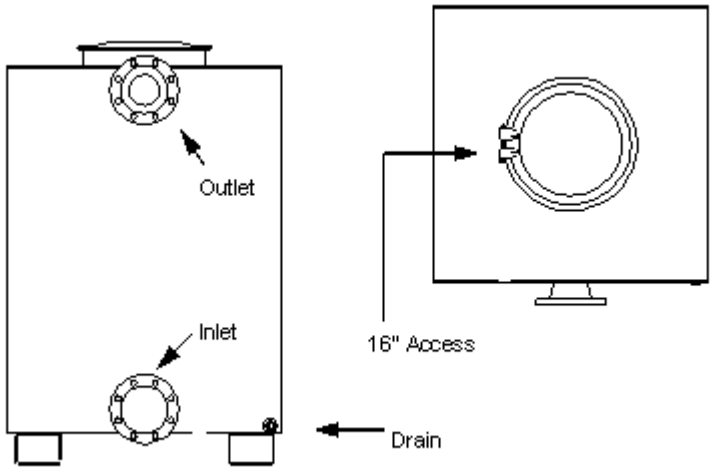
- Vinyl Chloride, DCE, TCE, PCE, Ethyl Mercaptan, Methyl Mercaptan
- Penta Mercaptan, Propylene Glycol, Chloroethane

VF SERIES FILTERS
MODEL VF-1000

The VF-1000 filter is a media filter vessel designed to treat vapor streams where pressure drop is a strong concern. While the typical design application is a activated carbon adsorbtion unit, the filter can easily accommodate many medias. The sturdy construction makes these filter vessels ideal for long term treatment units. Some applications include:

- Soil Vapor Extraction Treatment
- Air Stripper Off Gas Treatment
- Odor Removal System
- Storage Tank Purge Vapor Treatment
- Pilot Study
- Industrial Process Treatment





VF-1000 SPECIFICATIONS			
Overall Height	4'8''	Vessel/Internal Piping Materials	CS/ CS (False Floor)
Footprint	4' x 4'	Internal Coating	Polyamide Epoxy Resin
Inlet / Outlet (150# FLNG)	6"	External Coating	Epoxy Mastic (Light Grey)
Drain / Vent (FNPT)	1/2"	Maximum Pressure / Temp	3 PSIG / 250° F
GAC Fill (lbs)	1000	Cross Sectional Bed Area	16 FT^2
Shipping / Operational Weight (lbs)	1,450/1,600	Bed Depth/Volume	2.2 FT / 36 FT^3

Tetrasolv Filtration

Operation & Maintenance Manual

VFD ● VFV ● VF ● VR SERIES

Tetrasolv Filtration Vapor Filters

Liquid & Vapor Filtration
Remedial • Industrial • Municipal

CONTENTS

1.0 GENERAL DESCRIPTION

The liquid series filters utilize fixed bed filtration to treat vapor. The filters employ a variety of medias to remove or catalyze contaminants. Flow through the filter may be either up flow or down flow depending upon the media supplied and the operation parameters. Generally inlet and outlet locations are indicated on the filter and or the filter drawings.

The most common application utilizes activated carbon as the adsorption media. Typically vapor which contains low levels of organic contaminants flows upward through the column of activated carbon where the larger organic molecules adhere to the porous structure of the activated carbon granules. This adsorption begins at the bottom of the “bed” and continues upward as the original adsorptive area becomes saturated.

Complete saturation of the carbon is dependent upon many factors such as contaminant levels, temperature, compounds being adsorbed, humidity, etc. Typically a carbon isotherm has been run on the influent stream to determine the expected rate of consumption of the activated carbon media. When monitoring has determined discharge air no longer meets discharge requirements the carbon will have to be removed and replaced ***(refer to section 5.0)***.

2.0 SAFETY CONSIDERATIONS

It is important that the entire O&M manual be read prior to set up and operation of the carbon system. If you have any questions please contact Tetrasolv Filtration at the number listed below or support@tetrasolv.com.

- ***WARNING: Where system pressure may exceed design pressure we strongly recommend the use of a relief device. Exceeding the maximum pressure of the filter could result in catastrophic failure***

of the vessel.

- Always adhere to “lockout/tagout” procedures when servicing the system.

- Wear appropriate safety equipment when operating system.

♦ ***WARNING: Wet or dry activated carbon preferentially removes oxygen from air. In closed or partially closed containers, oxygen depletion may reach hazardous levels. If workers must enter a container containing carbon, appropriate sampling and work procedures should be followed for potentially low-oxygen spaces - including all applicable federal and state requirements.***

♦ ***WARNING: High concentrations of certain compounds such as BETX and low concentrations such as ketones, aldehydes, organic acids and sulphur may cause severe temperature rises.***

- Understand the potential hazards of the stream being treated by the system. The activated carbon may contain higher concentrations of the contaminants being adsorbed than is in the influent stream. In addition the carbon may be considered hazardous material and therefore may require specific handling precautions unknown to Tetrasolv Filtration.

3.0 INSTALLATION

3.1 Shipment

Typically filters are shipped with media installed. However, in certain instances media is shipped to the site to be installed after installation. In very large systems it may be advisable to not install the media until adsorbers have been placed into final position and secured.

3.2 Unloading

Refer to the product data sheet for weight information for appropriate sizing information for the equipment to be used.

All components should be lifted either by crane or forklift as designated by the model.

♦ ***WARNING: Failure to follow the procedures outlined below can result in catastrophic damage to the system.***

Crane Lift - If a crane lift is to be used we recommend the following method. A “spreader” equaling 75% of the distance between the opposing lifting eyes on each adsorber should be used to insure proper lifting force direction. Attach an appropriately sized spreader beam and lifting cables to each lift eye of the component. The use of an experienced crane operator and quality equipment is highly recommended.

Fork-Lift - When using a forklift we recommend that the fork tubes on the filter be used or a pallet if the unit was shipped on a pallet.

3.3 Inspection

Perform the following inspections after un-loading the system. Note any discrepancies and contact TetraSolv immediately.

- Check the vessel exterior for damage which may have occurred during shipment. Inspect the support structures and piping support for damage.

- Inspect the piping system for damage. Insure the valves operate properly. Check installed instruments and instrument installation points for damage.

- If the filters are shipped without carbon visually inspect the interior of the vessel for damaged internals.

- Inspect the carbon discharge, drain and vent valves for damage

3.4 Set Up

The filter should be placed on a level concrete pad of appropriate thickness to support the system at it’s maximum operational weight. The filter should be secured to the pad using appropriately sized anchor bolts.

Connect the site piping to the filter inlet and outlet connection points. It is important that all piping connected to the filter should be self supported. We also recommend in hard pipe installation that a flexible joint be used to further insulate the filter from vibration and stress.

Connect any gauges and instrumentation shipped

loose with the system.

The outlet piping if connected to a stack or vent should be designed to prevent the introduction of water or debris into the adsorber piping. Discharge piping should be sized equal to or greater than the diameter of the system piping or back pressure could occur creating excess pressure drop on the system.

Flowrates greater than 60 cfm / sq ft can produce bed fluidization in vapor phase filters. When this occurs carbon granules can be lifted and propelled out of the carbon bed in up-flow applications. In extreme cases large amounts of carbon can be expelled. If the system will be operating near or greater than the amount stated above please contact Tetrasolv for recommendations.

Carbon filters can be manifold in parallel operation for higher flowrates. Series operation is the preferred method of operation as it provides for the greatest degree of bed utilization.

Vapor conditions such as high humidity and high temperature (> 125º F) can cause inefficient adsorbtion to occur. If these conditions exist contact Tetrasolv for support. Also, any free water or product and debris should be eliminated with a knockout filter prior to the vapor stream entering the system. Many other vapor issues may effect Adsorber operation and we therefore recommend you discuss your specific installation with a representative.

4.0 OPERATION

4.1 Modes of Operation

With certain applications (2) filters in series flow are utilized. Listed below are typical operational modes.

- Shutdown - Both filters completely off-line and isolated.
- Series Flow - Influent enters primary filter and exits through secondary adsorber (this is the preferred method of operation)
- Isolation Flow - Only one filter is receiving influent. This mode is typically used when the operator is maintaining the off-line filter.
- Parallel Flow - Both filters are receiving the influent as the primary. Flow is split equally between the filters. This mode is used when higher flow rates need to be achieved and contact times are not critical.

4.3 Monitoring

Adsorber units only require periodic monitoring if properly installed. The following items may be monitored:

Pressure: Check inlet and outlet pressure. Increase in pressure differential may indicate media breakdown or presence of high moisture. Rapid increase in pressure drop could indicate adsorber failure.

Samples: Inlet and outlet sample points if provided for vapor analysis to determine system performance.

5.0 ADSORBER SERVICING

The Adsorber may be serviced on-site using a vacuum removal method. Prior to servicing the unit should be closed off from influent and effluent lines and any electrical devices or connections should be tagged off.

After removal of the spent carbon is complete, it is recommended that the inside of the Adsorber be checked thoroughly and any minor maintenance conducted.

5.1 Carbon Loading - Bulk Bag

- ***WARNING - Dry activated carbon generates considerable dust. While activated carbon poses no health risk the dust can cause respiratory irritation and occasional skin rash. Therefore we recommended the use of proper clothing and dust mask during filling operation.***

Hoist the bag over the manway and untie the outer bag exposing the inner chute. Untie the inner chute while clasping it shut. Remain holding the chute and carefully lower the chute into the manway. Un-clasp the chute and allow the carbon to discharge from the sack. The carbon should flow out very quickly and completely. When finished shake the bag and invert the chute into the bag.

If at any time you wish to stop the flow of carbon simply re-grasp the chute up high and cinch. Re-tie the bag.

5.2 Carbon Loading - Vacuum Method

In this method dry-activated carbon will be loaded into to the adsorbers using a vacuum rig. To add the carbon to the filters use the following method:

WARNING: Due to the low vacuum rating of the VF series adsorbers (< 60" H_20) only experienced change-out personnel should attempt this method of re-filling. Exceeding the recommend vacuum rating could lead to failure of the superstructure of the vessel.

1. Connect a 3" vacuum source to the auxiliary connection of the adsorber to be filled.

2. Install a 16" bolted transfer lid onto the manway opening of the adsorber to be filled.

3. Turn on the vacuum and check for good flow of air through the adsorber. Connect the fill line to the transfer lid and lead enough hose to reach the fresh carbon source (Note: This should be as short of a distance as possible).

4. Begin vacuuming carbon into the adsorber. It is important to note that the loading method is actually conveying and not true vacuum. The hose should contain 1/3 air with the carbon. Closely view the adsorber being filled. If the adsorber is collasping in excessively take less carbon and more air. This is something from experience and cannot be adequately explained here.

5. When transfer is complete the transfer lid should be removed and the carbon in the adsorber should be leveled out to insure even pressure drop across the bed.

6. Close the manway and turn the adsorber back on.

> ***Note: When the system if first started up small amounts of fines may be present in the discharge stream. This is normal and should discontinue within a short period of time.***

6.0 MAINTENANCE

6.1 Extended Shutdown

If the system is to be shutdown for extended period of time it is recommended that the valve be placed in shutdown mode and the system water drain valve be left open.

Monitor the system closely after extended shutdown for signs of potential problems such as interior manifold failure or leaking valves and gaskets.

tigerflex®

"COLD-FLEX" MATERIALS | TRANSPARENT CONSTRUCTION | WATER

W™ Series

Heavy Duty PVC Liquid Suction Hose

Made In USA

The Original Heavy Duty Suction Hose

General Applications:

- Extreme cold conditions (Sizes 4" - 16")
- Fish suction
- Gold dredging
- Pumps, rental and construction dewatering
- Pumps, trash
- Slurry handling
- Water suction – heavy duty

Construction: PVC tube with rigid PVC helix.

Service Temperature:
Sizes 1" - 3": -4°F (-20°C) to 150°F (+65°C)*;
Sizes 4" - 16": -40°F (-40°C) to 150°F (+65°C)*

Features and Advantages:

- **"Cold-Flex" Materials (Sizes 4" - 16")** – Hose remains flexible in sub-zero temperatures.
- **Transparent Construction** – "See-the-flow." Allows for visual confirmation of material flow.
- **Convoluted Outer Cover** – Provides increased hose flexibility.

Nominal Specifications

Series	ID (in.)	ID (mm)	OD (in.)	OD (mm)	Working Pressure (psi) 68°F	Working Pressure (psi) 104°F	Vacuum Rating (in. Hg) 68°F	Vacuum Rating (in. Hg) 104°F	Approx. Bending Radius (in. @ 68°F)	Standard Length (ft.)	Weight (lbs./ft.)
W100	1	25.4	1.30	33.0	55	35	Full	28	1	100	0.21
W125	1 1/4	31.7	1.60	40.6	50	30	Full	28	2	100	0.28
W150	1 1/2	38.1	1.85	47.0	50	30	Full	28	2	100	0.34
W200	2	50.8	2.40	61.0	50	30	Full	28	3	100	0.52
W250	2 1/2	63.5	2.99	75.9	45	25	Full	28	4	100	0.77
W300	3	76.2	3.64	92.5	45	25	Full	28	6	100	1.18
W400	4	101.6	4.76	121.0	35	18	Full	28	8	100	1.92
~~W500~~	~~5~~	~~127.0~~	~~5.75~~	~~146.0~~	~~35~~	~~18~~	~~28~~	~~25~~	~~12~~	~~100/20~~	~~2.42~~
W600	6	152.4	7.00	177.8	30	15	28	25	14	100/20	3.76
W800	8	203.2	9.18	233.2	30	15	28	25	24	40/20	5.99
W1000	10	254.0	11.56	293.5	25	12	28	25	39	40/20	9.74
W1200	12	304.8	13.64	346.5	20	10	28	25	59	40/20	12.77
W1400†	14	357.6	15.59	396.0	18	8	26	23	80	20	13.50
W1600†	16	408.4	17.72	450.0	12	5	24	20	95	20	16.00

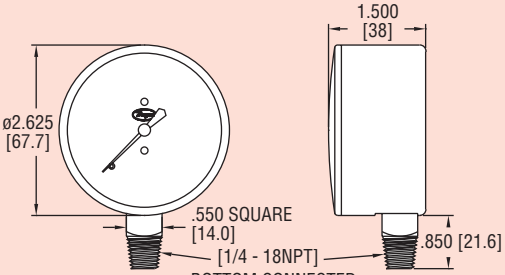
NOTE: For details of the following compliances, refer to footnotes listed on page 62.
NOTE: Service life may vary depending on operating conditions and type of material being conveyed.
***Actual service temperature range is application dependent.**
†Non-stock item, minimum order required. Contact Kuriyama customer service for details.
RoHS(10)

Because we continually examine ways to improve our products, we reserve the right to alter specifications or discontinue products without prior notice.

Series LPG4

2.5" Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2" Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5" (63 mm).
Process Connections: 1/4" male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)

Model	Range
LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

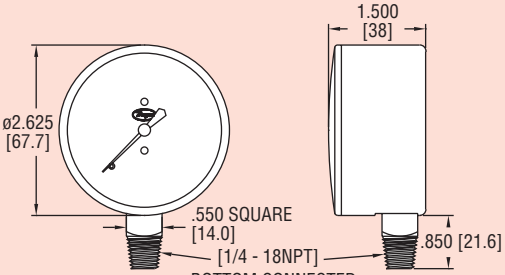
OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

Series LPG4

2.5″ Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2″ Gage



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SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)

Model	Range
LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

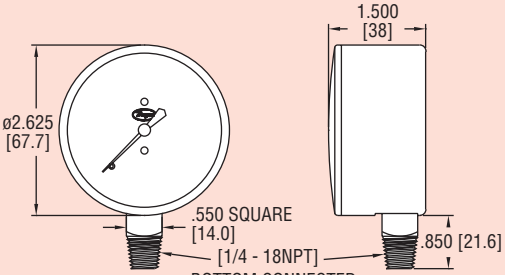
OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

Series LPG4

2.5" Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2" Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5" (63 mm).
Process Connections: 1/4" male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)

Model	Range
LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

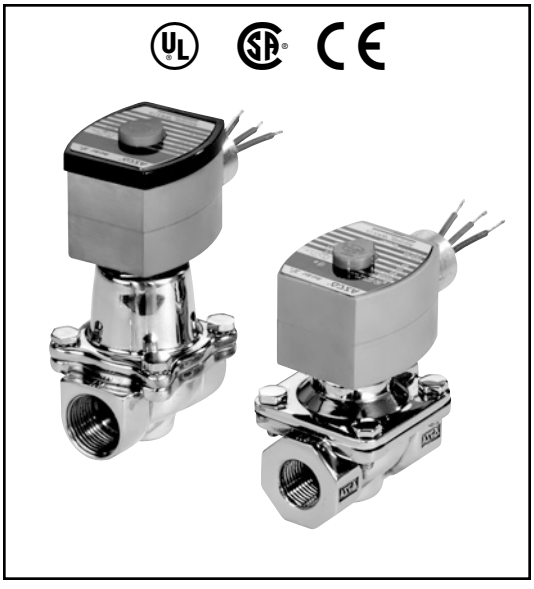
SECTION 9 - 600 SERIES PROCESS EQUIPMENT - PUMP AIR SUPPLY MANIFOLD

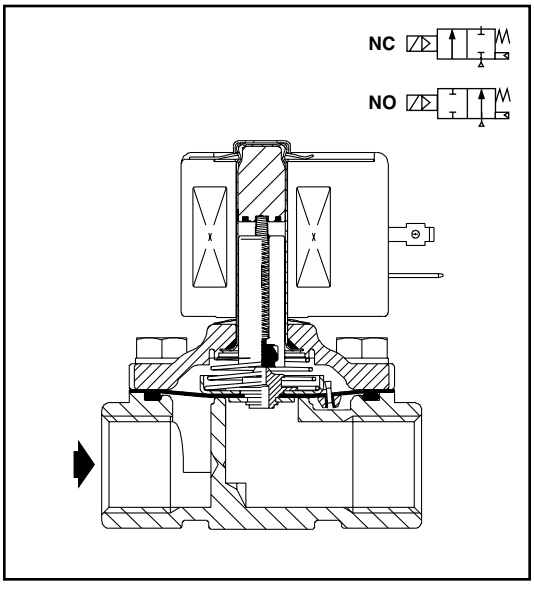
SOLENOID VALVE, 1", N.C - ASCO MODEL 8210G054

PRESSURE INDICATOR - AV MODEL 4FLZ8

Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage
- High Flow Valves for liquid, corrosive, and air/inert gas service
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps





Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910	-	238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering.
Other voltages available when required.

Solenoid Enclosures

Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.

(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B057, 8210B058, and 8210B059, which are not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

RedHat II/
RedHat AC: 32˚F to 125˚F (0˚C to 52˚C)

RedHat II DC: 32˚F to 104˚F (0˚C to 40˚C)
RedHat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)

8210G227 AC: 32˚F to 130˚F (0˚C to 54˚C)
DC: 32˚F to 90˚F (0˚C to 32˚C)

Refer to Engineering Section for details.

Approvals

UL listed as indicated. CSA certified.
RedHat II meets applicable CE directives.
Refer to Engineering Section for details.

2/2 SERIES 8210

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. ˚F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Const. Ref. ④	UL ⑤ Listing	Catalog Number	Const. Ref. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G073 ③	1P	●	8210G036 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G093	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G001	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G006	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G015 ③	2P	●	8210G037 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G094	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G087	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G002	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G007	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	130	90	8210G227	5D	❍ †	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G088	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G009	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G095	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G003	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B026 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G026 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B054 ‡	31D	-	8210D089	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G054	41D	●	8210G089	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G004	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G027 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G078 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B055 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G055	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G008	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B056 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G056	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G022	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G033	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G011 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G034	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G030	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G012 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G035	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G038	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C013	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G013	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B057 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D014	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G014	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B058 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D018	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G018	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B059 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D032	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G032	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210 103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210 104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

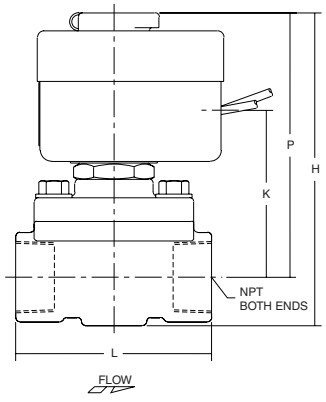
① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless steel disc-holder.
‡ Must have solenoid mounted vertical and upright.
† UL listed for fire protection systems per UL429A.

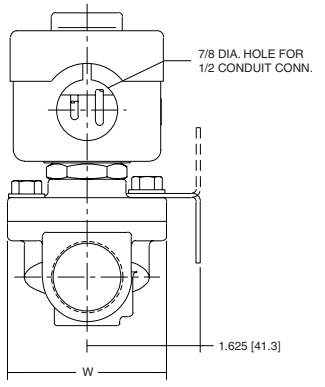
Dimensions: inches (mm)

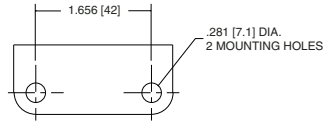
Const. Ref.		H	K	L	P	W
30	ins.	8.22	X	5.06	5.47	4.87
	mm	209	X	129	139	124
31	ins.	5.25	X	3.75	4.44	3.25
	mm	133	X	95	113	83
32	ins.	5.69	X	3.66	4.69	3.25
	mm	145	X	93	119	83
33	ins.	6.06	X	4.38	4.94	3.91
	mm	154	X	111	125	99
34	ins.	6.91	X	3.75	6.09	3.25
	mm	176	X	95	155	83
35	ins.	7.34	X	3.66	6.34	3.25
	mm	186	X	93	161	83
36	ins.	7.66	X	4.38	6.56	3.91
	mm	1.95	X	111	167	99
37	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
38	ins.	4.61	2.75	2.81	3.89	2.39
	mm	117	70	71	99	61
39	ins.	5.42	2.31	2.75	4.86	3.80
	mm	138	59	70	123	97
40	ins.	5.20	3.29	2.81	4.50	2.28
	mm	132	83	71	114	58
41	ins.	5.13	3.10	3.75	4.32	3.25
	mm	130	79	95	110	83
42	ins.	6.43	4.40	3.93	5.62	3.25
	mm	163	112	100	143	83
43	ins.	5.57	3.35	3.66	4.57	3.25
	mm	142	85	93	116	83
44	ins.	5.90	3.57	4.38	4.79	3.91
	mm	150	91	111	122	99
45	ins.	5.26	3.17	3.75	4.38	3.84
	mm	134	81	95	111	98
46	ins.	4.95	3.10	3.84	4.31	2.75
	mm	126	79	98	110	70
47	ins.	6.43	3.59	3.75	4.81	3.52
	mm	163	91	95	122	90
48	ins.	6.43	3.59	3.66	4.81	3.73
	mm	163	91	93	122	95
49	ins.	6.91	3.75	4.38	4.96	4.40
	mm	176	95	111	126	112
50	ins.	8.13	4.15	5.06	5.37	4.87
	mm	207	105	129	136	124
51	ins.	8.13	4.15	5.50	5.37	5.18
	mm	207	105	140	136	132

IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

Const. Ref. 10, 15, 24, 26-36

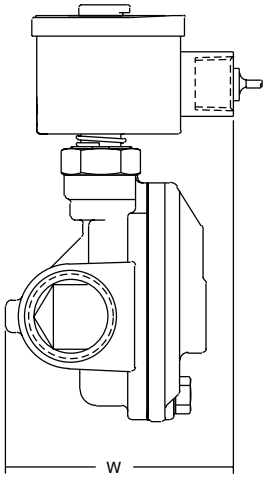


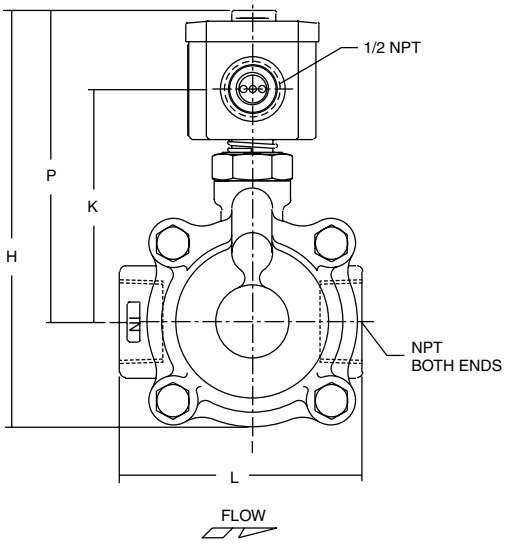




OPTIONAL MOUNTING BRACKET

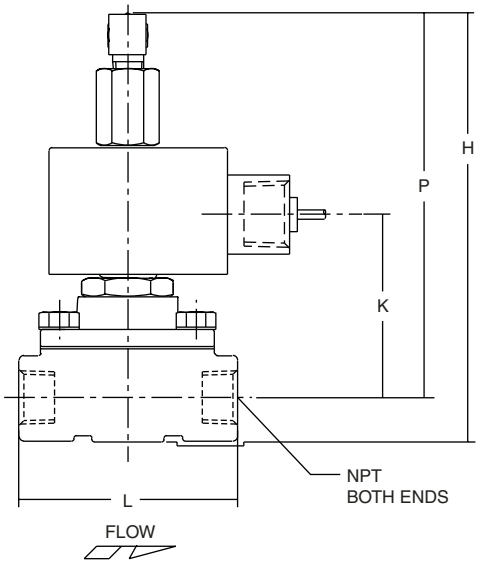
Const. Ref. 12, 16, 18

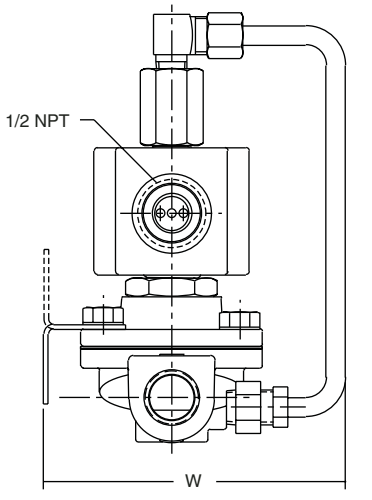


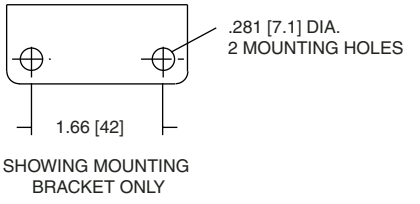


Dimensions: inches (mm)

Const. Ref. 39

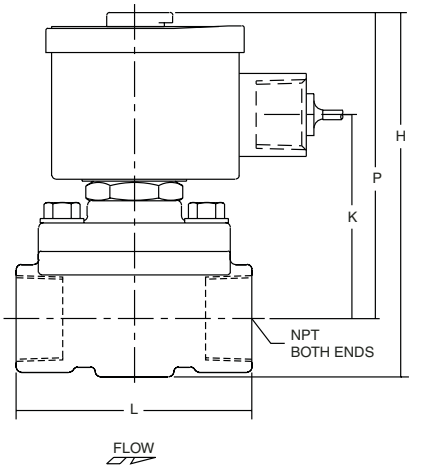


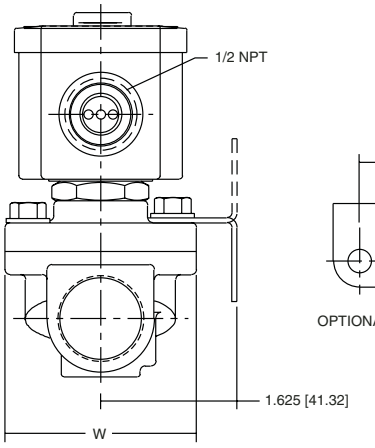


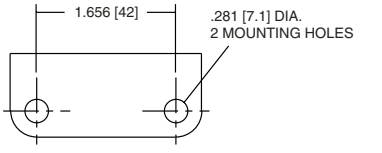


SHOWING MOUNTING
BRACKET ONLY

Const. Ref. 40-51







OPTIONAL MOUNTING BRACKET

Installation & Maintenance Instructions

2–WAY INTERNAL PILOTED–OPERATED SOLENOID VALVES
BRASS AND STAINLESS STEEL CONSTRUCTION
NORMALLY CLOSED OPERATION — 1″, 1 1/4″, & 1 1/2″ NPT

SERIES
8210
8211

Form No.V5455R5

NOTICE: See separate solenoid installation and maintenance instructions for information on: Wiring, Solenoid Temperature, Cause of Improper Operation, Coil or Solenoid Replacement.

DESCRIPTION

Series 8210 valves are 2–way normally closed internal pilot–operated solenoid valves designed for general service. Valves are made of rugged forged brass or stainless steel. Series 8210 valves are provided with a general purpose solenoid enclosure.
Series EF8210 and 8211 are the same as Series 8210 except they are provided with an explosionproof or explosionproof/watertight solenoid enclosure.

OPERATION

Normally Closed: Valve is closed when solenoid is de–energized; open when energized.

NOTE: No minimum operating pressure differential required.

Manual Operator (optional feature)

Manual operator allows manual operation when desired or during an electrical power outage. To engage manual operator (open the valve), remove operator cap and gasket base of valve. Turn manual operator stem clockwise as far as possible. Do not force operator stem. Valve will then be in the same position as when the solenoid is energized. To disengage manual operator, turn stem counterclockwise as far as possible.

⚠ CAUTION: Stem must be fully retracted counterclockwise before operating valve electrically.

Replace manual operator cap gasket and cap.

INSTALLATION

Check nameplate for correct catalog number, pressure, voltage, frequency, and service. Never apply incompatible fluids or exceed pressure rating of the valve. Installation and valve maintenance to be performed by qualified personnel.

Future Service Considerations

Provision should be made for performing seat leakage, external leakage, and operational tests on the valve with a nonhazardous, noncombustible fluid after disassembly and reassembly.

Temperature Limitations

For maximum valve ambient and fluid temperatures, refer to chart below. Check catalog number prefix and watt rating on nameplate.

Watt Rating AC/DC	Catalog Number Prefix	Coil Class	Maximum Ambient Temp.	Maximum Fluid Temp.
15.1 & 16.1 AC	None, KF, SF or SC	F	125°F (51.7°C)	180°F (82°C)
	HT, KH, ST or SU	H	140°F (60°C)	180°F (82°C)
30.6 DC	HT	H	104°F (40°C)	77°F (25°C)

Positioning

AC Construction (Alternating Current): Valve is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertical and upright so as to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area.

DC Construction (Direct Current): Valve must be mounted with solenoid vertical and upright.

Piping

Connect piping to valve according to markings on valve body. Apply pipe compound sparingly to male pipe threads only. If applied to valve threads, the compound may enter the valve and cause operational difficulty. Avoid pipe strain by properly supporting and aligning piping. When tightening the pipe, do not use valve or solenoid as a lever. Locate wrenches applied to valve body or piping as close as possible to connection point.

⚠ CAUTION: To protect the solenoid valve, install a strainer or filter suitable for the service involved in the inlet side as close to the valve as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601 and 8602 for strainers.

MAINTENANCE

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize valve, and vent fluid to a safe area before servicing the valve.

NOTE: It is not necessary to remove the valve from the pipeline for repairs.

Cleaning

All solenoid valves should be cleaned periodically. The time between cleanings will vary depending on the medium and service conditions. In general, if the voltage to the coil is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. In the extreme case, faulty valve operation will occur and the valve may fail to open or close. Clean strainer or filter when cleaning the valve.

Preventive Maintenance

- Keep the medium flowing through the valve as free from dirt and foreign material as possible.
- While in service, the valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Causes of Improper Operation

- **Incorrect Pressure:** Check valve pressure. Pressure to valve must be within range specified on nameplate.
- **Excessive Leakage:** Disassemble valve and clean all parts. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

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Valve Disassembly

1. Disassemble valve in an orderly fashion using exploded views for identification and placement of parts. Refer to Figure 2 for AC construction; Figure 3 for DC construction.
2. Remove solenoid enclosure. See separate instructions.
3. Unscrew solenoid base sub−assembly. For DC construction, a special wrench is supplied in ASCO Rebuild Kit. For wrench only, Order ASCO Wrench Kit No. K168146−001.
4. Remove bonnet screws, valve bonnet,bonnet gasket, spring retainer (AC construction only) core spring, core/diaphragm sub−assembly and body gasket.
5. For valves equipped with a manual operator, remove cap, cap gasket, bonnet and bonnet gasket. Remove stem assembly with stem gasket from bonnet.
6. All parts are now accessible for cleaning or replacement. If parts are worn or damaged, install a complete ASCO Rebuild Kit.

Valve Reassembly

1. Lubricate all gaskets and the disc at the base of the core /diaphragm sub−assembly with DOW CORNING 111® Compound lubricant or an equivalent high−grade silicone grease.
2. Replace body gasket and core/diaphragm sub−assembly. Locate bleed hole in core/diaphragm sub−assembly directly over valve outlet. For 1 1/2″ NPT construction, locate bleed hole in core/diaphragm sub−assembly approximately 30° from valve outlet.
3. Replace core spring and spring retainer (AC construction only). Install small end of core spring in core first, wide end protruding from top of core. For DC construction, install core spring, small end down toward valve body.
4. Replace valve bonnet and bonnet screws. Hand tighten bonnet screws as far as possible.

IMPORTANT: Press firmly down on core/diaphragm sub−assembly to seat diaphragm assembly against valve seat. While holding this position, torque bonnet screws in a crisscross manner to 144 ± 15 in−lbs [16,3 ± 1,7 Nm].

5. Replace bonnet gasket and solenoid base sub−assembly. Torque solenoid base sub−assembly to 175 ± 25 in−lbs [19,8 ± 2,8 Nm]. For DC construction, the solenoid base sub−assembly must be placed inside the housing before assembling into the valve body. Before doing this, read separate lubrication instructions in ***Solenoid Installation & Maintenance Instructions***.
6. For valves provided with a manual operator, replace stem assembly and bonnet (with gaskets). Torque bonnet to 75 ± 10 in−lbs [8,5 ± 1,1 Nm]. Replace cap gasket and cap.
7. Install solenoid. See separate instructions.

⚠ **WARNING: To prevent the possibility of death, serious injury or property damage, check valve for proper operation before returning to service. Also perform internal seat and external leakage tests with a nonhazardous, noncombustible fluid.**

8. Restore line pressure and electrical power supply to valve.
9. After maintenance is completed, operate the valve a few times to be sure of proper operation. A metallic *click* signifies the solenoid is operating.

ORDERING INFORMATION

FOR ASCO REBUILD KITS

Parts marked with an asterisk (*) in the exploded view are supplied in Rebuild Kits. When Ordering Rebuild Kits for ASCO valves, order the Rebuild Kit number stamped on the valve nameplate. If the number of the kit is not visible, order by indicating the number of kits required, and the Catalog Number and Serial Number of the valve(s) for which they are intended.

Torque Chart

Part Name	Torque Value Inch−Pounds	Torque Value Newton−Meters
Manual operator bonnet	75 ± 10	8,5 ± 1,1

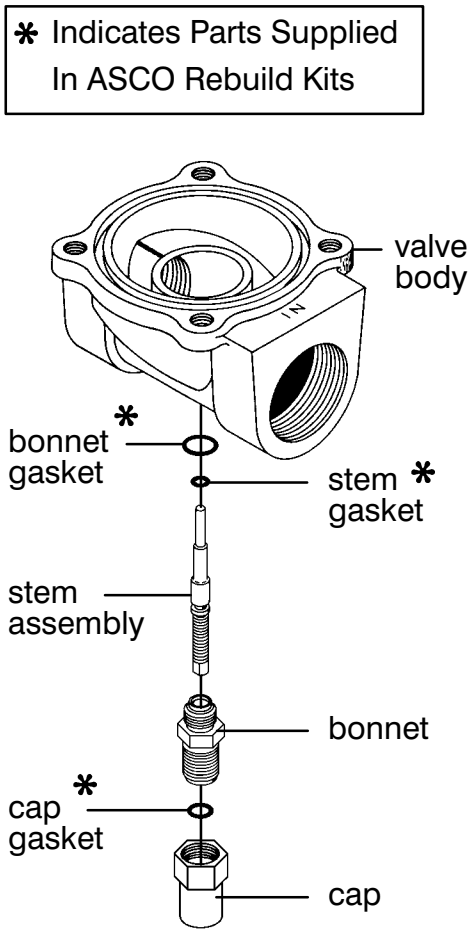

Figure 1. Manual operator (optional feature)

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Torque Chart

Part Name	Torque Value Inch−Pounds	Torque Value Newton−Meters
Solenoid base sub−assembly	175 ± 25	19,8 ± 2,8
Bonnet screw	144 ± 15	16,3 ± 1,7

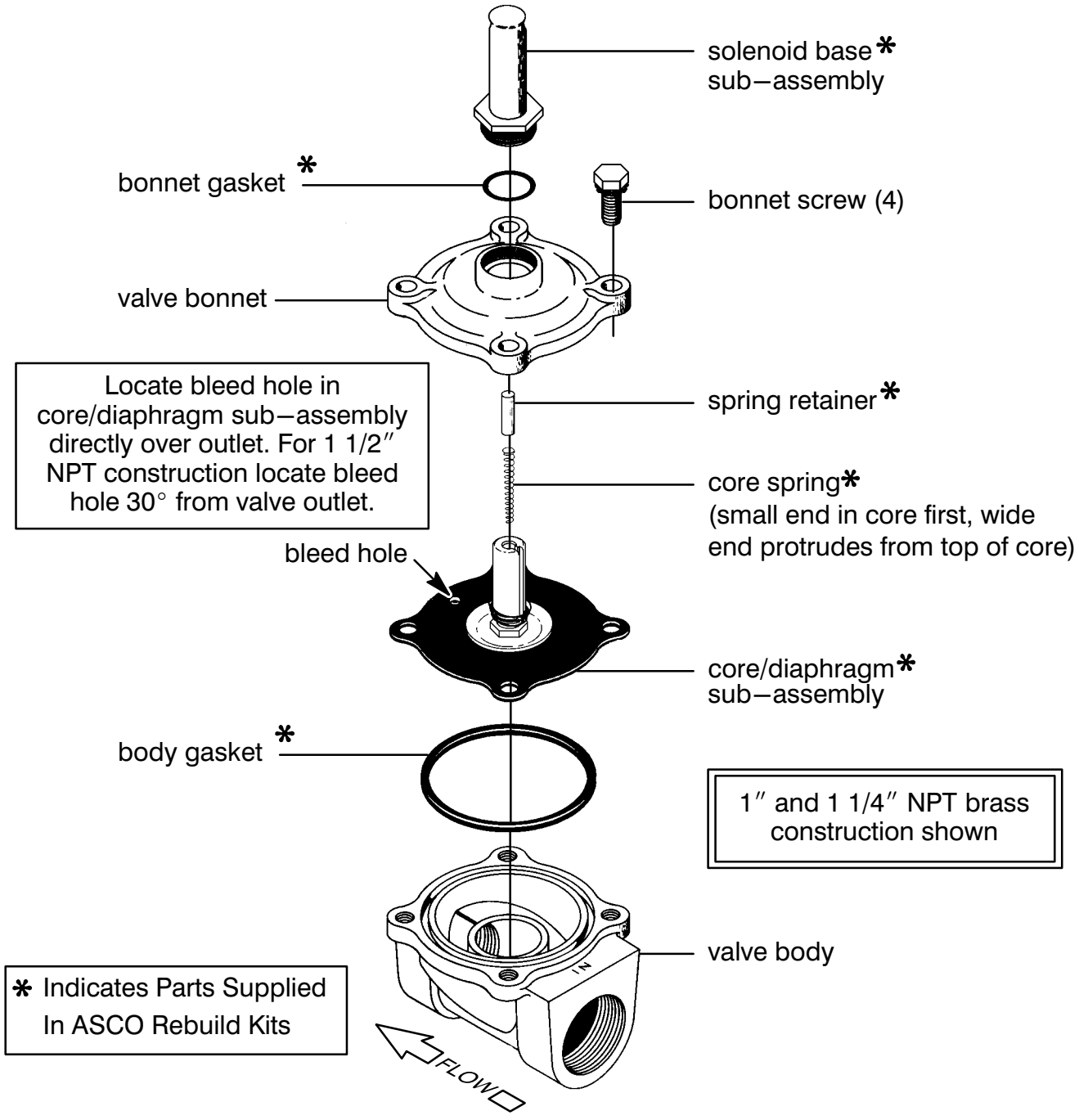

Figure 2. Series 8210 valve without solenoid (AC construction shown).

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Torque Chart

Part Name	Torque Value Inch−Pounds	Torque Value Newton−Meters
Solenoid base sub−assembly	175 ± 25	19,8 ± 2,8
Bonnet screw	144 ± 15	16,3 ± 1,7

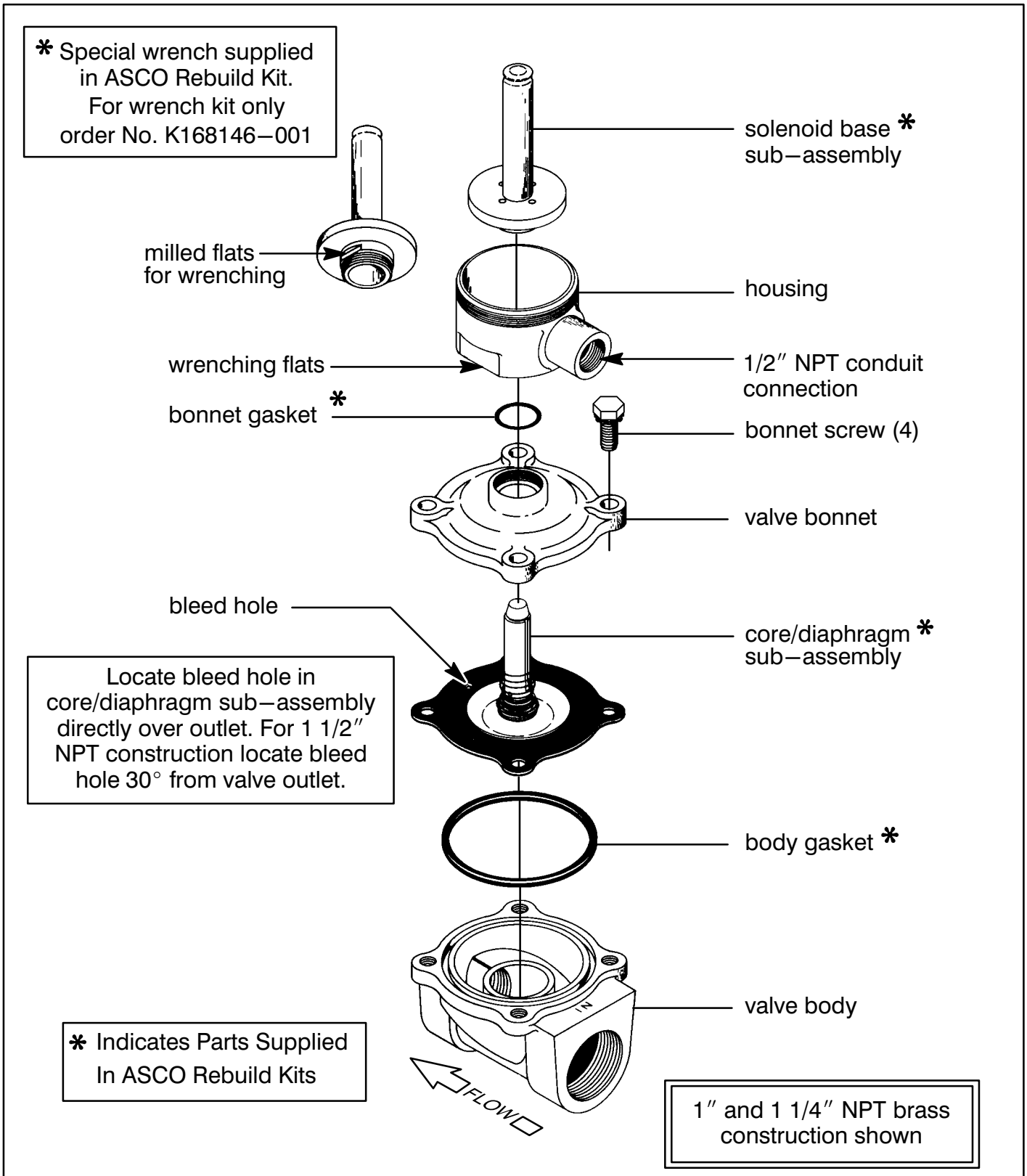

Figure 3. Series 8210 valve without solenoid (DC construction shown).

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GRAINGER® FOR THE ONES WHO GET IT DONE GRAINGER INTERNATIONAL, INC. GLOBAL SOURCING DIVISION	-- GGS TECHNICAL SPECIFICATION --	
	TECHNICAL SPECIFICATION NUMBER: 4FLZ2_TSREV0	GGS SKU(s): See below
	PRODUCT DESCRIPTION: 1.5" ABS Standard Pressure Gauge	PROGRAM NAME: Pressure Gauges 2010

1.0 PRODUCT DESCRIPTION:	1.5" ABS Standard Pressure Gauge

2.0: BRAND:	No Brand

3.0 PRODUCT IMAGE(S):	

NOTE: Product photos are shown for display purposes only and may not be representative of the actual product. The product is to be manufactured according to the specific requirements listed below Sections 4.0 through 11.0 below and the included technical drawings.

4.0 PRODUCT REQUIREMENTS:

4.1 Key Product Attributes
Uses: General Use with Water, Oil, Air and Chemicals Compatible with Beryllium Copper, Phosphor Bronze and Brass
Accuracy: ASME B40.1 Grade B (±3%-2%-3% of full scale)
Dial Scale: Dual scale PSI (primary; outer) and kPa (secondary; inner)
Dial Face Plate Marking (must be printed on dial face): ABS Case, Bronze Tube, Brass Socket
SKU label must be applied to the back of the gauge case
Rotation Direction: Clockwise for pressure, counter-clockwise for vacuum
Warning statement label must be applied to gauge diameter: 

This specification is based on the manufacturer's design and is to be used as a Quality Control document.

4.2 Properties / Performance / Reliability	Requirement

Dial Size (in.)	1 1/2"
Accuracy (%)	+/-3-2-3%
Lens Material	Acrylic (Clear)
Case Material	ABS
Case Color	Black
Connection Material	Brass (Natural)
Bourdon Tube Material	Bronze (Natural)
Connection Size (NPT)	1/8" NPT
Connection Location	Back
Pointer	Aluminum (Black)
Fill	None
Ambient Operating Temp (°F)	-40 to 150

SKU	Range (PSI)	Range (kPa)	Smallest Graduation
4FLZ2	30 to 0 Hg Vac	-100 - 0 kPa	1 Hg
4FLZ3	30Hg Vac to 30 PSI	-100 - 200 kPa	2 Hg; 1PSI
4FLZ4	0 - 15 PSI	0 - 100 kPa	0.5 PSI
4FLZ5	0 - 30 PSI	0 - 200 kPa	0.5 PSI
4FLZ6	0 - 60 PSI	0 - 400 kPa	1 PSI
4FLZ7	0 - 100 PSI	0 - 700 kPa	2 PSI
4FLZ8	0 - 160 PSI	0 - 1100 kPa	5 PSI
4FLZ9	0 - 200 PSI	0 - 1400 kPa	5 PSI
4FMA1	0 - 300 PSI	0 - 2000 kPa	5 PSI
4FMA2	0 - 400 PSI	0 - 2800 kPa	10 PSI
4FMA3	0 - 600 PSI	0 - 4000 kPa	10 PSI
4FMA4	0 - 1,000 PSI	0 - 7000 kPa	20 PSI
4FMA5	0 - 2,000 PSI	0 - 14000 kPa	50 PSI
4FMA6	0 - 3,000 PSI	0 - 20000 kPa	100 PSI
4FMA7	0 - 4,000 PSI	0 - 28000 kPa	100 PSI
4FMA8	0 - 5,000 PSI	0 - 35000 kPa	100 PSI
4FMA9	0 - 6,000 PSI	0 - 40000 kPa	200 PSI

4.4 Finish / Color	Requirement
All Surface Finishes	a) Surface finishes must be uniform and continuous. The surface finish must not exhibit any visual defects such as blisters, rust, corrosion, scratches, peeling, bubbles, and/or cracking. b) All exposed surfaces must be free of burrs and sharp edges. c) All applied finishes must adhere to the surface and show no signs of delamination or peeling. d) All painted or coated surface finishes must be lead-free.
Color	Case – Black Lens – Clear Connection, Tube and Ring - Natural

This specification is based on the manufacturer's design and is to be used as a Quality Control document.

4.5 Labels or Printing Applied to Product	Requirement
Appearance of all Labels and/or Printing	All labels must be applied straight and even without any air-bubbles or creases. The labels must adhere uniformly to the surface. Any surface printing must be permanent and legible without pinholes, smearing, or other such defects that would render the print unreadable.

4.6 Product Packaging	Requirement
Product Packaging (including Master Pack, Inner Pack, and Sell Pack): Ship Test Integrity & Durability **See Section 2.2 of the GGS Supplier Handbook for General Shipping & Packaging Requirements**	a) All products must be securely packaged in such a manner as to pass the **ISTA 1A or 1B** (refer to www.ista.org) shock/drop test or other GGS Engineering defined tests as outlined in this specification. These tests simulate repeated product handling and shipping by sea, air, rail and truck. b) The product must be packaged and protected as necessary to prevent any shipping damage that may be incurred by abrasion, corrosion, humidity, vibration and/or shock. c) Upon receipt at GGS, all packaging must be intact and all product components must remain functional and firmly attached to the product as when the unit was originally built. There shall be no evidence of breakage, scratches, burnishing, rust, corrosion and/or dents.
Special Packaging Requirements	

5.0 ACCESSORIES TO BE INCLUDED WITH THE PRODUCT:

Description	Quantity / Notes
OIPM, Instruction Sheet, Separate Parts, Assembly Drawings, etc.	ASME B40.1-1991 standard

6.0 AGENCY CERTIFICATION & REGULATORY COMPLIANCE:

6.1 Agency Certification (UL, CSA, NSF, ANSI, etc.)	Requirement

6.2 Regulatory Compliance	Requirement
Product must meet all applicable US Federal and State rules, bans, standards and regulations such as, CPSC (see below), California Prop 65, RoHS, etc.	• Proof of agency certification must be submitted to the GGS Compliance Department prior to each shipment. Email certifications to www.ggscompliance@grainger.com .
	•
In addition to meeting all applicable US Federal and State regulations, supplier must notify the GGS Compliance Department if the product contains lead or lead compounds, nickel, mercury, cadmium, hexavalent chromium, phthalates, asbestos, brass, bronze, or any other controlled substance.	• Contact GGS Compliance Department prior to shipment. • Email notification to ggscompliance@grainger.com.

SECTION 10 - 700 SERIES PROCESS EQUIPMENT - LIQUID SEPARATION

VACUUM INDICATOR - DWYER MODEL LPG4-D7322N

FLOW INDICATOR - OMEGA MODEL FL-4216-V

FLOW INDICATOR SENSOR - GF SIGNET MODEL P51530-P0

PRE-SEPARATION CHAMBER - HYDROQUIP MODEL 500 GLN CUSTOM

LEVEL SWITCH - CONDUCTIVITY INSTALL FITTING - GEMS MODEL 3E2C

LEVEL SWITCH - CONDUCTIVITY - GEMS MODEL 3R2C5

LEVEL SWITCH - FPI SENSORS MODEL LS-500-1 POS

OIL WATER SEPARATOR - HYDROQUIP MODEL AG-3SS-150V-IP

BELT SKIMMER - ABENAKI MODEL TOTE IT / ST2CR

BELT SKIMMER MOTOR, 0.33 HP / 115 VAC, 1 PH, XP - LEESON MODEL A617EC2ON

LEVEL SWITCH - MULTI-POSITION - FPI SENSORS MODEL LS-500-3 POS

LEVEL SWITCH - MULTI-POSITION - FPI SENSORS MODEL LS-500-3 POS

METERING PUMP (BIOCIDE) 115 VAC, 1 PH, EXP - LMI MODEL E711-363SI

METERING PUMP (EMULSIFICATION BREAKER) 115 VAC, 1 PH, EXP - LMI MODEL E711-363SI

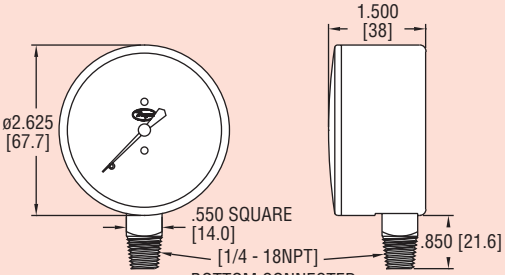
LEVEL SENSOR (BIOCIDE) - DWYER MODEL F7-SS2

LEVEL SENSOR (EMULSIFICATION BREAKER) - DWYER MODEL F7-SS2

Series LPG4

2.5″ Low Pressure Gage

1.5% Full-Scale Accuracy in a 2-1/2″ Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full-scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Enclosure Rating: NEMA 3 (IP54).
Weight: 7.3 oz (0.21 kg).

Model	Range	Model	Range
LPG4-D7122N	-10-0 in w.c. (-2.5-0 kPa)	LPG4-D8322N	0-40 in w.c. (0-10 kPa)
LPG4-D7222N	-16-0 in w.c. (-4-0 kPa)	LPG4-D8422N	0-60 in w.c. (0-15 kPa)
LPG4-D7322N	-25-0 in w.c. (-6-0 kPa)	LPG4-D8522N	0-80 in w.c. (0-20 kPa)
LPG4-D7422N	-40-0 in w.c. (-10-0 kPa)	LPG4-D8622N	0-100 in w.c. (0-25 kPa)
LPG4-D7522N	-60-0 in w.c. (-15-0 kPa)	LPG4-D8722N	0-160 in w.c. (0-40 kPa)
LPG4-D7622N	-80-0 in w.c. (-20-0 kPa)	LPG4-D8922N	-4-0-6 in w.c. (-1-0-1.5 kPa)
LPG4-D7722N	-100-0 in w.c. (-25-0 kPa)	LPG4-D9022N	-6-0-10 in w.c. (-1.5-0-2.5 kPa)
LPG4-D7822N	-160-0 in w.c. (-40-0 kPa)	LPG4-D9122N	-8-0-16 in w.c. (-2-0-4 kPa)
LPG4-D7922N	-235-0 in w.c. (-60-0 kPa)	LPG4-D9222N	-16-0-24 in w.c. (-4-0-6 kPa)
LPG4-D8022N	0-10 in w.c. (0-2.5 kPa)	LPG4-D9322N	-24-0-40 in w.c. (-6-0-10 kPa)
LPG4-D8122N	0-15 in w.c. (0-3.75 kPa)	LPG4-D9422N	-30-0-50 in w.c. (-7.5-0-14.5 kPa)
LPG4-D8222N	0-25 in w.c. (0-6 kPa)	LPG4-D9522N	-40-0-60 in w.c. (-10-0-0.15 kPa)

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

OEM-STYLE ACRYLIC ROTAMETERS

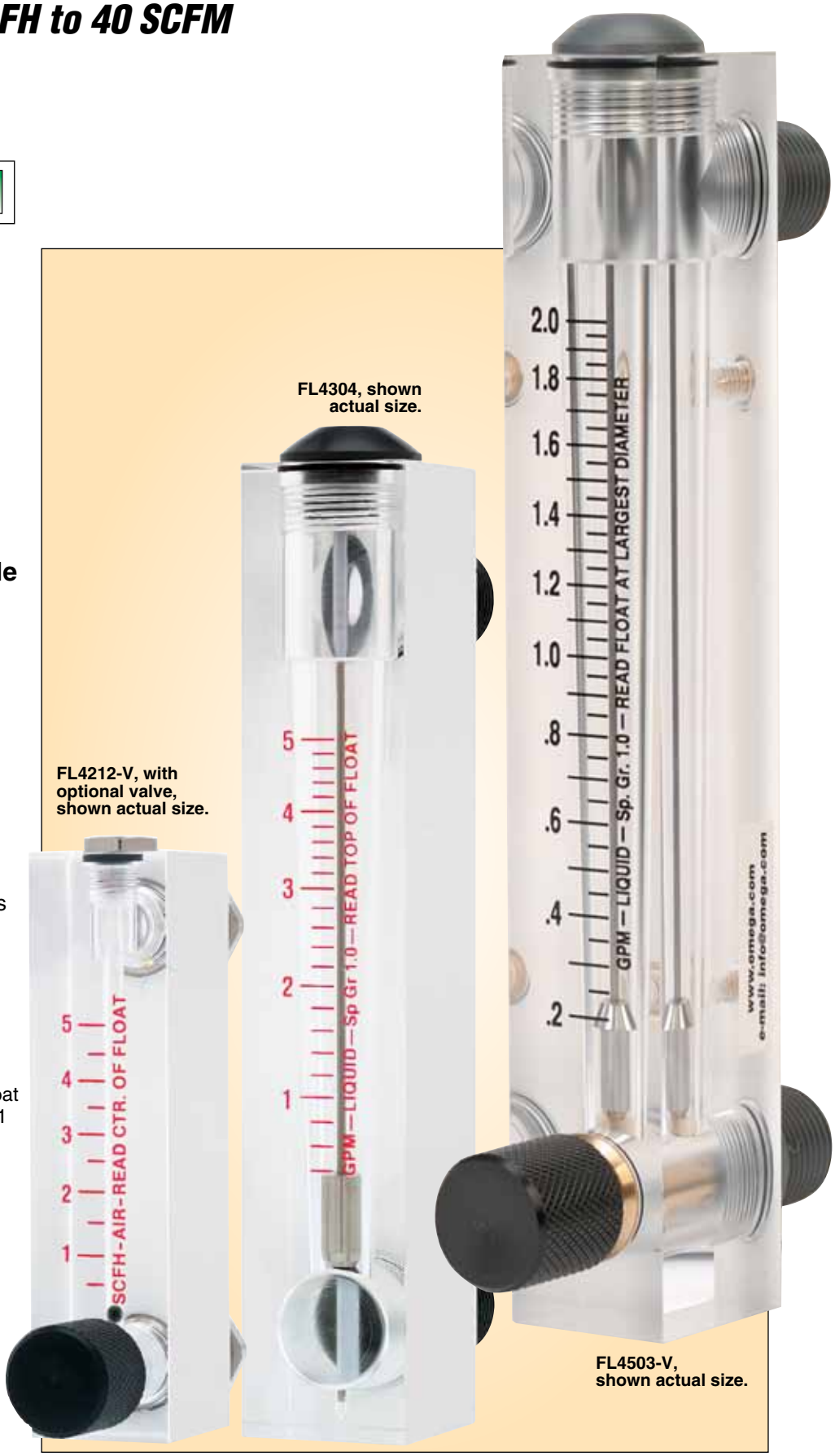
Capacities: Water: 6.5 GPH to 20 GPM
Air: 2 SCFH to 40 SCFM

FL4000 Series

Optional††

- **50, 75, 127, and 250 mm (1.97, 2.96, 5, and 9.85") Scale Lengths**
- **Floats are Rod-Guided in Most Models**
- **Metering Valves Available**
- **Rear Inserts Provided for Panel Mounting**
- **Direct-Reading Scales**

FL4000 OEM-style rotameters are precisely machined from solid acrylic blocks. They are available in 50, 75, 127, and 250 mm (1.97, 2.96, 5, and 9.85") scale lengths and have accuracies between 2 and 6%. Designed for front-panel mounting, the rear ports extend through the panel for easy hookup. Mounting threads are also provided. Units are available with and without valves.



SPECIFICATIONS

Construction: Acrylic tube, 316 SS float and guide rod (no guide rod for FL4211 through FL4215 air meters), PVC end fittings (brass on FL4200 Series), EPR O-rings, optional brass valve

Max Pressure/Temperature:

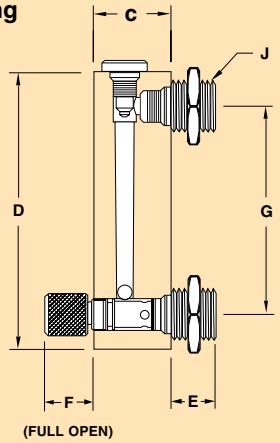
Water Ranges:
125 psig @ 21°C (70°F);
54°C (130°F) at 0 psig

Air Ranges:
100 psig @ 21°C (70°F);
38°C (100°F) @ 0 psig

Full Scale Accuracy/Repeatability:

FL4200: 6/2%
FL4300 and FL4400: 4/1%
FL4500: 3/1⁄2%
FL4600: 2/1⁄2%

Dimensional Drawing



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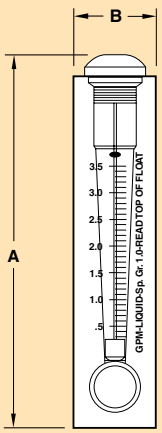

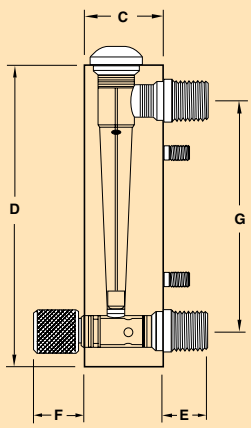

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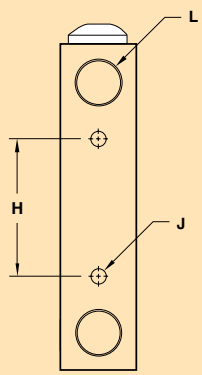
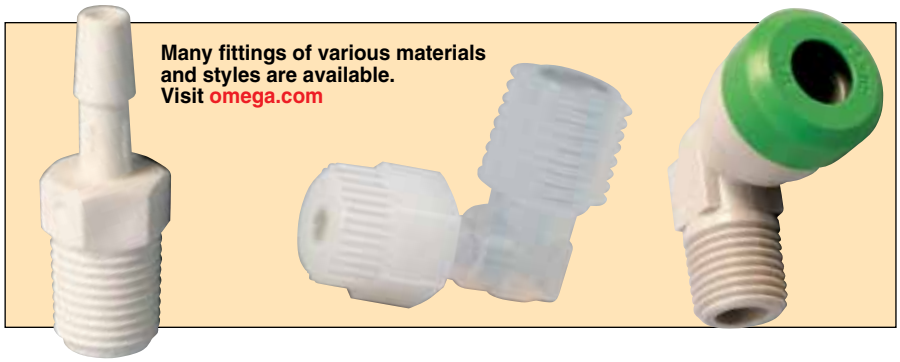


REAR VIEW

Connection: FL4200: ¼ FNPT; FL4300 and FL-4500: ¼ FNPT x ½ MNPT; FL4400: 1 MNPT; FL4600: ½ FNPT



Dimensions mm (in)	FL4200	FL4300	FL4400	FL4500	FL4600
A	102 (4.0)	168 (6.6)	225 (8.9)	210 (8¼)	362 (14¼)
B	25 (1.0)	32 (1.3)	44 (1.8)	32 (1¼)	44 (1¾)
C	32 (1.3)	35 (1.4)	46 (1.9)	35 (1⅜)	46 (1 13/16)
D	105 (4.1)	173 (6.8)	232 (9.9)	213 (8⅜)	368 (14½)
E	13 (0.5)	25 (1.0)	32 (1.3)	25 (1)	19 (¾)
F	29 (1.1)	32 (1.3)	48 (1.9)	32 (1¼)	48 (1⅞)
G	76 (3.0)	127 (5.0)	165 (6.5)	164 (6 7/16)	311 (12¼)
H	—	76 (3.0)	102 (4.0)	100 (3 15/16)	222 (8¾)
L	17 (0.7)	25 (1.0)	35 (1.4)	25 (1)	32 (1¼)
J Mounting Thread Size*	†	¼ x 20	¼ x 20	¼ x 20	⅜ x 24

** Threaded stud.*

† FL4200 has ⅞" hex lock nuts around ports; requires ¾" holes to be drilled through the panel.

To Order *Visit omega.com/fl4200_4600 for Pricing and Details*

Water				Air	
Model No.	Range (Max)*	Pressure Drop, inH_2O** No Valve	Valve	Model No.	Range (Max)*
FL4201	7 GPH	1**	1.3**	**FL4211**	2.6 SCFH
FL4202	12 GPH	15**	17**	**FL4212**	5.0 SCFH
FL4203	22 GPH	35**	51**	**FL4213**	10.0 SCFH
FL4204	44 GPH	149**	200**	**FL4214**	20.0 SCFH
FL4205	60 GPH	100**	250**	**FL4215**	30.0 SCFH
FL4301	1 GPM	18**	26**	**FL4216**	60.0 SCFH
FL4302	2.0 GPM	70**	125**	**FL4217**	100.0 SCFH
FL4303	3.5 GPM	200**	290**	**FL4218**	180.0 SCFH
FL4304	5 GPM	290**	440**	**FL4219**	4.0 SCFM
FL4401	10 GPM	53	220	**FL4411**	40.0 SCFM
FL4402	15 GPM	132	330	**FL4412**	62.0 SCFM
FL4403	20 GPM	200	400	—	—
FL4501	1 GPM	18	33	**FL4511**	4.0 SCFM
FL4502	100 GPH	45	75	**FL4512**	6.8 SCFM
FL4503	2 GPM	70	155	**FL4513**	8.0 SCFM
FL4504	5 GPM	240	400	**FL4514**	20.0 SCFM
FL4601	2 GPM	5	21	**FL4611**	8.5 SCFM
FL4602	3.5 GPM	13	50	**FL4612**	14.5 SCFM
FL4603	5 GPM	20	95	**FL4613**	20.0 SCFM
FL4604	10 GPM	110	270	**FL4614**	40.0 SCFM

Comes complete with operator's manual.

** Minimum flow rate = 10% of maximum flow rate listed.*

*** For water ranges. For air ranges, contact the Flow Department. For units with brass valve, add suffix "**-V**" to model number, additional cost for FL4200s, FL4300s, FL4400s, FL4500s and FL4600s.*

*†† For NIST calibration certificate, and "**-NIST 5PT**" to the model number for 5-point calibration, or "**-NIST 10PT**" for 10-point calibration for additional cost.*

***Ordering Examples: FL4303-V,** acrylic rotameter, 3.5 GPM flow rate.*

***FL-4613,** acrylic rotameter, 40 SCFM max flow.*

MANUAL FOR SERIES FL4000 & SERIES FL7000

ROTAMETERS

To get the most from the flowmeter you are about to install take time to read the following information before beginning work.

1) Carefully inspect the meter for damage that may have occurred during shipping.
2) Make sure your pressure, temperature, fluid and other requirements are compatible with the meter.
3) Select a suitable location for installation to prevent excess stress on the meter which may result from:
   a) Misaligned pipe.
   b) The weight of related plumbing.
   c) "Water Hammer" which is most likely to occur when flow is suddenly stopped as with quick closing solenoid and operated valves. (If necessary a surge chamber should be installed. This will also be useful in high pressure start-up situations.)
   d) Thermal expansion of liquid in a stagnated or valve isolated system.
   e) Instantaneous pressurization which will stress the meter and could result in tube failure.
   Note: In closed thermal transfer or cooling systems install the meter in the cool side of the line to minimize meter expansion and contraction and possible related fluid leaks.
4) Handle the meter carefully during installation.
   a) Use an appropriate amount of Teflon tape on external pipe threads before making connections. Do not use paste or stick type thread sealing products.
   b) **Extreme caution should be exercised when using PVC solvent cement around Acrylic. Solvents can cause acrylic to stress crack.**
5) Install the meter vertically with the inlet port at the bottom.
6) Meters should be cleaned with a mild soap solution. This will be an effective cleaner of rust stains. Caution must be used so that materials of construction are not damaged by cleaning solutions. Hard water deposits can be removed with a 5% acetic acid solution (vinegar).

CAUTION:

7) Meters are not oxygen cleaned. Use with incompatible fluids will cause O-rings to swell and break tubes. Meters used in gas service should have suitable valves plumbed in at the inlet and outlet of the meter. The valve at the outlet should be used to create back pressure as required to prevent float bounce. The inlet valve should be used for throttling purposes.
8) **Meters with shields must never be operated without shields securely in place. Failure to use safety shields may result in serious injury to personnel and property.**
9) **Meters without case enclosures are designed to operate at 14.7 psia. Meters in pressure service must be sufficiently shielded using 3/8" polycarbonate to protect personnel and equipment in the event of tube failure.**
10) **Pressure and temperature maximums must never be exceeded.**

PRESSURE/TEMPERATURE

ACRYLIC BLOCK MODELS

Water Service	PSIG/^{0}F
	125/130
Air Service	100/100

Signet 515/2536 Rotor-X Flow Sensors

English

Instructions for all versions of: 515/8510-xx and 2536/8512-xx

3-0515.090 Rev F 01/08

SAFETY INSTRUCTIONS

1. Depressurize and vent system prior to installation or removal.
2. Confirm chemical compatibility before use.
3. DO NOT exceed maximum temperature/pressure specifications.
4. ALWAYS wear safety goggles or faceshield during installation/service.
5. DO NOT alter product construction.

1. Specifications

General Data

Flow Rate Range:	515:	0.3 to 6 m/s (1 to 20 ft/s)
	2536:	0.1 to 6 m/s (0.3 to 20 ft/s)
Pipe Size Range:	DN15 to DN1000 (½ in. to 12 in.)	
Linearity:	±1% of maximum range	
Repeatability:	±0.5% maximum range	
Cable Length:	7.6 m (25 ft) standard	
	515:	60 m (200 ft.) maximum
	2536:	305 m (1000 ft) maximum
Cable Type:	2-conductor twisted pair w/shield (22 AWG)	
Minimum Reynolds Number Required: 4500		
Cap Material:	Glass Filled Polypropylene (red or blue)	
	Wetted Materials:	
• Sensor Body:	Glass filled Polypropylene (black) or PVDF	
• O-Rings:	FPM (Std), EPDM or FFPM optional	
• Pin:	Titanium or Hastelloy-C or PVDF; other material options available	
• Rotor:	Black PVDF or natural PVDF; optional Tefzel® with or w/o Fluoroloy B® sleeve	
Shipping Weight:	-X0	0.454 kg (1 lb)
	-X1	0.476 kg (1.04 lbs)
	-X2	0.680 kg (1.50 lbs)
	-X3	0.794 kg (1.75 lbs)
	-X4	0.850 kg (1.87 lbs)
	-X5	1.0 kg (2.20 lbs)
	3519	1.3 kg (2.86 lbs)

515 Sensor

Frequency:	19.7 Hz per m/s nominal (6 Hz per ft/s)
Amplitude:	3.3 V p/p per m/s nominal (1 V p/p per ft/s)
Source Impedance:	8 kΩ

Chinese RoHS (Go to www.gfsignet.com for details)

2536 Sensor

Frequency:	49 Hz per m/s nominal (15 Hz per ft/s nominal)
Supply voltage:	3.5 to 24 VDC regulated
Supply current:	<1.5 mA @ 3.3 to 6 VDC
	<20 mA @ 6 to 24 VDC
Output Type:	Open collector transistor, sinking
Output current:	10 mA max.

Chinese RoHS (Go to www.gfsignet.com for details)

Fluid Conditions

Rotor-X Sensor Pressure/Temperature Ratings:

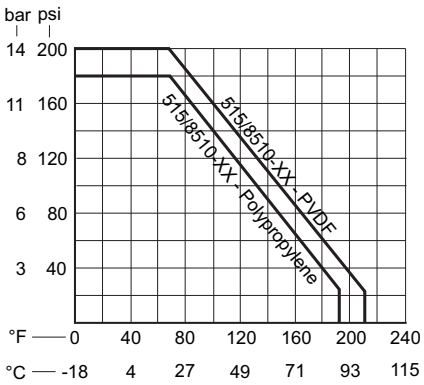
Polypropylene Body:

- 12.5 bar (180 psi) max. @ 20 °C (68 °F)
- 515: 1.7 bar (25 psi) max. @ 90 °C (194 °F)
- 2536: 1.7 bar (25 psi) max. @ 85 °C (185 °F)

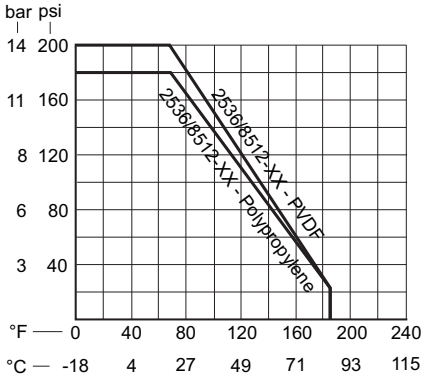
PVDF Body:

- 14 bar (200 psi) max @ 20 °C (68 °F)
- 515: 1.7 bar (25 psi) max @ 100 °C (212 °F)
- 2536: 1.7 bar (25 psi) max @ 85 °C (185 °F)

515 Sensor

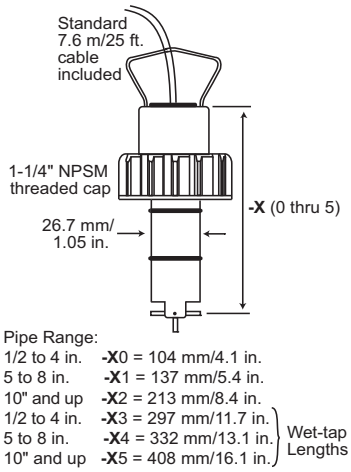


2536 Sensor

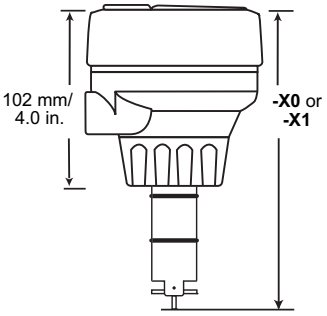


Dimensions

515/2536 Sensor



8510-XX/8512-XX Integral Sensor shown with Transmitter and Integral Adapter Kit (sold separately)

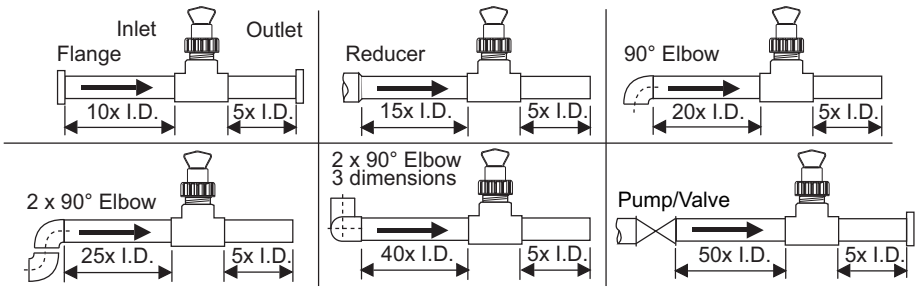


Standards & Approvals

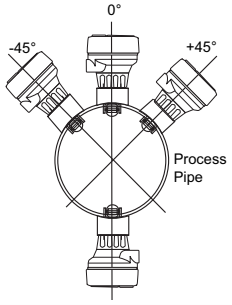
- Manufactured under ISO 9001 and ISO 14001
- CE
- FM (515 Only) IS/ I, II, III / ABCDEFG / T5

2. Location of Fitting

Recommended sensor upstream/downstream mounting requirements



3. Sensor Mounting Position



- Horizontal pipe runs: Mount sensor in the upright (0°) position for best performance. Mount at a maximum of 45° when air bubbles are present (pipe must be full). Do not mount on the bottom of the pipe when sediments are present.
- Vertical pipe runs: Mount sensor in any orientation. Upward flow is preferred to ensure full pipe.

4. Standard Sensor Installation

- Lubricate the sensor O-rings with a suitable lubricant. Do not use any petroleum based lubricant that will attack the O-rings.
- Using an alternating/twisting motion, lower the sensor into the fitting, making sure the installation arrows on the black cap are pointing in the direction of flow, see Figure A.
- Engage one thread of the sensor cap then turn the sensor until the alignment tab is seated in the fitting notch. Hand tighten the sensor cap. DO NOT use any tools on the sensor cap or the cap threads and/or fitting flange threads will be damaged, see Figure B.

Figure A

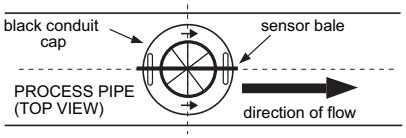
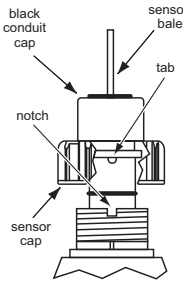


Figure B

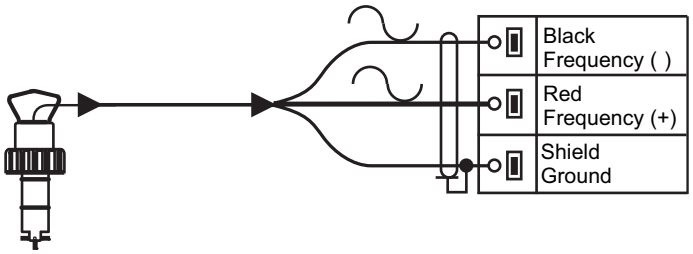


5. Sensor Wiring

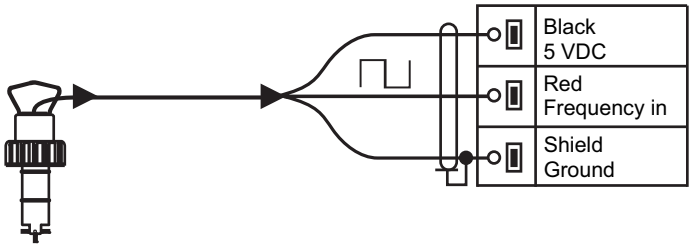
Technical Notes

- Use 2-conductor shielded cable for cable extensions.
- Cable shield must be maintained through cable splice.
- Refer to your instrument manual for specific wiring details.
- 515 Installations can be made intrinsically safe by installing two Intrinsic Safety barriers (part number 6400-9001).

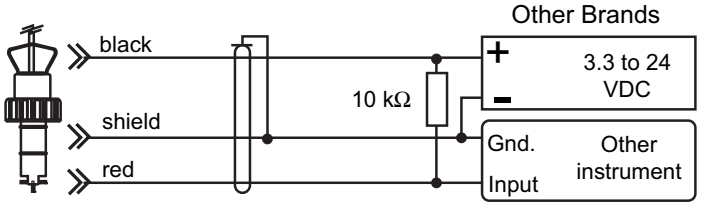
515 Sensor Connections to Signet Instruments



2536 Sensor Connections to Signet Instruments



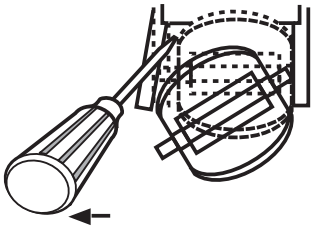
2536 Sensor Connections to Other Brand Instruments



● DC sensor power supplied from Signet instrument.
10KΩ Pull up resistor may be required for non Signet brand instrument.

6. Rotor Replacement Procedure

- To remove the rotor, insert a small screwdriver between the rotor and the ear of the sensor.
- Twist the screwdriver blade to flex the ear outward enough to remove one end of the rotor and pin. DO NOT flex the ear any more than necessary! If it breaks, the sensor cannot be repaired.
- Install the new rotor by inserting one tip of the pin into the hole, then flex the opposite ear back enough to slip rotor into place.



7. K-Factors

A **K-Factor** is the number of pulses a sensor will generate for each engineering unit of fluid that passes the sensor. K-factors for water are listed below in U.S. gallons and liters. For example, in a 1-inch PVC pipe, the 515 paddlewheel generates 174.67 pulses per gallon of water passing the rotor. K-factors are listed for pipes up to 12 inches. For pipes over 12 inches, consult your Signet distributor.

PIPE SIZE (IN.)	FITTING	515/8510-XX		2536/8512-XX	
		U.S. GAL	LITERS	U.S. GAL	LITERS
SCH 80 PVC TEES FOR SCH 80 PVC PIPE					
1/2	PV8T005	480.19	126.87	991.71	262.01
3/4	PV8T007	257.72	68.090	545.14	144.03
1	PV8T010	174.67	46.148	352.44	93.114
1-1/4	PV8T012	83.390	22.032	177.18	46.812
1-1/2	PV8T015	58.580	15.477	117.85	31.137
2	PV8T020	32.480	8.5812	66.739	17.633
2-1/2	PV8T025	21.833	5.7683	42.994	11.359
3	PV8T030	13.541	3.5775	26.652	7.0414
4	PV8T040	7.6258	2.0147	15.006	3.9645
SCH 80 CPVC TEES FOR SCH 80 CPVC PIPE					
1/2	CPV8T005	480.19	126.87	991.71	262.01
3/4	CPV8T007	257.72	68.090	545.14	144.03
1	CPV8T010	174.67	46.148	352.44	93.114
1-1/4	CPV8T012	83.390	22.032	177.18	46.812
1-1/2	CPV8T015	58.580	15.477	117.85	31.137
SCH 80 PVC SADDLES FOR SCH 80 PVC PIPE					
2	PV8S020	32.480	8.5812	66.739	17.633
2-1/2	PV8S025	21.833	5.7683	42.994	11.359
3	PV8S030	13.541	3.5775	26.652	7.0414
4	PV8S040	7.6258	2.0147	15.006	3.9645
6	PV8S060	4.1623	1.0997	8.3246	2.1994
8	PV8S080	2.3705	0.6263	5.0164	1.3253
10	PV8S100	1.5300	0.4042	3.0600	0.808
12	PV8S120	1.0600	0.2801	2.1600	0.571
SCH 80 PVC SADDLE ON SCH 40 PVC PIPE					
2	PV8S020	27.350	7.2259	54.700	14.452
2-1/2	PV8S025	18.874	4.9866	37.159	9.8175
3	PV8S030	12.638	3.3389	23.697	6.2608
4	PV8S040	6.7282	1.7776	13.456	3.5552
6	PV8S060	3.7297	0.9854	7.4594	1.9708
8	PV8S080	2.1527	0.5688	4.5292	1.1966
10	PV8S100	1.3500	0.3567	2.8000	0.740
12	PV8S120	0.9600	0.2536	1.9800	0.523
PP CLAMP-ON SADDLE ON SCH 80 PP PIPE					
10	PPS100	1.5300	0.4042	3.0600	0.808
12	PPS120	1.0600	0.2801	2.1600	0.571
PP CLAMP-ON SADDLE ON SCH 40 PP PIPE					
10	PPS100	1.3500	0.3567	2.8000	0.740
12	PPS120	0.9600	0.2536	1.9800	0.523

PIPE SIZE (IN.)	FITTING	515/8510-XX		2536/8512-XX	
		U.S. GAL	LITERS	U.S. GAL	LITERS
CARBON STEEL TEES ON SCH 40 PIPE					
1/2	CS4T005	370.20	97.808	756.00	199.74
3/4	CS4T007	212.06	56.027	438.69	115.90
1	CS4T010	141.14	37.289	286.78	75.768
1-1/4	CS4T012	60.655	16.025	121.22	32.026
1-1/2	CS4T015	45.350	11.982	91.139	24.079
2	CS4T020	26.767	7.0717	54.468	14.391
STAINLESS STEEL TEES ON SCH 40 PIPE					
1/2	CR4T005	358.96	94.838	734.20	193.98
3/4	CR4T007	202.61	53.530	412.10	108.88
1	CR4T010	127.14	33.590	252.70	66.764
1-1/4	CR4T012	61.910	16.357	128.12	33.849
1-1/2	CR4T015	40.410	10.676	77.320	20.428
2	CR4T020	22.300	5.8917	45.780	12.095
GALVANIZED IRON TEES ON SCH 40 PIPE					
1	IR4T010	104.54	27.619	213.01	56.277
1-1/4	IR4T012	62.979	16.639	127.75	33.751
1 1/2	IR4T015	46.688	12.335	94.401	24.941
2	IR4T020	29.459	7.7832	59.420	15.699
BRONZE TEES ON SCH 40 PIPE					
1	BR4T010	104.54	27.619	213.01	56.277
1-1/4	BR4T012	62.979	16.639	127.75	33.751
1-1/2	BR4T015	46.688	12.335	94.401	24.941
2	BR4T020	29.459	7.7832	59.420	15.699
COPPER TEE FITTINGS ON COPPER PIPE SCH K					
1/2	CUKT005	443.21	117.10	917.84	242.50
3/4	CUKT007	212.16	56.052	428.27	113.15
1	CUKT010	127.18	33.600	256.43	67.749
1-1/4	CUKT012	88.218	23.307	176.44	46.615
1-1/2	CUKT015	56.962	15.049	115.69	30.565
2	CUKT020	29.370	7.7595	63.385	16.746
COPPER TEE FITTINGS ON COPPER PIPE SCH L					
1/2	CUKT005	414.41	109.49	858.22	226.74
3/4	CUKT007	191.09	50.485	385.74	101.91
1	CUKT010	119.84	31.662	241.64	63.841
1-1/4	CUKT012	85.451	22.576	170.90	45.152
1-1/2	CUKT015	55.160	14.573	112.03	29.598
2	CUKT020	28.605	7.5575	61.74	16.310

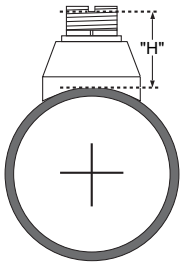
PIPE SIZE (IN.)	FITTING	515/8510-XX		2536/8512-XX	
		U.S. GAL	LITERS	U.S. GAL	LITERS
STAINLESS STEEL WELDOLETS ON SCH 40 PIPE					
2-1/2	CR4W025	18.800	4.9670	37.600	9.9339
3	CR4W030	12.170	3.2153	24.340	6.4306
4	CR4W040	6.9600	1.8388	13.920	3.6777
5	CR4W050	5.2600	1.3897	10.860	2.8692
6	CR4W060	3.6900	0.9749	7.5200	1.9868
8	CR4W080	2.1300	0.5627	4.3400	1.1466
10	CR4W100	1.3500	0.3567	2.7600	0.7292
12	CR4W120	0.9600	0.2536	1.9400	0.5125
CARBON STEEL WELDOLETS ON SCH 40 PIPE					
2-1/2	CS4W025	18.800	4.9670	37.600	9.9339
3	CS4W030	12.170	3.2153	24.340	6.4306
4	CS4W040	6.9600	1.8388	13.920	3.6777
5	CS4W050	5.2600	1.3897	10.860	2.8692
6	CS4W060	3.6900	0.9749	7.5200	1.9868
8	CS4W080	2.1300	0.5627	4.3400	1.1466
10	CS4W100	1.3500	0.3567	2.7600	0.7292
12	CS4W120	0.9600	0.2536	1.9400	0.5125
COPPER/BRONZE BRAZOLETS ON SCH 40 PIPE					
2-1/2	BR4B025	18.800	4.9670	37.600	9.934
3	BR4B030	12.170	3.2153	24.340	6.431
4	BR4B040	6.9600	1.8388	13.920	3.678
5	BR4B050	5.2600	1.3897	10.860	2.869
6	BR4B060	3.6900	0.9749	7.5200	1.987
8	BR4B080	2.1300	0.5627	4.3400	1.147
10	BR4B100	1.3500	0.3567	2.7600	0.729
12	BR4B120	0.9600	0.2536	1.9400	0.513
SCH 80 IRON SADDLES ON SCH 80 PIPE					
2	IR8S020	32.360	8.5495	64.720	17.099
2-1/2	IR8S025	22.220	5.8705	42.480	11.223
3	IR8S030	13.420	3.5456	26.420	6.980
4	IR8S040	7.6600	2.0238	14.700	3.884
5	IR8S050	5.8600	1.5482	12.180	3.218
6	IR8S060	4.0900	1.0806	8.4400	2.230
8	IR8S080	2.3300	0.6156	4.9000	1.295
10	IR8S100	1.5300	0.4042	3.0600	0.808
12	IR8S120	1.0600	0.2801	2.1600	0.571
SCH 80 IRON SADDLE ON SCH 40 PIPE					
2	IR8S020	26.820	7.0859	53.640	14.172
2-1/2	IR8S025	18.800	4.9670	37.600	9.934
3	IR8S030	11.990	3.1678	23.220	6.135
4	IR8S040	6.8500	1.8098	13.260	3.503
5	IR8S050	5.3300	1.4082	11.040	2.917
6	IR8S060	3.7600	0.9934	7.2400	1.913
8	IR8S080	2.1300	0.5627	4.4000	1.162
10	IR8S100	1.3500	0.3567	2.8000	0.740
12	IR8S120	0.9600	0.2536	1.9800	0.523

K-Factors DIN Pipes

PIPE SIZE	FITTING	515/8510-XX		2536/8512-XX		
		U.S. GAL	LITERS	U.S. GAL	LITERS	CODE
POLYPROPYLENE FITTINGS (DIN/ISO AND BS AND ANSI)						
DN 15	PPMT005	481.55	127.23	952.87	251.75	198.150.522
DN 20	PPMT007	277.09	73.207	563.10	148.77	198.150.523
DN 25	PPMT010	141.18	37.300	291.60	77.042	198.150.524
DN 32	PPMT012	83.540	22.071	169.22	44.709	198.150.525
DN 40	PPMT015	51.265	13.544	103.90	27.450	198.150.526
DN 50	PPMT020	29.596	7.8193	60.789	16.060	198.150.527
PVDF FITTINGS (DIN/ISO AND BS AND ANSI)						
DN 15	SFMT005	420.87	111.19	827.26	218.56	198.150.529
DN 20	SFMT007	228.15	60.277	489.87	129.42	198.150.530
DN 25	SFMT010	136.70	36.116	283.55	74.915	198.150.531
DN 32	SFMT012	79.294	20.950	158.59	41.899	198.150.532
DN 40	SFMT015	43.490	11.490	86.980	22.980	198.150.533
DN 50	SFMT020	25.908	6.8450	50.385	13.312	198.150.534
PVC FITTINGS (DIN/ISO) - EUROPE ONLY						
DN 15	PVMT005	486.18	128.45	972.37	256.90	198.150.480
DN 20	PVMT007	242.85	64.160	485.69	128.32	198.150.481
DN 25	PVMT010	148.64	39.270	297.274	78.540	198.150.482
DN 32	PVMT012	85.125	22.490	170.249	44.980	198.150.483
DN 40	PVMT015	51.855	13.700	103.709	27.400	198.150.484
DN 50	PVMT020	29.750	7.8600	59.500	15.720	198.150.485

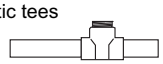
8. H-Dimensions

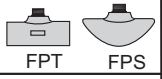
The plastic sensor insert in the Weldolet fitting MUST be removed during the welding process. When reinstalled, it is important that the insert be threaded to the proper height ("H" dimension).



Weldolet part number	"H" dimension inches	mm		Weldolet part number	"H" dimension inches	mm
CS4W020	2 38	60.45		CS4W240	4.16	105.66
CS4W025	2 33	59.18		CS4W360	4.10	104.14
CS4W030	2 32	58 92				
CS4W040	2 30	58.42		CR4W020	2.38	60.45
CS4W050	3 09	78.48		CR4W025	2.33	59.18
CS4W060	2 96	75.18		CR4W030	2.32	58.92
CS4W080	2.73	69 34		CR4W040	2.30	58.42
CS4W100	5.48	139.19		CR4W050	3.09	78.48
CS4W120	5 25	133.35		CR4W060	2.96	75.18
CS4W140	5.10	129.54		CS4W080	2.73	69.34
CS4W160	4 85	123.19		CR4W100	5.48	139.19
CS4W180	4.60	116.84		CR4W120	5.25	133.35
CS4W200	4.38	111.25				

9. Signet Fittings

Type	Description
Plastic tees 	• 0.5 to 4 inch versions • PVC or CPVC
PVC Glue on Saddles 	• Available in 10 and 12 inch sizes only • Cut 2 1/2 inch hole in pipe • Weld in place using solvent cement
PVC Saddles 	• 2 to 4 inch, cut 1 7/16 inch hole in pipe • 6 to 8 inch, cut 2 1/8 inch hole in pipe
PP Clamp on Saddles 	• Available in 10 and 12 inch sizes only • Cut 2 1/8 inch hole in pipe
Iron Strap on saddles 	• 2 to 4 inch, cut 1 7/16 inch hole in pipe • Over 4 inch, cut 2 1/8 inch hole in pipe • Special order 12 in. to 36 in.

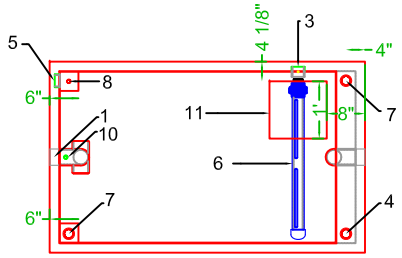
Type	Description
Iron, Carbon Steel, 316 SS Threaded tees 	• 0.5 to 2 in. versions • Mounts on threaded pipe ends
Carbon steel & stainless steel Weld on Weldolets 	• 2 to 4 inch, cut 1 7/16 inch hole in pipe • Over 4 inch, cut 2 1/8 inch hole in pipe
Fiberglass tees & saddles:  FPT FPS	• 1.5 in. to 8 in. PVDF insert • > 8 in. PVC insert • Special order 12 in. to 36 in.
Metric Union Fitting 	• For pipes from DN 15 to 50 mm • PP or PVDF

515/8510-XX Ordering Information		2536/8512-XX Ordering Information		Product Description
Part No.	**Code**	**Part No.**	**Code**	
P51530-P0	198 801 620	3-2536-P0	198 840 143	Sensor, Polypropylene, Titanium Rotor Pin, PVDF Rotor (black), ½ to 4 Inch
P51530-P1	198 801 621	3-2536-P1	198 840 144	Sensor, Polypropylene, Titanium Rotor Pin, PVDF Rotor (black) 5 to 8 Inch
P51530-P2	198 801 622	3-2536-P2	198 840 145	Sensor, Polypropylene, Titanium Rotor Pin, PVDF Rotor (black) 10 to 36 Inch
P51530-P3	198 840 310	3-2536-P3	159 000 758	Sensor, Wet-Tap, Polypropylene, Titanium Rotor Pin, PVDF Rotor (black), ½ to 4 Inch
P51530-P4	198 840 311	3-2536-P4	159 000 759	Sensor, Wet-Tap, Polypropylene, Titanium Rotor Pin, PVDF Rotor (black) 5 to 8 Inch
P51530-P5	198 840 312	3-2536-P5	159 000 760	Sensor, Wet-Tap, Polypropylene, Titanium Rotor Pin, PVDF Rotor (black) 10 to 36 Inch
P51530-V0	198 801 623	3-2536-V0	198 840 146	Sensor, PVDF (natural), Hastelloy Rotor Pin, PVDF Rotor (natural), ½ to 4 Inch
P51530-V1	198 801 624	3-2536-V1	198 840 147	Sensor, PVDF (natural), Hastelloy Rotor Pin, PVDF Rotor (natural), 5 to 8 Inch
P51530-V2	198 801 625	N/A	N/A	Sensor, PVDF (natural), Hastelloy Rotor Pin, PVDF Rotor (natural), 10 to 36 Inch
P51530-T0	198 801 663	3-2536-T0	198 840 149	Sensor, PVDF (natural), PVDF (nat.) Rotor Pin, PVDF Rotor (nat.), ½ to 4 Inch
P51530-T1	198 801 664	N/A	N/A	Sensor, PVDF (natural), PVDF (nat.) Rotor Pin, PVDF Rotor (nat.), 5 to 8 Inch
3-8510-P0	198 864 504	3-8512-P0	198 864 513	Sensor, Integral, PP, Titanium Rotor Pin, PVDF Rotor (black), ½ to 4 Inch
3-8510-P1	198 864 505	3-8512-P1	198 864 514	Sensor, Integral, PP, Titanium Rotor Pin, PVDF Rotor (black) 5 to 8 Inch
3-8510-T0	159 000 622	3-8512-T0	198 864 518	Sensor, Integral, PVDF (nat.), Hastelloy Rotor Pin, PVDF Rotor (nat.), ½ to 4 In.
3-8510-V0	198 864 506	3-8512-V0	198 864 516	Sensor, Integral, PVDF (nat.), PVDF (nat.) Rotor Pin, PVDF Rotor (nat.), ½ to 4 In.
3-3519/515-P3	159 000 819	3-3519/2536-P3	159 000 822	Sensor & Wet-Tap Assy., PP, Titanium Rotor Pin, PVDF Rotor (black), ½ to 4 In.
3-3519/515-P4	159 000 820	3-3519/2536-P4	159 000 823	Sensor & Wet-Tap Assy., PP, Titanium Rotor Pin, PVDF Rotor (black), 5 to 8 In.
3-3519/515-P5	159 000 821	3-3519/2536-P5	159 000 824	Sensor & Wet-Tap Assy., PP, Titanium Rotor Pin, PVDF Rotor (black), 10 to 36 In.
Accessories				
M1538-2	198 801 181	3-2536.320-1	198 820 052	Rotor, PVDF Black
P51547-3	159 000 474	3-2536.320-2	159 000 272	Rotor, PVDF Natural
M1538-4	198 820 018	3-2536.320-3	159 000 273	Rotor, Tefzel®
P51550-3	198 820 043	3-2536.321	198 820 054	Rotor and Pin, PVDF Natural
3-0515.322-1	198 820 059	3-2536.322-1	198 820 056	Sleeved Rotor, PVDF Black
3-0515.322-2	198 820 060	3-2536.322-2	198 820 057	Sleeved Rotor, PVDF Natural
3-0515.322-3	198 820 017	3-2536.322-3	198 820 058	Sleeved Rotor, Tefzel®
M1546-1	198 801 182	M1546-1	198 801 182	Rotor Pin, Titanium
M1546-2	198 801 183	M1546-2	198 801 183	Rotor Pin, Hastelloy-C
M1546-3	198 820 014	M1546-3	198 820 014	Rotor Pin, Tantalum
M1546-4	198 820 015	M1546-4	198 820 015	Rotor Pin, Stainless Steel
P51545	198 820 016	P51545	198 820 016	Rotor Pin, Ceramic
1220-0021	198 801 186	1220-0021	198 801 186	O-Ring, FPM
1224-0021	198 820 006	1224-0021	198 820 006	O-Ring, EPDM
1228-0021	198 820 007	1228-0021	198 820 007	O-Ring, FFKM
P31536	198 840 201	P31536	198 840 201	Sensor Plug, Polypro
P31536-1	198 840 202	P31536-1	198 840 202	Sensor Plug, PVDF Metric
P31536-2	159 000 649	P31536-2	159 000 649	Sensor Plug, PVDF
P31542	198 801 630	P31542	198 801 630	Sensor Cap, Red (for use w/515)
----	----	P31542-3	159 000 464	Sensor Cap, Blue (for use w/2536)
P31934	159 000 466	P31934	159 000 466	Conduit Cap
P51589	159 000 476	P51589	159 000 476	Conduit Adapter Kit
5523-0222	159 000 392	5523-0222	159 000 392	Cable (per foot), 2 cond. w/shield, 22 AWG
6400-9001	159 001 466	----	----	Intrinsic Safety barrier for 515 use ONLY (2 req'd per installation)

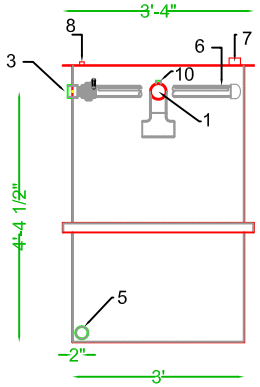
+GF+

Georg Fischer Signet LLC, 3401 Aerojet Avenue, El Monte, CA 91731-2882 U.S.A. • Tel. (626) 571-2770 • Fax (626) 573-2057
For Worldwide Sales and Service, visit our website: www.gfsignet.com • Or call (in the U.S.): (800) 854-4090

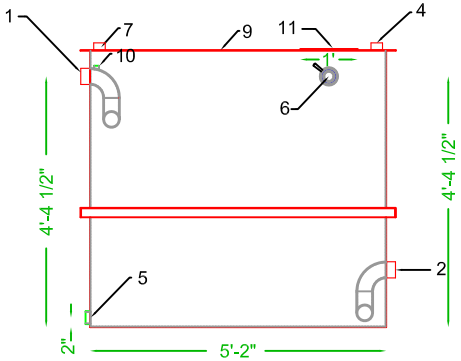
ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION
1	1	3" FNPT INLET	8	1	0.5 INCH FNPT VACUUM CONNECTION
2	1	3" FNPT OUTLET	9	1	REMOVABLE COVER
3	2	2" FNPT OIL OUTLET	10	1	0.5 INCH COUPLING (VENT)
4	3	2" FNPT VENT	11	1	12 INCH X 12 INCH X 1/4 INCH PLEXI-GLASS VIEWPORT
5	4	2" FNPT DRAIN			
6	1	PVC OIL SKIMMER			
7	1	2" FNPT PROBE CONNECTION			

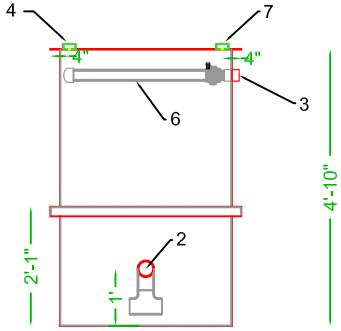


PLAN VIEW



FRONT VIEW





REAR VIEW

NOTES:
1. MATERIAL: 12 GAUGE 304 STAINLESS STEEL
2. GASKET: NEOPRENE
3. HARDWARE: 18-8 STAINLESS STEEL
4. INTERNAL SKIMMER PIPE: SCH 80 PVC
5: APPROXIMATE OPERATIONAL VOLUME: 500 GALLONS
6. SHIPPING WEIGHT: 475 LBS
7. OPERATING WEIGHT: 4,625
8. ALL WELDS TO BE PASSIVATED

REV	DESCRIPTION	DATE	APPROVED
A	AS-BUILT	01-12-15	CJJ

REVISIONS

DRWN BY CJJ DATE 10-16-14
CHK BY CJJ DATE 01-12-15
APPR BY DATE

NES NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

TITLE: PRE-SEPARATION TANK

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	C	M-5	1 OF 1	A

Warrick® Sensor Fittings and Probes

Warrick Liquid Level Sensors are available in single- and multi-probe models and with a variety of fittings. The versatility of the Warrick design makes these sensors ideal for a diverse range of applications.

Examples include:

- Food and Beverage
- Caustics and Acids
- Sumps
- Reservoirs
- Pharmaceuticals
- Boilers and Steam Generators
- Ponds
- Sewage and Wastewater

Probe Styles

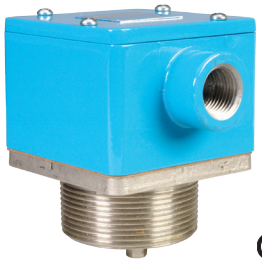
- Metal Rods
- Wire Suspended
- Corrosion Resistant
- Sanitary

Fitting Styles

- 3/8˝ to 3˝ Threaded Mount
- Bracket Mount
- Flange Mount
- External Mount
- Sanitary Mount
- Condulet Mount

Sensor Selection Chart

SERIES		3E	3N	3F	3G	3C	3K	3J	3L	3M	3MT	3S	3R	3T	3B	3H	3W	3Y
Page Number		E-23	E-23	E-22	E-22	E-26	E-26	E-21	E-21	E-28	E-28	E-27	E-24	E-24	E-23	E-21	E-25	E-25
Body Options	Flange			•	•													
	Pipe Thread	•			•			•										
	Flat Mount		•		•													
	Side Chamber					•	•											
	Non-Contact Electrodes											•						
	Food Grade Connection									•	•							
	Bracket Mount											•						
Fitting Body Material Options	Brass	•	•	•		•		•										
	PVC		•	•	•													
	1018 Carbon Steel			•														
	Stainless Steel	•		•														
	Forged Steel			•														
	Nylon									•	•							
	Cast Iron	•				•	•	•				•						
Housing Material	Coated Aluminum	•	•	•		•	•	•				•						
	Polycarbonate				•													
Number of Probes	1 to 3		•					•										
	1 to 4					•	•			•	•							
	1 to 7	•		•	•							•						
Electrodes	Electrode Only								•				•	•	•	•	•	•

3E	3N	3B
		
1" to 3" NPT	#10 Machine Screws from Underside	3/8" - 18NPT, 5/8" - 18UNF, 5/8" - 24UNEF
1 thru 7	1 thru 3	1
Series 3E fittings are cast metal, pressure-tight assemblies capable of handling 1-7 probes. Attachment to vessels is accomplished with external pipe threading. 3E Fittings require the use of 3R rigid or 3W wire suspended electrodes.	Series 3N fittings accommodate 1-3 probes operating at atmospheric pressure. The assembly mounts on a flat surface atop open tanks or closed vessels. 3N Fittings require the use of 3R rigid or 3W wire suspended electrodes.	Series 3B fittings are compact pressure tight assemblies that hold a single electrode probe for use in water and chemicals. These fittings incorporate a 1/4-20 female thread that must be combined with a Series 3R (rigid rod electrode) or Series 3W/3Y (wire suspended electrode) to make a complete assembly.
Die-cast aluminum, epoxy coated	Die-cast aluminum, epoxy coated	—
Cast iron, red brass, 316 stainless steel	PVC, red brass, 316 stainless steel	316 stainless steel
Teflon®	Teflon®	Teflon®
125 psig @ 353°F (cast iron) 250 psig @ 406°F (brass, 316 S.S.)	0 psig @ 150°F (PVC) 0 psig @ 500°F (brass, 316 S.S.)	400 psig @ 406°F (saturated steam)
U.L. File #MP2489, Vol. 1 Sec. 1; CSA; FM	CSA File #LR11644	U.L. File #MP2489, Vol. 1 Sec. 1; CSA; FM

	No. of Probes	Attachment to Vessel	Conduit Boss Thread Size	Terminal Housing Size (W" x D" x H")
3E	1	1" NPT	1/2" NPT	2-1/4 x 2-1/4 x 2-1/4
	2-3	2" NPT	1/2" NPT	3-1/4 x 3-1/4 x 2-3/8
	4	2-1/2" NPT	1/2" NPT	3-1/4 x 3-1/4 x 2-3/8
	5-7	3" NPT	3/4" NPT	4 x 4 x 2-1/2
3N	1-3	2-1/4" square flat pad, 1-1/2" dia. hole in top of vessel secured with #10 machine screws at the corners of a 1-1/2" square	1/2" NPT	2-1/4 x 2-1/4 x 2-1/4

3E X X

Series
3E

Number of Probes
1 thru **7**

Body Material
A – Cast Iron
B – Red Brass
C – 316 Stainless Steel

3N X X

Series
3N

Number of Probes
1 thru **3**

Body Material
A – PVC
B – Red Brass
C – 316 Stainless Steel

3B X B

Series
3B

Thread
1 – 3/8" - 18 NPT
2 – 5/8" - 18 UNF
3 – 5/8" - 24 UNEF

Metal Parts
B – 316 Stainless Steel

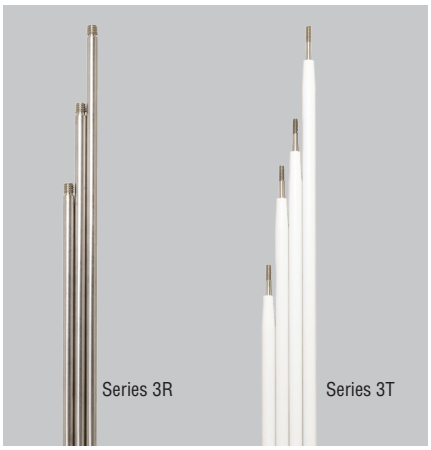
3R, 3W[1]	3R, 3W[1]	3R solid rod (up to 4') 3W[1] or 3Y[2] (greater than 4')

Custom options available. Consult factory.

Series 3R/3T
General Purpose Probes

- Metallic Rods
- Available in Many Materials for Various Requirements
- Adaptable for Various Fittings

For general purpose use, Series 3R probes are metallic rods with threaded ends that screw into a fitting that extends vertically down into the liquid. Available in a variety of materials for different applications. 3T tapered rods are also available.



Specifications

Style	
Series 3R	1/4˝ (.64 cm) threaded rod
Series 3T	1/4˝ (.64 cm) tapered rod
Material	Brass, Hastelloy C, Monel, 316 stainless steel, titanium, Carp. 20
Sheathing (optional)	PVC heat shrink 200°F (93°C), Teflon® heat shrink 350°F (177°C)

How to Order

Use the **Bold** characters from the chart below to construct a product code.

3R X X X

Series
- **3R**
- **3T**

Length (Feet)
- **1** – One
- **2** – Two
- **3** – Three
- **4** – Four
- **5** – Five
- **6** – Six
- **7** – Seven
- **8** – Eight
- **9** – Nine
- **10** – Ten

Probe Material
- **A** – Brass
- **C** – 316 Stainless Steel
- **D** – Carp. 20
- **E** – Hastelloy B
- **F** – Hastelloy C
- **G** – Monel
- **H** – Titanium

Sheathing Heat Shrink
- **0** – None
- **4** – PVC
- **5** – Teflon®

Contact your representative for custom lengths.

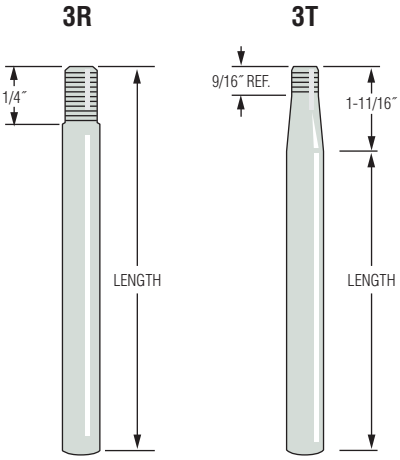
Note: Long lengths can be coupled to facilitate shipping and installation. Consult factory.

Applications

3R: For use with Series 3E, 3F, 3G, 3B fittings

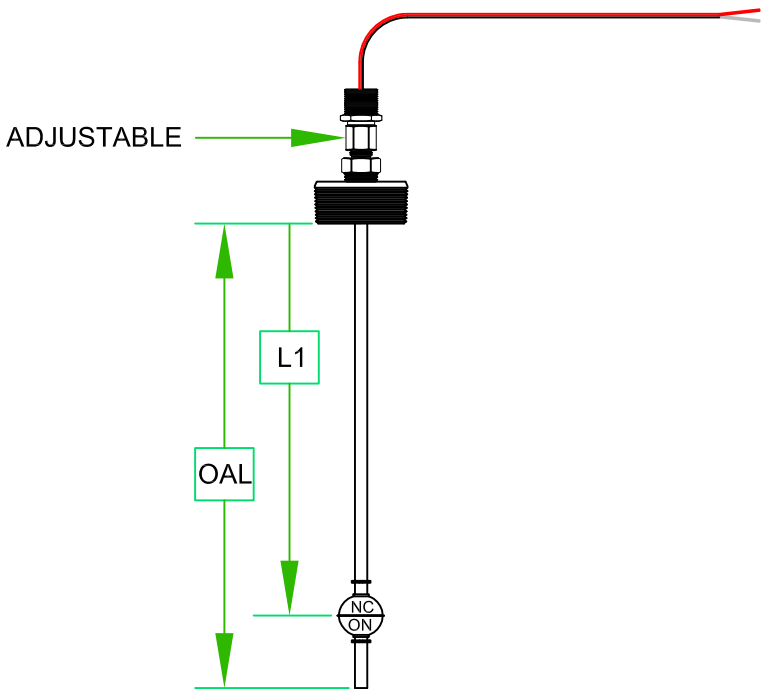
3T: For use with Series 3G and other custom configurations

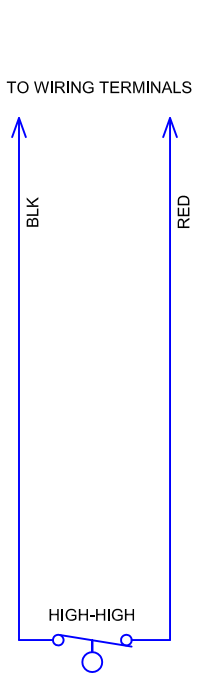
Dimensions



WARRICK CONDUCTIVITY SENSORS

L1	RED BLACK	NORMALLY CLOSED	HIGH-HIGH COMMON





UL LISTED

HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT

OAL - 12 INCHES
L1 - 10 INCHES
18 AWG CONDUCTOR LENGTH - 120 INCHES
ADJUSTABILITY RANGE - 5 INCHES
NES FACTORY ADJUSTED HEIGHT - 8 $\frac{5}{8}$"

GENERAL NOTES:

1. UL LISTED PRODUCT
2. FOR TERMINAL BLOCK LOCATION SEE DRAWING (I-1)
3. FOR WIRING TERMINAL DESIGNATION SEE DRAWING (I-2)
4. IF PROBE IS ADJUSTABLE, L1 DIMENSION IS AT FULL EXTENSION, AND INCLUDES ALLOWANCE FOR ADJUSTABILITY

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS

DRWN BY	MJS	DATE	11-12-14
CHK BY	CJJ	DATE	01-12-15
APPR BY	--	DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

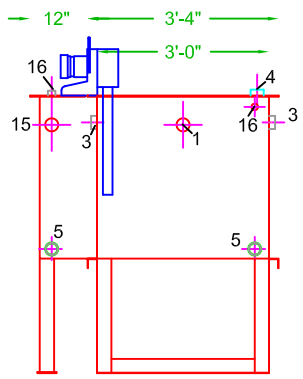
TITLE: 1 POSITION LEVEL SENSOR (ADJUSTABLE) (LSHH-701)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

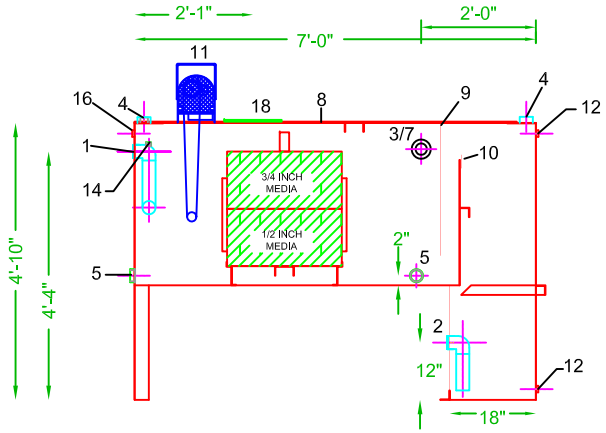
JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	M-6	1 OF 1	A

ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION
1	1	3" FNPT INLET	8	2	REMOVABLE COVER	15	1	2" FNPT OIL INLET
2	1	3" FNPT OUTLET	9	1	OIL STOP WEIR	16	2	0.5" VACUUM VENT PORT
3	2	2" FNPT OIL OUTLET	10	1	ADJ. OVERFLOW WEIR	17	0	2" FNPT PRODUCT OUTLET
4	3	2" FNPT VENT	11	1	ABANAKI BELT SKIMMER	18	1	12" X 12" PLEXI-GLASS
5	4	2" FNPT DRAIN	12	4	1" SIGHT GLASS PORTS			COVER CENTERED OVER
6	1	COALESCING PLATES	13	1	INTEGRAL PRODUCT TANK			PACKING
7	1	PVC OIL SKIMMER	14	1	0.5" FNPT PORT			

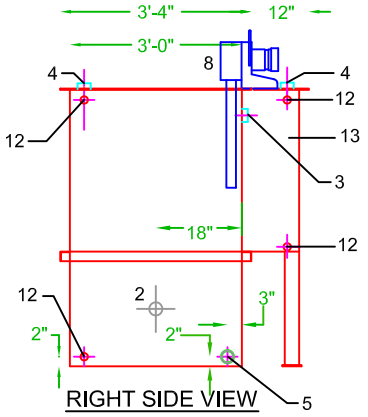
SHIPPING WEIGHT	1350 LBS
OPERATING WEIGHT	5670 LBS
SEPARATOR VOLUME	540 GALLONS
EFFLUENT TANK VOLUME	150 GALLONS
SLUDGE VOLUME	6 GALLONS
COALESCING AREA	12 FT^3
OPT. PRODUCT TANK VOL	120 GALLONS



LEFT SIDE VIEW



ELEVATION



RIGHT SIDE VIEW

GENERAL NOTES:
1. MATERIAL OF CONSTRUCTION: 12 GAUGE 304 STAINLESS STEEL
2. GASKET MATERIAL: NEOPRENE
3. HARDWARE CONSTRUCTION: 18-8 STAINLESS STEEL
4. INTERNAL PIPE: SCHEDULE 80 PVC
5. ALL WELDS ARE PASSIVATED

REV	DESCRIPTION	DATE	APPROVED
A	AS-BUILT	01-26-15	CJJ

REVISIONS

DRWN BY CJJ DATE 10-16-14
CHK BY DATE
APPR BY DATE

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TITLE: MODEL AG-3SS-150V-IP

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	C	M-7	1 OF 1	A

1.0) INTRODUCTION

Hydro Quip, Inc. (HQI) Oil Water Separator (OWS) Model AG-3SS-150V-IP will remove essentially all free and dispersed, non-emulsified oil, and settleable solids from the oil water mixture at a flow rate of 40 GPM at a temperature of 55 degrees F. The design utilizes the difference in specific gravity between oil and water (buoyancy force) enhanced by the use of 12 cubic feet of HD Q-PAC coalescing plates. The separator is designed to receive oily water by gravity/pumped flow that will not mechanically emulsify the oil and will process it on a once through basis. The tank will be a single wall, rectangular unit installed above grade. It will be constructed of stainless steel. The HD Q-PAC coalescing plates are manufactured of UV-Resistant Polypropylene material.

2.0 SYSTEM DESCRIPTION AND REQUIREMENTS

2.1 *FABRICATION:* The oil water separator is a special purpose prefabricated parallel corrugated plate, rectangular, gravity displacement, type oil water separator. The separator shall be comprised of a tank containing an inlet compartment, separation chamber, sludge chamber, and clean water outlet chamber.

2.2 *TANK:* The tank shall be a single wall construction of 12 gauge stainless steel conforming to ASTM A240, type 304 stainless steel. Welding will be in accordance with AWS D1.1 to provide a watertight tank that will not warp or deform under load. Pipe connections to the exterior shall be as follows:

2.2.1 *PIPE CONNECTIONS*: All connections 3” and smaller are FNPT couplings. All connections 4“ and larger are flat face flanges with ANSI 150 pound standard bolt circle. Use flanged piping connections that conform to ANSI B16.5.

2.3 *SEPARATOR CORROSION PROTECTION*: (For Carbon Steel Only) after shop hydrostatic test has been successfully completed, a coating system will be applied to the interior and exterior surfaces of the separator. Interior and exterior shall be sandblasted to SSPC-SP10 & SSPC-SP6; Interior lined with Tnemec Series 61 liner to 9 mils MDFT; Exterior coated with polyamide epoxy to 6 mils MDFT.

2.4 *LIFTING LUGS*: The tank shall be provided with properly sized lifting lugs for handling and installation.

2.5 *COVERS:* The tank will be provided with vapor tight covers for vapor control. Gas vents and suitable access openings to each compartment will be provided. The covers shall be constructed of marine grade aluminum and will be fastened in place. A gasket shall be provided for vapor tightness. 3/8-16 bolts and threaded knobs will be provided for cover attachment.
2.6 *INLET COMPARTMENT*: The inlet chamber shall be comprised of a non-

clog diffuser to distribute the flow across the width of the separation chamber. The inlet compartment shall be of sufficient volume to effectively reduce influent suspended solids, dissipate energy and begin separation. The media will sit elevated on top of a sludge baffle. The sludge baffle will be provided to retain settleable solids and sediment from entering the separation chamber.

2.7 *SEPARATION CHAMBER*: The oil separation chamber shall contain HD Q-PAC Coalescing Media containing a minimum of 132 square feet per cubic foot of effective coalescing surface area. The medias needle like elements (plates) shall be at 90 degrees to the horizontal or longitudinal axis of the separator. Spacing between these elements shall be spaced 3/16" apart for the removal of a minimum of 99.9% of free droplets 20 micron in size or greater. The elements are positioned to create an angle of repose of 90 degrees to facilitate the removal of solids that may tend to build up on the coalescing surfaces, which would increase velocities to the point of discharging an unacceptable effluent. Laminar flow with a Reynolds Number of less than 500 at a maximum designed flow rate shall be maintained throughout the separator packed bed including entrance and exit so as to prevent re-entrainment of oils with water. Flow through the polypropylene coalescing media shall be crossflow perpendicular to the vertical media elements such that all 132 square feet/cubic foot of coalescing media is available for contact with the coalescing surfaces. None of the coalescing media surfaces shall be pointing upward so as not to be available for contact with the crossflowing oily water. The media shall have a minimum of 87% void volume to facilitate sludge and dirt particles as they fall off the vertical elements and settle in the sludge compartment. The media when installed in crossflow OWS shall meet US EPA Method 413.2 and also European Standard 858-1.

2.8 *BAFFLES:* An oil retention & underflow weir, and overflow weir. Position underflow weir to prevent resuspension of settled solids.

2.9 *SLUDGE BAFFLE:* The sludge baffle shall be located prior to and under the coalescing compartment for the settling of any solids. It shall also prevent any solids from entering the clean water chamber.

2.10 *OIL SKIMMERS*: The oil separation chamber will be provided with a rotatable pipe skimmer for gravity decanting of the separated oil to a 125 gallon product storage tank. An Abanaki Belt skimmer will also be provided for removal of separated oil to the integral oil storage tank.

2.11 *CLEAN WATER CHAMBER:* The tank will be provided with a 150 gallon clean water chamber that allows the water to leave the separator by pumped flow through the clean water outlet port. An absorbent bag filter will be provided after the overflow weir plate to remove any further hydrocarbons not removed by the coalescer (further treatment may be required).

2.12 VENTS: 2" vents will be provided for vent piping to atmosphere.

WWMI

HYDROCARBON ABSORBAG

WWMI's advanced hydrocarbon absorbags remove oil-related contaminants from water in recycling systems , oil-water separators, and sump pits.

- **Excellent filtration at a minimal price**
- **Models available to fit RGF® Recycling Systems and many oil-water separators**
- **Free lab analysis to document performance with your water (typical free oil effluent less than 1.0 ppm.)**
- **Keeps your system running better with inexpensive filter changes.**
- **Floating "pillow-type" models also available**

BENEFITS:

- **Very cost efficient filtration**
- **Easy to handle and dispose**
- **Vertical round and horizontal square models available**
- **Custom shapes and sizes available**

Performance: Water containing free oils enters the filter through the poly mesh support. As the water flows around the randomly oriented, multi-faceted polyisocyanurate foam cells, the free oils are absorbed into the foam. All water is repelled and continues to pass through the filter after the free oils are removed.

Photos are representations only. Actual product may vary due to availability and/or modification of components.

Waste Water Management, Inc.
The Leader in Water Treatment & Recycling Systems
150 Evernia Street ♦ Jupiter, Florida 33458
(561) 747-8028 ♦ Fax: (561) 747-0642 ♦ wwmi@recyke.com
www.recyke.com

A B A N A K I

TOTE-IT® PORTABLE OIL SKIMMER

Enjoy the Benefits of Oil Skimming!

- Tote-It is easily hand carried to the source of the problem
- Most inexpensive way to remove oil from water
- Saves coolants by removing tramp oil
- Conserves parts wash water by removing oily wastes
- Prevents recontamination of parts as they are removed from wash tank
- Prevents plugging of spray heads and filters
- Reduces fluid disposal costs
- Skimmed oil can be recycled and reused as a lubricant or fuel
- Helps meet government requirements for water discharge

General Description

The Tote-It's patented design is a dependable and effective means of removing free floating oil from water. The single assembly unit can be used in any application where 115 VAC, 60 or 220V, 50 Hz power is available.

The Tote-It utilizes a continuous belt and wiper to remove up to 12 gallons of oil per hour from the fluid surface. The belt operates on a motor and pulley system attached to a stabilizer bar that is immersed in the contaminated liquid. After traveling over the head pulley, the belt passes through tandem wiper blades where oil is scraped off both sides of the belt, and discharged through a 1-1/4 in. ID hose. The tail pulley has flanges which allow it to roll freely on the inside of the belt without becoming dislodged. It does not need to be fastened to the tank.

Oil skimming makes use of the differences in specific gravity and surface tension between oil and water. These physical characteristics allow the belt to attract oil and other hydrocarbon liquids from the surface of the fluid.

The Tote-It is especially well suited for parts washing and machining center applications. By removing surface oil from a wash tank, the parts will not be recontaminated as they are withdrawn. Removing tramp oil from a coolant tank prevents excessive smoke and fumes due to oil burning during cutting operations. It also reduces bacteria growth in the tank, along with the resulting odor.

The Tote-It Advantages

- Multiple site usage — easily moved from one place to another
- 36 lb., single unit portability
- A single unit elevates and separates oil
- Can be used in tanks as shallow as a few inches
- Requires no tank modifications in most applications
- Maintains skimming efficiency in fluctuating fluid levels
- Easy mounting and fast cleaning, with minimal maintenance

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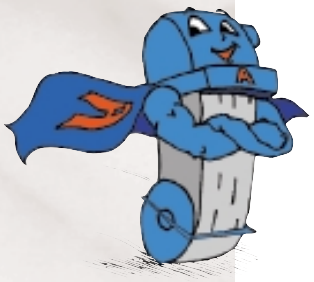
http://www.abanaki.com

TOTE-IT® PORTABLE OIL SKIMMER

Where To Use The Tote-It

The Tote-It is designed for those applications where multiple tanks can take advantage of a single portable unit. It also can be used in permanent installations with limited access areas, such as small parts washers and machining center coolant tanks.



Typical Applications

- Wastewater sumps
- Parts washers
- Coolant systems
- Heat treating fluids
- Food processing plants
- Parking lots, garages, and service facilities
- Aircraft service areas and tarmac runoff
- Truck, locomotive, and other mobile equipment washing facilities

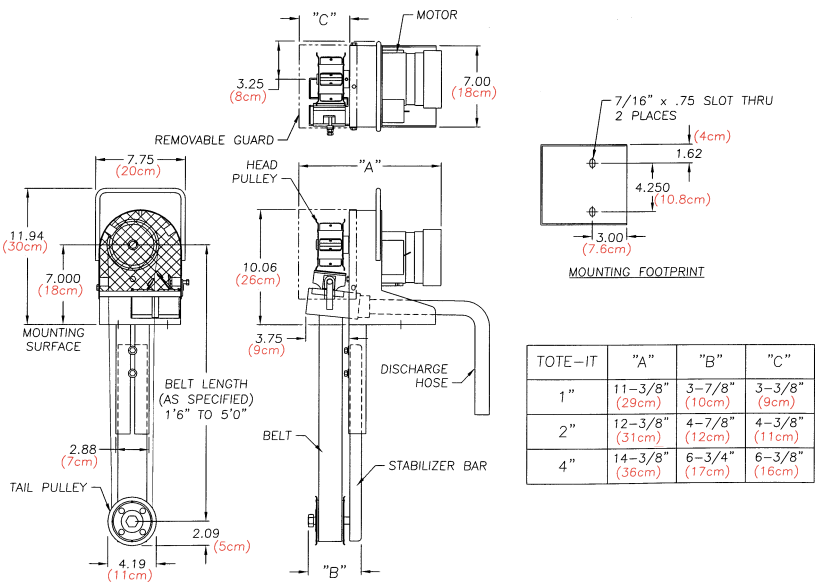
Rugged Construction for Harsh Conditions

The Tote-It has been designed to last for many years. Belts are made of corrosion-resistant steel, or a polymer material. A tough power train keeps the Tote-It running under the most severe conditions. With the proper configuration the Tote-It can handle liquid temperatures up to 212˚F, and the pH of the fluid can range from 1 to 13.

Key Features of the Tote-It:

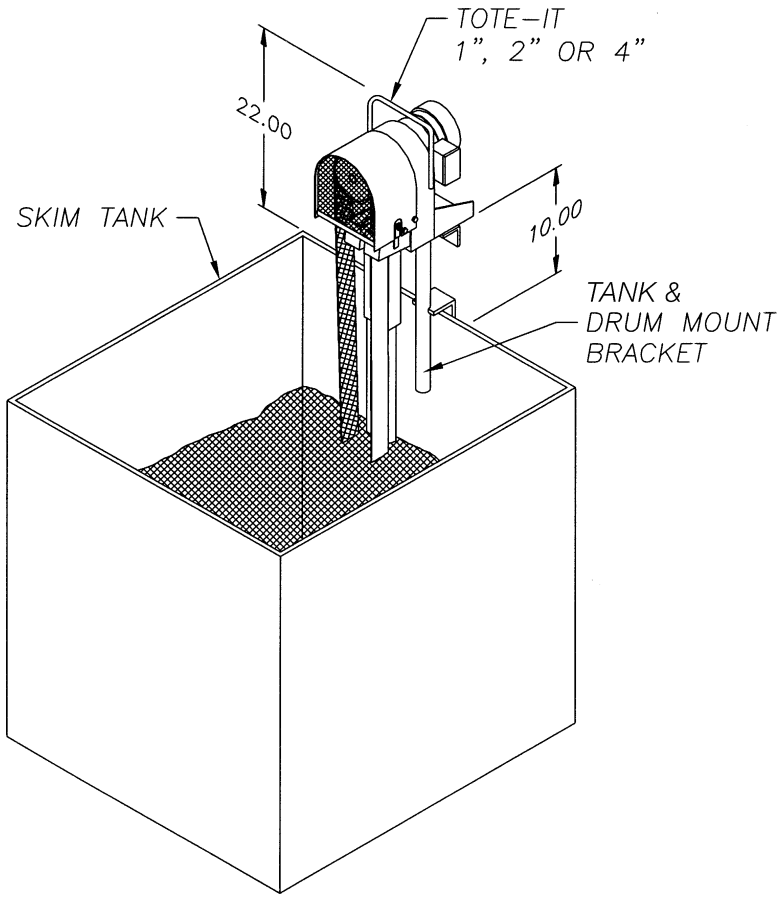
- Small mounting and operating area
- Easily hand carried from tank to tank
- Easily mounted on a flat surface
- Belt and wipers impervious to oils and fuels
- High temperature capability
- Chip resistant powder coated finish
- Customized belt lengths and materials
- Fast cleaning with minimal maintenance

TOTE-IT DIMENSIONS



TOTE-IT	"A"	"B"	"C"
1"	11-3/8" (29cm)	3-7/8" (10cm)	3-3/8" (9cm)
2"	12-3/8" (31cm)	4-7/8" (12cm)	4-3/8" (11cm)
4"	14-3/8" (36cm)	6-3/4" (17cm)	6-3/8" (16cm)

MOUNTING DETAIL



Specifications:

Oil Removal Rate	12gph (45.4 lph) with 4 in.(10 cm) wide belt 6 gph (22.8 lph) with 2 in.(5 cm) wide belt 3 gph (11.4 lph) with 1 in.(2.5 cm) wide belt (Removal rate is based on 30 weight oil in water.)
Motor	Fractional hp gear motor, 115VAC, 60 Hz
Belt Width	Specify 4 in. (10 cm), 2 in. (5 cm), or 1 in. (2.5 cm)
Belt Length	User specified (See "Belt Selection" next page.)
Belt Material	Specify corrosion-resistant steel, or specially engineered polymer. (See "Belt Selection.")
Wiper	Nitrile standard, Viton, ceramic/UHMW hybrid, and ceramic optional. Specify wiper material based on temperature and fluid compatibility. (See "Operating Limits.")
Mounting Method	Flat base mount with oil discharge through a 1-1/4 in. I.D. hose. See installation drawing.
Mounting Area	See installation drawing.
Weights[1]	Complete assembly with stabilizer bar, tail pulley, and steel belt: 1 in.: average 30 lbs. (13.6 kg) 2 in.: average 34 lbs. (15.4 kg) 4 in.: average 36 lbs. (16.3 kg)
Options (Specify)	• Oil Concentrator® for virtually water-free oil discharge (See description next page.) • Storage stand • Special belt lengths, over 5 ft. center to center • Stainless steel construction • Timer • Level switch • Pneumatic or special electric motors • Explosion proof

Operating Limits

Wipers[2]

Temperature of Liquid	pH 1-5 (acidic)	pH 6-8 (neutral)	pH 9-14 (alkaline)
33°F-180°F (0.5°C-82°C)	Ceramic hybrid, CRV	Ceramic hybrid, CRV, nitrile	Ceramic hybrid, CRV, nitrile
181°F-212°F (83°C-100°C)	CRV	CRV	CRV

Belts[2]

Temperature of Liquid	pH 1-5 (acidic)	pH6-8 (neutral)	pH 9-14 (alkaline)
33°F-140°F (0.5°C-60°C)	Elastomer	Poly, Elastomer	Poly, Elastomer
33°F-180°F (0.5°C-82°C)	Corrosion Resistant	Corrosion Resistant, Carbon Steel, Poly	Corrosion Resistant, Poly
181°F-212°F (83°C-100°C)	CR steel	Corrosion Resistant, Carbon Steel	Corrosion Resistant

Standard Configuration	The Abanaki Tote-It is supplied with a belt guard, adjustable wiper blade assembly, skimmer belt, tail pulley, and stabilizer bar.

1. The Tote-It is UPS shippable.
2. Consult factory for recommendations covering operating conditions not listed here.

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Tote-It® 2”
with Explosion Proof Motor
Installation and Maintenance Instructions

Your Abanaki Tote-It®2” is shipped with these items:

1. Base Unit w/Gear Reducer.
2. Explosion Proof Motor
3. Stabilizer Bar & Tail Pulley.
4. Belt.

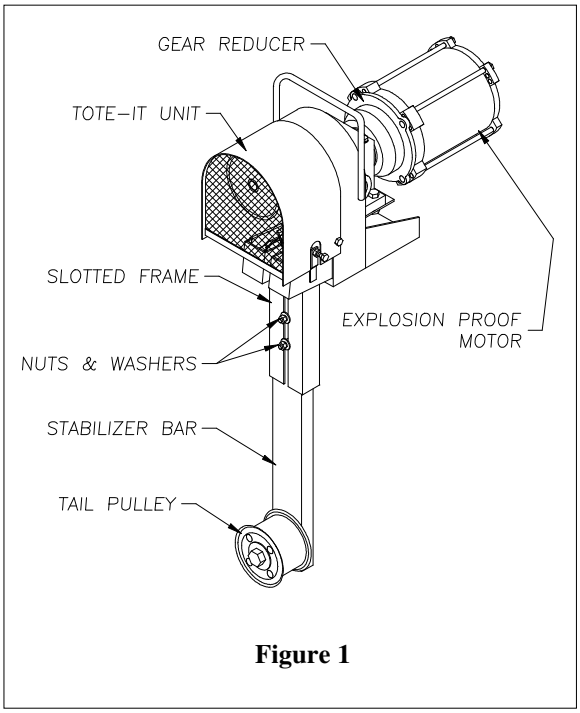

Figure 1

Step 1. Temporarily mount the Tote-It® on a clean flat surface high enough above floor level (belt center plus 12”) to permit assembly of stabilizer bar and belt.

Step 2. Loosen nuts and washers on stabilizer bar. Slide stabilizer bar into the slotted frame on the bottom of the unit, making sure that the fasteners are on the outside of the slot. **(See Fig. 1)** Slide stabilizer bar as far up as possible. Lock bar temporarily in place by tightening top nut and washer assembly.

Step 3. Install bottom tail pulley on stabilizer bar. See figure 2 when a steel belt is used. See figure 3 when an Elastomer belt is used.

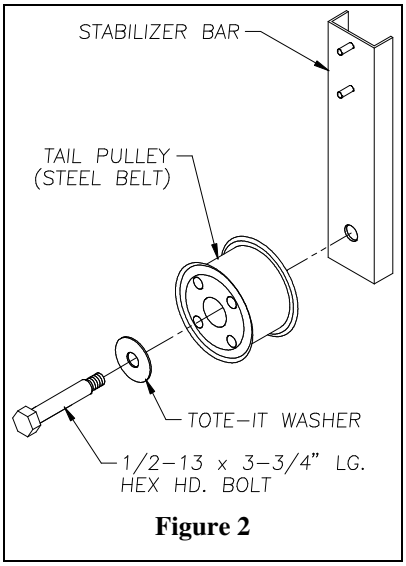

Figure 2

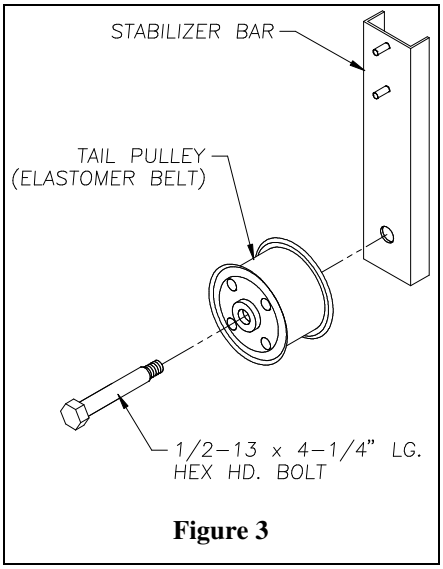

Figure 3

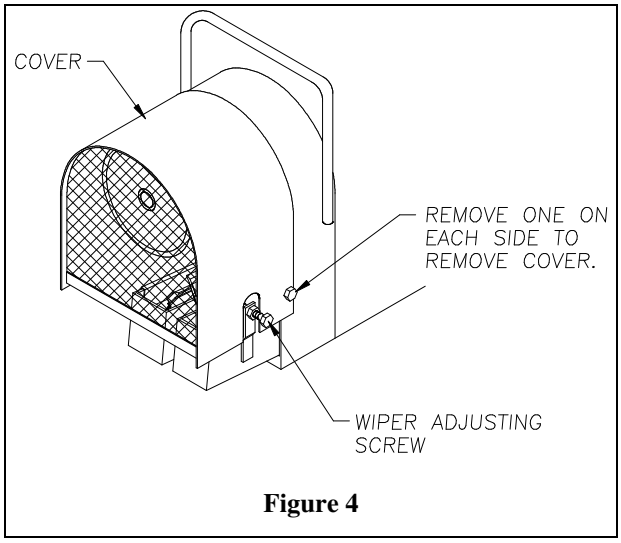

Figure 4

Step 4. Remove the cover by unbolting the two ¼-20 bolts, one on each side, and lift off. **(See Fig. 4)**

Step 5. Unscrew the wiper adjusting screw as far as possible without removing it. **(See Fig. 4)**

Step 6. Remove the belt from its carton. If it is metal, unroll slowly, being careful not to dent or crease. (Abanaki recommends the use of gloves when handling metal belts.)

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Tote-It® 2”
with Explosion Proof Motor
Installation and Maintenance Instructions

Step 7. Hold belt with both hands about 9” from the top and gently bend it into a large loop. Insert the belt through the wiper blades, troughs and over the head pulley. Lower it in place onto the head pulley, making sure it is centered. **(See Fig. 5)**

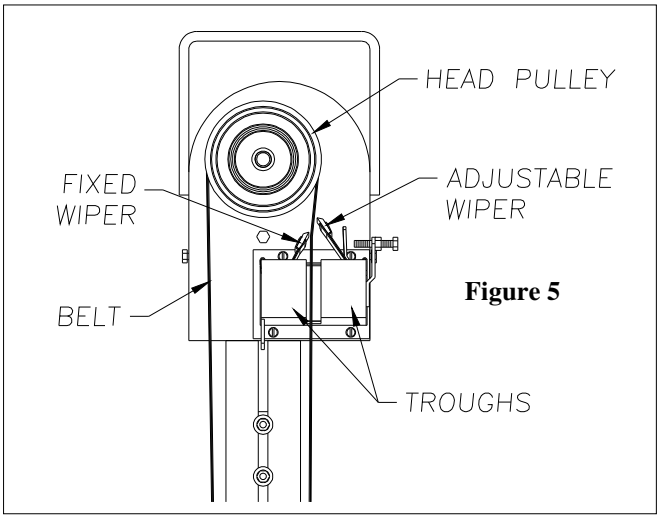

Figure 5

Step 8. Gently lower the belt until the bottom loop hangs beneath the tail pulley.

Step 9(A). Metal belt units only.

Loosen the top stabilizer fasteners and gently lower the stabilizer bar until:

1. A black felt marker line on the stabilizer bar shows just below the bottom edge of the slotted frame, **(See Fig. 6)** and/or
2. The belt supports the tail pulley with the ½” bolt shaft in the center of the tail pulley hole. **(See Fig. 7)**

Note: The stabilizer bar should not be tensioning the belt. The **only** pressure on the belt should be the weight of the tail pulley.

3. Tighten both sets of fasteners.

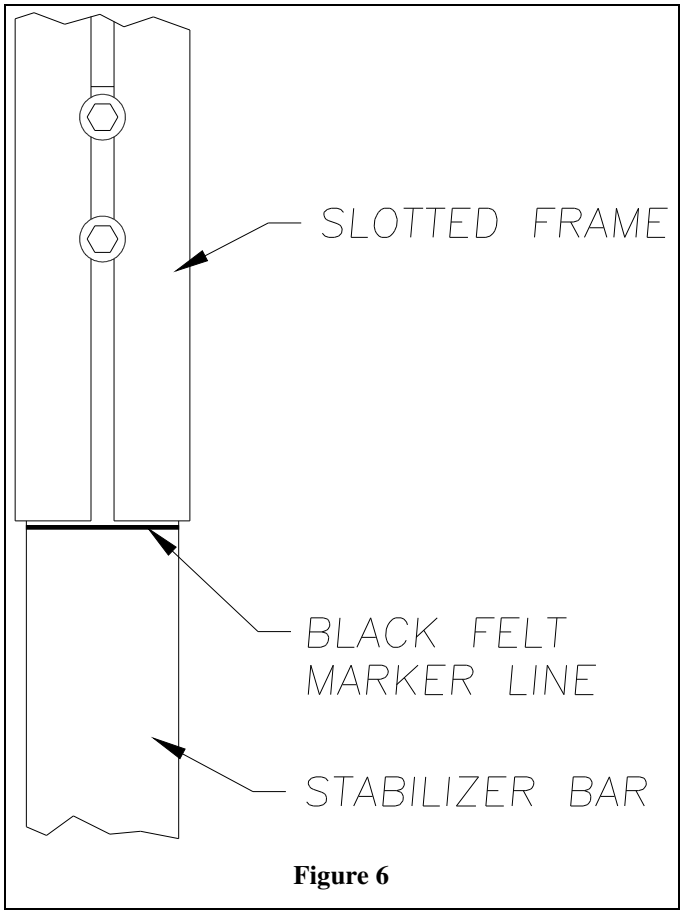

Figure 6

Step 9(B). Elastomer belt units only.

Loosen the top stabilizer fasteners and gently lower the stabilizer bar until the belt is taut. Tighten both sets of fasteners.

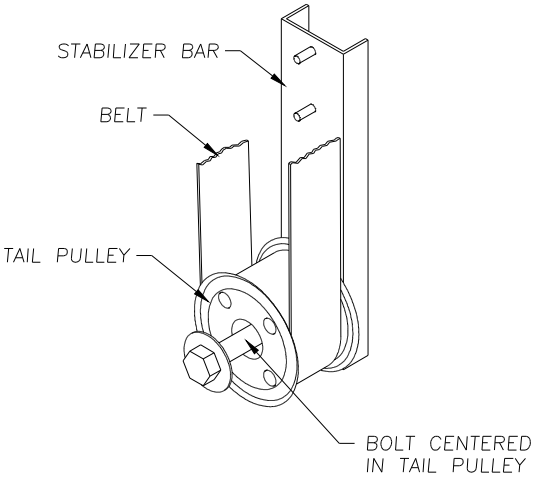

Figure 7

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Tote-It® 2”
with Explosion Proof Motor
Installation and Maintenance Instructions

Step 10. Check to be certain the belt is hanging plumb from the head pulley to the tail pulley.

Step 11. Bolt the unit in position where it is to be operated using the 2 holes in the bottom of the base.

Step 12.

A. Remove the plastic protective plug from the gear reducer top and replace with breather plug supplied. **(See Fig. 8)**

B. Motor/Gear Reducer Key Installation:

NOTE: Do Not use key provided with motor. Use only key provided with gear reducer.

1. Place key FLUSH with end of motor shaft.
2. Carefully insert motor shaft into gear reducer. **DO NOT FORCE.**
3. If motor and gear reducer do not easily slide together, the key is binding. Repeat steps 1 & 2.
4. Bolt motor to gearbox with four bolts and lock washers provided.

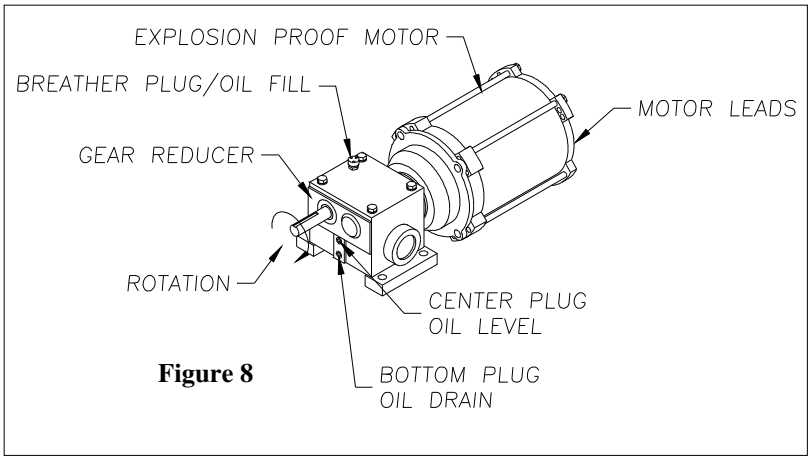


Figure 8

Step 13. Wiring of unit should be made by a licensed electrician and shall be in accordance with all national and local electrical codes.
Connect motor leads to power so that the belt is carried downward through the wiper blades. (Rotation is in direction of the arrow as shown in figure 8)

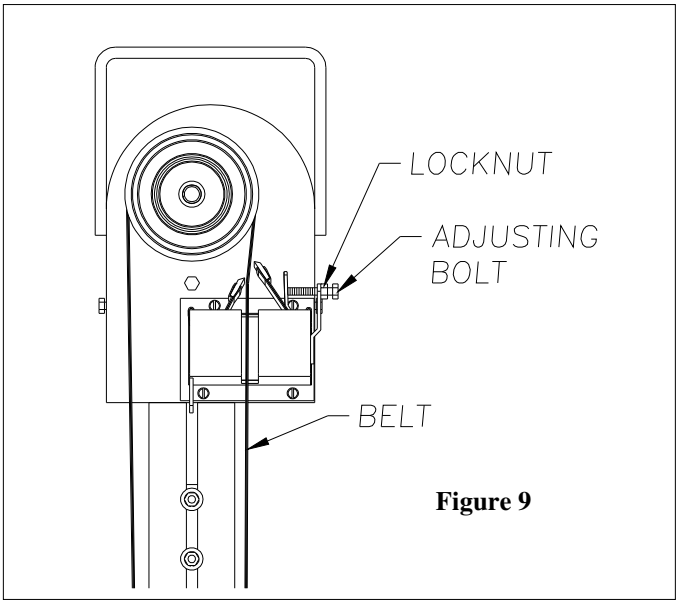


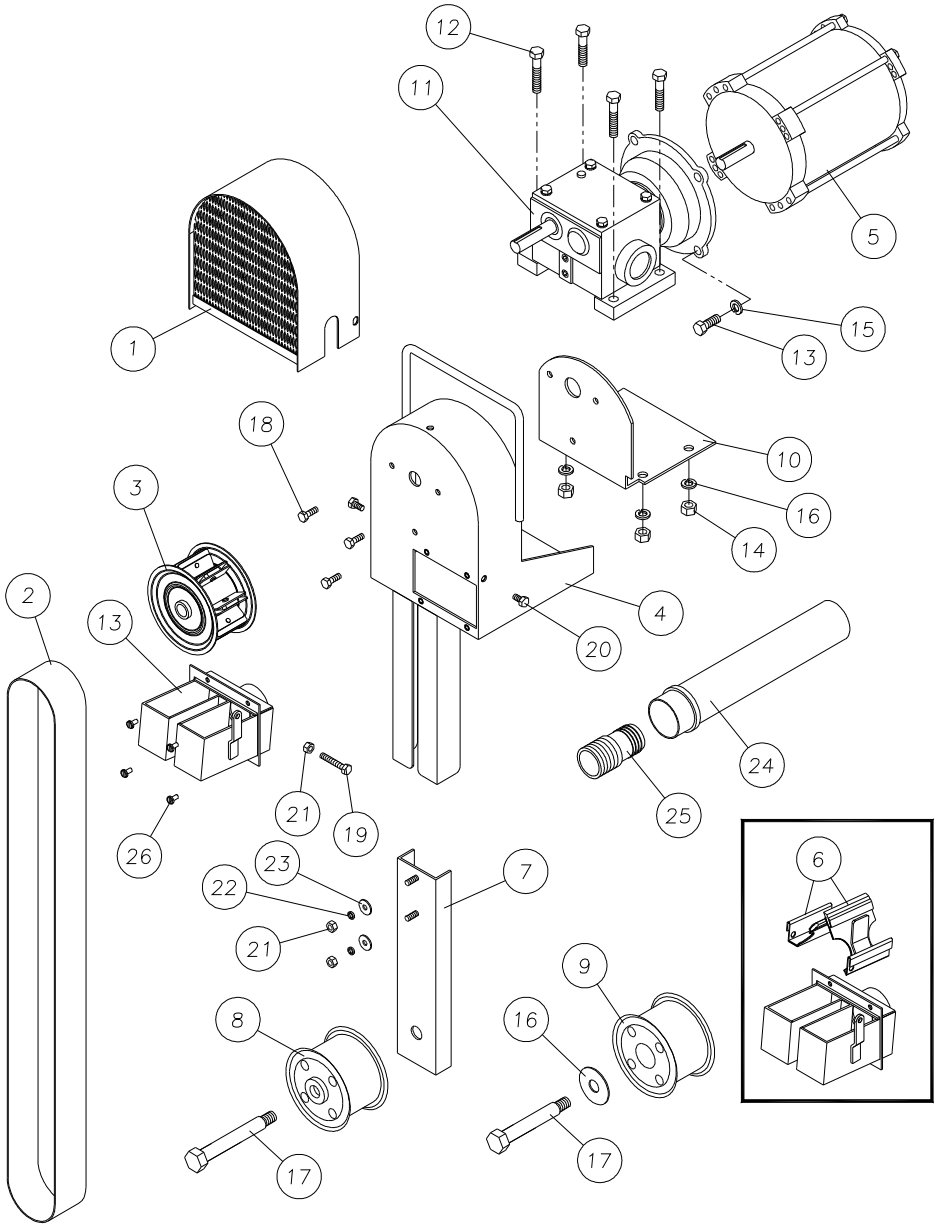
Figure 9

Step 14. Carefully adjust the wiper adjusting screw on the outside wiper blade so that both blades are gently wiping the belt. When adjustment is complete, tighten the locknut. **(See Fig. 9)**

Step 15. Attach optional discharge hose or piping to 1-1/4” pipe coupling outlet located at rear of Tote-It® base.

Step 16. Replace head pulley cover and fasten with ¼-20 bolts.

The installation is now complete and your Abanaki Tote-It® is ready to operate.



Item	Qty.	Part Name	Item	Qty.	Part Name
1	1	Cover	14	4	3/8-16 Nut
2	1	Corrosion Resistant Stl Belt (Std.) Elastomer Belt (Optional) Poly Belt (Optional)	15	8	3/8" Lock washer
3	1	Head Pulley C.S. Head Pulley SS316 w/Magnets	16	1	Washer (Used w/Steel Belt Only)
4	1	Base Weldment	17	1	1/2-13 x 3-3/4" Lg. Hex Bolt
5	1	Explosion Proof Motor	18	3	1/4-20 x 3/4" Lg. Hex Bolt
6	1	Nitrile Wiper Blade Set (Std.) CRV Wiper Blade Set (Opt.)	19	1	1/4-20 x 1-1/2" Lg. Full Thd. Bolt
7	1	Stabilizer Bar – 11" Lg. / 17" Lg. Stabilizer Bar – 23" Lg. / 29" Lg. Stabilizer Bar – 35" Lg. / 41" Lg. Stabilizer Bar – 47" Lg. / 53" Lg.	20	2	1/4-20 x 5/8" Lg. Hex Bolt
8	1	Tail Pulley (Elastomer Belt)	21	3	1/4-20 Hex Nut
9	1	Tail Pulley (Steel Belt)	22	2	1/4" Lock Washer
10	1	Gear Reducer Adapter Plate	23	2	1/4" Flat Washer
11	1	Gear Reducer	24	1	Discharge Hose
12	4	3/8-16 x 2" Lg. Hex Bolt	25	1	1-1/4 Male PVC Adapter
13	4	3/8-16 x 1" Lg. Hex Bolt	26	4	10-32 x 3/8" Lg. Pan Head Screw

ABANAKI® CORPORATION
17387 Munn Road
Chagrin Falls, OH 44023
Phone: (440) 543-7400
Fax: (440) 543-7404
1-800-358-SKIM (7546)
www.abanaki.com

Tote-It® 2”
with Explosion Proof Motor
Installation and Maintenance Instructions

MAINTENANCE

1. Check magnetized head pulley and wiper blades for buildup and clean if necessary.
2. Inspect discharge troughs and hose for accumulated sludge or waste, cleaning if necessary.
3. Check belt condition for evidence of wear or cracks and replace if necessary. Make certain belt is still running in center of head pulley.
4. Check wiper blades for wear and for proper setting. Reset adjustable wiper for proper wiping action if necessary.
5. Check all bolts for proper tightness.
6. Abanaki recommends keeping a spare belt and a spare set of wiper blades in stock.

STORAGE

For frequent or intermittent Tote-It® storage, Abanaki recommends the use of its optional Storage Stand. **(See Fig. 10)**
To store the Tote-It® on the optional stand:

1. Remove the nuts and washers from the 3/8” studs on the top of the stand.
2. Set the Tote-It® on the top plate allowing the 3/8” studs to protrude through the skimmer base. Fasten with the nuts and washers.

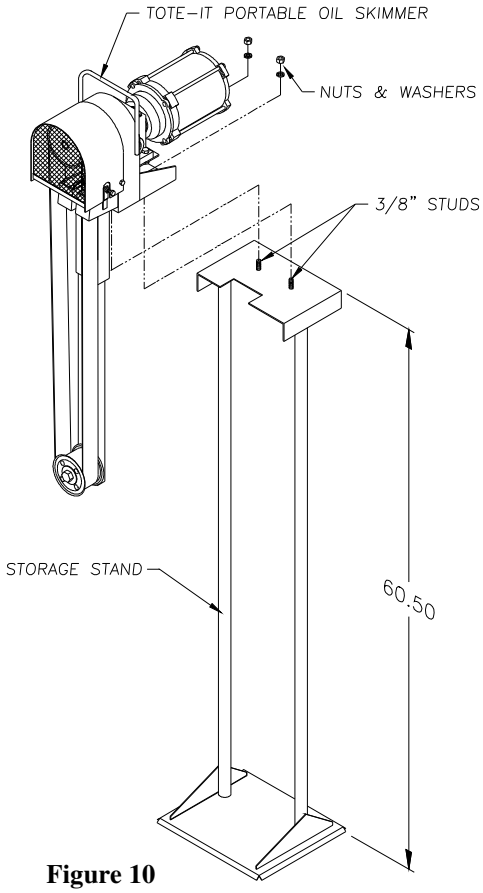
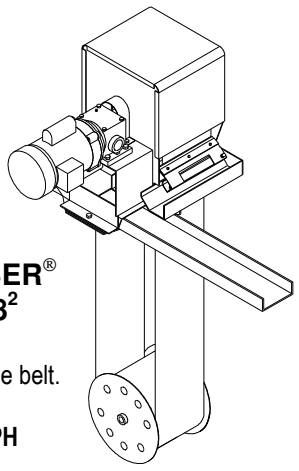


Figure 10

OTHER ABANAKI UNITS AVAILABLE

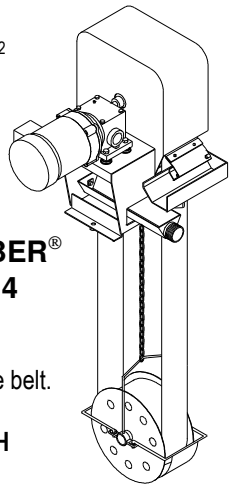
For Most Applications:



OIL GRABBER® MODEL 8²

Single 8-inch wide belt.
Any length belt.
Capacity: 40 GPH

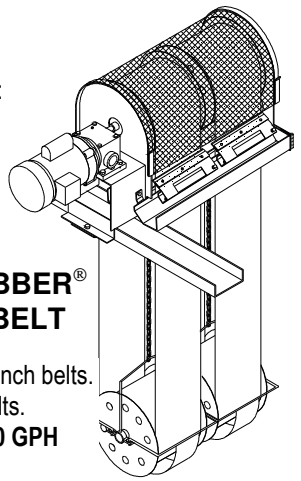
When the Model 8² Oil Grabber is too Large:



OIL GRABBER® MODEL 4

Single 4-inch wide belt.
Any length belt.
Capacity: 20 GPH

For High Volume Use:



OIL GRABBER® MULTI-BELT

Two to five 8-inch belts.
Any length belts.
Capacity: 200 GPH

Lubrication Instructions For Ball Bearing Motors

Lubrication
This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

Relubrication Intervals
The following intervals are suggested as a guide:

SUGGESTED RELUBRICATION INTERVALS		
HOURS OF SERVICE PER YEAR	H.P. RANGE	RELUBE INTERVAL
5,000	Sub Fractional to 7 1/2 10 to 40 50-200	5 Years 3 Years 1 Year
Continuous Normal Applications	Sub Fractional to 7 1/2 10 to 40 50 to 200	2 Years 1 Year 9 Months
Season Service Motor Idle 6 Months or More	All	1 Year (Beginning of Season)
Continuous High Ambients Dirty or Moist Locations High Vibrations Where Shaft End is Hot (Pumps-Fans)	Sub Fractional to 40 50 to 200	6 Months 3 Months

Lubrication

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

LUBRICATION CONSISTENCY				
INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL LUBRICATION	FRAME TYPE
B & F F & H	Medium	Polyurea	Shell Dolium R and/or Chevron SR1 2	Sub Fractional to 447T All

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.

LEESON®

ELECTRIC MOTORS, GEARMOTORS AND DRIVES

LEESON ELECTRIC
GRAFTON, WISCONSIN 53024-0241 U.S.A.
TEL (262)377-8810 FAX (262)377-9025 www.leeson.com

A Subsidiary of Regal-Beloit Corporation

Installation Maintenance Instructions
AC Induction Motors

Installation

After unpacking, check for damage. Be sure that shaft rotates freely. Before making electrical power connections, check for proper grounding of motor and application. All electrical contacts and connections must be properly insulated and enclosed. Couplings, belts, chains or other mounted devices must be in proper alignment, balance and secure to insure safe motor operation.

Electrical Wiring

Prior to connecting to the power line, check nameplate for proper voltage and rotation connection. This motor should be installed in compliance with the National Electrical Code and any other applicable codes. Voltage at motor not to exceed + or -10% of nameplate. Authorized person should make all electrical connections.

Mounting

This motor should be securely mounted to the application. Sufficient ventilation area should be provided to insure proper operation.

RECOMMENDED COPPER WIRE & TRANSFORMER SIZE

SINGLE PHASE MOTORS - 230 VOLTS

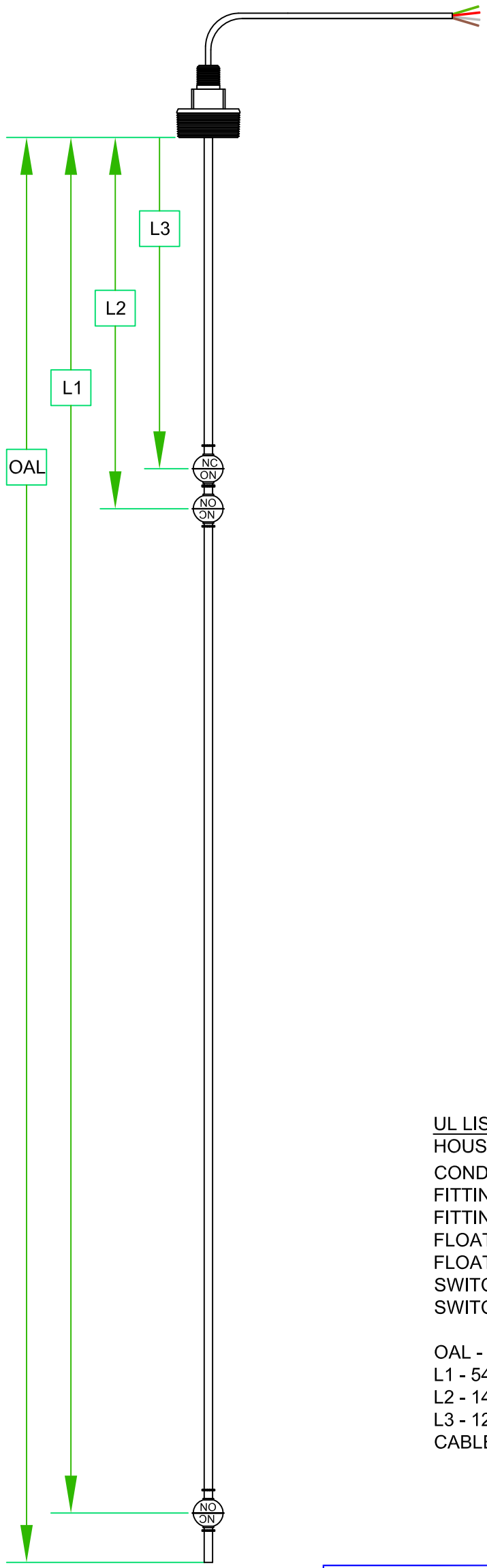
H.P.	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
		100	150	200	300	500
1 1/2	3	10	8	8	6	4
2	3	10	8	8	6	4
3	5	8	8	6	4	2
5	7 1/2	6	4	4	2	0
7 1/2	10	6	4	3	1	0

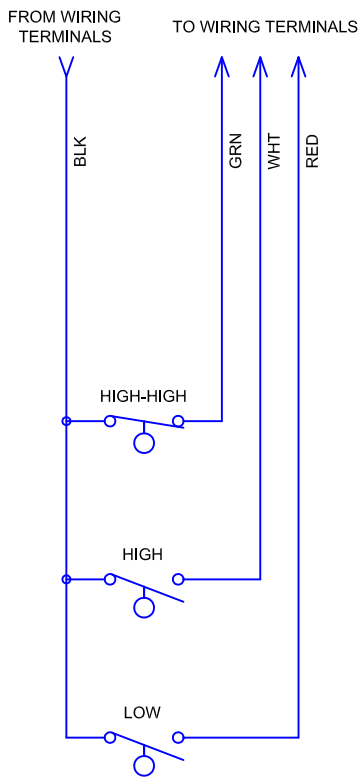
THREE PHASE MOTORS - 230 & 460 VOLTS

H.P.	VOLTS	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
			100	150	200	300	500
1 1/2	230	3	12	12	12	12	10
1 1/2	460	3	12	12	12	12	12
2	230	3	12	12	12	10	8
2	460	3	12	12	12	12	12
3	230	5	12	10	10	8	6
3	460	5	12	12	12	12	10
5	230	7	10	8	8	6	4
5	460	1/2	12	12	12	10	8
7 1/2	230	7 1/2	8	6	6	4	2
7 1/2	460	10	12	12	12	10	8
10	230	10	6	4	4	4	1
10	460	15	12	12	12	10	8
15	230	15	4	4	4	2	0
15	460	20	12	10	10	8	6
20	230	20	4	2	2	1	000
20	460		10	8	8	6	4
25	230		2	2	2	0	000
25	460	Consult	8	8	6	6	4
30	230	Local	2	1	1	00	0000
30	460	Power	8	6	6	4	2
40	230	Company	1	0	00	0000	300
40	460		6	6	4	2	0
50	230		1	0	00	0000	300
50	460		4	4	2	2	0
60	230		1	00	000	250	500
60	460		4	2	2	0	00
75	230		0	000	0000	300	500
75	460		4	2	0	00	000

LEESON®

L3	GREEN	NORMALLYCLOSED	HIGH-HIGH
L2	WHITE	NORMALLY OPEN	HIGH
L1	RED	NORMALLY OPEN	LOW
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT

OAL - 56.75 INCHES
L1 - 54.75 INCHES
L2 - 14 INCHES
L3 - 12.5 INCHES
CABLE LENGTH - 120 INCHES

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS

REVISIONS

DRWN BY	MJS
DATE	11-12-14
CHK BY	CJJ
DATE	01-12-15
APPR BY	--
DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

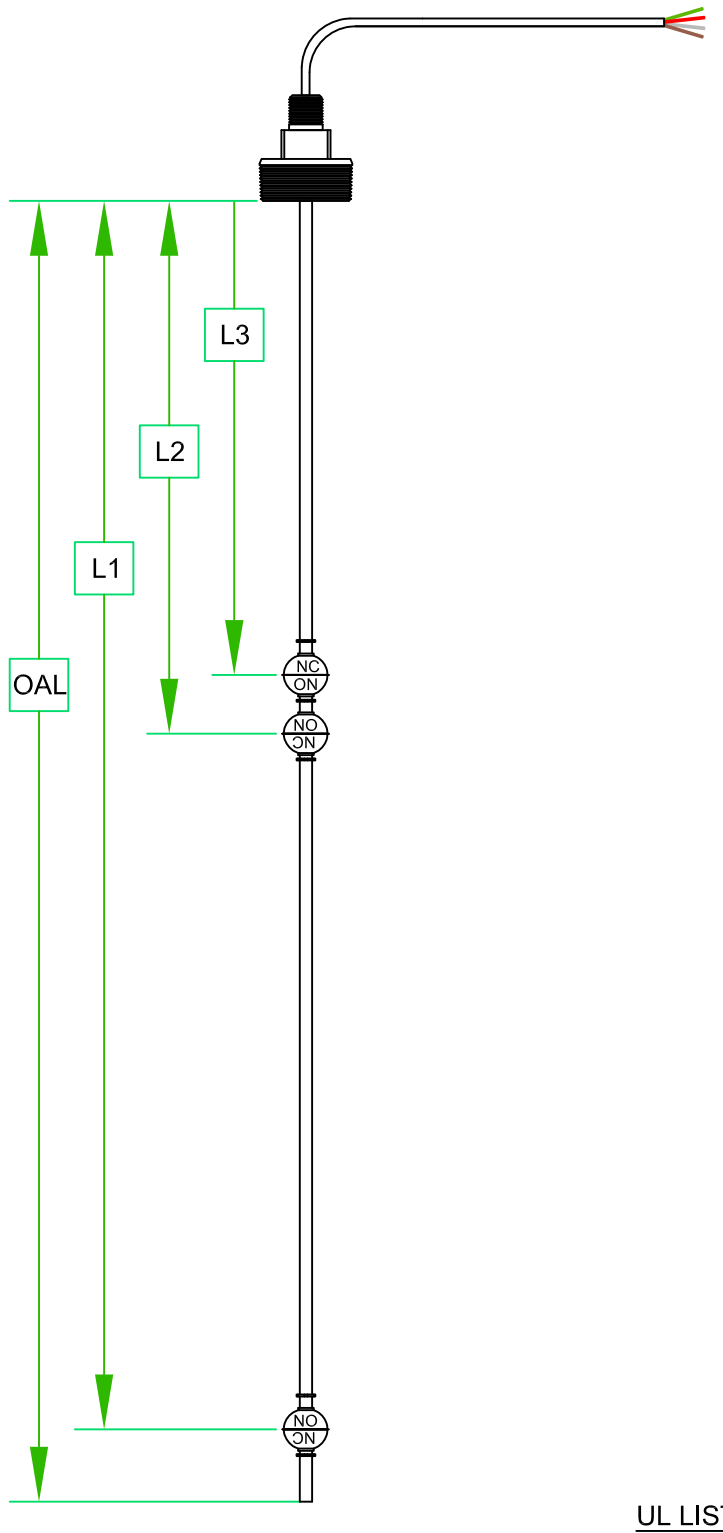
TITLE: 3 POSITION LEVEL SENSOR (LSHH-702, LSH-702, & LSL-702)

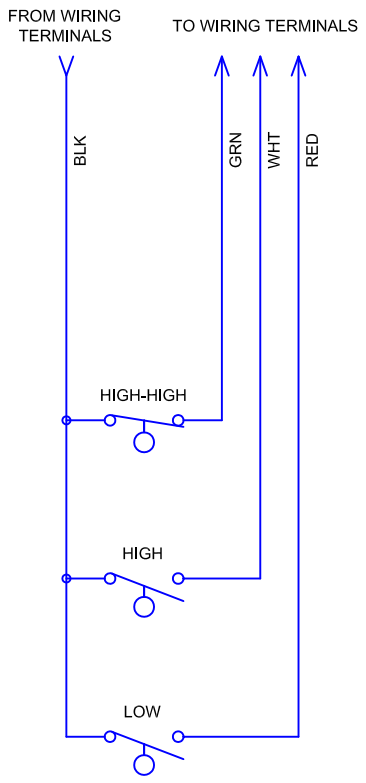
AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-8	1 OF 1	A

L3	GREEN	NORMALLYCLOSED	HIGH-HIGH
L2	WHITE	NORMALLY OPEN	HIGH
L1	RED	NORMALLY OPEN	LOW
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT

OAL - 33.25 INCHES
L1 - 31.25 INCHES
L2 - 13.5 INCHES
L3 - 12 INCHES
CABLE LENGTH - 120 INCHES

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	01-12-15	MJS
REVISIONS			

DRWN BY	MJS
DATE	11-12-14
CHK BY	CJJ
DATE	01-12-15
APPR BY	--
DATE	--

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

TITLE: 3 POSITION LEVEL SENSOR (LSHH-703, LSH-703, & LSL-703)

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
13-214	NTS	B	M-9	1 OF 1	A

Data Sheet

Series E

Electronic Metering Pumps

Configuration Data

Model E74 1 - 30

Control & Output Code

Instrument Responsive/Manual Control

Explosion proof electromagnetic metering pumps. UL and CUL Listed, meets or exceeds all standards for Division 1 and 2, Class I, Groups C and D; Class II, Groups E, F, and G. Manual adjustment or switch conversion to external control for automatic systems.

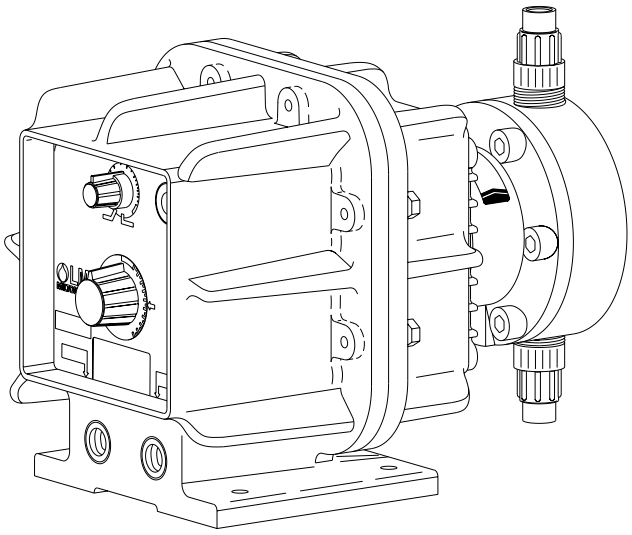
E70* --- 1.3 GPH (4.9 l/h) .... 300 psi (20.7 Bar)
E71* --- 2.5 GPH (9.5 l/h) .... 150 psi (10.3 Bar)
E72* --- 4.0 GPH (15.1 l/h) .... 100 psi (6.9 Bar)
E73* --- 8.0 GPH (30 l/h) ..... 60 psi (4.1 Bar)
E74* ---20.0 GPH (76 l/h) ..... 25 psi (1.7 Bar)

Voltage Code

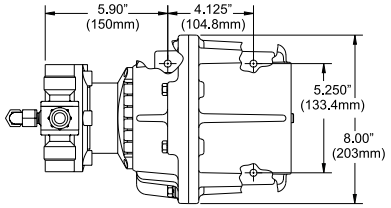
1 --------- 120 VAC Hardwired
2 --------- 240 VAC Hardwired

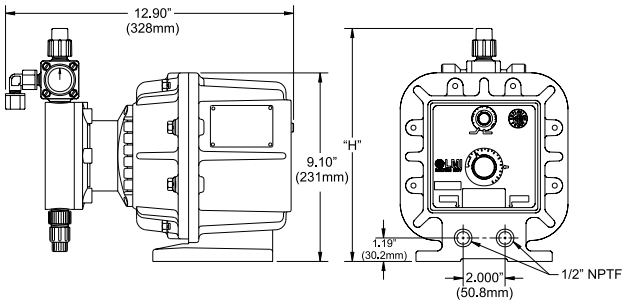
Liquid End

See next page for complete liquid end specifications & selection.



Dimensions





* Dimensions shown are maximums for largest available Liquid End. Dimensions will vary depending on Liquid End selected.

Specifications

Series	Strokes per Minute (Adjustable) Min	Max	Stroke Length (Adjustable) Recommended Minimum	Average Input Power @ Max Speed	Shipping Weight
E70* E71* E72* E73* E74*	5	100	10%	44 watts	(41 lbs) 18.6 kg

LMI MILTON ROY

8 Post Office Square
Acton, MA 01720 USA
TEL: (978) 263-9800
FAX: (978) 264-9172
http://www.lmipumps.com

Replaces same of Rev. C 10/97
1586.D 12/99

Configuration Data and Materials of Construction

Drive Assembly	Liquid End No.	Size Code	Materials of Construction: Head & Fittings	Balls	Liquifram™	Seal Ring	Accessory	Tubing & Connections: Discharge	Suction
E70 ☐ -	297	0.9	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	
	94	0.9	PVC	Ceramic	Fluorofilm™	PTFE		Pipe 1/4" NPT M	
	94S	0.9	PVC	Ceramic	Fluorofilm™	PTFE	4FV	Pipe 1/4" NPT M	
E71 ☐ -	361TI	1.8	PGC™/ PGC™	Ceramic	Fluorofilm™	PGC™/ Polyprel®	3FV	PE .375" O.D.	
	361SI	1.8	PGC™/ PGC™	Ceramic	Fluorofilm™	PGC™/ Polyprel®	4FV	PE .375" O.D.	
	362TI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel®	3FV	PE .375" O.D.	
	362SI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel®	4FV	PE .375" O.D.	
E72 ☐ -	363TI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	3FV	PE .375" O.D.	
	363SI	1.8	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV	PE .375" O.D.	
	360TI	1.8	Acrylic / PGC™	Ceramic	Fluorofilm™	PGC™/ Polyprel®	3FV	PE .375" O.D.	
	360SI	1.8	Acrylic / PGC™	Ceramic	Fluorofilm™	PGC™/ Polyprel®	4FV	PE .375" O.D.	
	277	1.8	316 S.S.	316 S.S.	Fluorofilm™	316 S.S.		Pipe 1/4" NPT M	
	71FS	1.8	Acrylic / PVDF	PTFE	Hypalon®	Hypalon®	4FV	PE .5" O.D.	Vinyl .5" O.D.
	72S	1.8	PVC	Ceramic	Fluorofilm™	PTFE	4FV	PE .5" O.D.	
	72T	1.8	PVC	Ceramic	Fluorofilm™	PTFE		PE .5" O.D.	
	74	1.8	PVC	Ceramic	Fluorofilm™	PTFE		Pipe 1/4" NPT M	
	74S	1.8	PVC	Ceramic	Fluorofilm™	PTFE	4FV	Pipe 1/4" NPT M	
	75HV	1.8	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D.	Vinyl .938" O.D.
	75S	1.8	Polypropylene	Ceramic	Fluorofilm™	PTFE	4FV	PE .5" O.D.	
	75T	1.8	Polypropylene	Ceramic	Fluorofilm™	PTFE		PE .5" O.D.	
	76HV	1.8	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon®		PE .5" O.D.	Vinyl .938" O.D.
	79	1.8	UHMW PE	Ceramic	Hypalon®	Hypalon®		PE .5" O.D.	Vinyl .5" O.D.
E73 ☐ -	311TI	3.0	PGC™/ PGC™	Ceramic	Fluorofilm™	PGC™ / Polyprel®	3FV	PE .375" O.D.	
	311SI	3.0	PGC™/ PGC™	Ceramic	Fluorofilm™	PGC™ / Polyprel®	4FV	PE .375" O.D.	
	312TI	3.0	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel®	3FV	PE .375" O.D.	
	312SI	3.0	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / Polyprel®	4FV	PE .375" O.D.	
	313TI	3.0	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	3FV	PE .375" O.D.	
	313SI	3.0	PVDF / PVDF	Ceramic	Fluorofilm™	PVDF / PTFE	4FV	PE .375" O.D.	
	310TI	3.0	Acrylic / PGC™	Ceramic	Fluorofilm™	PGC™/ Polyprel®	3FV	PE .375" O.D.	
	310SI	3.0	Acrylic / PGC™	Ceramic	Fluorofilm™	PGC™/ Polyprel®	4FV	PE .375" O.D.	
	20HV	3.0	Acrylic / PP	316 S.S.	Fluorofilm™	Hypalon®		PE .5" O.D.	Vinyl .938" O.D.
	20	3.0	Acrylic / PVC	Ceramic	Fluorofilm™	Hypalon®		PE .5" O.D.	Vinyl .5" O.D.
	20S	3.0	Acrylic / PVC	Ceramic	Fluorofilm™	Hypalon®	4FV	PE .5" O.D.	Vinyl .5" O.D.
	24	3.0	PVC	Ceramic	Fluorofilm™	PTFE		Pipe 1/2" NPT M	
	25HV	3.0	Polypropylene	316 S.S.	Fluorofilm™	PTFE		PE .5" O.D.	Vinyl .938" O.D.
	25P	3.0	Polypropylene	Ceramic	Fluorofilm™	PTFE		Pipe 1/2" NPT M	
	25T	3.0	Polypropylene	Ceramic	Fluorofilm™	PTFE		PE .5" O.D.	
	26	3.0	PVC	Ceramic	Fluorofilm™	Viton®		PE .5" O.D.	
	26S	3.0	PVC	Ceramic	Fluorofilm™	Viton®	4FV	PE .5" O.D.	
	27	3.0	316 S.S.	316 S.S.	Fluorofilm™	PTFE		Pipe 1/2" NPT M	
	29	3.0	UHMW PE	Ceramic	Fluorofilm™	Hypalon®		PE .5" O.D.	
E74 ☐ -	30	6.0	Acrylic / PVC	Ceramic	Fluorofilm™	PTFE		PE .5" O.D.	Vinyl .5" O.D.
	34	6.0	PVC	Ceramic	Fluorofilm™	PTFE		Pipe 1/2" NPT M	
	35P	6.0	Polypropylene	Ceramic	Fluorofilm™	PTFE		Pipe 1/2" NPT M	
	35T	6.0	Polypropylene	Ceramic	Fluorofilm™	PTFE		PE .5" O.D.	
	36	6.0	PVC	Ceramic	Fluorofilm™	PTFE		PE .5" O.D.	
	37	6.0	316 S.S.	316 S.S.	Fluorofilm™	PTFE		Pipe 1/2" NPT M	

☐ See front page for voltage code specifications.

3FV indicates that the pump is equipped with an LMI Three Function Valve (pressure relief, priming aid, line drain).

4FV indicates that the pump is equipped with an LMI Four Function Valve. This diaphragm type anti-syphon/pressure relief valve is installed on the pump head. It provides anti-syphon protection and aids in priming, even under pressure.

Fluorofilm™ is a copolymer of PTFE and PFA.
Polyprel® is an elastomeric PTFE copolymer.

Polyprel is a registered trademark of Liquid Metronics, Incorporated. Flourofilm, Liquifram, PGC are trademarks of Liquid Metronics, Incorporated. Hypalon, Viton are registered trademarks of E. I. du Pont de Nemours & Co., Inc.

Output Information

Series	Gallons per Hour Min	Gallons per Hour Max	Liters per Hour Min	Liters per Hour Max	mL/cc per Minute Min	mL/cc per Minute Max	mL/cc per Stroke Min	mL/cc per Stroke Max	Maximum Injection Pressure	
E70*	0.007	1.3	0.025	4.9	0.41	82	0.08	0.82	300 psi	(20.7 Bar)
E71*	0.013	2.5	0.048	9.5	0.79	158	0.16	1.58	150 psi	(10.3 Bar)
E72*	0.020	4.0	0.076	15.1	1.26	252	0.25	2.52	100 psi	(6.9 Bar)
E73*	0.040	8.0	0.151	30.0	2.52	505	0.50	5.05	60 psi	(4.1 Bar)
E74*	0.100	20.0	0.380	76.0	6.33	1267	1.27	12.67	25 psi	(1.7 Bar)

* Minimum output can be reduced to zero (0) when in external mode.

Instruction Manual
Electronic Metering Pumps

Carefully read and understand all precautions before installing or servicing any metering pump.

For file reference, please record the following data:

Model No: _____

Serial No: _____

Installation Date: _____

Installation Location: _____

When ordering replacement parts for your LMI Metering Pump or Accessory, please include complete Model Number and Serial Number of your unit.

LMI
MILTON ROY

201 Ivyland Road
Ivyland, PA 18974
TEL: (215) 293-0401
FAX: (215) 293-0445
www.lmipumps.com

Replaces same of Rev. Q 7/09
1615.R 7/2010

Contents

1.0 Introduction

LMI is the world's most versatile manufacturer of economical and efficient metering pumps. This manual addresses the installation, maintenance and troubleshooting procedures for manually and externally controlled pumps. LMI has a worldwide network of stocking representatives and authorized repair centers to give you prompt and efficient service.

Please review this manual carefully. Pay particular attention to warnings and precautions. Always follow good safety procedures, including the use of proper clothing, eye and face protection.

This manual is for Series AA, B, C, E, J5, and P pumps.

1.1 Spare Parts

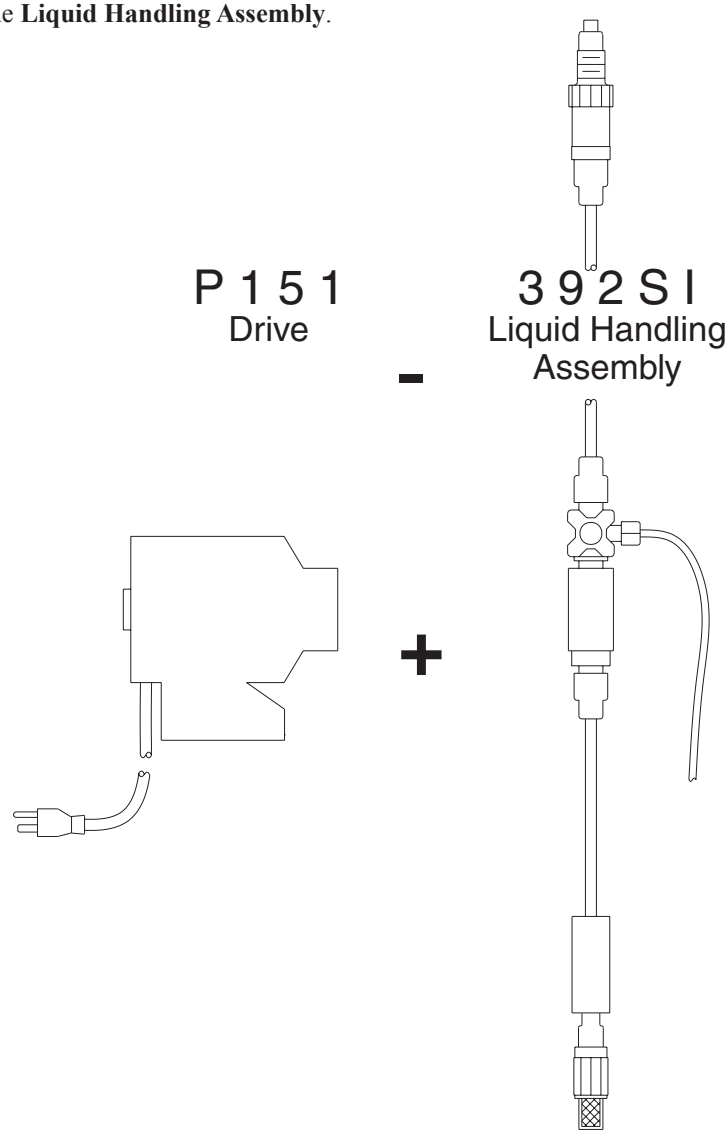
LMI recommends replacing the elastomeric components of the pump on an annual basis. RPM Pro Pacs™ and spare part kits are available from your local LMI Master Stocking Distributor.

Example:

Your pump consists of two main components:

1. The **Drive Assembly**; and

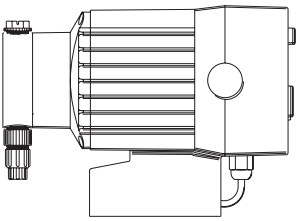
2. The **Liquid Handling Assembly**.



2.0 Unpacking Check List

Your carton will contain many or all of the following items. Please notify the carrier immediately if there are any signs of damage to the pump or its parts.

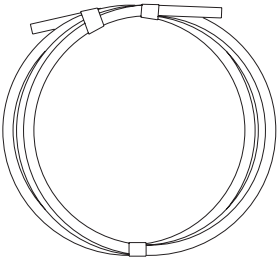
Please refer to the enclosed Instruction Supplement for an illustration and electrical diagram of your complete pump.



Metering Pump

Foot Valve

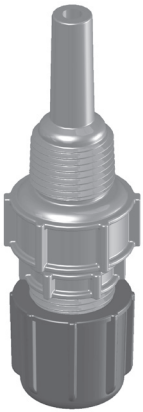
Ceramic Foot Valve Weight



Tubing

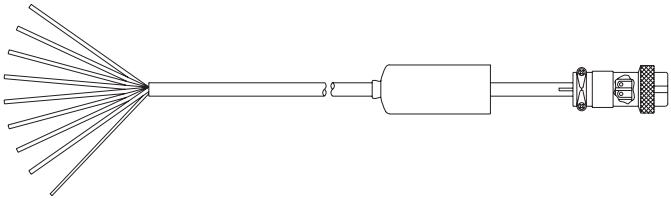
Depending on the model, your carton may contain 0, 1, 2 or 3 rolls of tubing. Your carton may contain a roll of vinyl tubing: DO NOT USE ON PRESSURIZED LINES. The vinyl tubing is for connection to the SUCTION SIDE OF THE PUMP HEAD OR THE 3 OR 4 FUNCTION VALVE RETURN LINE ONLY.

Tubing Connection Hardware

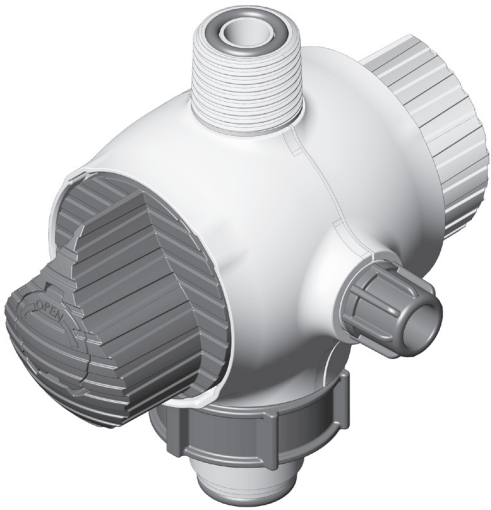


Injection Check Valve

Instruction Supplement



Optional Milliamp Input Cable



Optional 4-Function Valve (pictured) or
Optional 3-Function Valve

3.0 Pre-Installation Instructions

The following precautions should be taken when working with LMI metering pumps. Please read this section carefully prior to installation.

Precautions

Protective Clothing

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to MSDS precautions from your solution supplier.

Water Pre-Prime

All LMI pumps are pre-primed with water when shipped from the factory. If your solution is not compatible with water, disassemble the Pump Head Assembly. Thoroughly dry the pump head, valves, seal rings, balls and Liquifram™ (diaphragm). Reassemble head assembly tightening screws in a crisscross pattern. Refill the pump head with the solution to be pumped before priming the pump. (This will aid in priming.)

Solution Compatibility

Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. LMI pumps are tested by NSF for use on muriatic acid (up to 37% hydrochloric acid), and sodium hypochlorite (up to 12.5% solution). Always refer to the solution supplier and the **LMI Chemical Resistance Chart** for compatibility of your specific LMI metering pump. Contact your local LMI distributor for further information.

Tubing Connections

Inlet and outlet tubing or pipe sizes must not be reduced. Make certain that all tubing is SECURELY ATTACHED to fittings prior to start-up (see Section 4.3, Tubing Connections). ALWAYS use LMI supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.

Fittings And Machine Threads

All fittings should be hand-tightened. An additional 1/8 - 1/4 turn after the fitting contacts the seal ring may be necessary to provide a leak-proof seal. Excessive overtightening or use of a pipe wrench can cause damage to the fittings, seals, or pump head.

All LMI pumps have straight screw machine threads on the head and fittings and are sealed by the seal rings or O-rings. **DO NOT use Teflon® tape or pipe dope to seal threads. Teflon® Tape may only be used on the 1/2" NPT thread side of the Injection Check Valve as well as stainless steel liquid end connections.**

Plumbing

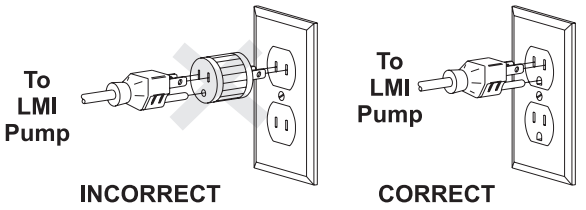
Always adhere to your local plumbing codes and requirements. Be sure installation does not constitute a cross connection. Check local plumbing codes for guidelines. LMI is not responsible for improper installations.

Back Pressure/Anti-Syphon Valve

If you are pumping downhill or into low or no system pressure, a back pressure/anti-syphon device such as LMI's Four Function Valve should be installed to prevent overpumping or syphoning. Contact your LMI distributor for furthur information.

Electrical Connections

To reduce the risk of electrical shock, install only on a circuit protected by a ground-fault circuit-interrupter (GFCI). The metering pump must be plugged into a grounded outlet with ratings conforming to the data on the pump control panel. The pump must be connected to a good ground. **DO NOT USE ADAPTERS!** All wiring must conform to local electrical codes.



WARNING: Do not hook a US style pump plug into a non-US (UK, Aust, NZ or Swiss) wired power system. The US style 240VAC power system has two 110VAC hot legs and one neutral. The European style system has one 240VAC hot leg and a neutral. Hooking up a US pump to the European wired system will cause pump failure.

4.0 Installation

4.1 Pump Location and Installation

Locate pump in an area convenient to solution tank and electrical supply.

The pump should be accessible for routine maintenance, and should not be subjected to ambient temperatures above 122°F (50°C). If the pump will be exposed to direct sunlight, LMI black, UV resistant tubing should be installed.

4.2 Pump Mounting

The pump can be mounted in one of two ways:

A. FLOODED SUCTION (ideal installation); or

B. SUCTION LIFT - when suction lift is less than 5 feet (1.5 m) for solutions having a specific gravity of water. For denser solutions, consult distributor.

Your LMI metering pump must be mounted so that the suction and discharge valves are vertical. **NEVER position pump head and fittings horizontally.**

4.2.1 Flooded Suction

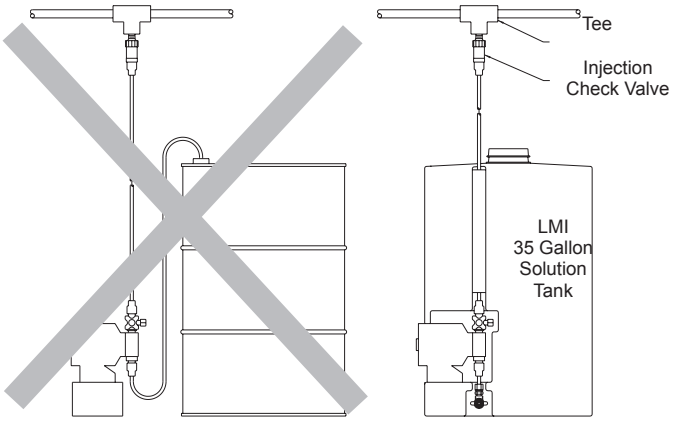
The pump is mounted at the base of the storage tank. This installation is the most trouble-free , and is recommended for very low outputs, solutions that gasify, and high-viscosity solutions. Since the suction tubing is filled with solution, priming is accomplished quickly and the chance of losing prime is reduced.

CAUTION

When pumping downhill or into low or no pressure system, a back pressure/anti-syphon device should be installed to prevent overpumping or syphoning.

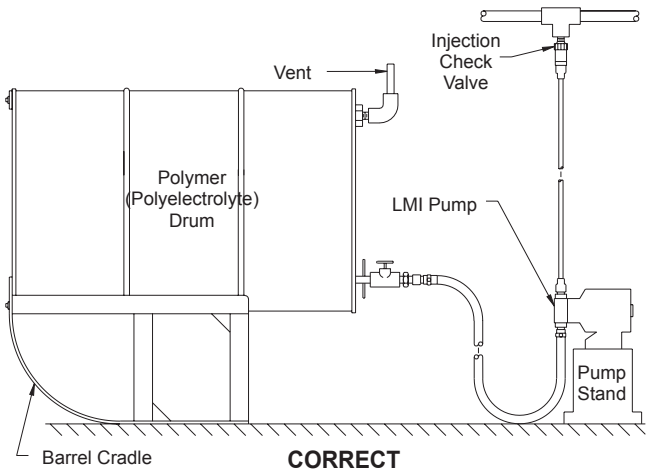
Note

Although popular for all solutions, LMI recommends flooded suction installations for all high-viscosity fluid applications.



INCORRECT **CORRECT**

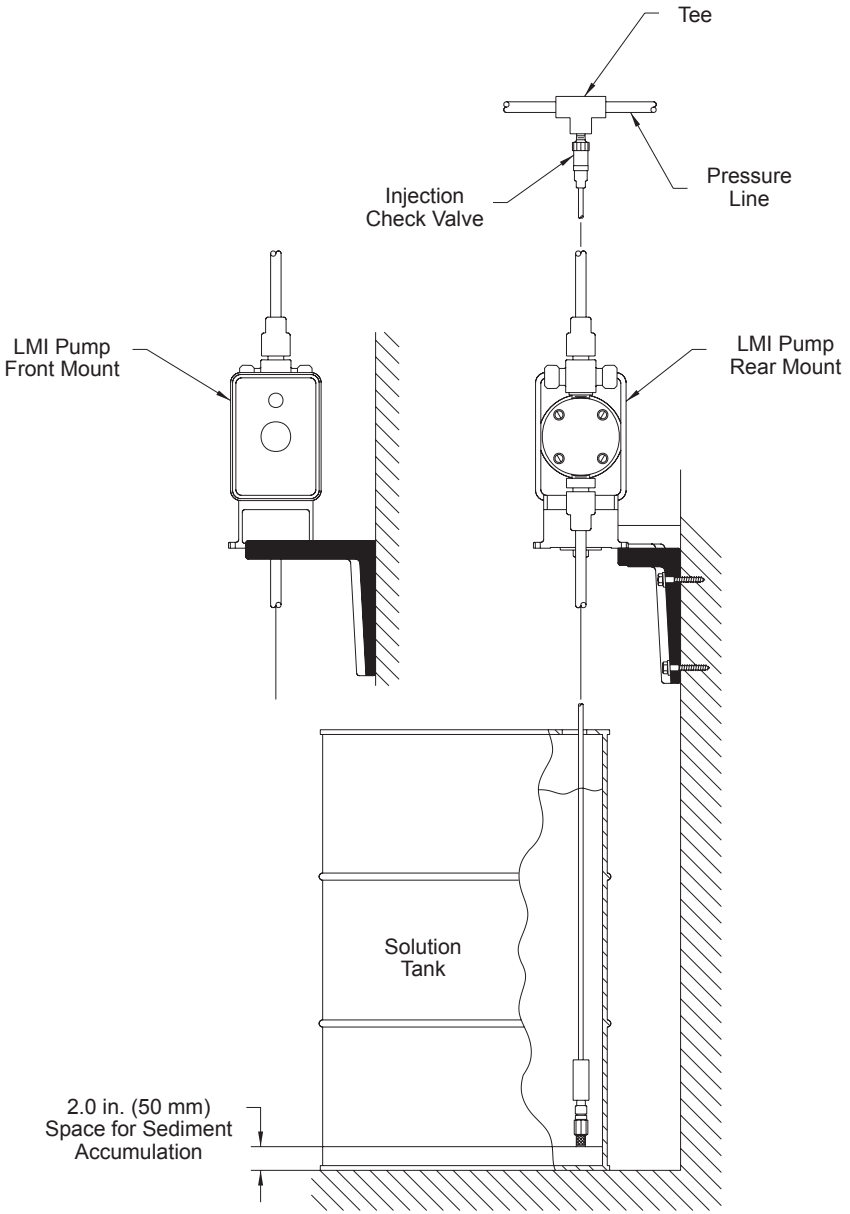
Avoid this type of false flooded suction.



CORRECT

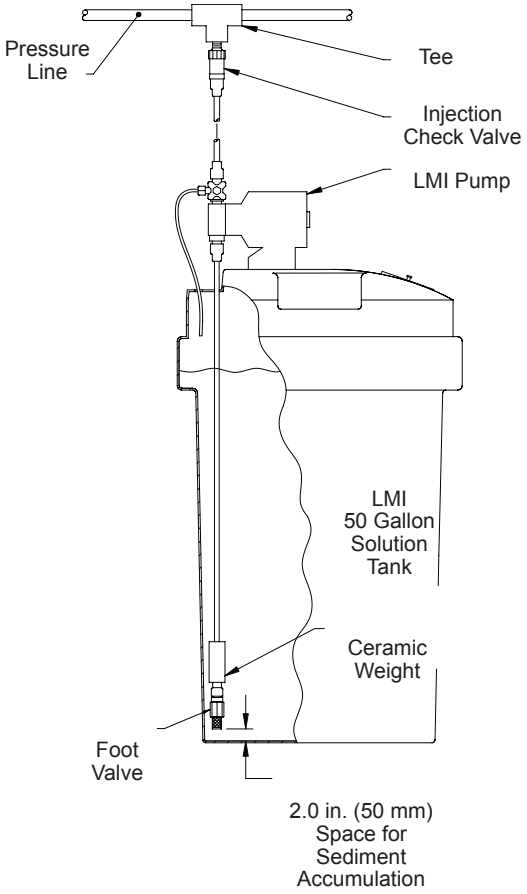
4.2.2 Suction Lift - Wall Bracket Mount

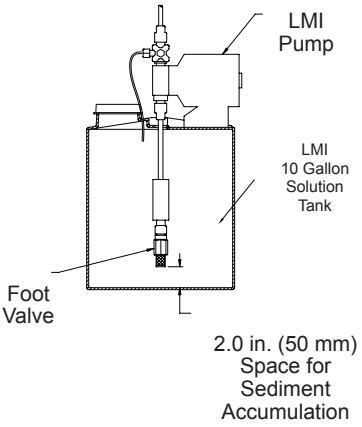
The pump may be mounted using an LMI Wall Mount Bracket Assembly (part no. 34643) directly above the solution tank. A pump mounted in this manner allows for easy changing of solution tanks or drums.



4.2.3 Suction Lift - Tank Mount

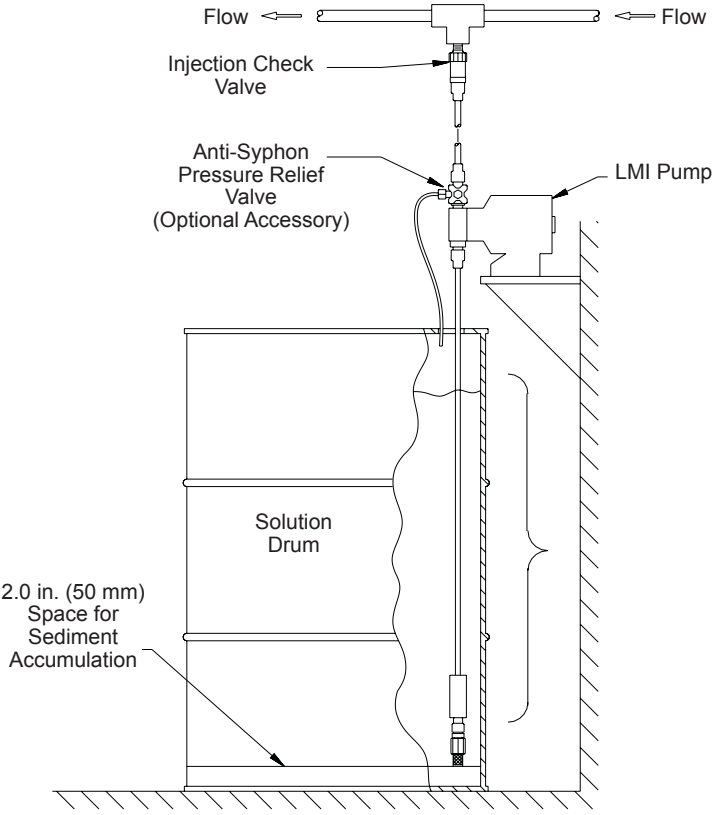
The pump may be mounted on a molded tank provided there is a recess to keep the pump stationary. LMI 10-gallon tank (part no. 27421), 35-gallon tank (part no. 27400), and 50-gallon tank (part no. 26350) have molded recesses for pump mounting.





4.2.4 Suction Lift - Shelf Mount

The pump may be mounted on a shelf (customer supplied) maintaining a suction lift of less than 5 ft (1.5 m). An LMI mounting kit (part number 10461) is available for securing the pump to a shelf.



4.3 Tubing Connections

1. Insert tubing through Coupling Nut—Tubing should enter the smaller end of the Coupling Nut first, orienting the larger opening of the Coupling Nut toward the tubing end.

2a. For 1/4" OD tubing: Position the Female Ferrule so that 1/4" to 3/8" (5-10 mm) of tubing protrudes from the Female Ferrule. Orient the raised collar of the Ferrule toward the Coupling Nut (reference FIGURE 1).

2b. For 3/8" or 1/2" OD tubing: Position a Female Ferrule about one inch (25 mm) from end of tubing. Orient the raised collar of the Female Ferrule toward the Coupling Nut. Then, insert the Male Ferrule onto the end of the tube, pushing the tube into the bottom of the groove in the Male Ferrule. Then slide the Female Ferrule down the tubing and with your fingers, press tightly into the Male Ferrule (reference FIGURE 2).

3. Firmly hand tighten the Coupling Nut onto the fitting. Note: Tightening with pliers may cause the Ferrules to break.

CAUTION

A. USE ONLY LMI TUBING—ALWAYS use LMI supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings.

B. *DO NOT USE CLEAR VINYL TUBING ON THE DISCHARGE SIDE OF THE PUMP.* The pressure created by the pump can rupture vinyl tubing.

C. Before installation, all tubing must be cut with a clean square end.

D. Valve and head connections from the factory are capped or plugged to retain pre-prime water. Remove and discard these caps or plugs before connecting tubing.

DO NOT USE PLIERS OR PIPE WRENCH ON COUPLING NUTS OR FITTINGS.

DO NOT REUSE FERRULES—USE ONLY NEW FERRULES.

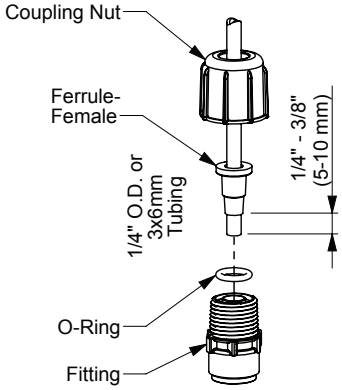


FIGURE 1

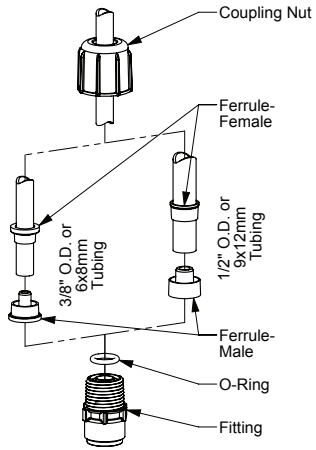


FIGURE 2

4.4 Multi-Function Valves

Your pump may be equipped with one of the following multi-function valves: 3-FV, 4-FV, or standard discharge valve. If your pump is not equipped with a multi-function valve and you feel it is needed in your application, it can be purchased as an accessory. Contact your local LMI stocking distributor.

4.4.1 Three Function Valve (3-FV)

1. **Pressure Relief**

   If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.

2. **Line Depressurization**

   Opening the relief knob provides line drain back to the supply tank.

3. **Priming Aid**

   Opening the relief knob assists in priming the pump by venting the discharge line to the atmosphere.

4.4.2 Four Function Valve (4-FV)

1. **Pressure Relief**

   If the discharge line is over pressurized, the valve opens sending solution back to the supply tank.

2. **Line Depressurization**

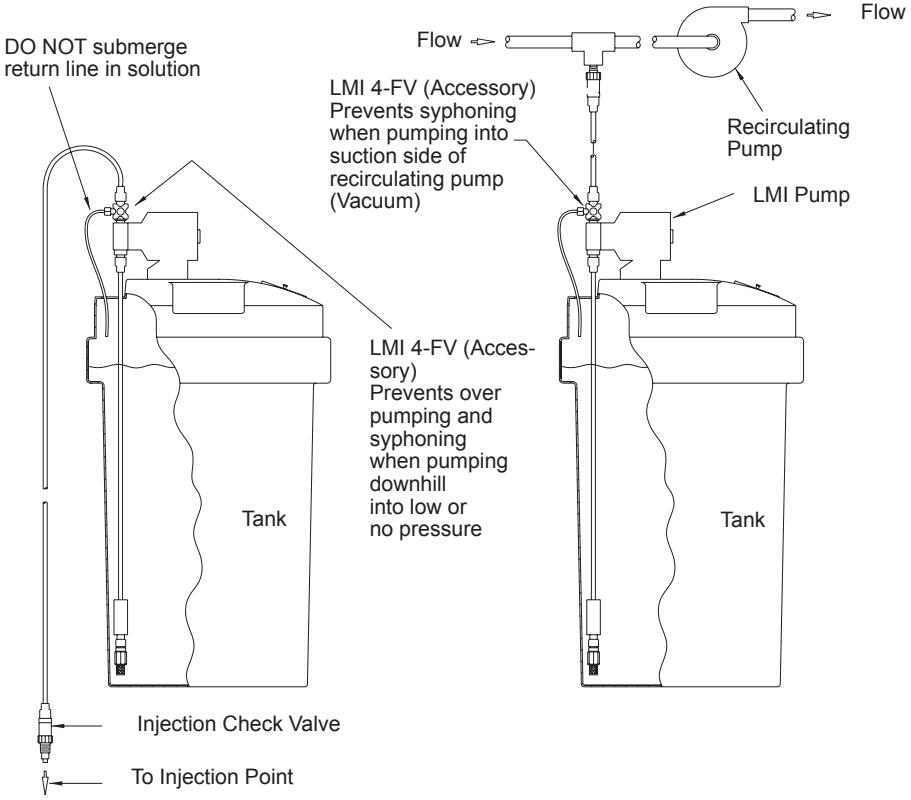
   Opening the relief knob provides line drain back to the supply tank.

3. **Anti-Syphon**

   Prevents syphoning when pumping solution downhill or into a vacuum.

4. **Back Pressure**

   Supplies approximately 25 psi back pressure to prevent overpumping when little or no system back pressure is present.

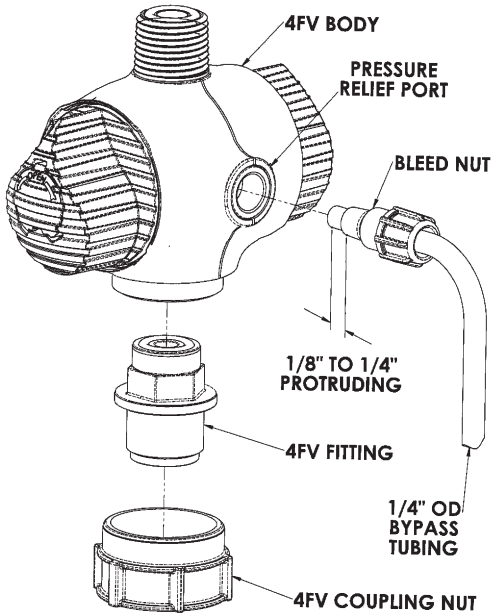


Typical 4-FV Installation

4.5 4-Function Valve Installation

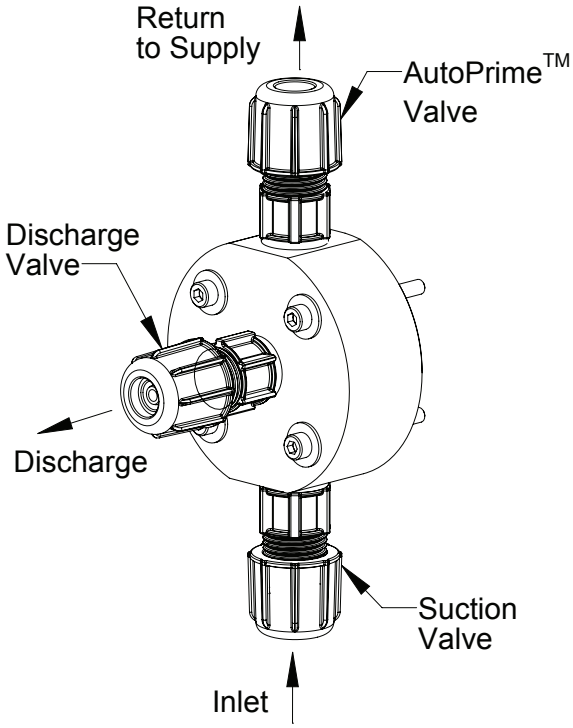
- To mount to a pump, remove the discharge fitting from the pump (if present) leaving the cartridges in the pump head. Position the 4FV coupling nut on pump head over cartridges with threads up, and insert 4FV fitting and thread into pump head over cartridges. Tighten the fitting to 50 in-lbs using a 13/16" or 20 mm socket. Insert the large opening on the 4-Function valve into the 4FV coupling nut and hand tighten. You can position the valve to have the pressure relief port in any convenient location by tightening the 4FV coupling nut with the pressure relief port positioned 90º CCW from desired location, then holding the nut stationery while turning the valve the final 90º to desired position.
- Connect 1/4" tubing to the pressure relief port and route to supply container.
- Connect discharge line using LMI tubing connection system or 1/2" pipe thread.

  The 4-Function Valve is designed for double¬ballchecks. A second valve cartridge is required when mounting a new 4-Function Valve to an existing pump with a 300, 400 or 700 liquid end.



4-Function Valve Tubing Connection

4.6 AutoPrime™ Liquid End



AutoPrime™ Liquid End

AutoPrime™

Pumps installed with the AutoPrime™ Liquid End are equipped with a valve that allows for constant removal of vapors and gasses inherent with effervescent chemicals such as Sodium Hypochlorite and Hydrogen Peroxide. The valve keeps the pump primed automatically. When installing a pump equipped with an AutoPrime™ Liquid End, connect the 1/2" OD Polyethylene tubing to the top vertical fitting, and route this line back to the supply tank. To ensure priming, this tubing should not be submerged in the solution. The horizontal fitting is the discharge, and the bottom vertical fitting is the suction.

4.7 Foot Valve/Suction Tubing Installation

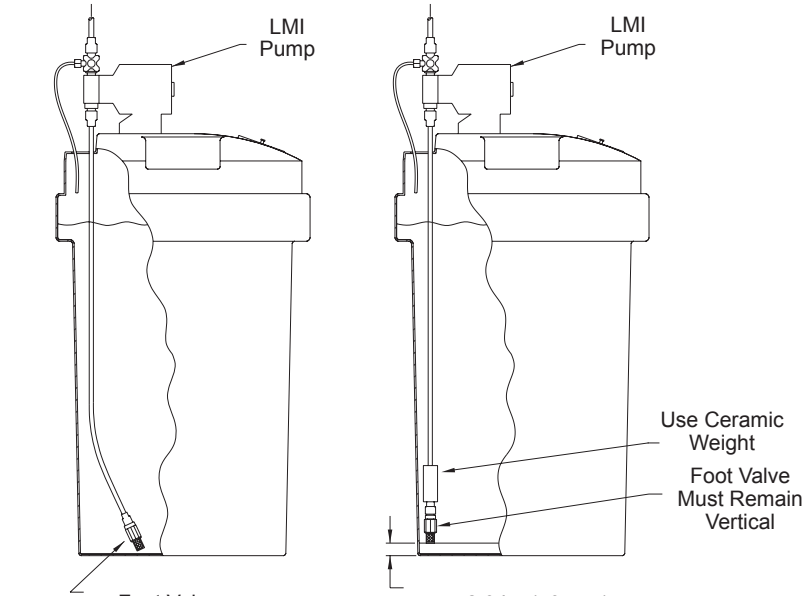
The Foot Valve acts as a check valve to keep the pump primed in suction lift applications.

The foot valve is designed to be submersed in the solution tank or drum and must sit in a vertical position at the bottom. Position approximately 2 inches (50 mm) off the bottom if the tank or drum contains sediment.

Pump models equipped with high-viscosity liquid ends are not equipped with foot valves. Flooded suction is recommended. A 1/2" NPT connector is included for flooded suction installations.

The ceramic weight, when installed, positions the foot valve in a vertical position.

1. Attach the foot valve to one end of the suction tubing (see Tubing Connections, Section 4.3).
2. Slide the ceramic weight over the tubing end until it contacts the top of the foot valve coupling nut.
3. Place foot valve and tubing into the solution tank. Check that the foot valve is vertical and approximately 2 inches (50 mm) from the bottom of the tank or drum (see illustration). Connect the other end of the tubing to the suction side of the pump head (bottom side) (see Tubing Connections, Section 4.3).



Proper Foot Valve Position

4.8 Injection Check Valve and Discharge Tubing Installation

A. Installing Injection Check Valve (Figure 1)

1. The Injection Check Valve prevents backflow from a treated line. Install the injection check valve at the location where chemical is being injected into the system.
2. Any size Female NPT fitting or pipe tee with a reducing bushing to ½" Female NPT will accept the injection check valve. PTFE tape should only be used on threads that are connected with pipes.
3. When installing the Injection Check Valve, be sure to position it so that the valve enters the bottom of your pipe in a vertical position. Variations 40° left and right are acceptable.

B. Connecting Discharge Tubing

Note: ***Cut tubing to length needed for discharge line.***

1. Route tubing from the injection check valve to the metering pump, making sure it does not touch hot or sharp surfaces, or is bent so sharply that it kinks.
2. Reference 4.3 Tubing Connections.

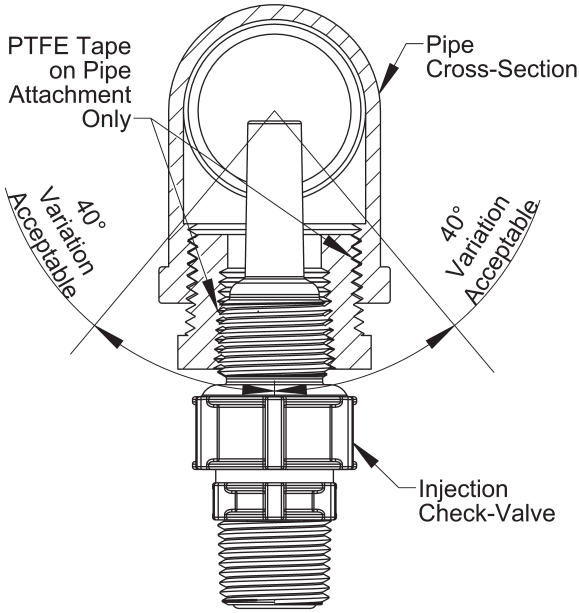


FIGURE 1

5.0 Liquid End Parts List

Reference Liquid End Sheets on LMI Online Library at: www.lmipumps.com.

1. Select “Online Literature Library” in the Navigation Bar on left.
2. Once on Online Literature Library use “Product” drop down to select “Liquid Handling Assemblies.”
3. Select “Gallery” or ”Index” to view Liquid End sheets.

6.0 Start-up and Adjustment

a.) The pump is normally self-priming if suction lift is 5 ft (1.5m) or less and the steps below are followed.

b.) Pumps are shipped from the factory with water in the pump head to aid in priming.

6.1 Output Adjustment Controls

Manual series pump controls are not equipped with pressure control.

1. Pressure Control Adjustment (if equipped): Pressure control provides the adjustment of the pump's pressure capability and power consumption, reducing heat, pipe shock and pulsation while increasing pump life. See Section 7.0 after priming for proper adjustment settings.
2. Speed Adjustment (Upper Knob) (if equipped): Speed control provides adjustment of the percent of maximum strokes per minute. Turning this knob clockwise increases stroke frequency (speed).
3. Stroke Adjustment (Lower Knob): Stroke control provides adjustment of the percent maximum of solution discharged during each pump actuation. Turning this knob clockwise ↻ increases solution displacement.

***A7 and P7 Only**: When operating the pump in external mode, the speed control knob should be turned fully counter-clockwise ↺.*

6.2 Start-Up/Priming for Pump Supplied with Multi-Function Valve

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now start priming the pump.

1. Plug in or switch the pump on.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.

If the pump is equipped with pressure control, turn fully clockwise. ↷

3. 1/4 turn open the relief side (black knob) of the multi-function valve.
4. The suction tubing should begin to fill with solution from the tank.
5. A small amount of solution will begin to discharge out the return line of the multi-function valve. Once this happens, 1/4 turn or release the knob and **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord.)
6. The pump is now primed.
7. Proceed to output adjustment, Section 6.4.

If the pump does not self-prime, remove the multi-function valve on the discharge side of the pump head. Remove the check valve and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

6.3 Start-Up/Priming without Multi-Function Valve

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may now prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob at 80% and the stroke knob at 100%.

If the pump is equipped with pressure control, turn fully clockwise ↻.

3. The suction tubing should begin to fill with solution from the tank.
4. Once the solution begins to exit the pump head on the discharge side, **SHUT THE PUMP OFF**. (If pump is not equipped with an on/off switch, disconnect the power cord).
5. The pump is now primed.
6. Proceed to output adjustment, Section 6.4.

If the pump does not self-prime, remove the fitting on the discharge side of the pump head. Remove the ball and pour water or solution into the port until the head is filled. Replace valve, then follow start up/priming steps.

Start-Up/Priming for AutoPrime™ Heads

Read this entire section completely before proceeding.

When all precautionary steps have been taken, the pump is mounted, and the tubing is securely attached, you may prime the pump.

1. Plug in or switch on the pump.
2. While the pump is running, set the speed knob and the stroke knob at 100%.
3. The suction tubing should begin to fill with solution from the tank as the AutoPrime™ valve purges air from the pump head.
4. Once the solution begins to exit the pump head through both the discharge valve and the AutoPrime™ valve, **SHUT THE PUMP OFF**.
5. The pump is now primed.
6. Proceed to output adjustment, Section 6.4.

6.4 Output Adjustment

Once the pump has been primed, an appropriate output adjustment **MUST** be made. Pump output should be calculated and adjustments made accordingly.

6.5 Total Pump Output

Calculate the total output of the pump as follows:

PUMP OUTPUT = MAX PUMP OUTPUT x % SPEED x % STROKE

Example: P151-392SI

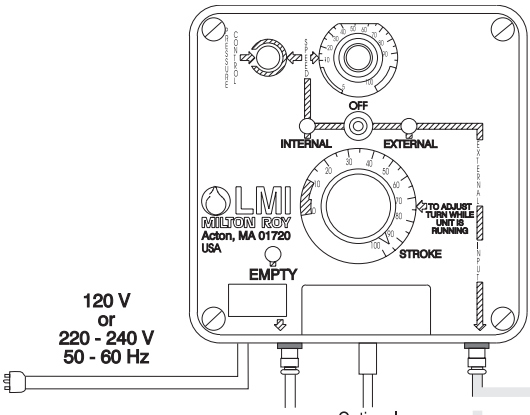
Use MAX Output (from dataplate on bottom center of pump control panel) = 24 GPD (24 gallons per day).

If the pump is set at 60% speed and 70% stroke length, the approximate pump output is:

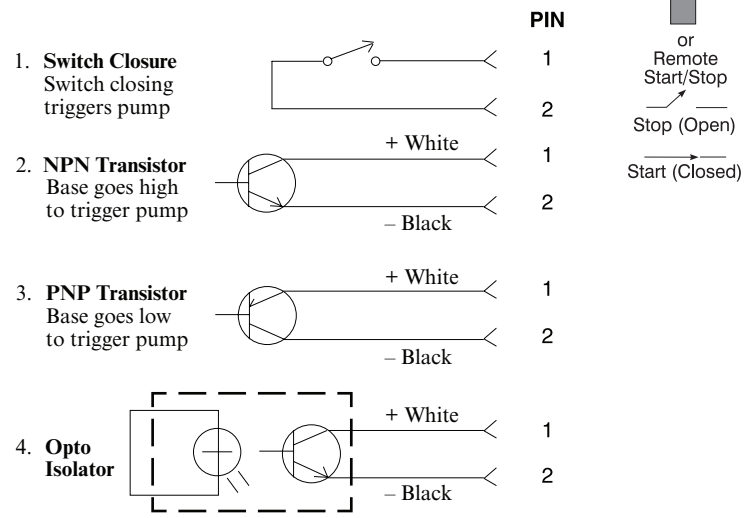
24.0 x 0.60 x 0.70 = 10.08 GPD (gallons per day). Divide by 24 (hours in one day) to calculate in gallons per hour.

If pump is not equipped with speed adjustment, calculate by ***Max Pump Output x % Stroke*** *only.*

7.0 Methods of Externally Triggering

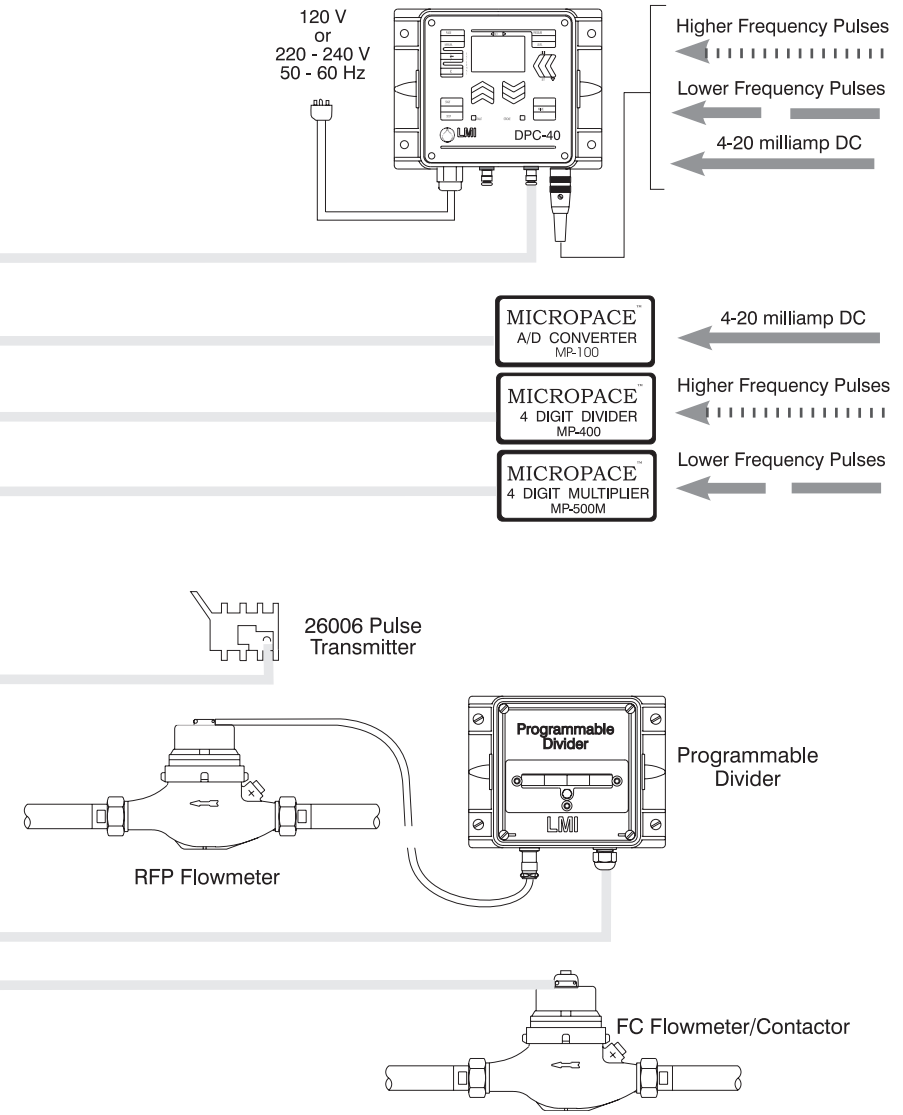


Method of Triggering LMI Pump Through 4-Pin Connector



Switch or transistors must be capable of switching 15V DC at 2 milliamperes. Minimum time in low impedance state (ON) is 50 milliseconds. Minimum time in high impedance state (OFF) is 100 milliseconds.

or Pacing B7, C7 and P7 Pumps



8.0 Calibration

Once installation is complete and the approximate output has been determined, the pump should be calibrated to adjust speed and stroke for your actual desired output. (Calibration cylinders may be purchased from your local LMI distributor, ref. publication 1798.)

. **1**. Be sure the pump is primed, and discharge tubing and Injection Check Valve are installed as they would be in normal service (i.e., including factors such as injection pressure, fluid viscosity, and suction lift).

2. Place the Foot Valve in a graduated container with a volume of 1000 ml or more.

3. Plug in and switch pump to Internal Mode. Pump until all the air is exhausted from the suction line and head.

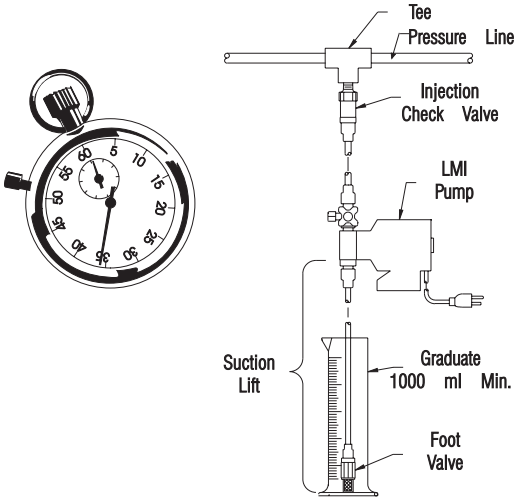
4. Turn the pump off. Refill graduated container to a level starting point.

If pump is equipped with pressure control, see Section 8.1 before proceeding.

5. Using a stopwatch or timer, turn the pump on for a measured amount of time (50 pump strokes minimum). The longer the time period, the more confident you can be of the results. Be sure to count the number of strokes during the calibration period when making comparisons.

6. Turn the pump off. Note the time elapsed in relation to volume displaced in the graduate. Now, calculate the output in the time unit you choose (minutes, hours, days, etc.).

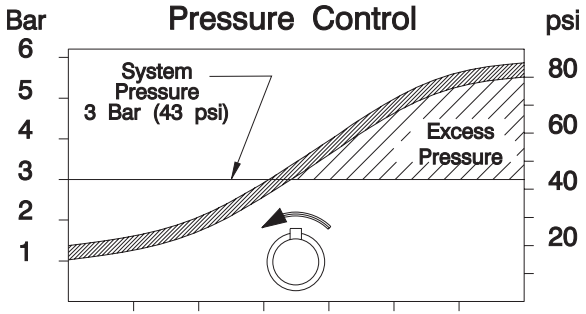
7. If the output is too low or too great, adjust speed and or stroke, estimating required correction and repeat steps 1-7.



8.1 Pressure Control

Adjust Pressure Control: While unit is running, turn Pressure Control Potentiometer slowly counter-clockwise ↶ until unit just begins to stall. From this stall point, now turn Pressure Control Potentiometer clockwise ↷ halfway between the stall point and maximum setting. This is the optimum pressure control setting for your application.

Increase setting if back pressure is increased. Adjusting pressure control decreases pressure rating of pump.



Adjust pressure control to reduce heat, shock, and pulsations; and to prolong pump life.

8.2 Calibration Procedure - On-Site Volumetric Calibration in External Mode

1. Since pump output is governed by an external device such as Flowmeter-Pulser, Liquitron™ Controller, or 4-20 mA DC signal from an instrument with an LMI Analog-to-Digital Converter, **only the output per stroke may be calibrated**.
2. With pump primed and discharge tubing connected to the injection point as it would be in normal service, place Foot Valve Assembly in a graduated container with a volume of 1000 ml or more.
3. Switch pump to **Internal** mode with Speed Knob set at 100 until air is exhausted from suction line and pump head.
4. **Adjust Pressure Control (if desired)** - See Section 8.1.
5. Switch pump **OFF** and note solution level in graduated container. Refill graduate to a starting point.
6. Switch pump **ON** and **count the number of strokes** for exactly one minute, then switch pump **OFF**.
7. Note volume pumped during the calibration period of one minute. Divide into this the number of strokes to determine the volume of solution pumped per stroke.

   Example: 500 ml in 100 strokes = 5.0 ml per stroke.

Multiply this by your expected stroke rate per minute, per hour or per day and compare with desired output requirements.

8. Adjust Stroke Length Knob (lower knob) to your best estimate of required correction and repeat calibration procedure.

9.0 Spare Parts Replacement Routine Maintenance

9.1 Depressurizing the Discharge Line (For Pumps Equipped with a 3-FV or a 4-FV only)

ALWAYS wear protective clothing, face shield, safety glasses and gloves when performing any maintenance or replacement on your pump.

Read steps 1 and 2 below before proceeding.

1. Be sure the Injection Check Valve is properly installed and is operating. If a shut off valve has been installed downstream of the Injection Valve, it should be closed.

Be sure your relief tubing is connected to your multi-function valve and runs back to your solution drum or tank.

2. 1/4 turn the black knob on the valve. The discharge line is now depressurized. Keep valve open until solution drains back down the discharge tubing into solution drum or tank. Then 1/4 turn knob to normal position.

9.2 Liquifram™ (Diaphragm) Replacement

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

LMI metering pumps are designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the Liquifram™, cartridge valves or seal rings/valve balls, multi-function valve cap assemblies and the injection check valve spring. LMI recommends replacing these parts at least once a year; however, frequency will depend on your particular application.

When replacing the Liquifram™ and the cartridge valves or seal rings/valve balls, the injection check valve spring should also be replaced (see next Section 9.3). A Spare Parts Kit (SP-#) or RPM Pro Pac™ kit containing these parts may be obtained from your local distributor.

Replacing the Liquifram™:

1. Carefully depressurize, drain, and disconnect the discharge line (see Section 8.1 in this manual). Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump head has been flushed, lift the Foot Valve out of the solution and continue to pump air into the pump head until the pump head is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture using protective clothing, gloves and face shield, carefully disconnect the suction and discharge tubing. Remove the four screws to the head and immerse the head in water or other neutralizing solution.

2. Start the pump. While running, set the stroke knob to zero and turn the pump off.

See Section 10.0 for proper zero

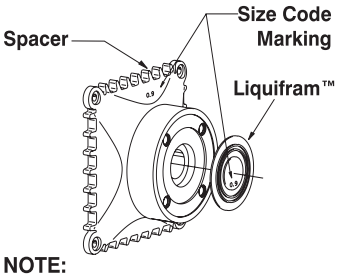
.

3. With the unit off, unscrew the Liquifram™ by carefully grasping the outer edge and turning it counter-clockwise ↶ . Discard old Liquifram™. Remove the Liquifram™ disk if so equipped (located behind the Liquifram™) and check that the size code matches the size code on the replacement Liquifram™ (see illustration).

4. Reinstall the disk so the alignment pin on the disk (if present) seats in the recessed hole in the EPU.

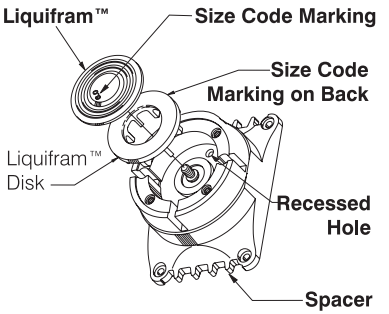
Be careful not to scratch the Teflon® face of the new Liquifram™.

For Series B, C, & E



NOTE:
Size code markings for pumps supplied with 6.0 Liquiframs™ (diaphragms) should be referenced to the 6.0 Black Adapter, not the 3.0 Spacer

For Series AA, J, & P



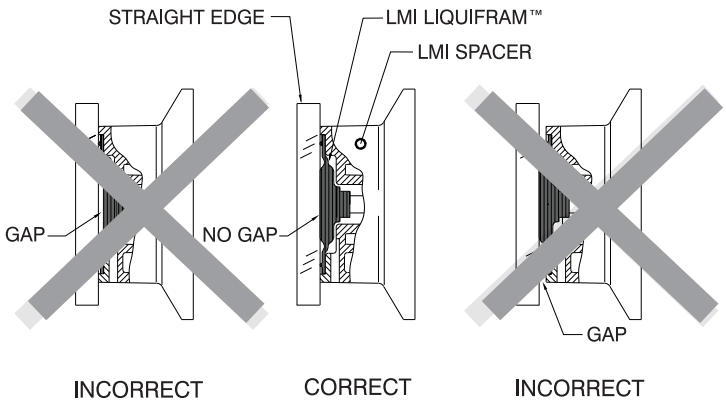
5. Start the pump and turn the stroke knob to the setting indicated on the following Stroke Setting Chart which matches the pump series number located on the pump dataplate. With the pump stroking (running), screw on the new Liquifram™ clockwise ↷ until the center begins to buckle inwards. Stop the pump.

Liquifram™ Stroke Setting Chart

Pump Series	Stroke Knob Setting
All AA, B, J, P Series C10, C11, C12, C70, C71, C72, C76, C90, C91, C92, E70, E71, E72	90%
C78	50%
C13, C14, C73, C74, C77, C93, C94, E73, E74	70%

* Liquifram™ on M Series pumps only, must be bottomed completely (turned all the way in). ***Do Not Use Straight Edge***.

6. Grasp the outer edge of the Liquifram™ and adjust by screwing it in or out so that the center of the Liquifram™ is flush with the outside of the spacer edge (see illustration below).



(Liquifram™ is flush with spacer and straight edge.)

7. Once the Liquifram™ is properly positioned, remount the pump head to the spacer using the four (4) screws. Tighten in a criss-cross pattern. After one week of operation, recheck the screws and tighten if necessary.

9.3 Cartridge Valves, Seal Rings/Valve Balls and Injection Check Valve Spring Replacement

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or performing any maintenance or replacement on your pump. See MSDS information from solution supplier for additional precautions.

1. Refer to the LMI Metering Pump Price List for the proper Spare Parts Kit or RPM Pro Pac™ kit number or contact your local LMI stocking distributor.

2. Carefully depressurize and disconnect the discharge line (see Section 9.1 in this manual). Place the Foot Valve into a container of water or other neutralizing solution. Turn the pump on to flush the head assembly. Once the pump has been flushed, lift the Foot Valve out and continue to pump to let air into the pump head until pump is purged of water or neutralizing solution.

Once the pump has been flushed, lift the Foot Valve out and continue to let air into the pump head until pump is purged of water or neutralizing solution.

If the liquid cannot be pumped due to Liquifram™ rupture, with protective clothing, gloves and face shield, carefully disconnect the tubing and four screws to remove the head. Immerse the head in water or other neutralizing solution.

Spare part replacement kits include specific instructions for valve replacement. Please follow the instructions included with the replacement kit.

***IMPORTANT**: Before disassembling the check valves, note the orientation of the valve.*

3. Carefully disconnect one tubing connection and fitting at a time, then remove and replace the worn valve.

If necessary, carefully loosen stuck valves by prying side to side using a small screwdriver through the center hole of the valve.

4. Install new check valves in each location.

IMPORTANT: *Note correct orientation of each check valve.*

5. Install the new spring in the Injection Check Valve.

Depressurize and drain pipeline (or isolate I.C.V. point using valves) so that I.C.V. can safely be disassembled.

10.0 Checking Pump for Proper Zero Position (Stroke Knob)

1. With pump running, turn stroke knob counter-clockwise ↶ toward zero or end of black or red band on dial.

2. LISTEN to the clicking as the pump is running. The pump should operate quietly at the zero position (no clicking).

3. If the pump continues to click at zero or stops clicking before zero is reached, the pump zero must be reset (see Section 10.1 or 10.2).

10.1 Type I - Push on Knob
Re-Zeroing and Stroke Knob Disassembly and Assembly

`

1. Remove stroke knob from the pump by grasping the knob firmly and pulling it toward you.

2. Pry off the yellow cap.

3. Place the knob on a flat surface.

4. Using needle-nose pliers, squeeze the inner section together while lifting the outer section up.

5. Push the inner section back onto the “D” shaped stroke shaft.

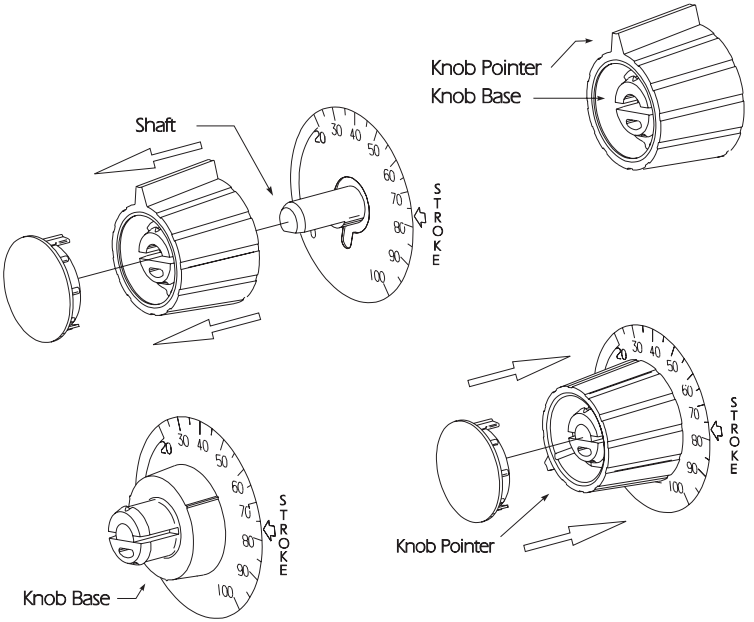
6. With the pump running, zero the pump by turning the inner section of the knob counter-clockwise ↶ until the pump stops clicking.

7. Position the outer section of the knob so that the pointer aligns with zero on the nameplate or end of the black or red band.

8. Push down on the outer section (a snap sound indicates parts are locked together).

9. Replace the yellow cap over the outer section of the knob, aligning the tabs on the cap with the slots inside the knob.

Stroke Knob Assembly (Type I)



11.0 Troubleshooting

PROBLEM	POSSIBLE CAUSE
Pump Will Not Prime	1. Pump not turned on or plugged in.
	2. Output dials not set properly.
	3. Foot Valve not in vertical position on bottom of tank.
	4. Pump suction lift too high.
	5. Suction tubing is curved or coiled in tank.
	6. Fittings are over tightened.
	7. Air trap in suction valve tubing.
	8. Too much pressure at discharge. (Pumps without multi-function valve.)
Pump Loses Prime	1. Solution container ran dry.
	2. Foot Valve is not in a vertical position on the bottom of the tank.
	3. Pump suction lift is too high.
	4. Suction tubing is curved or coiled in tank.
	5. Fittings are over tightened.
	6. Air trap in suction valve tubing.
	7. Air leak on suction side.

	SOLUTION
	1. Turn on pump/plug in pump.
	2. Always prime pump with speed at 80% and stroke at 100%.
	3. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	4. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	5. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	6. Do not overtighten fittings. This causes seal rings to distort and not seat properly which causes pump to leak back or lose prime.
	7. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	8. Shut off valves in pressurized line. Disconnect tubing at injection check valve (see Priming Section 6.0). When pump is primed, reconnect discharge tubing.
	1. Refill container with solution and reprime (see Section 6.0).
	2. Foot Valve must be vertical (see Foot Valve Installation, Section 4.6).
	3. Maximum suction lift is 5 ft (1.5 m). Pumps with High Viscosity Liquid Handling Assemblies require flooded suction.
	4. Suction tubing must be vertical. Use LMI tubing straightener supplied with pump (see Section 4.6).
	5. DO NOT OVERTIGHTEN FITTINGS. This causes seal rings to distort and not seat properly which caused pump to leak back or lose prime.
	6. Suction tubing should be as vertical as possible. AVOID FALSE FLOODED SUCTION! (see Section 4.2.1).
	7. Check for pinholes, cracks. Replace if necessary.

Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE
Leakage at tubing	1. Worn tubing ends.
	2. Loose or cracked fitting.
	3. Worn seal rings.
	4. Solution attacking Liquid Handling Assembly material.
Low Output or Failure to Pump Against Pressure	1. Pump's maximum pressure rating is exceeded by injection pressure.
	2. Worn Seal Rings.
	3. Ruptured Liquifram™.
	4. Incorrect stroke length.
	5. Tubing run on discharge may be too long.
	6. Clogged Foot Valve strainer.
Failure to Run	1. Pump not turned on or plugged in.
	2. EPU failure.
	3. Pulser failure.
Excessive Pump Output	1. Syphoning. (Pumping downhill without a multi-function valve).
	2. Little or no pressure at injection point.
	3. Excessive strokes per minute.

	SOLUTION
	1. Cut about 1 in (25 mm) off tubing and then replace as before.
	2. Replace fitting if cracked. Carefully hand tighten fittings. *DO NOT USE PIPE WRENCH.* Once fitting comes into contact with seal ring, tighten an additional 1/8 or 1/4 turn.
	3. Replace balls and seal rings (see Section 8.3) Spare Parts (SP-#).
	4. Consult your local distributor for alternate materials.
	1. Injection pressure cannot exceed pump's maximum pressure. See pump data plate.
	2. Worn seal rings or cartridge valves may need replacement (see Section 9.3). Spare Parts (SP- #), or RPM Pro Pac™ kit.
	3. Replace Liquifram™ (see Section 9.2).
	4. Check zero on pump/Re-zero pump (see Section 10.0).
	5. Longer tubing runs may create frictional losses sufficient to reduce pump's pressure rating. Consult factory for more information.
	6. Remove Foot Valve strainer when pumping slurries or when solution particles cause strainer to clog.
	1. Turn on or plug in pump.
	2. Disassemble pump and measure the resistance of the EPU across the EPU wires. Resistance reading should be in accordance to the EPU Resistance Chart (see Section 12.0). Also, check EPU leads to ground. Consult supplier or factory.
	3. The pulser should be replaced if EPU checks out OK. Consult supplier or factory.
	1. Move injection point to a pressurized location or install an LMI 4-FV (see Section 4.4).
	2. If pressure at injection point is less than 25 psi (1.7 Bar), an LMI 4-FV should be installed (see Section 4.4).
	3. Replace pulser or resistor. Consult factory.

12.0 EPU Resistance Chart

Pump Series	Voltage	Coil Resistance (Ohms) @ 20° C (68° F)*
PW4, PW5, PW6 P04, P05, P06 P14, P15 P16 P74, P75, P76	115 VAC 230 VAC	76 - 87 307 - 353
(see Note 1) P02, P03 P12, P13	115 VAC 230 VAC	152 - 176 583 - 671
(see Note 2) AA14, AA74, AA94 AA15, AA75, AA95 AA16, AA76, AA96 AA17, AA77, AA97 P02, P03 P12, P13	115 VAC 230 VAC	76- 87 291- 335
J54D, J55D, J56D	12 VDC	1.1 - 1.3
E70, E71, E72, E73, E74	115 VAC 230 VAC	22.8 - 26.2 91 - 105
B11, B12, B13, B14 B71, B72, B73, B74, B91, B92, B93, B84	115 VAC 230 VAC	43 - 49 167 - 193
C10, C11, C12, C13, C14 C70, C71, C72, C73, C74 C90, C91, C92, C93, C94	115 VAC 230 VAC	22.8 - 26.2 91 - 105
C76, C77, C78	115 VAC 230 VAC	14.4 - 16.6 57.7 - 66.3

* Let pump cool down completely before checking resistance. EPU checked within 10 hours of operation can increase coil resistance reading as much as 20%.

NOTES:

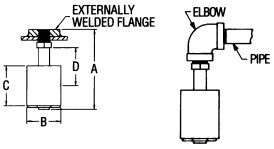
1. Pumps with serial numbers **LOWER** than: **960113429**
2. Pumps with serial numbers **HIGHER** than: **960113429**

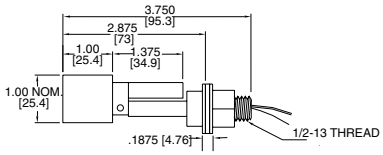
LMI MILTON ROY

201 Ivyland Road
Ivyland, PA 18974
TEL: (215) 293-0401
FAX: (215) 293-0445
http://www.lmipumps.com

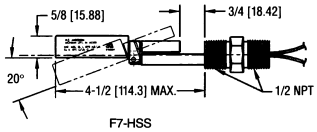
SERIES F7 LIQUID LEVEL SWITCHES

Specifications – Installation and Operating Instructions

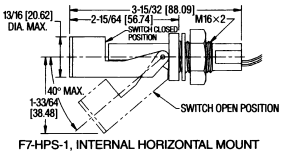




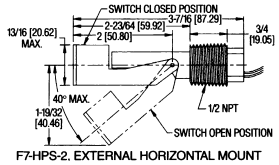
F7-MHS, INTERNAL HORIZONTAL MOUNT



F7-HSS



F7-HPS-1, INTERNAL HORIZONTAL MOUNT



F7-HPS-2, EXTERNAL HORIZONTAL MOUNT

Series F7 Level Switches provide simple, inexpensive control of liquid level within tanks or similar vessels. Switch ratings are suitable for many solid state control systems and monitors or alarms. Simple relay interfaces can be used for higher current applications. Two basic styles offer a choice of vertical or horizontal mounting. Hermetically sealed reed switches are actuated by magnets permanently bonded inside the float and can be easily adapted to open or close a circuit on rising or falling levels.

SWITCH ACTION (Normally open/Normally closed)

Vertical Models

Vertical mount models are shipped with normally open switch contacts which close as the float rises toward the mounting threads. Reverse switch action by removing the float, rotating it end-for-end and replacing it on the stem.

Horizontal Models

Horizontal models are in the normally open position when the indicating arrow points up (float is down), and normally closed when the arrow points down (float is up).

INSTALLATION

Choose a location away from fill pipes, drains, or other areas where turbulence or wave motion might occur. Turbulence will cause false actuation and shorten contact life. Excess contaminants in fluid may inhibit float operation and occasional wipe-down may be necessary. Care should be taken that switches are always operated within electrical ratings. Read and understand all safety precautions on back of this sheet before installing.

MOUNTING

Install vertical mount models in an appropriate 1/8″ NPT fitting. Vertical models mount internally, oriented within 30° of vertical, or select optional fittings for external mounting. Models F7-HPS-1 and F7-MHS must be mounted internally, which means the switch must be secured to the wall of the tank or vessel from the inside. Install horizontal model F7-HPS-1 in a 5/8″ (16 mm) hole or model F7-MHS in a 1/2″ (12.7 mm) hole. Secure into place with the nut provided. Tank wall should not exceed 1/8″ (3 mm). Model F7-HPS-2 requires a horizontal 1/2″ NPT female fitting and can be fitted to the tank or vessel from the outside. Model F7-HSS requires a horizontal 1/2″ NPT female fitting and can be mounted from the inside or outside (internally or externally) of the tank or vessel.

SPECIFICATIONS

Electrical Rating (Maximum):

F7-SB, -SS2 AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

F7-PP, -BT, -HSS, -MHS AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

F7-HPS-1, -2 AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

(F7-HSS is rated explosion-proof for Class I, Groups A, B, C, D; Class II, Groups E, F, G; Class III).

Mounting Connection: 1/8″ NPTM (all vertical mount), 1/2″ NPTM (F7-HPS-2, F7-HSS), M16 x 2 (F7-HPS-1), 1/2″ x 13 thread (F7-MHS)

Wire leads: 22 AWG x 18″ (46 cm), vertical mount models; 22 AWG x 39″ (1 m), models F7-HPS-1, -2; 22 AWG x 24″ (61 cm), models F7-HSS, -MHS.

Magnet: Alnico (F7-SB, -PP, -BT, -HPS), ceramic (F7-SS2, -HSS, -MHS).

Weight: 2 oz. (58 g), F7-SB; 1.2 oz. (34g), F7-SS2; 0.8 oz. (23 g), F7-PP; 0.7 oz.. (20 g), F7-BT; 1.5 oz. (43 g), F7-HPS-1; 2 oz. (57 g), F7-HPS-2 and -MHS; 3 oz. (94 g), F7-HSS.

DIMENSIONS, INCHES (MM) - Vertical Mount

Model Number	(A) Stem Length	(B) Float Diameter	(C) Float Height	(D) Actuation from HEX*
F7-SB	2.75 (70)	1.13 (29)	1.38 (35)	1.2 (31)
F7-SS2	2.06 (52)	1.0 (25)	1.0 (25)	0.73 (19)
F7-PP	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)
F7-BT	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)

*Distance between HEX and liquid (S.G. = 1) level @ actuation pt. will vary with specific gravity changes.

PHYSICAL DATA

Model Number	Material Float/Stem	Max. Temp.	Max. Press.	Min. S.G.	Approx. Deadband
Vertical Mount					
F7-SB	Buna-N & Epoxy/ 316SS	220°F 105°C	150 psig 10 bar	0.60	1/16″ 2 mm
F7-SS2	316/SS (CYC)/ 316SS	300°F 149°C	450 psig 31 bar	0.75	1/16″ 2 mm
F7-PP	Polypropylene & Epoxy/ Polypropylene	220°F 105°C	100 psig 6.89 bar	0.60	1/8″ 4 mm
F7-BT	Buna-N & Epoxy/ PBT*	220°F 105°F	150 psig 10 bar	0.45	1/8″ 4 mm
Horizontal Mount					
F7-HPS -1, -2	Polysulfone/ Polysulfone	185°F 85°C	150 psig 10 bar	0.85	3/16″ 5 mm
F7-HSS	316SS/316SS	392°F 200°C	300 psig 20.7 bar	0.60	1/8″ 4 mm
F7-MHS	316 SS/316SS	392°F 200°C	100 psig 6.89 bar	0.70	3/16″ 5 mm

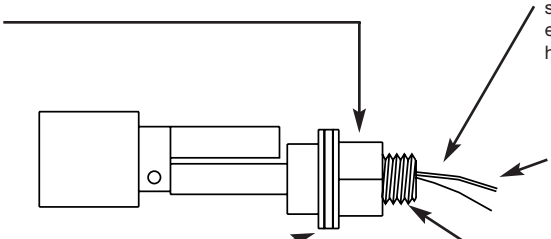
* PBT - Polybutylene Terephtalate

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, ,U.S.A.
Phone: 219/879-8000
Fax: 219/872-9057
Lit-By Fax: 888/891-4963
www.dwyer-inst.com
e-mail: info@dwyer-inst.com

Installation Notes-

Do not subject reed switch controls to excessive shock or vibration or any of the following:

- Bending or placing force loads on reed switch housing.
- Over-torquing fittings on reed switch housing.
- Placing pull-out force on lead wires.



CIRCUIT INFORMATION FOR REED SWITCH PROTECTION

READ INFORMATION BELOW BEFORE INSTALLING YOUR NEW REED SWITCH CONTROL!

Exceeding the current capacity of this Reed Switch control may cause FAULTY OPERATION! Be aware of the inductive and capacitive or lamp loads you may be placing on your Reed Switch Control. the circuits below outline possible solution to preventing overloads due to inrush or surge currents exceeding maximum or when the switch current and product of the inductive back EMF exceed the switch's power rating. Also, the circuit for prevention of overload when switching filament lamps (low "cold" resistance) is outlined below. Failure to follow these measures to protect Reed Switch Contacts may cause the contacts to weld together or result in premature wear.

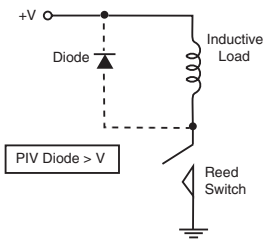
Possible Circuit Solutions Indicated by Dashed Lines

Inductive Loads

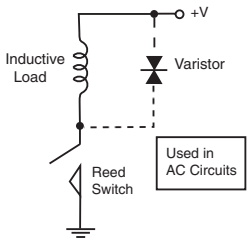
Possible causes-

An electromagnetic relay, electromagnetic solenoid, electromagnetic counter with inductive component as circuit load.

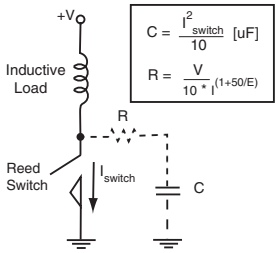
DIODE SUPPRESSION



VARISTER PROTECTION



RC SUPPRESSION

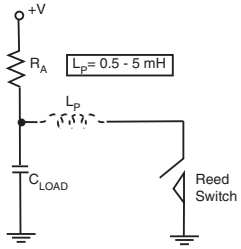


Capacitive Loads

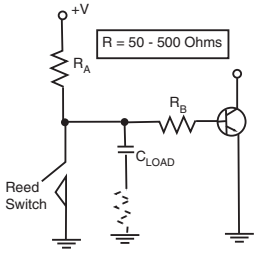
Possible causes-

A capacitor connected in series or parallel with Reed Switch Control. In a closed circuit, a cable length (usually greater than 50m [162.5 ft]) used to connect reed switch may also introduce static capacitance.

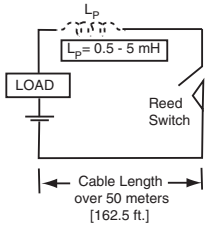
SURGE LIMITER FOR CAPACITANCE IN SERIES



RESISTOR PROTECTION FOR CAPACITIVE LOAD



INDUCTIVE PROTECTION FOR CABLE LENGTH CAPACITANCE

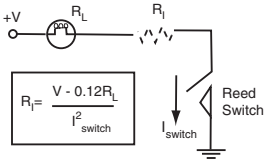


Lamp Loads

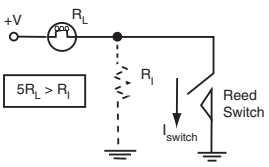
Possible causes-

A tungsten filament lamp load.

CURRENT LIMITING RESISTOR IN SERIES



CURRENT LIMITING RESISTOR IN PARALLEL



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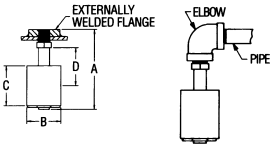
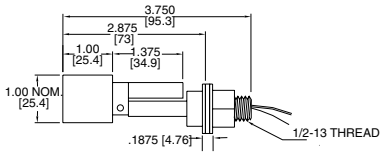
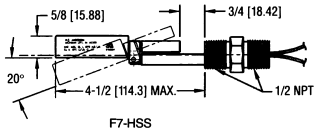
SERIES F7 LIQUID LEVEL SWITCHES

Specifications – Installation and Operating Instructions

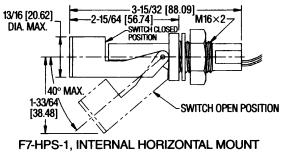




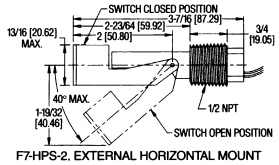
F7-MHS, INTERNAL HORIZONTAL MOUNT



F7-HSS



F7-HPS-1, INTERNAL HORIZONTAL MOUNT



F7-HPS-2, EXTERNAL HORIZONTAL MOUNT

Series F7 Level Switches provide simple, inexpensive control of liquid level within tanks or similar vessels. Switch ratings are suitable for many solid state control systems and monitors or alarms. Simple relay interfaces can be used for higher current applications. Two basic styles offer a choice of vertical or horizontal mounting. Hermetically sealed reed switches are actuated by magnets permanently bonded inside the float and can be easily adapted to open or close a circuit on rising or falling levels.

SWITCH ACTION (Normally open/Normally closed)

Vertical Models

Vertical mount models are shipped with normally open switch contacts which close as the float rises toward the mounting threads. Reverse switch action by removing the float, rotating it end-for-end and replacing it on the stem.

Horizontal Models

Horizontal models are in the normally open position when the indicating arrow points up (float is down), and normally closed when the arrow points down (float is up).

INSTALLATION

Choose a location away from fill pipes, drains, or other areas where turbulence or wave motion might occur. Turbulence will cause false actuation and shorten contact life. Excess contaminants in fluid may inhibit float operation and occasional wipe-down may be necessary. Care should be taken that switches are always operated within electrical ratings. Read and understand all safety precautions on back of this sheet before installing.

MOUNTING

Install vertical mount models in an appropriate 1/8″ NPT fitting. Vertical models mount internally, oriented within 30° of vertical, or select optional fittings for external mounting. Models F7-HPS-1 and F7-MHS must be mounted internally, which means the switch must be secured to the wall of the tank or vessel from the inside. Install horizontal model F7-HPS-1 in a 5/8″ (16 mm) hole or model F7-MHS in a 1/2″ (12.7 mm) hole. Secure into place with the nut provided. Tank wall should not exceed 1/8″ (3 mm). Model F7-HPS-2 requires a horizontal 1/2″ NPT female fitting and can be fitted to the tank or vessel from the outside. Model F7-HSS requires a horizontal 1/2″ NPT female fitting and can be mounted from the inside or outside (internally or externally) of the tank or vessel.

SPECIFICATIONS

Electrical Rating (Maximum):

F7-SB, -SS2 AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

F7-PP, -BT, -HSS, -MHS AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

F7-HPS-1, -2 AC: 25VA, 1.0A, 200 V DC: 10W, 1.0A, 200V

(F7-HSS is rated explosion-proof for Class I, Groups A, B, C, D; Class II, Groups E, F, G; Class III).

Mounting Connection: 1/8″ NPTM (all vertical mount), 1/2″ NPTM (F7-HPS-2, F7-HSS), M16 x 2 (F7-HPS-1), 1/2″ x 13 thread (F7-MHS)

Wire leads: 22 AWG x 18″ (46 cm), vertical mount models; 22 AWG x 39″ (1 m), models F7-HPS-1, -2; 22 AWG x 24″ (61 cm), models F7-HSS, -MHS.

Magnet: Alnico (F7-SB, -PP, -BT, -HPS), ceramic (F7-SS2, -HSS, -MHS).

Weight: 2 oz. (58 g), F7-SB; 1.2 oz. (34g), F7-SS2; 0.8 oz. (23 g), F7-PP; 0.7 oz.. (20 g), F7-BT; 1.5 oz. (43 g), F7-HPS-1; 2 oz. (57 g), F7-HPS-2 and -MHS; 3 oz. (94 g), F7-HSS.

DIMENSIONS, INCHES (MM) - Vertical Mount

Model Number	(A) Stem Length	(B) Float Diameter	(C) Float Height	(D) Actuation from HEX*
F7-SB	2.75 (70)	1.13 (29)	1.38 (35)	1.2 (31)
F7-SS2	2.06 (52)	1.0 (25)	1.0 (25)	0.73 (19)
F7-PP	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)
F7-BT	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)

*Distance between HEX and liquid (S.G. = 1) level @ actuation pt. will vary with specific gravity changes.

PHYSICAL DATA

Model Number	Material Float/Stem	Max. Temp.	Max. Press.	Min. S.G.	Approx. Deadband
Vertical Mount					
F7-SB	Buna-N & Epoxy/ 316SS	220°F 105°C	150 psig 10 bar	0.60	1/16″ 2 mm
F7-SS2	316/SS (CYC)/ 316SS	300°F 149°C	450 psig 31 bar	0.75	1/16″ 2 mm
F7-PP	Polypropylene & Epoxy/ Polypropylene	220°F 105°C	100 psig 6.89 bar	0.60	1/8″ 4 mm
F7-BT	Buna-N & Epoxy/ PBT*	220°F 105°F	150 psig 10 bar	0.45	1/8″ 4 mm
Horizontal Mount					
F7-HPS -1, -2	Polysulfone/ Polysulfone	185°F 85°C	150 psig 10 bar	0.85	3/16″ 5 mm
F7-HSS	316SS/316SS	392°F 200°C	300 psig 20.7 bar	0.60	1/8″ 4 mm
F7-MHS	316 SS/316SS	392°F 200°C	100 psig 6.89 bar	0.70	3/16″ 5 mm

* PBT - Polybutylene Terephtalate

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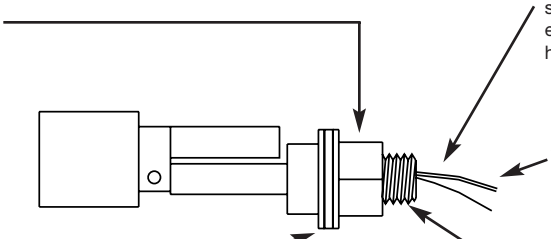
www.dwyer-inst.com
e-mail: info@dwyer-inst.com

Installation Notes-

Do not subject reed switch controls to excessive shock or vibration or any of the following:

- Bending or placing force loads on reed switch housing.
- Over-torquing fittings on reed switch housing.
- Placing pull-out force on lead wires.



CIRCUIT INFORMATION FOR REED SWITCH PROTECTION

READ INFORMATION BELOW BEFORE INSTALLING YOUR NEW REED SWITCH CONTROL!

Exceeding the current capacity of this Reed Switch control may cause FAULTY OPERATION! Be aware of the inductive and capacitive or lamp loads you may be placing on your Reed Switch Control. the circuits below outline possible solution to preventing overloads due to inrush or surge currents exceeding maximum or when the switch current and product of the inductive back EMF exceed the switch's power rating. Also, the circuit for prevention of overload when switching filament lamps (low "cold" resistance) is outlined below. Failure to follow these measures to protect Reed Switch Contacts may cause the contacts to weld together or result in premature wear.

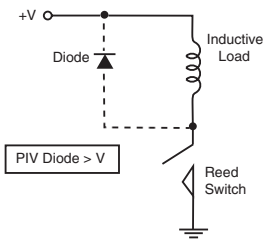
Possible Circuit Solutions Indicated by Dashed Lines

Inductive Loads

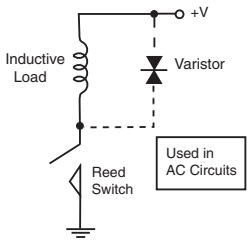
Possible causes-

An electromagnetic relay, electromagnetic solenoid, electromagnetic counter with inductive component as circuit load.

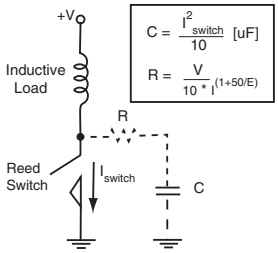
DIODE SUPPRESSION



VARISTER PROTECTION



RC SUPPRESSION

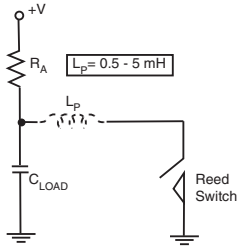


Capacitive Loads

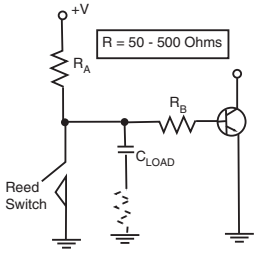
Possible causes-

A capacitor connected in series or parallel with Reed Switch Control. In a closed circuit, a cable length (usually greater than 50m [162.5 ft]) used to connect reed switch may also introduce static capacitance.

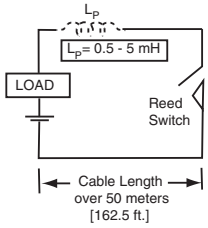
SURGE LIMITER FOR CAPACITANCE IN SERIES



RESISTOR PROTECTION FOR CAPACITIVE LOAD



INDUCTIVE PROTECTION FOR CABLE LENGTH CAPACITANCE

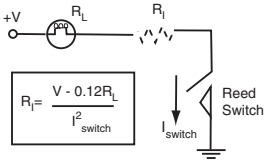


Lamp Loads

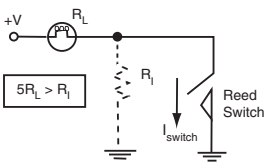
Possible causes-

A tungsten filament lamp load.

CURRENT LIMITING RESISTOR IN SERIES



CURRENT LIMITING RESISTOR IN PARALLEL



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SECTION 11 - 800 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - OIL

GEAR PUMP - DAYTON MODEL 4KHH8

GEAR PUMP MOTOR, 1/2 HP, 208 VAC, 3PH, TEFC - BALDOR MODEL M7006A / A-16690852

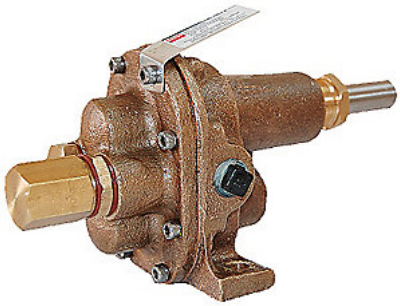
PRESSURE INDICATOR - DWYER MODEL SGY-D10422N

FLOW METER - OMEGA MODEL FTB-32P

FLOW TOTALIZER - OMEGA MODEL M0505/0300

LEVEL SENSOR (WARNING / ALARM) - FPI SENSORS MODEL LS-500-2 POS

GRAINGER
FOR THE ONES WHO GET IT DONE



close x

Using 360° Viewing:

1. Rotate: Use top-to-bottom, side-to-side by use of mouse arrow .
2. Zoom In: Double click on image.
3. Zoom Out/Reset: Put photo at full zoom & then double click.

Rotary Gear Pump Head, 1/4 In., 1/4 HP

DAYTON

Price: $354.50 / each

Deliver one time only

Auto-Reorder Every 1 Month

Typically in Stock

Add Repair & Replacement Coverage for $75.95 each.

Item # **4KHH8** Mfr. Model # **4KHH8** UNSPSC # **40151551**

Catalog Page # **3780** Shipping Weight **6.35 lbs.**

Country of Origin **India** Country of Origin is subject to change.

Repair Parts Available for this item

Technical Specs

Item	**Rotary Gear Pump Head**
Type	**Light Duty, with Carbon Graphite Bushings**
Pump Body Material	**Bronze**
Port Size (In.)	**1/4**
GPM @ Freeflow	**4.8**
HP @ Free Flow	**1/4**
GPM @ Freeflow @ 1725 RPM	**4.8**
HP @ Free Flow @ 1725 RPM	**1/2**
GPM @ 20 PSI	**3.7**
GPM @ 25 PSI	**4.8**
HP @ 25 PSI	**1/2**
GPM @ 40 PSI	**3.5**
GPM @ 50 PSI	**4.7**
HP @ 50 PSI	**3/4**
GPM @ 60 PSI	**3.2**
GPM @ 75 PSI	**4.6**
HP @ 75 PSI	**3/4**
GPM @ 80 PSI	**3**
GPM @ 100 PSI	**2.8**
HP @ 100 PSI	**1**

Suction Lift (Ft.)	**3.5**
Suction Lift (Ft.) @ 1725 RPM	**3.5**
Pump RPM	**1725**
Max. Temp. (F)	**210**
Temp. Range	**-20 to 210 F**
Max. Pressure (PSI)	**100**
Max. Viscosity (SSU)	**550**
Design	**Pedestal**
Gear	**Bronze**
Length (In.)	**3-5/8**
Width (In.)	**7-1/4**
Height (In.)	**3**
O-Ring	**Buna N**
Relief Valve	**With**
Seal	**PTFE, Kevlar Packing**
Shaft Dia. (In.)	**0.5**
Shaft Height (In.)	**2-23/64**
Shaft Material	**304 Stainless Steel**
Manufacturers Warranty Length	**1 Year**

Compliance and Restrictions

None

Documentation

Dayton Lite Duty Pedestal Rotary Gear Pump OIPM

Repair Parts

Displaying repair parts for model: 4KHH8

13 Parts Available

Mfr. Part#	Part Description	Brand	Item#	Availability	Price	Qty
PPM5ZN012G	Valve Lock Nut	DAYTON	29AG89	Item ships w ithin 3 business days from supplier	$9.10 / each	
PPR3ZN012G	Sphere Ball	DAYTON	29AG65	Item ships w ithin 3 business days from supplier	$4.70 / each	

Customers Also Viev

Disposable Gloves,Nitrile,L,Black,F
Item # 2VLZ8
HIGH FIVE
Price: $23.00
1

Disposable Gloves,Nitrile,XL,Black
Item # 2VLZ9
HIGH FIVE
Price: $23.00
1

Filter,Dry,Cartridge Filter,Paper,6-1/2 In
Item # 2W435
DAYTON
Price: $15.81
1

Coated Gloves,XL,Black,Polyu
Item # 2RA98
ANSELL
Price: $3.93
12

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Dayton® Light-Duty Pedestal Rotary Gear Pumps

Description

Dayton rotary gear pumps features self priming and positive displacement, designed to handle high viscous fluids. They are used in wide variety of applications including industrial, agricultural, marine, domestic and commercial apartments. The pumps can be used for low speed operation with pulseless flow. Pumps are bidirectional.

Bronze: Bronze type pumps are ideal for handling water based fluids. The shafts are made of 303-SS grade with PTFE (Polytetrafluoroethylene) seal. Wet end parts are brass 303-SS, bronze gear, PTFE and carbon. These models can withstand temperature from -20 to 210°F.

Cast Iron: Cast Iron pumps are designed for handling oil based fluids not to be used with water based fluid. These models have steel spur gears with steel shafts, Viton lip seal or PTFE seal. Viton has a temperature range of 32 to 280°F and PTFE has a temperature range of -20 to 210°F. The wet end parts are constructed from CI, steel, cellulose gasket and Viton or PTFE.

Figure 1. 4KHK1 to 4KHK6

Figure 2. 4KHG4 to 4KHH6

Figure 3. 4KHJ4 to 4KHJ9

Figure 4. 4KHH7 to 4KHJ3

PERFORMANCE

GPM PUMPING 10 Wt.Oil at 70°F

BRONZE MODELS	CAST IRON MODELS	PORT SIZE *	Max Input Torque in-lbs.	RPM	Suction Lift (ft) **	FREE FLOW		25 PSI		50 PSI		75 PSI		100 PSI	
						GPM	HP	GPM	HP	GPM	HP	GPM	HP	GPM	HP
4KHG4	4KHK1	1/4"	45	900	1.5	1.2	1/6	1.0	1/6	0.8	1/6	0.6	1/4	0.4	1/3
4KHH1	4KHJ4			1200	2.0	1.6	1/6	1.5	1/6	1.4	1/4	1.3	1/4	1.2	1/3
4KHH7				1725	2.5	2.2	1/6	2.1	1/4	2.0	1/4	2.0	1/3	1.9	1/3
4KHG5	4KHK2	1/4"	45	900	1.5	2.5	1/4	2.5	1/4	2.4	1/3	2.3	1/3	2.1	1/2
4KHH2	4KHJ5			1200	2.2	3.3	1/3	3.3	1/3	3.2	1/2	3.1	1/2	2.9	3/4
4KHH8				1725	3.5	4.8	1/2	4.8	1/2	4.7	3/4	4.6	3/4	4.4	1
4KHG6	4KHK3	3/8"	90	900	2.8	3.7	1/3	3.6	1/3	3.5	1/2	3.4	1/2	3.2	3/4
4KHH3	4KHJ6			1200	5.7	4.9	1/2	4.8	1/2	4.7	3/4	4.6	3/4	4.4	1
4KHH9				1725	7.9	7.0	3/4	6.9	3/4	6.8	1	6.7	1	6.5	1-1/2
4KHG7	4KHK4	1/2"	90	900	5.1	5.6	1/3	5.5	1/3	5.4	1/2	5.3	1/2	5.0	3/4
4KHH4	4KHJ7			1200	6.7	7.5	1/2	7.4	1/2	7.3	3/4	7.2	3/4	6.9	1
4KHJ1				1725	12.3	10.8	3/4	10.7	3/4	10.6	1	10.5	1	10.2	1-1/2
4KHG8	4KHK5	3/4"	160	900	6.6	10.8	3/4	10.6	1	10.5	1	10.4	1	10.0	1
4KHH5	4KHJ8			1200	9.3	14.3	1	14.2	1	14.1	1-1/2	13.9	1-1/2	13.5	2
4KHJ2				1725	15.2	20.6	1-1/2	20.5	1-1/2	20.3	2	20.2	2	19.8	2
4KHG9	4KHK6	1"	160	900	8.1	12.6	1	12.5	1	12.3	1	12.1	1	11.7	2
4KHH6	4KHJ9			1200	11.7	16.7	1	16.6	1	16.4	1-1/2	16.2	2	15.8	2
4KHJ3				1725	19.5	24.8	1-1/2	24.7	1-1/2	24.5	2	24.3	2	23.1	3

Refer to Key Notes, Page No.2 (continued)

See back page for Pump Guide

Form 5S6490

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Dayton® Light Duty Pedestal Rotary Gear Pumps

Key Note : 1) (*) Female NPT (inches) Inlet and outlet.
2) Maximun Pressure = 125 PSI
2) (**) Suction lift for packing seal models may be reduced based on packing tightness or viscosity; requires wetted gears.

Specifications - Construction

BRONZE MODELS	PORT SIZE NPT *	Shaft Material	Casting Material	Gear Material	Bushing Material	Relief Valve ***	Gasket Material	Packing/Lip Seal ****
4KHG4 +	1/4	303 SS	BR	BR	BR	NA	Cellulose	PTFE / Kevlar® Packing
4KHH1	1/4	303 SS	BR	BR	CG	NA	Cellulose	PTFE / Kevlar® Packing
4KHH7	1/4	303 SS	BR	BR	CG	SS & BR	Cellulose	PTFE / Kevlar® Packing
4KHG5 +	1/4	303 SS	BR	BR	BR	NA	Cellulose	PTFE / Kevlar® Packing
4KHH2	1/4	303 SS	BR	BR	CG	NA	Cellulose	PTFE / Kevlar® Packing
4KHH8	1/4	303 SS	BR	BR	CG	SS & BR	Cellulose	PTFE / Kevlar® Packing
4KHG6 +	3/8	303 SS	BR	BR	BR	NA	Cellulose	PTFE / Kevlar® Packing
4KHH3	3/8	303 SS	BR	BR	CG	NA	Cellulose	PTFE / Kevlar® Packing
4KHH9	3/8	303 SS	BR	BR	CG	SS & BR	Cellulose	PTFE / Kevlar® Packing
4KHG7 +	1/2	303 SS	BR	BR	BR	NA	Cellulose	PTFE / Kevlar® Packing
4KHH4	1/2	303 SS	BR	BR	CG	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ1	1/2	303 SS	BR	BR	CG	SS & BR	Cellulose	PTFE / Kevlar® Packing
4KHG8 +	3/4	303 SS	BR	BR	BR	NA	Cellulose	PTFE / Kevlar® Packing
4KHH5	3/4	303 SS	BR	BR	CG	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ2	3/4	303 SS	BR	BR	CG	SS & BR	Cellulose	PTFE / Kevlar® Packing
4KHG9 +	1	303 SS	BR	BR	BR	NA	Cellulose	PTFE / Kevlar® Packing
4KHH6	1	303 SS	BR	BR	CG	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ3	1	303 SS	BR	BR	CG	SS & BR	Cellulose	PTFE / Kevlar® Packing
Cast Iron Models								
4KHJ4	1/4	Steel	CI	Steel	CI	NA	Cellulose	Viton Lip Seal
4KHK1 +	1/4	Steel	CI	Steel	CI	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ5	1/4	Steel	CI	Steel	CI	NA	Cellulose	Viton Lip Seal
4KHK2 +	1/4	Steel	CI	Steel	CI	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ6	3/8	Steel	CI	Steel	CI	NA	Cellulose	Viton Lip Seal
4KHK3 +	3/8	Steel	CI	Steel	CI	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ7	1/2	Steel	CI	Steel	CI	NA	Cellulose	Viton Lip Seal
4KHK4 +	1/2	Steel	CI	Steel	CI	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ8	3/4	Steel	CI	Steel	CI	NA	Cellulose	Viton Lip Seal
4KHK5 +	3/4	Steel	CI	Steel	CI	NA	Cellulose	PTFE / Kevlar® Packing
4KHJ9	1	Steel	CI	Steel	CI	NA	Cellulose	Viton Lip Seal
4KHK6 +	1	Steel	CI	Steel	CI	NA	Cellulose	PTFE / Kevlar® Packing

(+) These Models have grease zerks that require frequent greasing.

(*) NPT inlet and out ports (inches).

(**) Relief valve includes stainless steel ball and spring (18-8 SS), hard fiber gasket and bronze stem and cap.

(***) Kevlar® Packing is Teflon impregnated. Viton lip seals have 300 series stainless steel case.

CG = Carbon Graphite bearings BR = Bronze CI = Cast Iron SS = Stainless Steel

Bronze models 4KHG4 to 4KHJ3
Cast Iron models 4KHJ4 to 4KHK6

Dimensions (Inches)

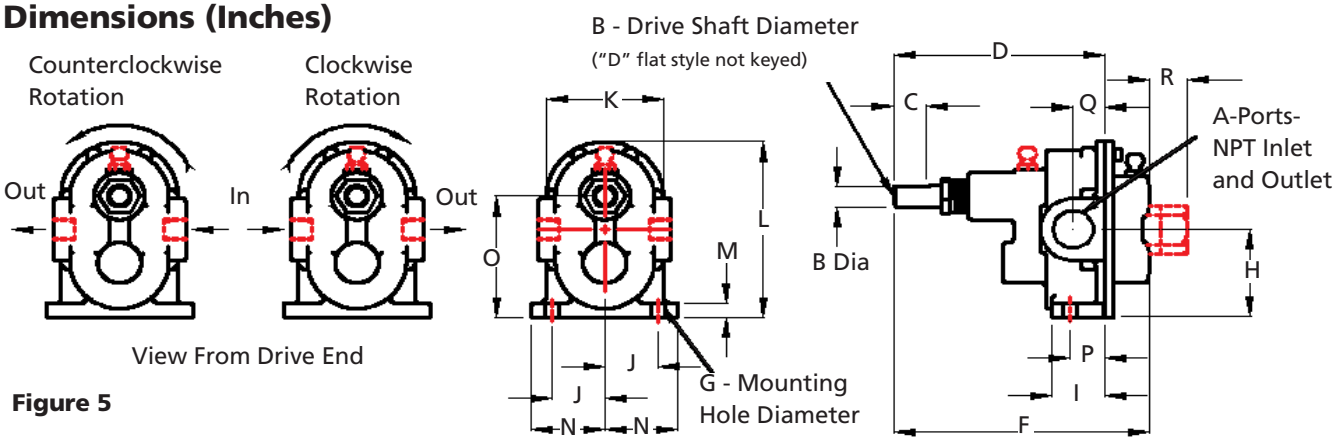

Figure 5

MODELS 1, 2, 3, 4	A	B	C	D	F	G	H	I	J	K
4KHG4, 4KHH1, 4KHH7, 4KHK1	1/4	1/2	7/8	5	5 1/2	9/32	1 3/4	1 1/8	7/8	2 1/2
4KHG5, 4KHH2, 4KHH8, 4KHK2	1/4	1/2	7/8	5	6	9/32	1 5/8	1 1/4	1 1/8	2 3/8
4KHG6, 4KHH3, 4KHH9, 4KHK3	3/8	5/8	1	5 3/8	6 1/2	25/64	1 7/8	1 1/4	1 7/16	2 3/4
4KHG7, 4KHH4, 4KHJ1, 4KHK4	1/2	5/8	1	5 3/4	7	25/64	1 7/8	1 1/4	1 7/16	2 3/4
4KHG8, 4KHH5, 4KHJ2, 4KHK5	3/4	5/8	1	5 3/4	7	25/64	2 9/16	1 1/2	1 5/8	3 3/8
4KHG9, 4KHH6, 4KHJ3, 4KHK6	1	5/8	1	6	7 1/4	25/64	2 9/16	1 1/2	1 5/8	3 3/8

(*) Only applies to pumps with pressure relief valves (PRV).

(1) Bronze grease zerk pumps, without PRV. (2) Bronze pumps with carbon bushings, without PRV. (3) Bronze pumps with carbon bushings and PRV. (4) Cast Iron grease zerk pumps with packing seal, without PRV.

NOTE: Dimensions have a tolerance of (+ or -)1/8".

MODELS 1, 2, 3, 4	L	M	N	O	P	Q	R(*)
4KHG4, 4KHH1, 4KHH7, 4KHK1	3 9/16	3/16	1 3/4	2 5/16	11/16	1/2	1 3/16
4KHG5, 4KHH2, 4KHH8, 4KHK2	3 9/16	3/16	1 1/2	2 3/8	13/16	15/32	1 3/8
4KHG6, 4KHH3, 4KHH9, 4KHK3	4	1/4	1 7/8	2 5/8	3/4	9/16	1 3/8
4KHG7, 4KHH4, 4KHJ1, 4KHK4	4	1/4	1 7/8	2 5/8	3/4	5/8	1 3/8
4KHG8, 4KHH5, 4KHJ2, 4KHK5	5 3/16	1/4	2	3 9/16	15/16	3/4	1 27/32
4KHG9, 4KHH6, 4KHJ3, 4KHK6	5 3/16	1/4	2	3 9/16	15/16	13/16	1 27/32

(*) Only applies to pumps with pressure relief valves.

(1) Bronze grease zerk pumps, without PRV. (2) Bronze pumps with carbon bushings, without PRV.
(3) Bronze pumps with carbon bushings and PRV. (4) Cast Iron grease zerk pumps with packing seal, without PRV.

NOTE: Dimensions have a tolerance of (+ or -)1/8".

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Dayton® Light Duty Pedestal Rotary Gear Pumps

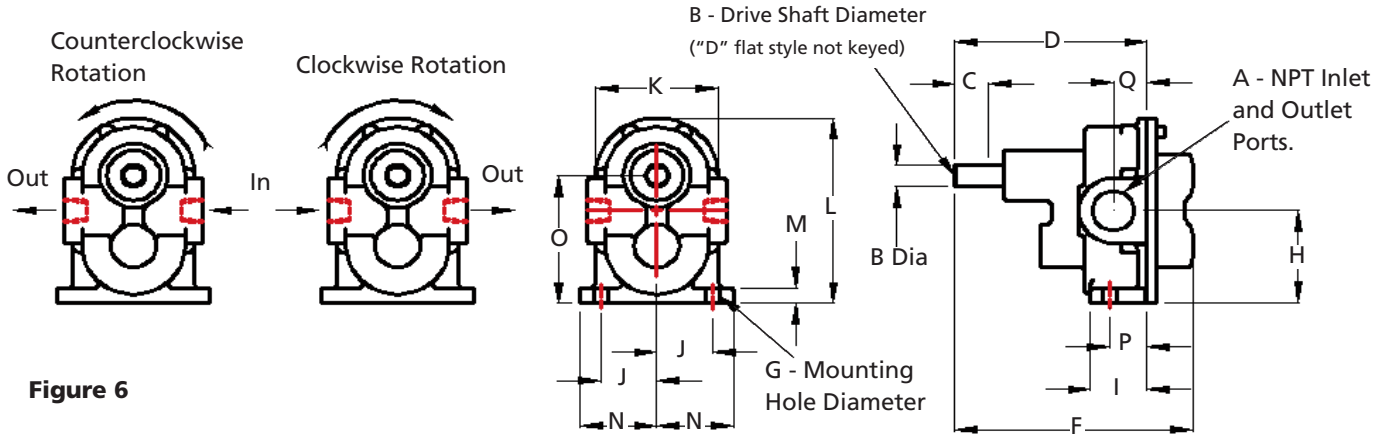


Figure 6

DIMENSIONS IN INCHES																
Models	**A**	**B**	**C**	**D**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
4KHJ4	1/4	1/2	7/8	3 3/8	4 1/2	9/32	1 3/4	1 1/8	7/8	2 1/2	3 9/16	3/16	1 3/4	2 5/16	11/16	1/2
4KHJ5	1/4	1/2	7/8	3 3/8	4 1/2	9/32	1 11/16	1 9/32	1 1/8	2 3/8	3 9/16	3/16	1 1/2	2 3/8	13/16	15/32
4KHJ6	3/8	5/8	1	4	5 3/8	25/64	1 7/8	1 9/32	1 7/16	2 3/4	4	5/16	1 7/8	2 5/8	3/4	9/16
4KHJ7	1/2	5/8	1	4 1/2	5 5/8	25/64	1 7/8	1 9/32	1 7/16	2 3/4	4	5/16	1 7/8	2 5/8	3/4	5/8
4KHJ8	3/4	5/8	1	4 1/2	5 5/8	25/64	2 9/16	1 1/2	1 5/8	3 3/8	5 3/16	3/8	2	3 9/16	15/16	3/4
4KHJ9	1	5/8	1	4 3/4	6	25/64	2 9/16	1 1/2	1 5/8	3 3/8	5 3/16	3/8	2	3 9/16	15/16	13/16

(1)Cast Iron pumps with lip seal,without pressure relief valve. (2) NOTE: Dimensions have a tolerance of (+ or -)1/8".

General Safety Information

READ AND FOLLOW SAFETY INSTRUCTIONS!

Please read this before installing or operating pump. this information is provided for SAFETY and to PREVENT EQUIPMENT PROBLEMS.

To help recognize this information, observe the following symbols:

NOTE: Indicates special instructions which are important but not related to hazards.

IMPORTANT: Indicates factors concerned with assembly, installation, operation, or maintenance which could result in damage to the machine or equipment if ignored.

This is the safety alert symbol. When you see this symbol on your pump or in this manual, look for one of the ollowing signal words and be alert to the potential for personal injury:

⚠ DANGER ***Warns about hazards that will cause serious personal injury, death or major property damage if ignored.***

⚠CAUTION ***Warns about hazards that can cause serious personal injury, death or major property damage if ignored.***

⚠ WARNING ***Warns about hazards that will or can cause minor personal injury or property damage if ignored.***

Carefully read and follow all safety instructions in this manual.

1. Most accidents can be avoided by using COMMON SENSE.

⚠CAUTION ***Do not wear loose clothing that may become entangled in the pump or other moving parts. Always wear appropriate safety gear, such as safety glasses, when working on the pump or piping.***

⚠CAUTION ***Pumps build up heat and pressure during operation. Allow time for pumps to cool before handling or servicing.***

⚠CAUTION ***Only qualified personnel should install, operate, and repair pump. Keep clear of suction and***

Bronze models 4KHG4 to 4KHJ3
Cast Iron models 4KHJ4 to 4KHK6

discharge openings. Do not insert fingers in pump with power connected.

OPERATIONAL SAFETY GUIDELINES

⚠WARNING ***Pumps are filled with liquid to prevent corrosion. Prime the liquid before plunging the pump into the main line. Only pump liquids that are compatible with pump materials.***

⚠ DANGER ***Gear pumps should not be used to pump flammable or explosive fluids like gasoline, fuel oil, kerosene, etc. The pumps should not be used in flammable or explosive atmospheres. While pumping hazardous or dangerous materials, use it in the designated or recommended area.***

NOTE: For more information on the handling of hazardous materials, contact local agencies such as fire department, insurance company or supplier of chemicals.

1. Before starting the pump, perform inspections to ensure that:
   a. The hoses are in good condition.
   b.The discharge line has been secured.
   c. The hose connections are tight.
2. Provide for an alternate method of relieving pressure in situations where the discharge line could be obstructed or shut off.
3. Pump should be routinely checked and do maintenance as required.
4. Limited self priming capability for PTFE seal type models.
5. If the pump is used through pulley driven operation, pillow shaft assembly is to be used. (See motor gear manual for more information.)
6. For direct driven pumps use a coupler.
7. Use only non abrasive and non-particulate fluid.
8. The pump can be operated in bidirectional, while operation on reverse rotation the pressure relief valve will not function unless you change the input and output valve screws.

⚠WARNING ***Pumps may generate loud operating noise depending upon the usage; provide necessary acoustics to reduce the noise in work area.***

⚠WARNING ***To reduce risk of electrical shock, always disconnect the pump from the power source before handling or servicing. Lock out power and tag.***

Dayton Electric Mfg. Co. is not responsible for losses, injury, or death resulting from a failure to observe these safety precautions, misuse or abuse of pumps or equipment.

UNPACKING

Handle carefully. Visually inspect for shipping damage. If damaged, immediately file a claim with the carrier.

NOTE: Do not attempt to assemble or operate pump if any parts are missing or damaged. Check the parts list in Page 10 -13.

PUMPS WITH MOTORS

The motor is designed to beused in a clean dry location with access to an adequate supply of cooling air. For outdoor installations, motor must be protected by a cover that does not block airflow.

ELECTRICAL CONNECTIONS

1. Motor wiring should conform to national, state and local electrical codes.
2. Use wire of adequate size to prevent voltage drop.
3. Pump should be on a branch or separate circuit, fused or circuit breaker, protected, with a manual disconnect.
4. Connect the electrical supply from the switch to the motor terminals, following the wiring diagram on the motor nameplate or terminal cover plate.

NOTE: Be sure that the connections to the motor terminals correspond with the voltage to be applied.

Check wiring and fuse charts before connecting wires to service line. Make sure the voltage and frequency of the electrical current supply agrees with that stamped on the motor nameplate. If in doubt, check with power company.

Some pumps are equipped with three phase motors. Three phase motors require magnetic starters, and can run in either direction, depending on how they are connected to the power supply.

GROUNDING MOTOR

Wiring to this pump must be installed and maintained in accordance with the National Electrical code or your State and local electrical code.

Dayton® Light Duty Pedestal Rotary Gear Pumps

INSTALLATION

1. Place the pump as close to the pumping fluid source as possible and keep the suction line as short and direct as possible.
2. Install pump mounting base on a flat, solid surface. A rubber pad in between the pump base and flat mounting surface can be provided to reduce the noise level.
3. Pump shaft and motor shaft to be carefully aligned, and for clear aligning, check for shims on the pump shaft or motor shaft ends.
4. Install a union, tee and a gate valve(not provided with the pump) on the delivery (discharge) side of the pump for better convenience of servicing and usage.

⚠CAUTION ***Ensure that the gate valve on the delivery line is fully open during operation, otherwise motor loading will occur.***

PIPING•OF•SUCTION•HEAD

1. Check the suction line and then connect to suction inlet of pump.
2. It is recommended to use the same size of pipes as per suction port. In case any larger length is required to be used in suction end, use next higher size of pipe.
3. Install foot valve on the suction end, below the suction fluid in case of fluid specific gravity is greater than 1.4 .If viscosity is greater than 500 SSU, foot valve is to be attached compulsorily on the suction pipe end.
4. Install filter on the suction line to avoid any solid particles entering the pump.
5. Use pipe joint sealant so all the suction piping connections will be airtight and it also prevents leakage in the connections.

VALVE ON DISCHARGE•SIDE

1. If a shut off valve is required to be installed on the discharge line, use pressure relief valve in place of shut off valve.
2. In some models, standard internal pressure relief valve would be available on the discharge side, and for this case, shut off valve on discharge line may not be required.
3. If inner pressure relief valve is not provided, then install one pressure relief valve externally on the discharge line.
4. Use supports on the pump and piping during assembly and installation to avoid breaking of pipe and damages to the pump.

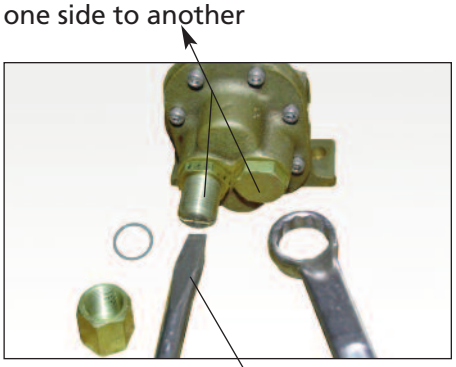
⚠CAUTION ***Globe valves or other restrictive valves should not be used in the place of gate valve as it may create more system pressure.***

⚠WARNING ***Ensure the system pressure does not exceed 100 psi. Do not shut off the system without using pressure relief valve on the discharge side.***

5. If the pump needs to be self draining, the pump head should be mounted in vertical position with suction port facing down. While using the higher viscosity fluid as pumping liquid, the suction port should be facing up (vertical position)
6. The pump models with internal relief valve should not be allowed to run continuously for more than one minute. If extended relief is required or anticipated, install one additional external pressure relief valve on the discharge line. Connect a pipe line from relief line of valve back to the suction source or tank or well down stream from the pump suction.
7. Suction lift and self priming of the pumps with packing, depends on viscosity, specific gravity, vapor pressure and air tightness of the packaging.
8. Adjust the pressure at 5 psi above the operating pressure in the discharge line with internal or external pressure relief valve.

Adjustment of internal pressure relief valve

Relief valve can be switched from one side to another



Adjusting pump pressure by changing the valve stem screw

Fig 7. Pressure relief valve adjustment

9. The standard internal pressure relief valve can be moved from one side to the other side (refer Fig 7).
10. Remove the cap of the pressure relief valve, loosen the valve

Bronze models 4KHG4 to 4KHJ3
Cast Iron models 4KHJ4 to 4KHK6

lock nut by using a flat tip screw driver and adjust the valve stem. Tightening the stem will increase pressure and loosening the stem will decrease pressure. After adjustment, tighten the lock nut till no leakage is found and reinstall the lock nut and cap.

DRIVE CONNECTION

1. The gear pumps will operate equally well in either directions.
2. When looking at the pump drive shaft end and rotation of the shaft clock wise, the discharge port should be in the right hand side. When turning counter clock wise, the discharge port is to be on the left hand side. Always remember, the pressure relief valve is positioned on the discharge port.

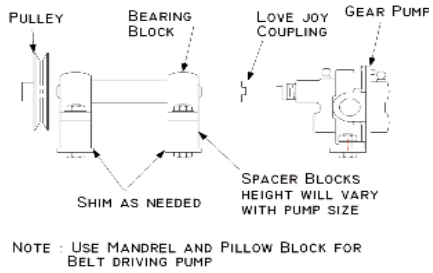


Fig 8. Pump Drive installation

Direct coupling drives

3. Flexible couplings should be used on the motor and pump shaft connecting portions. Avoid using rigid coupling. The flexible coupling will avoid any excessive load on the motor and pump bearings. Specifications for flexible couplings are typically 1 deg angular misalignment and .015" of parallel.
4. Avoid using excessive bends or misalignment and see that the motor and pump shaft are in proper alignment (refer fig 8. for drive installation of motors).For lower speed of pump, engine drive is not recommended, V belt pulley arrangement is advisable to reduce the torque loads on pump. The maximum rpm required is 1725 for viscosity of 500SSU.

SHIMS AND MOUNTING

5. The direct coupling of the pumps to motors is done through the accurate alignment of the pump shaft to the motor shaft. Adjust the motor and or pump height for proper alignment.
6. The shims are not the parts of either motor or pump. After the motor and pump is mounted on the flat base, the height alignment is done by using suitable spacers under either motor and or pump as required. Then shims are provided for adjusting this gap between base spacer and motor/pump bottom base as final adjustment. Horizontal and vertical misalignment to be checked by placing a straight edge across both couplings. Horizontal misalignment is corrected by loosening either or both motor and pump until proper alignment is achieved. Final vertical alignment is achieved through the shims for variation on the motor or pump shaft height (see fig 8). If misalignment is not corrected, it leads to noisy operation, leakage and reduce the life of motor and pump.

Note: Specification for flexible coupling are 1 angular and 0.015" parallel misalignment. Vertical alignment can be achieved by .005" and .010" shims.

Pulley Drive

7. For running the pumps in reduced speed belt and pulley is used to accomplish the necessary ajustment. But the belt tension will add side-thrust to the pump drive shaft which results in extra load on the bearings and reduce the pump life. To avoid this side- thrust, a ball bearing pillow block is introduced to support the belt load is (see Fig 8.) For pulley driven pumps, a single V belt is necessary upto 1 HP, 3450 rpm. For larger drive sizes, double V belts are recommended and the max. pump rpm is 1725.

⚠WARNING ***Install the safety guards to prevent any property damage and personal injury. Follow all electrical, safety codes, National Electric Codes (NEC) and occupational safety and health act (OSHA in the United States).***

⚠CAUTION ***Gasoline is a highly incombustible fuel. Never fill fuel when engine is hot. Improper use, handling or storage of gasoline is dangerous.***

OPERATION

1. For the self priming pump, gears and seals should be wetted before it is started.
2. The pump should be filled with pumping liquid through priming Tee, provided on the discharge side. If Tee is not provided, remove discharge pipe and fill liquid through discharge outlet of the pump. A primed pump (liquid is fully filled in both suction pipe and upto pump discharge outlet) is capable of lifting head of 19.5 foot both vertical and horizontal lift, depending on the model of the pump. Refer performance chart for actual suction lift values).
3. Once the pump is fully filled with liquid, replace the priming plug or reconnect the Tee end or discharge pipeline. Now it is ready to run.
4. Pumps with packing type seals are preset in the factory itself for betterstart and use. The packing rope/rings should not be too tight

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Dayton® Light-Duty Pedestal Rotary Gear pump

that at least one drop per 20 – 30 seconds. Check before continuous run.

5. If foot valve or check valve is not provided on the suction pipe, then priming should be done before every time the pump is stopped and restarted.
6. For longer life, always prime pumps before start up of pump every time. Avoid dry running to ensure longer life of gears, bearings and pump performance. The gear pumps are built in very close tolerances and these tolerances should not be disturbed. Hence, the liquid must be free of all abrasives, sand and dusts.
7. Pumps equipped with grease zerks should be greased prior to operation.

SERVICE AND MAINTAINCE

Make sure that the power connections to the motor are disconnected before attempt for servicing the pump or motor.

Bronze pressure relief valve model: 4KHH7 to 4KHJ3(Fig 15)

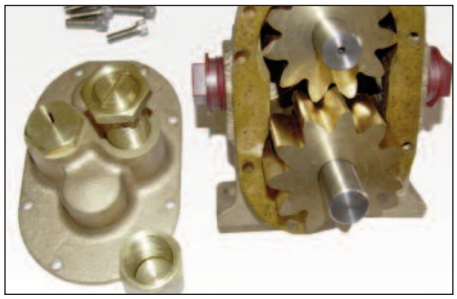

Fig. 9 Dissembled pressure relief model

1. Remove the cover (Ref. No.8) by removing 8 mounting screws (Ref. No. 9).
2. Pull the gears from the body (Ref. No. 11 & 12).
3. Remove PTFE rings from pump shaft. Do not cut pump shaft if stuck.
4. Remove valve cap, stem, lock nut, spring and ball from the cover (Ref no.1, 2, 3, 6 and 7).

⚠CAUTION ***Gasket surface must be free from any cuts or external material. Any increase in thickness will cause a reduction in pump performance.***

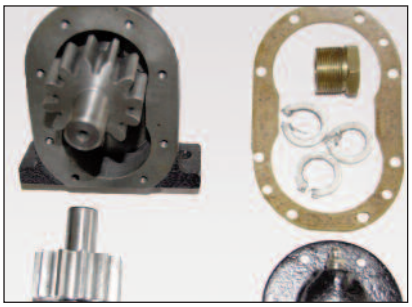

Fig.10 Dissemble view of zerk model

5. Reassemble pump parts starting with gears, then gasket, locknut.
6. Reassemble the pressure relief valve in the same order shown in the Fig 15.
7. Tighten all screws and locknut.

⚠CAUTION ***When you tighten the screw make sure your gears rotate freely. Tighten the screws from alternate edges simultaneously. If you are unable to rotate freely check the gasket and also loosen the screws and start again.***

1. Check the packing type seals and packing nut periodically to ensure whether the drip of liquid drop is within the norms of one drop in every 20 – 30 seconds or 10 drops in 3 – 5 minutes.
2. On pump models with grease fittings, the units should be greased and the lubrication to be checked.
3. Lip seal models require no particular maintenance, but it should be checked for leaks and performance.
4. Clean the suction foot valve, filter often for easy flow of liquid.

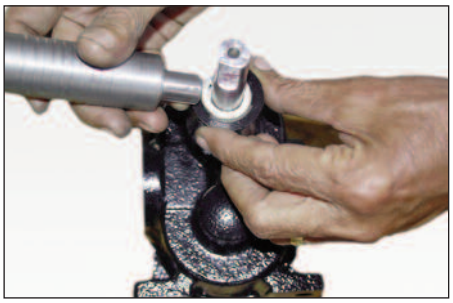

Fig.11. Installing gasket using pipe assembly

5. Periodically clean the dirt accumulations in open type motors, especially in and around vent openings by using vacuum cleaners.

GENERAL SERVICE

1. Check pump daily, weekly, monthly for proper operation. Any changes found in the unit, it should be replaced or repaired by authorized electricians or service technicians.
2. Check the motor and pump shaft alignment at regular intervals.
3. Pump should be drained if placed in an area where temperature is in freezing condition.
4. If pump is to be kept idle for long period, pour some quantity of light oil/machining coolant oil or some storage and rotate the gear for full immersion.

Assembly and disassembly

Seal replacement – packing type:

Cast Iron Model 4KHJ4 to 4KHK6
Bronze Model 4KHG4 to 4KHJ3

1. On pump models with packing seals, if the liquid drip is excessive than

Bronze models 4KHG4 to 4KHJ3
Cast Iron models 4KHJ4 to 4KHK6

the maximum limit, adjust the packing nut and replace the packing seal or rope. If the problem persist then replace the shaft itself with packing. To replace the packing, remove the pump from its application and prime mover end, then remove packing nut for relief valve pumps.

2. Remove the worn out packing rings. It can be picked from the bore or remove packing rings from shaft end one by one (see fig.11). The drive shaft and gear assembly should be inspected when the pump is apart. If excessive worn out on the shaft or the packing area, then replace the entire pump. These pumps are all throw away types.

For most of the pumps three or four packing rings are sufficient. The split in the packing rings should be staggered to ensure good sealing of the pump. Wet packing rings with water for bronze models and with oil for cast iron models before installation

3. Gently place each ring one by one by using a plastic pipe (see fig. 11)

4. Install packing nut and tighten.

Reinstall pump and all safety shields and prime the pump and see that the gears and seals are fully wetted.

5. Start the pump and adjust the packing nut in order to achieve the seal drips 10 drops every 3 – 5 minutes.

⚠CAUTION ***Too tight will cause excess heat and low drip of liquid reduces life of seal. Too loose will reduce suction lift capability and causes excess leakage.***

Model: 4KHJ4 to 4KHJ9 Cast Iron

Fig.12 REPLACEMENT – LIP SEAL TYPE

1. For pumps fitted with lip seals, remove pump from application and disassemble the pump.

2. Remove the retaining ring or washer (Ref. No. 1). Take out the old lip seal (Ref No. 8). This can be done externally or by splitting the pump, remove the drive shaft assembly and push the seal out from inside.

3. Install new lip seal by pushing it inside into the drive shaft housing with a wood dowel or socket and flush to the mechanical lip on the pump housing. Then replace the retainer ring (see fig12).

4. Lubricate the seal before installing into shaft and inspect the pump drive shaft for scratches or burrs before final assembly.

NOTE : Lubricate seal before installing into the drive shaft.

⚠CAUTION ***Only pump liquids that are compatible with pump materials. For more information check wet end components specification.***

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Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
No liquid delivered	1. Pump not primed	1. Prime pump
	2. Leak in suction line	2. Use thread sealant, repair or replace
	3. Foot valve clog	3. Clean or replace foot valve
	4. Suction lift too far	4. Shorten discharge head
	5. Discharge piping is too small	5. Match discharge outlet size on pump
Pump vibrates and/or is noisy	1. Pump not primed	1. Prime pump
	2. Faulty suction piping	2. Replace
	3. Suction height too great	3. Shorten the height
	4. Gear loose on shaft	4. Replace
	5. Seal broken	5. Replace
	6. Gasket damage	6. Replace

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

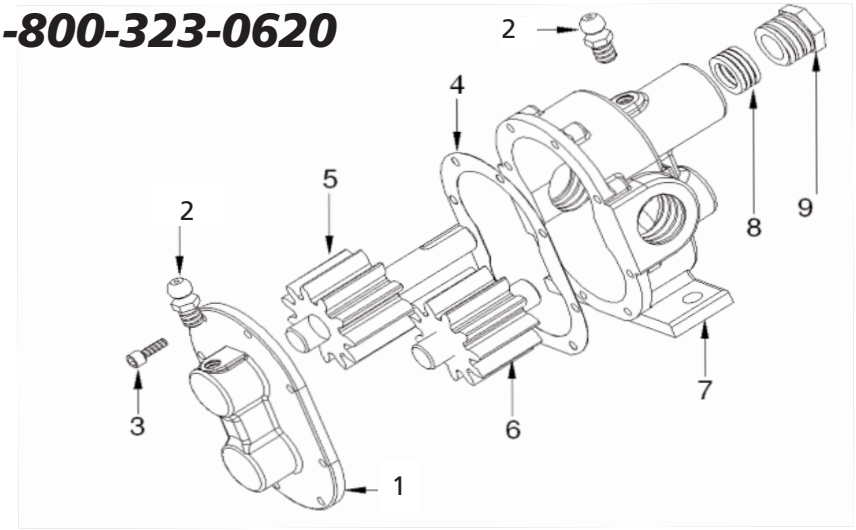

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Figure 13A – Repair Parts Illustration for Bronze Models with Grease Zerk Fittings

Ref No.	Description	4KHG4 Part No	4KHG5 Part No	4KHG6 Part No	4KHG7 Part No	4KHG8 Part No	4KHG9 Part No	Qty
1	Cover	*	*	*	*	*	*	N/A
2	Grease Fitting	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	2
3	Screw	+	+	+	+	+	+	N/A
4	Gasket	PPO9ZN000G	PPO9ZN001G	PPO9ZN002G	PPO9ZN002G	PPO9ZN003G	PPO9ZN003G	1
5	Drive Gear	PPM316701G	PPM316801G	PPM316901G	PPM317001G	PPM317101G	PPM317201G	1
6	Driven Gear	PPM3ZN006G	PPM3ZN007G	PPM3ZN008G	PPM3ZN009G	PPM3ZN009G	PPM3ZN010G	1
7	Body	*	*	*	*	*	*	N/A
8a	PTFE packing	PPO7ZN000G	PPO7ZN000G					3
8b	PTFE packing			PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	4
9	Packing nut	PPM5ZN000G	PPM5ZN000G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	1

(*) Part not available.

(+) Check for part availability at Grainger or local hardware store.
Screw bolt length (in.) 1/2. Threads per inch: 10-24 fully threaded. Material: Stainless Steel. Fastener Type: 3/16" Hex Cap Head.

Figure 13B – Repair Parts Illustration for Cast Iron Models with Grease Zerk Fittings

Ref No.	Description	4KHK1 Part No	4KHK2 Part No	4KHK3 Part No	4KHK4 Part No	4KHK5 Part No	4KHK6 Part No	Qty
1	Cover	*	*	*	*	*	*	N/A
2	Grease Fitting	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	PPR4ZN001G	2
3	Screw	+	+	+	+	+	+	N/A
4	Gasket	PPO9ZN000G	PPO9ZN001G	PPO9ZN002G	PPO9ZN002G	PPO9ZN003G	PPO9ZN003G	8
5	Drive Gear	PPM919100G	PPM919200G	PPM929300G	PPM939400G	PPM949500G	PPM959600G	1
6	Driven Gear	PPM91N000G	PPM91N001G	PPM92N001G	PPM93N001G	PPM94N001G	PPM95N001G	1
7	Body	*	*	*	*	*	*	N/A
8a	PTFE packing	PPO7ZN000G	PPO7ZN000G					3
8b	PTFE packing			PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	4
9	Packing nut	PPM5ZN000G	PPM5ZN000G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	1

(*) Part not available.

(+) Check for part availability at Grainger or local hardware store.
Screw bolt length (in.) 1/2. Threads per inch: 10-24 fully threaded. Material: Stainless Steel. Fastener Type: 3/16" Hex Cap Head.

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

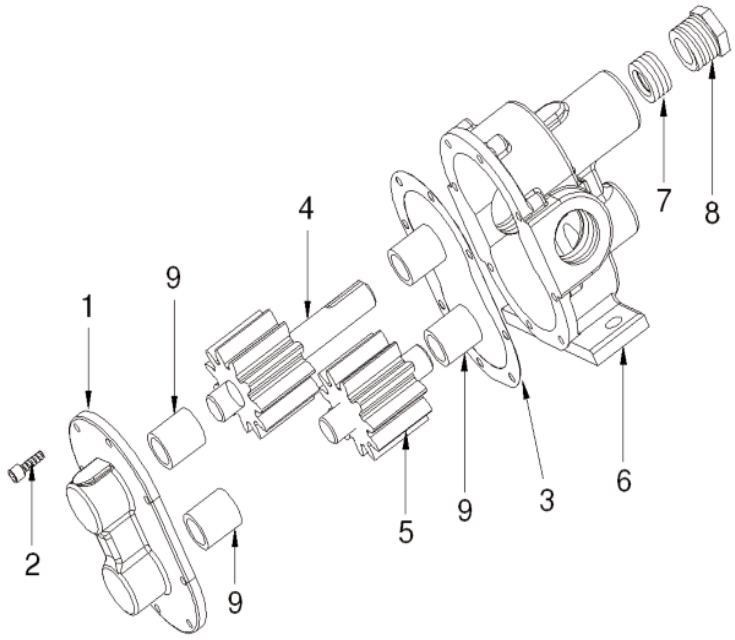

Figure 14 – Repair Parts Illustration for Bronze Models with Carbon-Graphite Bushing

Ref No.	Description	4KHH1 Part No	4KHH2 Part No	4KHH3 Part No	4KHH4 Part No	4KHH5 Part No	4KHH6 Part No	Qty
1	Cover	*	*	*	*	*	*	N/A
2	Screw	+	+	+	+	+	+	N/A
3	Gasket	PPO9ZN000G	PPO9ZN001G	PPO9ZN002G	PPO9ZN002G	PPO9ZN003G	PPO9ZN003G	1
4	Drive Gear	PPM3ZN000G	PPM3ZN001G	PPM3ZN002G	PPM3ZN003G	PPM3ZN004G	PPM3ZN005G	1
5	Driven Gear	PPM3ZN006G	PPM3ZN007G	PPM3ZN008G	PPM3ZN009G	PPM3ZN009G	PPM3ZN010G	1
6	Body	*	*	*	*	*	*	N/A
7a	PTFE packing	PPO7ZN000G	PPO7ZN000G					3
7b	PTFE packing			PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	4
8	Packing nut	PPM5ZN000G	PPM5ZN000G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	1
9	Bushing	PPO9ZN013G	PPO9ZN014G	PPO9ZN015G	PPO9ZN016G	PPO9ZN017G	PPO9ZN017G	4

(*) Part not available.

(+) Check for part availability at Grainger or local hardware store.
Screw bolt length (in.) 1/2. Threads per inch: 10-24 fully threaded. Material: Stainless Steel. Fastener Type: 3/16" Hex Cap Head.

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For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

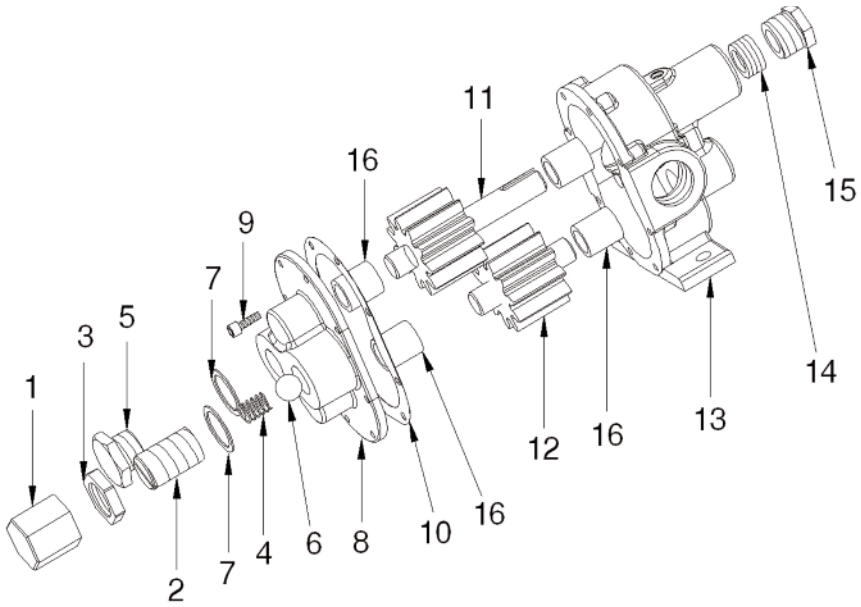

Figure 15– Repair Parts Illustration for Bronze Models with Carbon-Graphite Bushings and Relief Valve

Ref No.	Description	4KHH7 Part No	4KHH8 Part No	4KHH9 Part No	4KHJ1 Part No	4KHJ2 Part No	4KHJ3 Part No	Qty
1	Valve cap	PPM51N001G	PPM51N001G	PPM5ZN008G	PPM5ZN008G	PPM5ZN009G	PPM5ZN009G	1
2	Valve stem	PPM51N002G	PPM51N002G	PPM5ZN010G	PPM5ZN010G	PPM5ZN011G	PPM5ZN011G	1
3	Valve locknut	PPM51N003G	PPM51N003G	PPM5ZN012G	PPM5ZN012G	PPM5ZN013G	PPM5ZN013G	1
4	Valve spring	PPO31N001G	PPO31N001G	PPO3ZN003G	PPO3ZN003G	PPO3ZN004G	PPO3ZN004G	1
5	Hex. Plug	PPM51N004G	PPM51N004G	PPM5ZN014G	PPM5ZN014G	PPM5ZN015G	PPM5ZN015G	1
6	Ball	PPR31N001G	PPR31N001G	PPR3ZN012G	PPR3ZN012G	PPR3ZN013G	PPR3ZN013G	1
7	Valve gasket	PPM9ZN000G	PPM9ZN000G	PPM9ZN000G	PPM9ZN000G	PPM9ZN002G	PPM9ZN002G	1
8	Cover	*	*	*	*	*	*	N/A
9	Screw	+	+	+	+	+	+	N/A
10	Gasket	PPO9ZN000G	PPO9ZN001G	PPO9ZN002G	PPO9ZN002G	PPO9ZN003G	PPO9ZN003G	1
11	Drive Gear	PPM3ZN000G	PPM3ZN001G	PPM3ZN002G	PPM3ZN003G	PPM3ZN004G	PPM3ZN005G	1
12	Driven Gear	PPM3ZN006G	PPM3ZN007G	PPM3ZN008G	PPM3ZN009G	PPM3ZN009G	PPM3ZN010G	1
13	Body	*	*	*	*	*	*	N/A
14a	PTFE packing	PPO7ZN000G	PPO7ZN000G					3
14b	PTFE packing			PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	PPO7ZN001G	4
15	Packing nut	PPM5ZN000G	PPM5ZN000G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	PPM5ZN001G	1
16	Bushing	PPO9ZN018G	PPO9ZN014G	PPO9ZN020G	PPO9ZN021G	PPO9ZN022G	PPO9ZN023G	4

(*) Part not available.
(+) Check for part availability at Grainger or local hardware store.
Screw bolt length (in.) 1/2. Threads per inch: 10-24 fully threaded. Material: Stainless Steel. Fastener Type: 3/16" Hex Cap Head.

For Repair Parts, call 1-800-323-0620

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

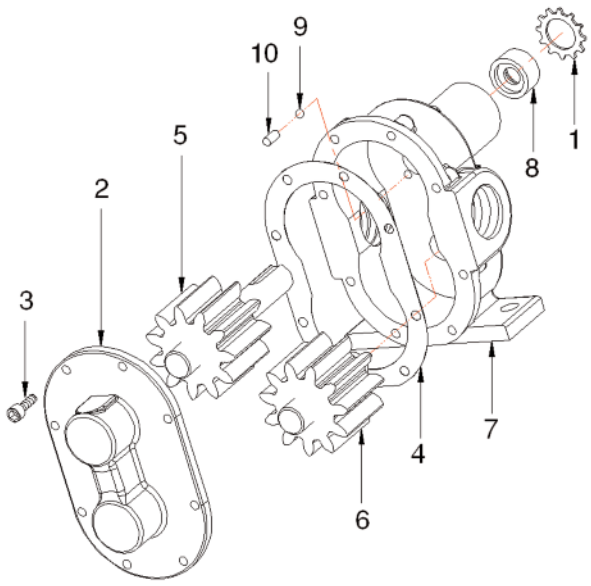

Figure 16 – Repair Parts Illustration for Cast Iron Models with Viton Lip Seal

Ref No.	Description	4KHJ4 Part No	4KHJ5 Part No	4KHJ6 Part No	4KHJ7 Part No	4KHJ8 Part No	4KHJ9 Part No	Qty
1	Retaining ring	PPO618500G	PPO618500G	PPO6ZN001G	PPO6ZN001G	PPO6ZN001G	PPO6ZN001G	1
2	Cover	*	*	*	*	*	*	N/A
3	Screw	+	+	+	+	+	+	N/A
4	Gasket	PPO9ZN000G	PPO9ZN001G	PPO9ZN002G	PPO9ZN002G	PPO9ZN003G	PPO9ZN003G	1
5	Drive Gear	PPM918500G	PPM918600G	PPM928700G	PPM938800G	PPM948900G	PPM959000G	1
6	Driven Gear	PPM91N000G	PPM91N001G	PPM92N001G	PPM93N001G	PPM94N001G	PPM95N001G	1
7	Body	*	*	*	*	*	*	N/A
8	Lip seal, Viton	PPR8ZN000G	PPR8ZN000G	PPR8ZN001G	PPR8ZN001G	PPR8ZN001G	PPR8ZN001G	1
9	Ball	PPR4ZN002G	PPR4ZN002G	PPR4ZN002G	PPR4ZN002G	PPR4ZN002G	PPR4ZN002G	2
10	Retainer pin	PPR4ZN003G	PPR4ZN003G	PPR4ZN003G	PPR4ZN003G	PPR4ZN003G	PPR4ZN003G	2

(*) Part not available.
(+) Check for part availability at Grainger or local hardware store.
Screw bolt length (in.) 1/2. Threads per inch: 10-24 fully threaded. Material: Stainless Steel. Fastener Type: 3/16” Hex Cap Head.

Dayton® Light Duty Pedestal Rotary Gear Pumps

Gear Pump Selection

Determine total pump discharge pressure and then select pump and motor HP combination that delivers the flow (in GPM) The viscosity/temperature of the liquid pumped will affect the pump speed (RPM). Use Table No. 1 as a guide. For better Suction/discharge, piping lines must be increased by at least 1 (or, better, 2) pipe size over the size of the pump ports. The motor's horsepower must be increased over the power required to pump water under the same pressure and flow. Use Table No. 2 to find the percentage increase in horsepower required for various pressures and viscosities.

TABLE 1 -- VISCOSITY VS. SPEED

VISCOSITY (SSU)	SPEED (RPM)
50 TO 500	1725
1200	1600
2500	1300
7000	1000
20,000	600
50,000	400
100,000	200

TABLE 2 - HP VS VISCOSITY (% IN INCREASE IN HP)

PRESSURE	VISCOSITY (SSU)					
(PSI)	500	1000	5000	10,000	50,000	100,000
2	10	20	40	80	120	150
20	12	25	50	90	150	200
40	15	30	60	105	180	250
60	20	40	80	120	220	300
80	25	50	100	160	260	350
100	30	60	120	200	300	400

Gear Pump Installation

Installation of gear pumps is done as shown in Fig.17. A foot valve and strainer is attached to the suction line to prevent any solid particles entering the pump. A vacuum switch is connected in the suction line and leads are given to the motor. The switch disconnects the power to the motor when there is no liquid flow in suction line.

To the delivery line a pressure guage, ball valve, quick disconnect valve and pressure relief valve should be connected for controlling pressure and flow. Gear pump is connected to the motor using a coupling.

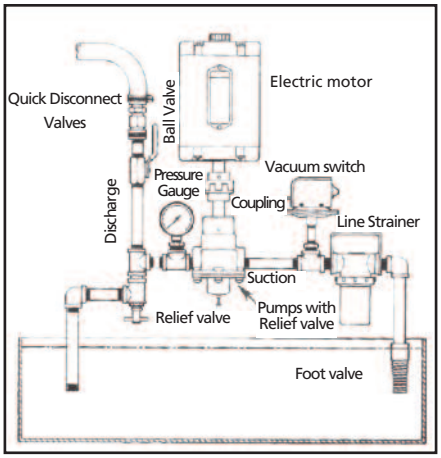

Figure 17 Gear Pump Installation

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Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 U.S.A.

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Product Information Packet

M7006A

.5HP,1725RPM,3PH,60HZ,56,X3416M,XPFC,F1

Part Detail							
Revision:	AD	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	3416M	**Elec. Spec:**	34WG1543	**CD Diagram:**	CD0007
Enclosure:	XPFC	**Mfg Plant:**		**Mech. Spec:**	34-5323	**Layout:**	34LY5323
Frame:	56	**Mounting:**	F1	**Poles:**	04	**Created Date:**	
Base:	RG	**Rotation:**	R	**Insulation:**	B	**Eff. Date:**	06-30-2014
Leads:	12#18					**Replaced By:**	
Literature:		**Elec. Diagram:**					

Nameplate NP0016XPSL					
NO.		CC			
SER.					
SPEC.	34-5323-1543				
CAT.NO.	M7006A				
HP	.5	T. CODE	T3C		
VOLTS	208-230/460				
AMPS	2.1-2/1				
RPM	1725				
HZ	60	PH	3	CL	B
SER.F.	1.00	DES	B	CODE	L
RATING	40C AMB-CONT				
FRAME	56	NEMA-NOM-EFF	74		
USABLE AT 208V	2.1	PF	63		
BLANK					

Parts List

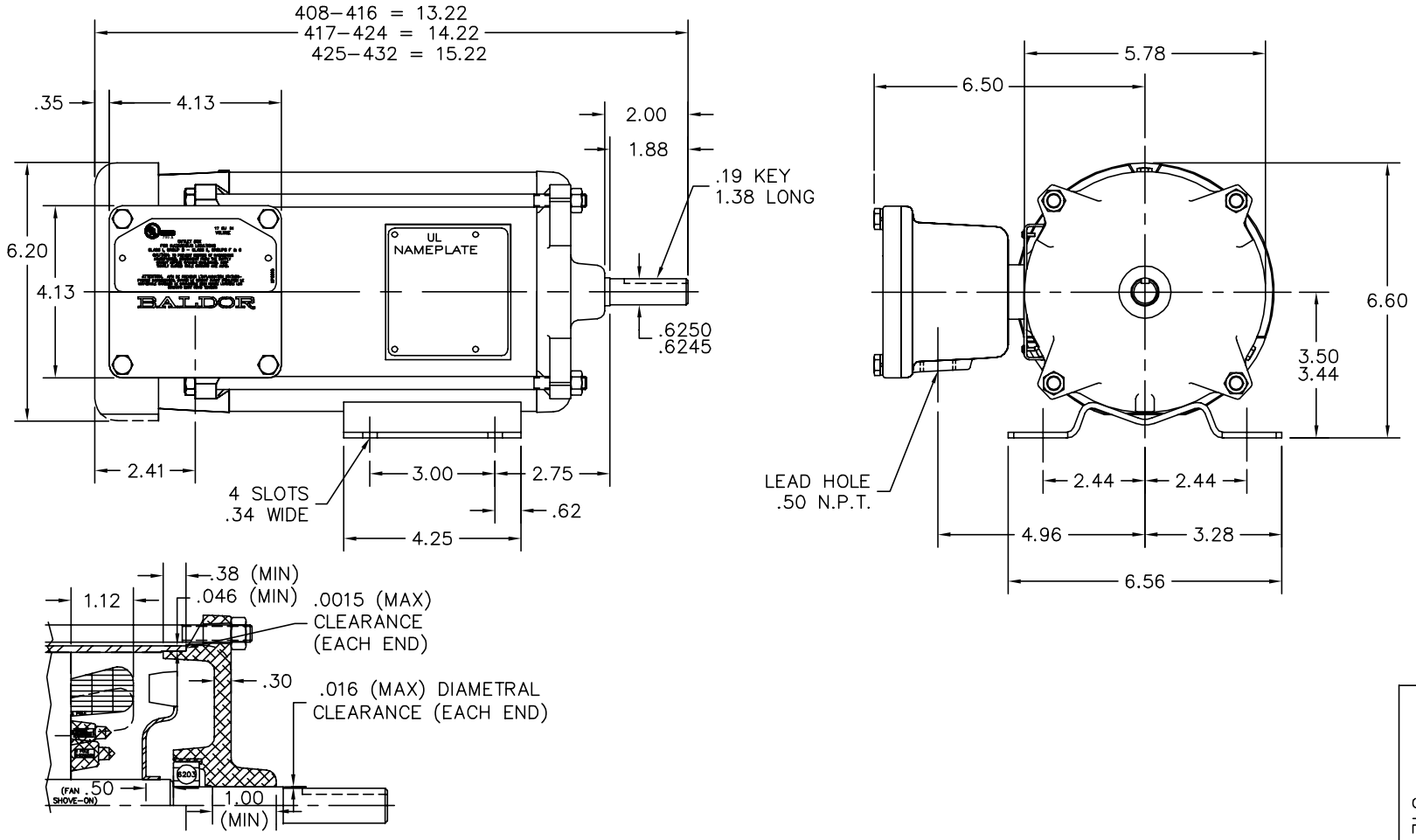
Part Number	Description	Quantity
SA008945	SA 34-5323-1543	1.000 EA
RA005392	RA 34-5323-1543	1.000 EA
TPMYJ70KX	THERMAL 3PH 0.75 AUT 120C	1.000 EA
MJ5000A01	SEALANT, CHICO A COMPOUND	0.050 LB
35CB3001A01SP	EXPL CONDUIT BOX, MACH, 1/2" PIPE TAP LE	1.000 EA
11XW1032G06	10-32 X .38, TAPTITE II, HEX WSHR SLTD U	1.000 EA
HW3001B01	003SS CUP WASHER, FOR #8 SCREW	1.000 EA
51XW0832A07	8-32 X .44, TAPTITE II, HEX WSHR SLTD SE	2.000 EA
34EP3703A01	FR ENDPLATE, MACH XP	1.000 EA
HW4002A02	1-11.5X2LG PIPE NIPPLE (F/S)	1.000 EA
HA1025A13	WSHR,FELT,.38" THICK F-26 CLASS	1.000 EA
HW3021E06	1/8 DIA X 5/8 ROLLPIN (F/S)	1.000 EA
HW5100A03SP	WAVY WASHER (W1543-017)	1.000 EA
34EP3704A01	PU ENDPLATE, MACH XP	1.000 EA
XY3118A12	5/16-18 HEX NUT DIRECTIONAL SERRATION	4.000 EA
34FN3002A01SP	EXTERNAL FAN, PLASTIC, .637/.639 HUB W/	1.000 EA
34FH4002A01	IEC FH NO GREASER	1.000 EA
51XW1032A06	10-32 X .38, TAPTITE II, HEX WSHR SLTD S	3.000 EA
35CB3500A01SP	CONDUIT BOX LID, MACH	1.000 EA
51XN2520A16	SCREW, HEX WS SLT, ZN, 1/4-20 X 1.00	4.000 EA
HW2501D13SP	KEY, 3/16 SQ X 1.375	1.000 EA
HA7000A04	KEY RETAINER 0.625 DIA SHAFTS	1.000 EA
NP0018	NP- XP CONDUIT BOX DO NOT MAKE SELLABLE	1.000 EA
HA6001A01	THERMAL RETAINER (PLATED)	1.000 EA

Parts List (continued)

Part Number	Description	Quantity
NS2500A05	INSULATOR, AUTO THER PROT	1.000 EA
12XF0632A06	6-32X3/8 TY F HEX HD SLT	2.000 EA
MG1025G29	MUNSELL 4.5Y 5.3/0.7 DARK CHARCOAL GREY	0.014 GA
85XU0407A04	#4-7 X 1/4 DRIVE PIN	6.000 EA
SP5037A01	TERMINAL PLATE ASS'Y MODEL 34 - 3 PHASE	1.000 EA
WD1000A16	2-520128-2 AMP FLAG TERMINAL(4M/RL)	12.000 EA
WD1000A16	2-520128-2 AMP FLAG TERMINAL(4M/RL)	12.000 EA
HA3104A05	THRUBOLT, 5/16-18 X 8.375	4.000 EA
MN416A01	TAG-INSTAL-MAINT no wire (1200/bx) 10/13	1.000 EA
LB1118	LABEL,WARNING (ROLL LABEL)	1.000 EA
LB1125C01	STD (STOCK) CARTON LABEL BALDOR WITH FLA	1.000 EA
LC0007	CONNECTION LABEL	1.000 EA
NP0016XPSL	SS XP UL CSA CC CL-I GP-D CL-II GP-F&G	1.000 EA
34PA1005	PACKING GROUP, BALDOR	1.000 EA

No performance data has been assigned to this product.

34LY5323



CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

REV. DESC: UPDATE PARTS, ADD/FIX DIMS & STANDARDIZE DESC.		
REV. LTR: J	VERSION: 06	TDR: 000000867652
FILE: \AAA\00026\312	REVISED: 11:11:03 08/18/2014	BY: ENJERWO
MTL: –		

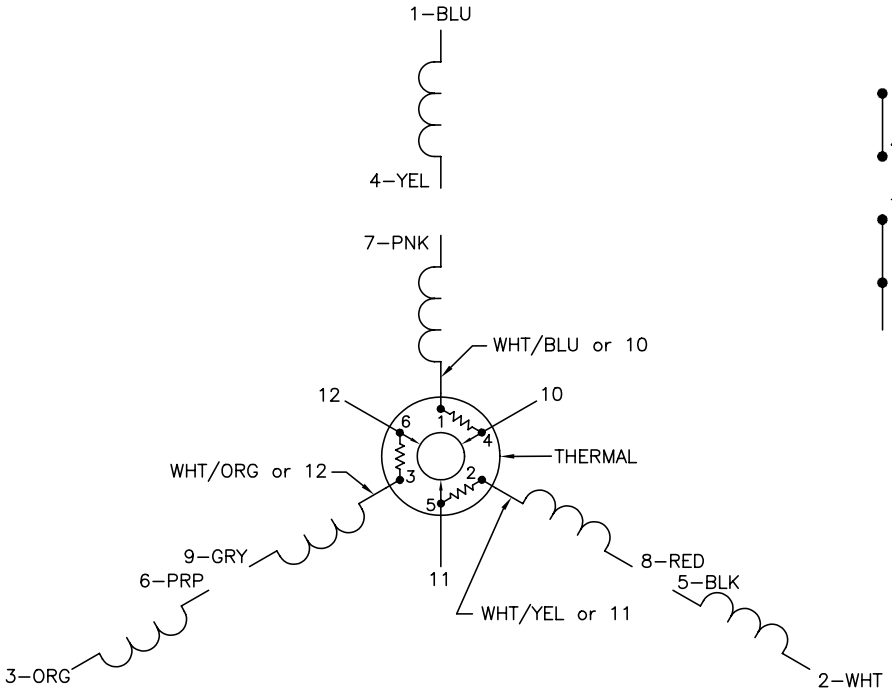
BALDOR

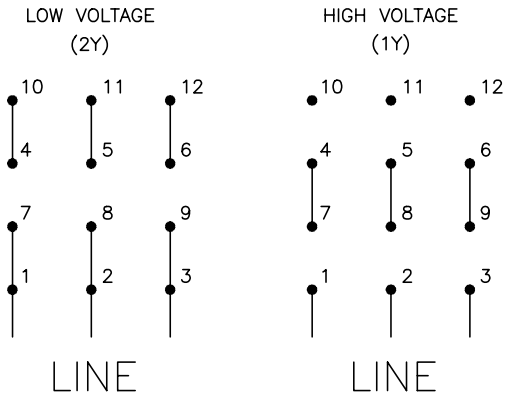
HORZ X34M NEMA 56 XPFC CL–I GP–D, CL–II GP–F&G

SH 1 of 1

34LY5323

CD0007





NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY VARY.
3. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

REV. DESC: ADDED "CK" PLANT CODE			BALDOR ELECTRIC Co.
REV. LTR: E	BY: EAH	REVISED: 05/06/99 17:1	TDR: 0181040
CD0007		FILE: AAA00008370	MDL: –
		MTL: –	3PH, DV, THERMAL, 12 LEADS

CD0007

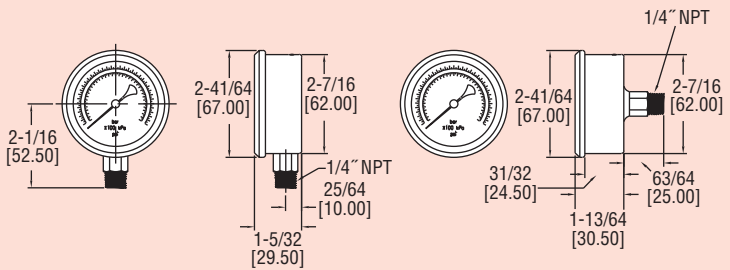
Series SGY

2.5″ Stainless Steel Industrial Pressure Gage

1.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales

SGY Bottom

SGY Back with Accessory Pointers



The Series SGY Gages have dual psi and bar (x100 kPa) scales with ±1.5% full-scale accuracy. The Series SGY gages are designed with 304 SS housings and brass wetted parts for excellent chemical compatibility. These gages cover a wide variety of ranges from full vacuum to 1,000 psi and are available in both bottom or back connections. Series SGY gages employ an easy-open breather plug on top, which allows liquid filled units to breathe, relieving any built up internal pressures. Plug easily pops open and does not need to be entirely removed or cut like a typical gages' rubber plug grommet.

APPLICATIONS

- Vacuums in pneumatic conveying lines
- Positive pressure in compressed air headers

Model	Range	Model	Range
SGY-D10122N	30″ Hg to 0	SGY-D10722N	0 to 200 psi
SGY-D10322N	0 to 30 psi	SGY-D11022N	0 to 300 psi
SGY-D10422N	0 to 60 psi	SGY-D11122N	0 to 500 psi
SGY-D10522N	0 to 100 psi	SGY-D11222N	0 to 1000 psi
SGY-D10622N	0 to 160 psi		

Note: To order with glycerin fill add - GF to the end of the model
For back connect, change ending from 22N to 42N

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Brass connection, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±1.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Weight: 4.9 oz (139 g) bottom, 5.8 oz (164 g) back. Add 2.8 oz (78 g) for fill.

ACCESSORIES

A-445D, U-Bracket Mounting Kit for 2.5″ Gage
A-499R, Red Sliding Color Pointer
A-499Y, Yellow Sliding Color Pointer
A-499G, Green Sliding Color Pointer

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

POSITIVE-DISPLACEMENT TOTALIZERS
For Oil Flow

FTB-30

All products shown smaller than actual size.

FTB-32

FTB-30

1 YEAR WARRANTY

FTB-31P

- For Flows Down to 0.26 GPH
- For #2, 4, or 6 Oil
- Direct Totalization in Engineering Units
- Scaled Pulse Output Available
- ±1% Rdg Accuracy
- Special Versions Available for Low-Viscosity Fluids, Including Water and Freon

FTB-30 Series totalizers are typically used in applications in which accurate measurement of (#2, 4, or 6) heating oil flow is required. The FTB-32 features a fully rotatable, easy-to-read face.

The FTB-30 is designed to be mounted horizontally; the FTB-30 and FTB-31 come with mounting brackets and compression fittings, while the FTB-32 is supplied with ¾ NPT couplings. All FTB totalizers are non-resettable and have an optional reed relay scaled pulse output [with 3 m (10') of cable] for remote totalization. This output must be specified at the time of the order; it is not field installable.

SPECIFICATIONS

Accuracy: ±1% rdg except ±0.5% rdg for FTB-31
Maximum Pressure: 225 psi for FTB-32 through FTB-35; 350 psi for FTB-30 and FTB-31; 360 psi for FTB-36
Pressure Loss:
FTB-30: 0.14 psi
FTB-31: 0.58 psi
FTB-32: 1.80 psi
Wetted Parts: Brass body and anodized aluminum piston; graphite or synthetic rubber piston optional
PULSE OUTPUT
Maximum Switch Load: 3 VA
Maximum Switch Current: 50 mA
Maximum Switch Voltage: 50 Vac
Output Frequency:
0.1 gal/pulse for FTB-30P, FTB-31P, FTB-32P (total only)

F

To Order

Model No. No Output	Model No. Pulse Output (For Total Only)	Flow Rate Minimum	Flow Rate Cont.	Flow Rate Maximum	Connections	Increments (Gallons)	Max Reading (Gallons)	Weight kg (lb)	Maximum Temperature °C (°F)
FTB-30	FTB-30P	0.26 GPH	6.5 GPH	20 GPH	¼" CF*	0.01	100,000	0.5 (1.1)	60 (140)
FTB-31A	FTB-31P	1.0 GPH	20.0 GPH	50 GPH	¾" CF*	0.01	1,000,000	1.3 (2.8)	60 (140)
FTB-32	FTB-32P	8.25 GPH	265.2 GPH	400 GPH	¾ MNPT	0.1	1,000,000	5.0 (11)	127 (260)
FTB-33	FTB-33P	2.6 GPH	105 GPH	160 GPH	½ NPT	0.1	1,000,000	2.1 (4.7)	127 (260)
FTB-34	FTB-34P	20 GPH	528 GPH	800 GPH	1 NPT	1.0	1,000,000	4.2 (9.3)	127 (260)
FTB-35	FTB-35P	59 GPH	1585 GPH	2375 GPH	1½ NPT	10.0	10,000,000	15.9 (35)	127 (260)
FTB-36	FTB-36P	199 GPH	5285 GPH	7925 GPH	2" flange†	—	100,000,000	40.0 (88)	127 (260)

** CF = Compression fitting*
† FTB-36 has 150 lb flange fittings.
Comes complete with operator's manual.
***Ordering Examples: FTB-30P**, pulse-output totalizer, with 0.26 to 20 GPH range.*
***FTB-33**, mechanical totalizer with 2.6 to 160 GPH range.*

FTB-30 Series

Positive Displacement Oil Flow Meters/Totalizers

INSTRUCTION SHEET

M0505/0300

GENERAL DESCRIPTION

The FTB-30 Series Totalizers are used in applications where accurate measurement of heating oil (#2, 4, 6) flow is required. The FTB-30 and FTB-31A are used mainly for light heating oil in small burners. The FTB-32 to FTB-36 are for large flow applications and can be used for all types of oil (2-6) including heavy preheated grades.

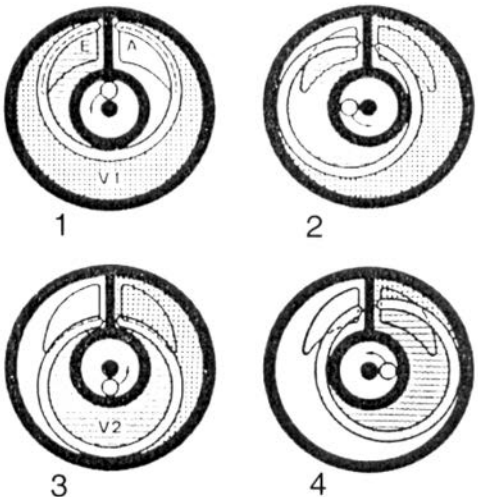
Models FTB-32 to FTB-36 feature fully rotatable, easy-to read faces. The FTB-30 and FTB-31A are shipped with compression fittings, while FTB-32 to FTB-35 are supplied with NPT couplings. All FTB totalizers are non-resettable (counters restart at zero after reaching maximum counting capacity). The FTB-36 has flanges.

The FTB-30 Series meters have an optional reed relay scaled pulse output for remote totalization. This output (option P) must be specified at the time of the order; it is not field installable.

THEORY OF OPERATION

The FTB-30 Series meters come under the category of positive displacement volumetric meters. Their main feature is the division of the measuring chamber into two compartments by the ring piston, which alternately fill and empty. Each cycle thus measures, volumetrically, a definite quantity of liquid. The operation of measurement is thus practically independent of the viscosity and density of the liquid.

Another feature of the volumetric measuring principle of the FTB-30 Series Oil Flowmeter, is the very large measuring range with relatively small metering errors. The range is limited at the highest flows by the maximum permissible cycling speed of the ring piston.

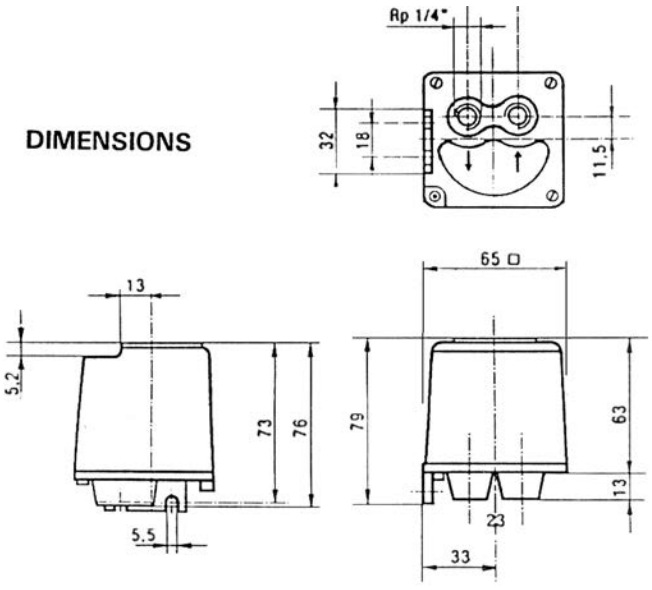


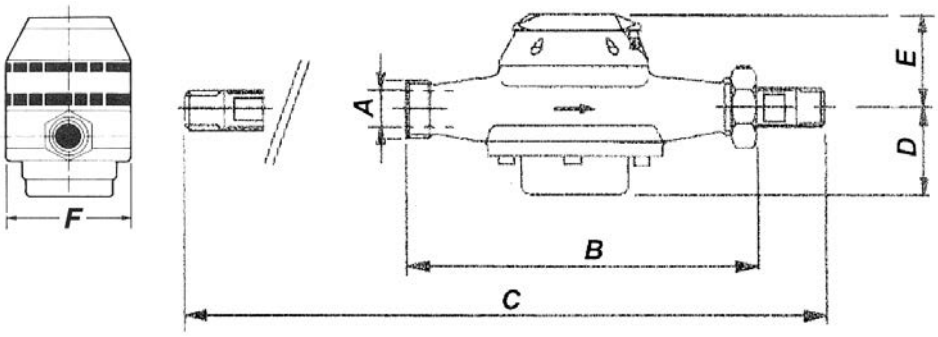
The Construction Diagram shows the measuring chamber with cover removed and the four steps in the metering cycle. In the center of the measuring chamber and top cover lies an annular piston guide. The measuring space is thus a circle, divided by a barrier. The inserted ring piston is guided, on the one hand, by its central spindle following the path of the annular guide; and on the other, by movement of the slit in the piston moving up and down the barrier. The movement is thus oscillatory; the outer diameter of the piston rolling around the inside of the measuring chamber, the inside of the piston around the outer cylindrical face of the annular guide. This creates two measuring chambers, outside (V1) and inside (V2) the piston, the volumes of which change with the piston movement.

The entry port E lies in the base of the measuring chamber and to the left of the barrier. The outlet A is on the opposite side of the barrier, either in the cover or the measuring chamber wall. Thus, there is no direct connection between the inlet and outlet ports. The entry port is so shaped that it feeds either the outer or the inner measuring chamber until both chambers contain the maximum possible volume of liquid. When the second is full, the combined chamber moves towards the outlet port. The chamber volume decreases and discharges the liquid. Thus, with each operating cycle of the piston, two defined and constant volumes V1 and V2 are passed from inlet to outlet. The created pressure differential causes the piston movement.

The drive from the piston to the counter is by means of magnetic coupling.

DIMENSIONS





	FTB-32	FTB-33	FTB-34	FTB-35	FTB-36
A	3/4"	1/2"	1"	1-1/2"	2" flg
B	6.5"	6.5"	7-1/2"	12"	13-3/4"
C	11"	11-1/4"	12"	17"	–
D	2"	2"	3"	4-1/2"	6-1/2"
E	2-3/8"	2-3/8"	2-1/2"	4-1/2"	4-3/4"
F	4-1/8"	4-1/8"	5-1/8"	8-1/4"	–

Model No. No Output	Model No. Pulse Output	Flowrate Min.	Flowrate Cont.	Flowrate Max.	Conn.	Increment Max. Readings-Gals		Weight Lbs.	Max. Temp CF
FTB-30	**FTB-30P**	0.25 gal/h	14.0 gal/h	20.0 gal/h	1/4" CF	0.01	100,000	1.1	60 (140)
FTB-31A	**FTB-31P**	1.0 gal/h	35.0 gal/h	50 gal/h	3/8" CF	0.1	1,000,000	1.1	60 (140)
FTB-32	**FTB-32P**	8 gal/h	265 gal/h	400 gal/h	3/4" mnpt	0.1	1,000,000	5.5	127 (260)
FTB-33	**FTB-33P**	2.6 gal/h	105 gal/h	160 gal/h	1/2" mnpt	0.1	1,000,000	4.7	127 (260)
FTB-34	**FTB-34P**	20 gal/h	528 gal/h	800 gal/h	1" mnpt	1.0	1,000,000	9.3	127 (260)
FTB-35	**FTB-35P**	60 gal/h	1600 gal/h	2400 gal/h	1-1/2"mnpt	10.0	10,000,000	35	127 (260)
FTB-36	**FTB-36P**	200 gal/h	5300 gal/h	8000 gal/h	2" Flg	10.0	10,000,000	88	127 (260)

ACCURACY: ±1% of reading lot
FTB-30; FTB-32-FTB-36
±1/2% of reading for FTB31A

PULSE OUTPUT
MAX. SWITCH LOAD: 3VA
MAX. SWITCH CURRENT: 50mA
MAX. SWITCH VOLTAGE: 50 Vac
OUTPUT FREQUENCY: 0.1 gal/pulse FTB-30P, FTB-31P, FTB-32P, FTB-33P
1.0 gal/pulse FTB-34P,
10.0 gal/pulse FTB-35P, FTB-36P

MAX. PRESSURE: 350 psi for FTB-30 and FTB-31A, 225 psi for FTB-32 thru FTB-34, 150 psi for FTB-35 thru FTB-36

FILTERING REQUIREMENTS:

Model No.	Filter Size or Mesh Width (Size of Opening)	
FTB-30	0.002"	0.05mm
FTB-31A	0.002"	0.05mm
FTB-32	0.004"	0.10mm
FTB-33	0.008"	0.20mm
FTB-34	0.010"	0.25mm
FTB-35	0.012"	0.30mm
FTB-36	0.012"	0.30mm

INSTALLATION AND OPERATION

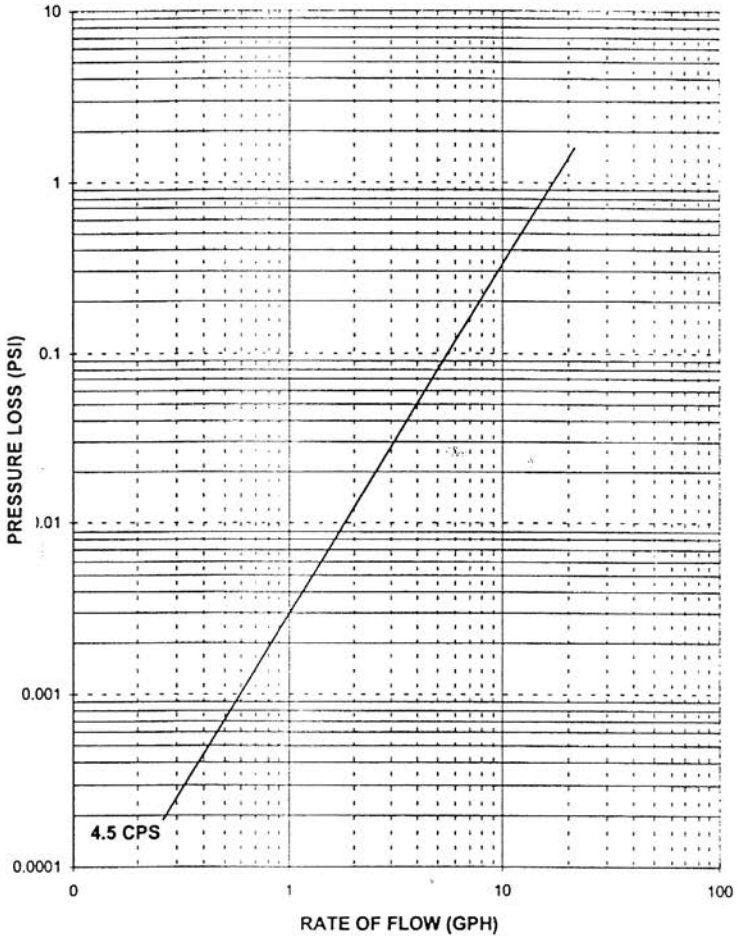
WARNING

THE FTB-30 Series Oil Flowmeters have to be protected against sediments. An oil filter or strainer is essential.

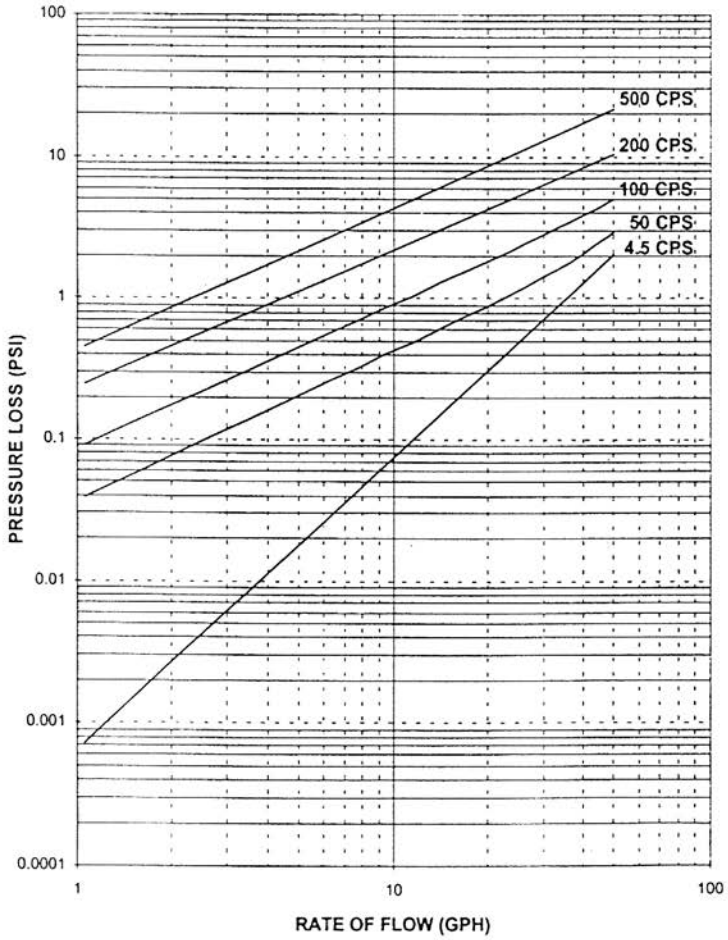
Make sure that the filter is installed upstream of the flowmeter. Remove plastic cover on threads of the flowmeter before installation.

PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-30 AND FTB-31A

1/8" OIL METER #FTB-30

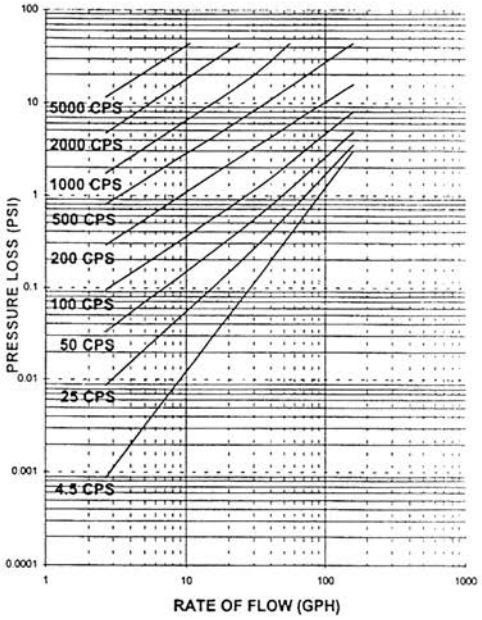


1/4" OIL METER #FTB-31A

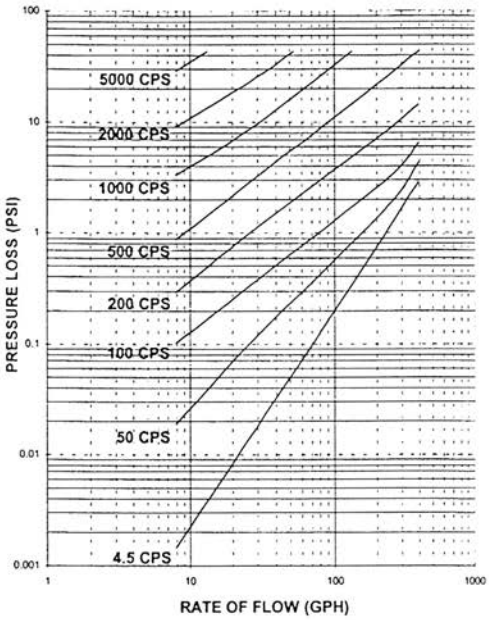


PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-33, FTB-32 AND FTB-34

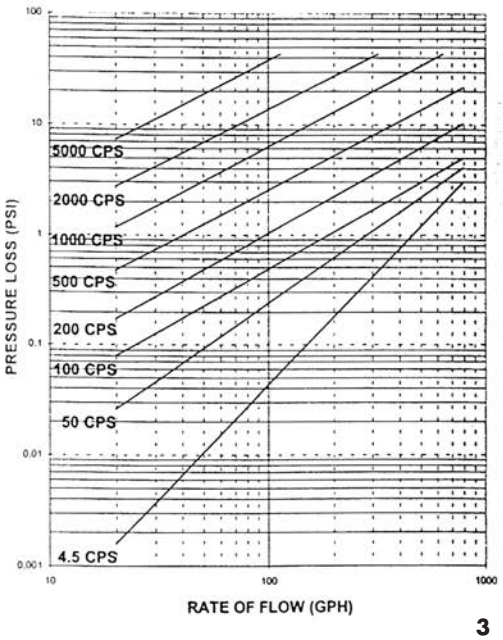
1/2" OIL METER #FTB-33



3/4" OIL METER #FTB-32

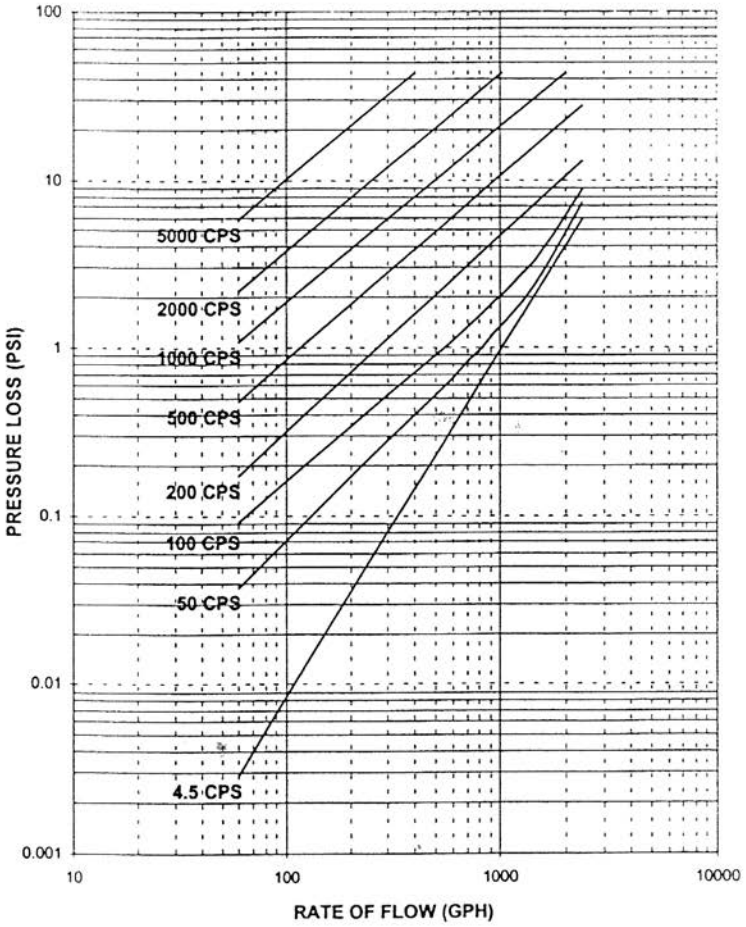


1" OIL METER #FTB-34

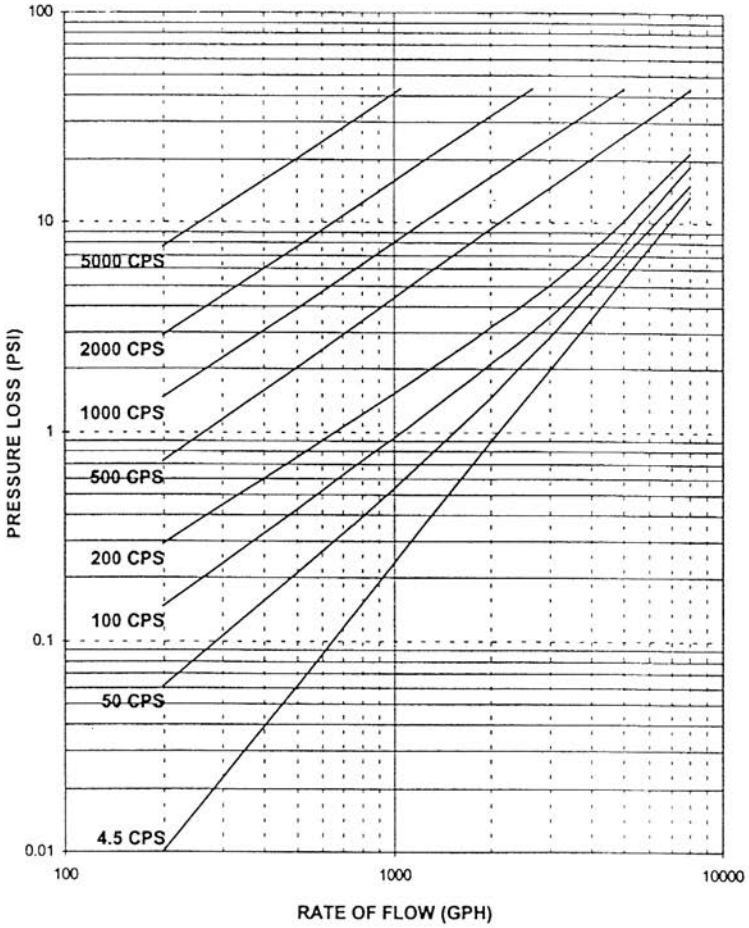


PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-35 AND FTB-36

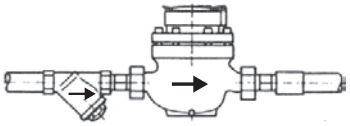
1-1/2" OIL METER #FTB-35



2" OIL METER #FTB-36

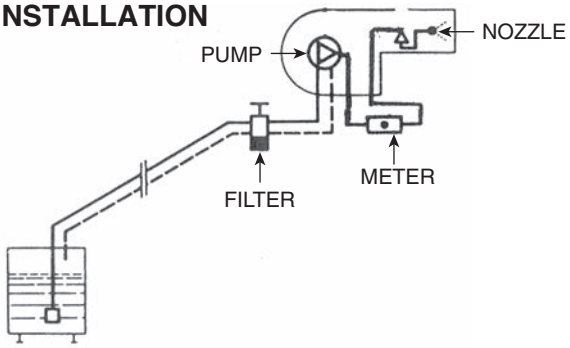


OBSERVE DIRECTION FLOW (ARROW):



STRAINER OR FILTER

TYPICAL INSTALLATION

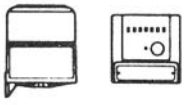


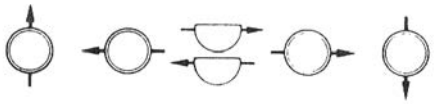
Meter should always be in lower position than the nozzle to prevent the oil from flowing out of the meter.

1. Location of Flowmeter

Because the OMEGA® Oil Flowmeters have high pressure and temperature ratings, they can be installed directly into the nozzle line.

Model	PSI Rating	Temp. Rating
FTB-30	350	140F
FTB-31A	350	140F
FTB-32	225	260F
FTB-33	225	260F
FTB-34	225	260F
FTB-35	150	260F
FTB-36	150	260F





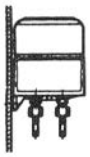
2. Installation Instructions

3. Flushing of Pipes

Make sure all pipes are flushed before installing the FTB-30 Series Flowmeter.

4. Securing Meter

The FTB-30 and FTB-31A should be additionally secured when installed in copper pipes. Use the two openings on the mounting frame.



5. Pressure Fittings & NPT Coupling Pieces

Use the pressure fittings provided for the FTB-30.

Model FTB-30 uses pressure fittings for 1/4" pipe size; the Model FTB-31A uses pressure fittings for 3/8" pipe size. Model FTB-32 - FTB-35 uses NPT fittings. Model FTB-36 has 2" flange (ANSI).

6. Start-up Operation

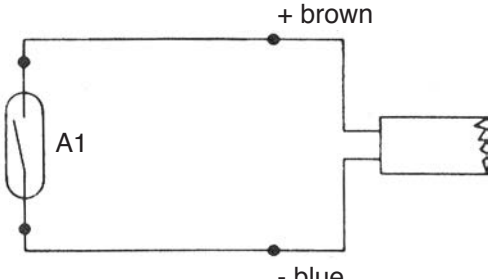
Slowly fill pipe system and carefully vent air in the line. Air trapped in pipes causes incorrect measurements and may damage the meter. Never allow the meter to run dry.

OPTIONAL REED RELAY SCALED PULSE OUTPUT

It is often necessary to transmit measurement parameters from a meter to a distant position. These parameters may also be used as manipulated variable in a regulating or control circuit. In such cases, an electric signal is necessary, which represents the parameter. Ideally this signal will be an impulse that occurs at a given quantity.

The Reed Relay Scaled Pulse Output incorporates a sensing unit. Like the standard counter capsule, it is vacuum sealed and thus protected from all possible foreign matter. One of the pointers is fitted with a small magnet which operates a reed contact inside the sensing unit once per revolution. This establishes an impulse in the control circuit.

WIRING DIAGRAM FOR REED RELAY SCALED PULSE OUTPUT



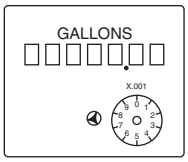
HOW TO READ OIL FLOWMETERS IN U.S. GALLONS

The FTB-30 has five black numbers which represent complete gallons. The last two numbers are red and represent decimals of gallons.

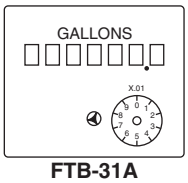
Example: RED RED
0 0 3 6 2. 7 5 = 362.75 Gallons
The round dial in right corner represents 1/1000th of a gallon.

The FTB-31A has six black numbers representing gallons. The last red number indicates 1/10th of a gallon and the dial represents 1/100th of a gallon.

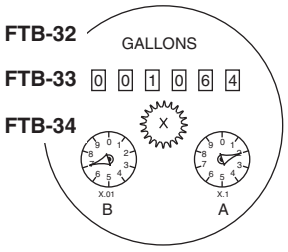
The entire counter unit of the FTB-32-FTB-36 can be rotated 360° to facilitate the reading. The counter FTB-32-FTB-34 has six black numbers representing U. S. gallons.
Dial "A" counts 1/10th of a gallon
Dial "B" counts 1/100th of a gallon



FTB-30



FTB-31A



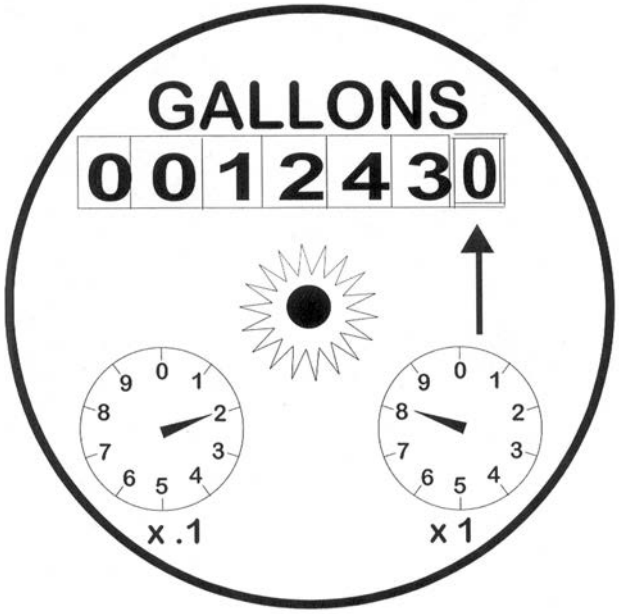
DIAL #FTB-32-FTB-34

Example: Top numbers read
0 0 1 0 6 4
Dial "A" reads 2 = .2
0 0 1 0 6 4. 2
The red dial "B" reads 7 = .07
0 0 1 0 6 4. 2 7 = Total reading

TRICKLE FLOW INDICATOR

All flowmeters can indicate even the smallest liquid movements with this indicator. (X)

How to read the oil meter FTB-35 (1-1/2") and FTB-36 (2")



The sample meter reading is 12438.2 gallons. The single gallon counter is on the right hand corner (small dial) and shows indication x1. The fraction of gallons is indicated on the left side of the dial indication that each number adds .1 gallon.

The counter is non-resettable and counts to 9 999 990 before it restarts to count up from zero.

omega.com info@omega.com

Servicing North America:

U.S.A.: Omega Engineering, Inc., One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047 USA
Toll-Free: 1-800-826-6342 (USA & Canada only)
Customer Service: 1-800-622-2378 (USA & Canada only)
Engineering Service: 1-800-872-9436 (USA & Canada only)
Tel: (203) 359-1660 Fax: (203) 359-7700
e-mail: info@omega.com

For Other Locations Visit omega.com/worldwide

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

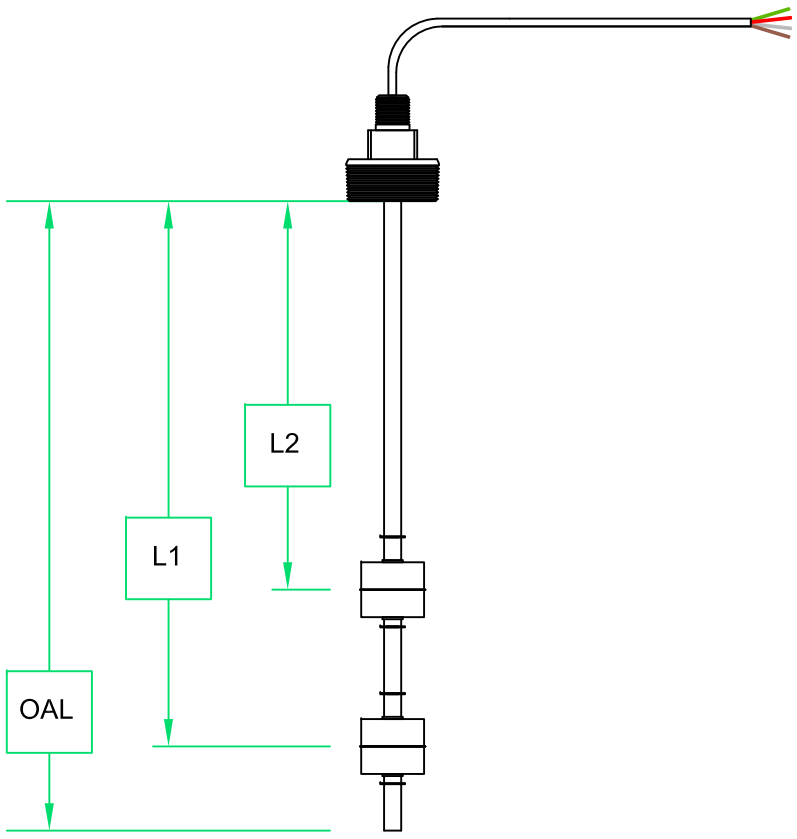
1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

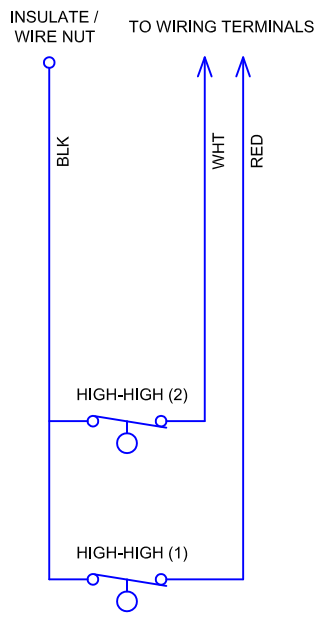
FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

L2	WHITE	NORMALLY CLOSED	HIGH-HIGH (2)
L1	RED	NORMALLY CLOSED	HIGH-HIGH (1)
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
STEM DIAMETER	$\frac{1}{2}$ INCH
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT
SPECIFIC GRAVITY	0.6

OAL - 21 INCHES
L1 - 19 INCHES
L2 - 13.25 INCHES
CABLE LENGTH - 288 INCHES

GENERAL NOTES:

1. FOR TERMINAL BLOCK LOCATION SEE DRAWING (I-1)
2. FOR WIRING TERMINAL DESIGNATION SEE DRAWING (I-2)

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	06-02-15	RB

REVISIONS

DRWN BY	DATE
JAD	05-27-15
CHK BY	DATE
APPR BY	DATE

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

TITLE: 2 POSITION LEVEL SENSOR
LSH & LSHH-801 / LSH & LSHH-1401

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-10	1 OF 1	A

SECTION 12 - 900 SERIES PROCESS EQUIPMENT - OWS TRANSFER PUMP - AQUEOUS

EFFLUENT PUMP, CENTRIFUGAL - GOULDS MODEL 1ST1G5B4

PRESSURE INDICATOR - DWYER MODEL SGY-D10522N

PRESSURE SWITCH - DWYER MODEL CS-150

TECHNICAL BROCHURE
BNPE

NPE

316L SS

NPE SERIES END SUCTION CENTRIFUGAL PUMPS
BOMBAS CENTRÍFUGAS DE SUCCIÓN FINAL SERIE NPE

GOULDS
WATER TECHNOLOGY
a xylem brand

A FULL RANGE OF PRODUCT FEATURES
UNA GAMA TOTAL DE CARACTERÍSTICAS DEL PRODUCTO

Superior Materials of Construction: Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

High Efficiency Impeller: Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustment.

Casing and Adapter Features: Stainless steel construction with NPT threaded, centerline connections, easily accessible vent, prime and drain connections with stainless steel plugs. Optional seal face vent/flush available.

Mechanical Seal: Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts. Optional high temperature and chemical duty seals available.

Motors: NEMA standard open drip-proof, totally enclosed fan cooled or explosion proof enclosures. Rugged ball bearing design for continuous duty under all operating conditions.

The various versions of the NPE are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown at left.

Materiales Superiores de Construcción: *Componentes completos para manejo de líquidos en acero inoxidable AISI 316L y consola para el montaje para resistencia a la corrosión, apariencia de calidad, y fuerza y ductilidad mejoradas.*

Impulsor de Eficiencia Superior: El impulsor encerrado con un diseño único de anillo del sello flotante, mantiene sin ajustes, la eficiencia máxima sobre la vida de la bomba.

Características de la Carcasa y del Adaptador: *Construcción en acero inoxidable con NPT roscado, conexiones centrales, válvulas de fácil acceso, conexiones de cebado y drenaje con enchufes de acero inoxidable. Cara del sello válvula/chorro opcional disponible.*

Sello Mecánico: *Estándar John Crane Tipo 21 con carbón en contraste con caras de silicón-carbide, elastómeros de Viton, y partes metálicas de acero inoxidable 316. Sellos de alta temperatura y productos químicos están disponibles.*

Motores: *Estándar NEMA a prueba de goteo, ventilador totalmente encerrado o recintos a prueba de explosión. Diseño robusto de balineras de bolas para trabajo continuo en todas las condiciones de funcionamiento.*

Las diferentes versiones de la NPE se identifican con un número de código del producto en la etiqueta de la bomba. Este número es también el número del catálogo para la bomba. El significado de cada dígito en el número de código del producto se muestra a la izquierda.

NPE PRODUCT LINE NUMBERING SYSTEM
LÍNEA DE PRODUCTO NPE SISTEMA DE NUMERACIÓN

Example Product Code,
Ejemplo Código del Producto

1 ST 2 C 1 A 4 F

Seal Vent/Flush Option,
Opción de Sello Válvula/ChorroSeal Ven

Mechanical Seal and O-ring
4 = Pre-engineered standard
For optional mechanical seal modify catalog order no. with seal code listed below.

Sello Mecánico y Anillo 'O'
4 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálogo con el código del sello anotado abajo.

John Crane Type 21 Mechanical Seal (⅝" seal),
Sello Mecánico John Crane Tipo 21 (sello de ⅝")

Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
2	Carbon	Silicon Carbide	EPR	316 SS	10K18
4			Viton		10K55
5	Silicon Carbide		EPR		10K81
6			Viton		10K62

Impeller Option . . . No Adder Required
For optional impeller diameters modify catalog order no. with impeller code listed. Select optional impeller diameter from pump performance curve.

Código del Impulsor Opcional
Para impulsores con diámetros opcionales modificar el número de orden del catálogo con el código del impulsor anotado. Escoger el impul con diámetro opcional de la curva de funcionamiento de la bomba.

Impeller Code, *Código del Impulsor*	Pump Size, *Tamaño de la Bomba*		
	1 x 1¼ – 6	1¼ x 1½ – 6	1½ x 2 – 6
	Diameter	Diameter	Diameter
K	–	6⅛	–
G	–	5 15/16	5⅜
H	–	5½	5
A	6⅛	5¼	4¾
B	5¾	5 1/16	4⅝
C	5 3/16	4⅞	4⅜
D	4¾	4⅝	4 1/16
E	4 7/16	4¼	3⅝
F	4 1/16	3⅞	–

Driver, *Conductor*
1 = 1 PH, ODP
2 = 3 PH, ODP
3 = 575 V, ODP
4 = 1 PH, TEFC
5 = 3 PH, TEFC
6 = 575 V, TEFC
7 = 3 PH, XP
8 = 575 V, XP
9 = 3 PH, TEFC Premium Eff.
0 = 1 PH, XP

HP Rating, *HP Potencia*
C = ½ HP E = 1 HP G = 2 HP J = 5 HP
D = ¾ HP F = 1½ HP H = 3 HP

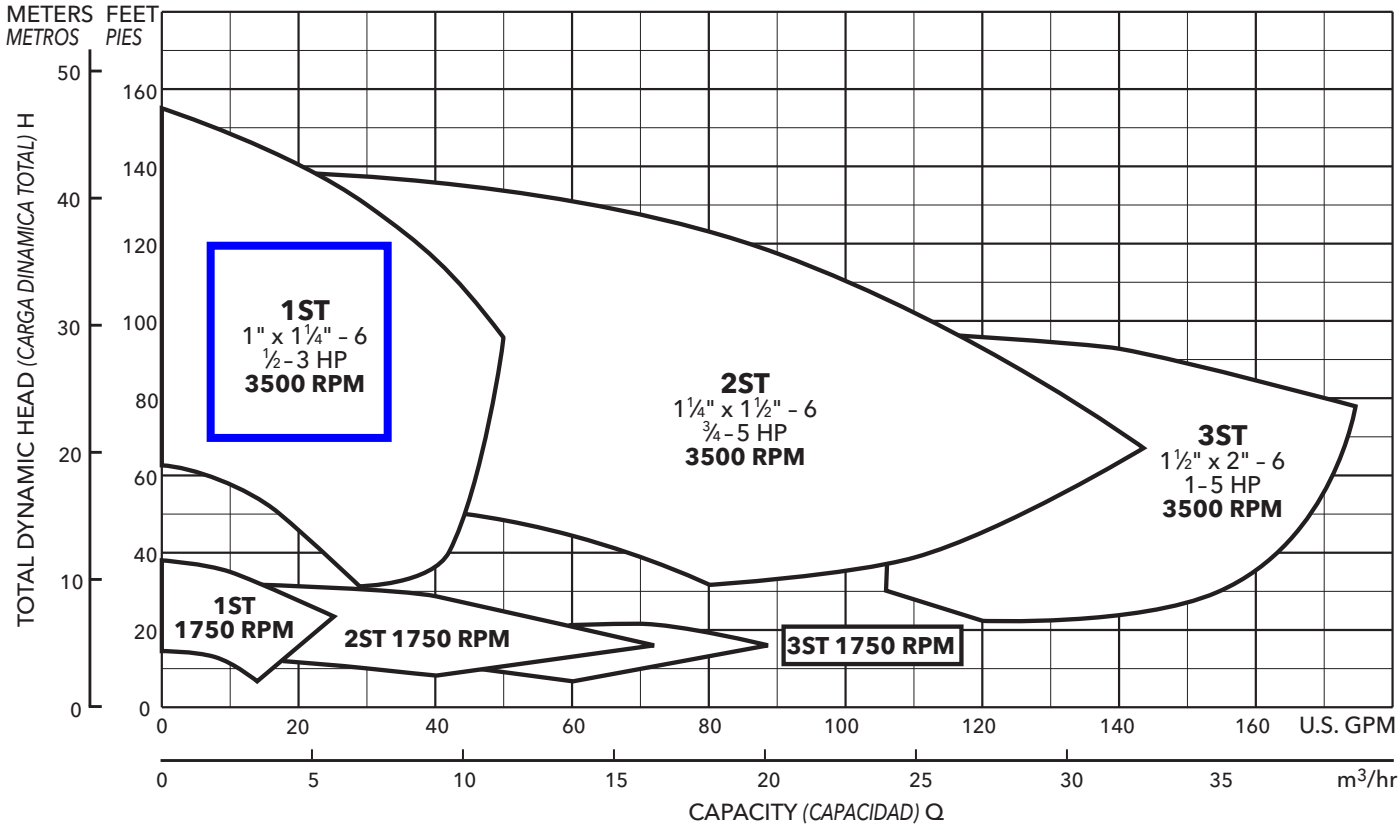
Driver: Hertz/Pole/RPM,
Conductor: Hercios/Polo/RPM
1 = 60 Hz, 2 pole, 3500 RPM
2 = 60 Hz, 4 pole, 1750 RPM
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

For frame mounted version, substitute the letters "FRM" in these positions.
Para la versión con el armazón montado, sustituya las letras "FRM" en estas posiciones.

Material
ST = Stainless steel, *Acero inoxidable*

Pump Size, *Tamaño de la Bomba*
1 = 1 x 1¼ – 6 2 = 1¼ x 1½ – 6 3 = 1½ x 2 – 6

PERFORMANCE COVERAGE (60 HZ)
ALCANCE DE FUNCIONAMIENTO (60 HZ)



NOTES:
Not recommended for operation beyond printed H-Q curve.

For critical application conditions consult factory.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

All standard 3500 RPM ODP and TEFC motors supplied by Goulds Pumps, have minimum of 1.15 service factor. Standard catalog units may utilize available service factor. Any motors supplied other than Goulds Pumps check available service factor.

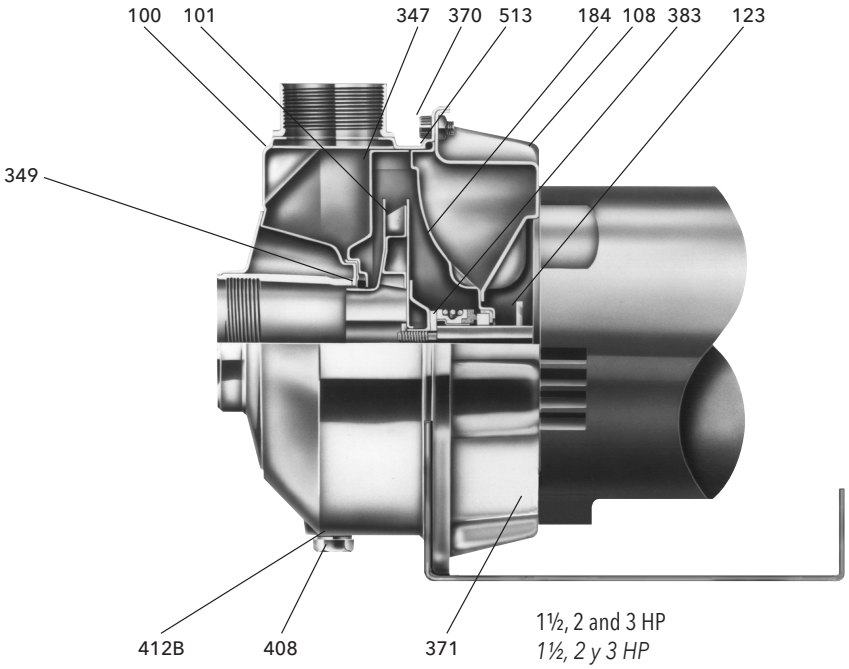
NOTAS:
No se recomienda para funcionamiento superior al impreso en la curva H-Q.

Para condiciones de aplicaciones críticas consultar con la fábrica.

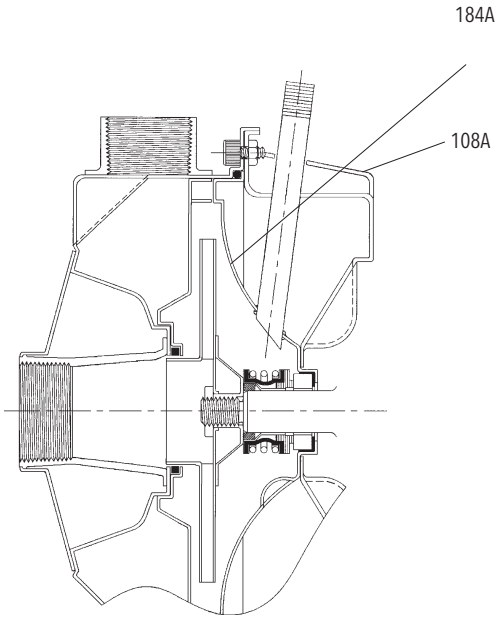
No todas las combinaciones de las opciones de motor, impulsor y sello están disponibles para cada modelo de bombas. Por favor verifique con G&L en los números no catalogados.

Todos los motores estándar de 3500 RPM, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado) provistos por Goulds Pumps tienen un factor mínimo de servicio de 1,15. Las unidades estándar de catálogo pueden utilizar el factor de servicio disponible. Verificar el factor de servicio disponible de todo motor no provisto por Goulds Pumps.

NPE CLOSE COUPLED PUMP MAJOR COMPONENTS: MATERIALS OF CONSTRUCTION
BOMBA CERRADA ACOPLADA NPE COMPONENTES PRINCIPALES: MATERIALES DE CONSTRUCCIÓN

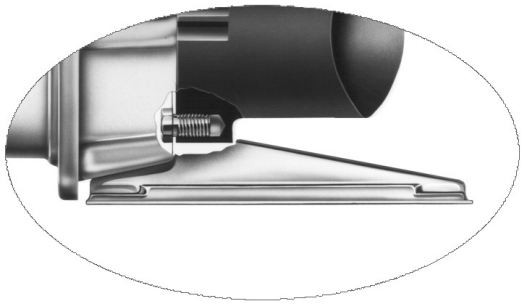


1½, 2 and 3 HP
1½, 2 y 3 HP



Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing; *Carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
101	Impeller; *Impulsor*	
108	Motor adapter; *Adaptador del motor*	
108A	Motor adapter seal vent/flush; *Sello válvula/chorro del adaptador del motor*	
123	Deflector; *Deflector*	BUNA-N
184	Seal housing; *Alojamiento del sello*	AISI 316L SS; *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush; *Sello válvula/chorro del alojamiento del sello*	
347	Guidevane; *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
370	Socket head screws, casing; *Encajes cabezas de tornillos, carcasa*	AISI 410 SS; *AISI 410 Acero inoxidable*
371	Bolts, motor; *Tornillos, motor*	Plated steel; Acero chapeado
383	Mechanical seal; *Sello mecánico*	**see chart, *ver tabla*
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	
Motor *Motor*	NEMA standard, 56J flange; *NEMA estándar, brida 56J*	

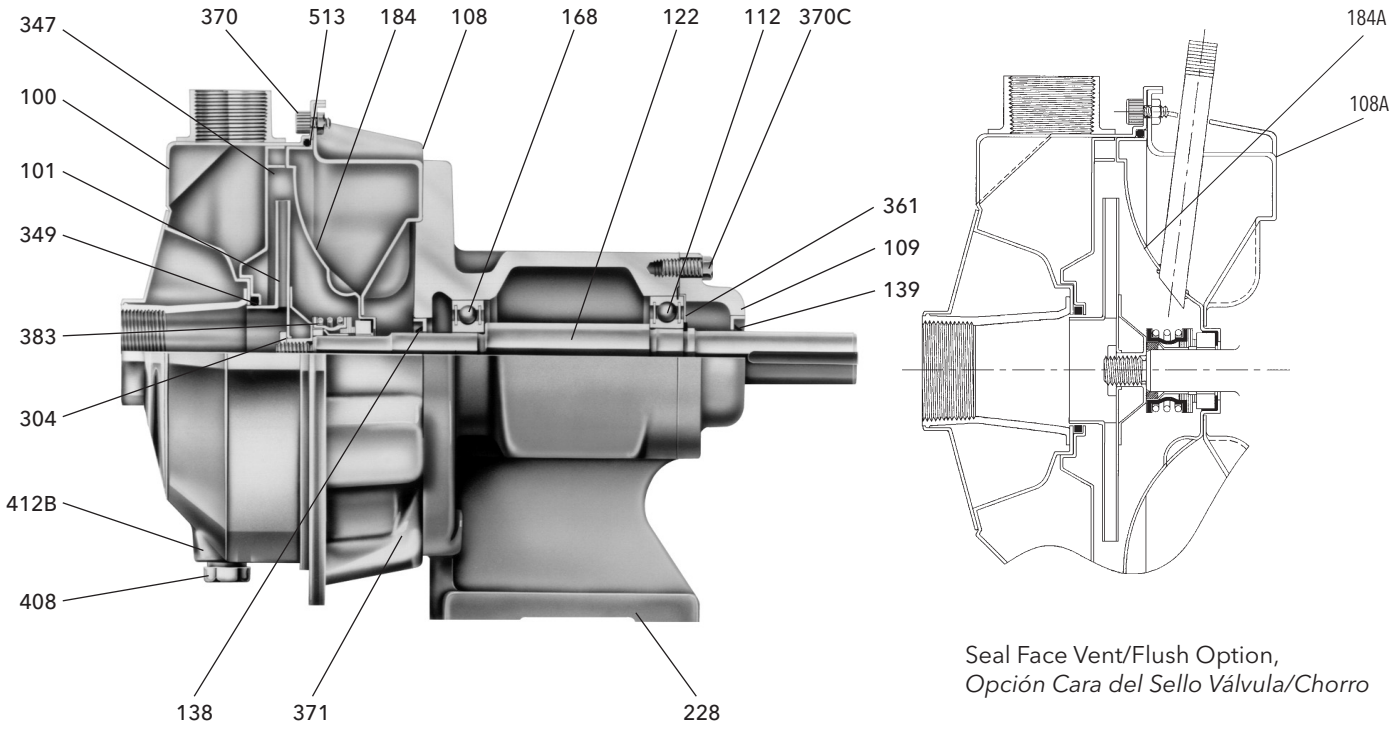


½, ¾ and 1 HP
½, ¾ y 1 HP

Footed motor for 5 HP ODP and TEFC, all explosion proof motors, see page 13.

Motor con pie para 5 HP ODP y TEFC, a prueba de explosiones motores, en la página 13.

NPE FRAME MOUNTED PUMP MAJOR COMPONENTS: MATERIALS OF CONSTRUCTION
BOMBA NPE DE ARMAZÓN MONTADO COMPONENTES PRINCIPALES: MATERIALES DE CONSTRUCCIÓN

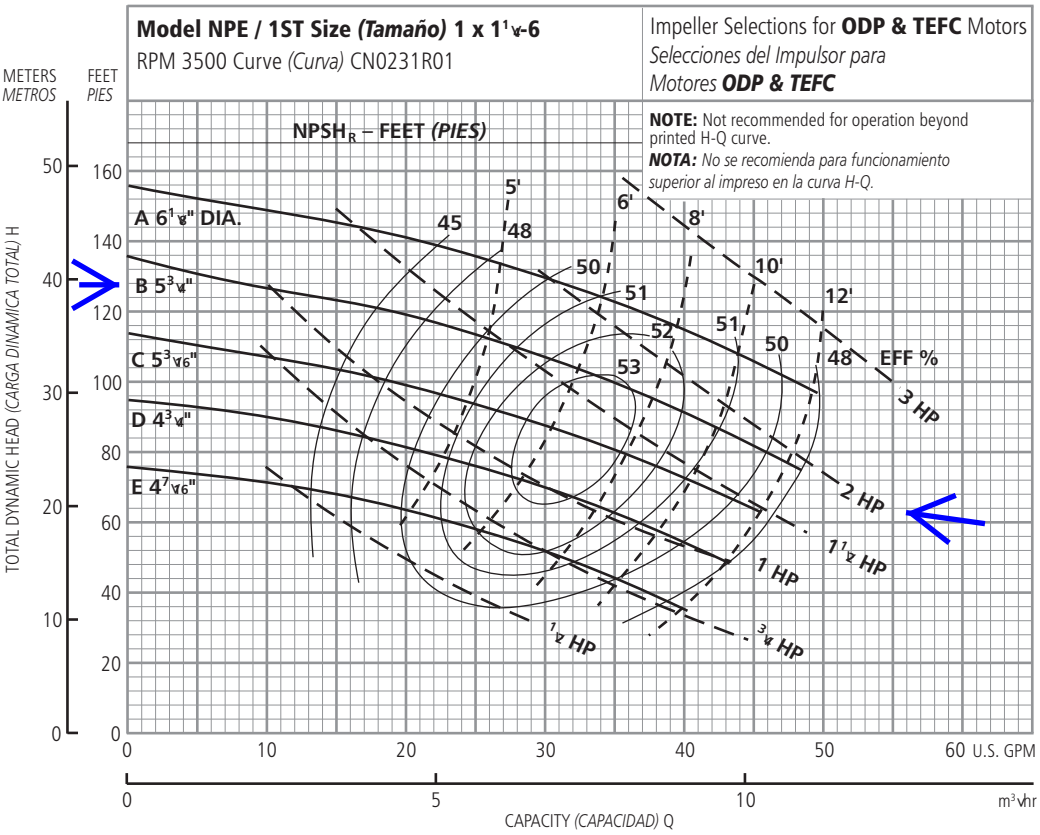


Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
100	Casing; *Carcasa*	AISI 316L SS; *AISI 316L Acero inoxidable*
101	Impeller; *Impulsor*	
108	Adapter; *Adaptador*	
108A	Motor adapter seal vent/flush; *Sello válvula/chorro del adaptador del motor*	
109	Bearing cover; *Cubierta de balineras*	Cast iron; *Hierro fundido*
112	Ball bearing (outboard); *Balineras de bolas (exterior)*	Steel; *Acero*
122	Shaft; *Eje*	AISI 316 SS; *AISI 316 Acero inoxidable*
138	Lip-seal (inboard); *Sello cubierto (interior)*	BUNA/steel; *BUNA/acero*
139	Lip-seal (outboard); *Sello cubierto (exterior)*	BUNA/steel; *BUNA/acero*
168	Ball bearing (inboard); *Balineras de bolas (interior)*	Steel; *Acero*
184	Seal housing; *Alojamiento del sello*	AISI 316L SS; *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush; *Sello válvula/chorro del alojamiento del sello*	
228	Bearing frame; *Armazón de balineras*	Cast iron, *Hierro fundido*

Item No., *Parte No.*	Description, *Descripción*	Materials, *Materiales*
304	Impeller locknut; *Contratuerca del impulsor*	AISI 316 SS; *AISI 316 Acero inoxidable*
347	Guidevane; *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
361	Retaining ring; *Anillo de retención*	Steel; Acero
370	Socket head screws, casing; *Encaje cabeza del tornillo, carcasa*	AISI 410 SS; *AISI 410 Acero inoxidable*
370C	Hex head screw, bearing cover; *Tornillo de cabeza hexagonal, cubierta de balineras*	Plated steel; *Acero chapeado*
371	Hex head screw, bearing frame; *Tornillo de cabeza hexagonal, armazón de balineras*	Plated steel; *Acero chapeado*
383	Mechanical seal; *Sello mecánico*	**see chart; ver tabla
400	Shaft key; *Llave del eje*	Steel; Acero
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316 SS; *AISI 316 Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton (Standard, *estándar*) EPR (Optional, *Opcional*)
513	O-ring, casing; *Anillo 'O', carcasa*	

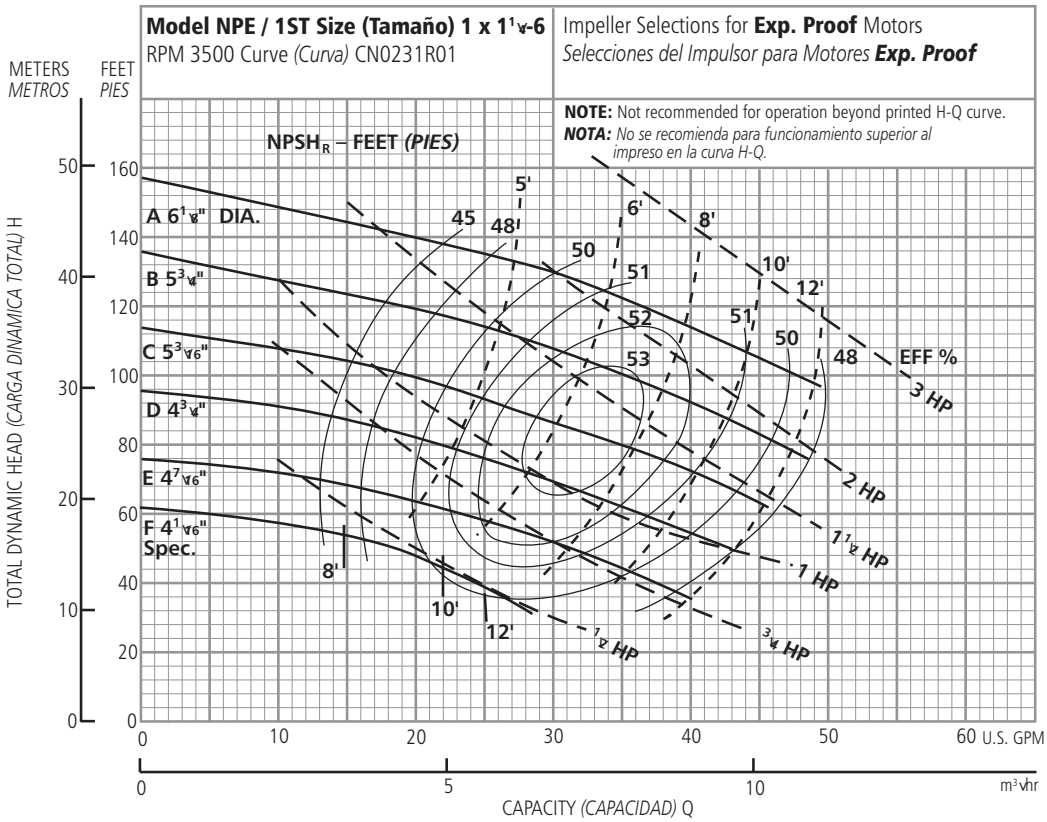
PERFORMANCE CURVES – 60 HZ, 3500 RPM
CURVAS DE FUNCIONAMIENTO – 60 HZ, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	½	4 7/16"
D	¾	4¾
C	1	5 3/16
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*



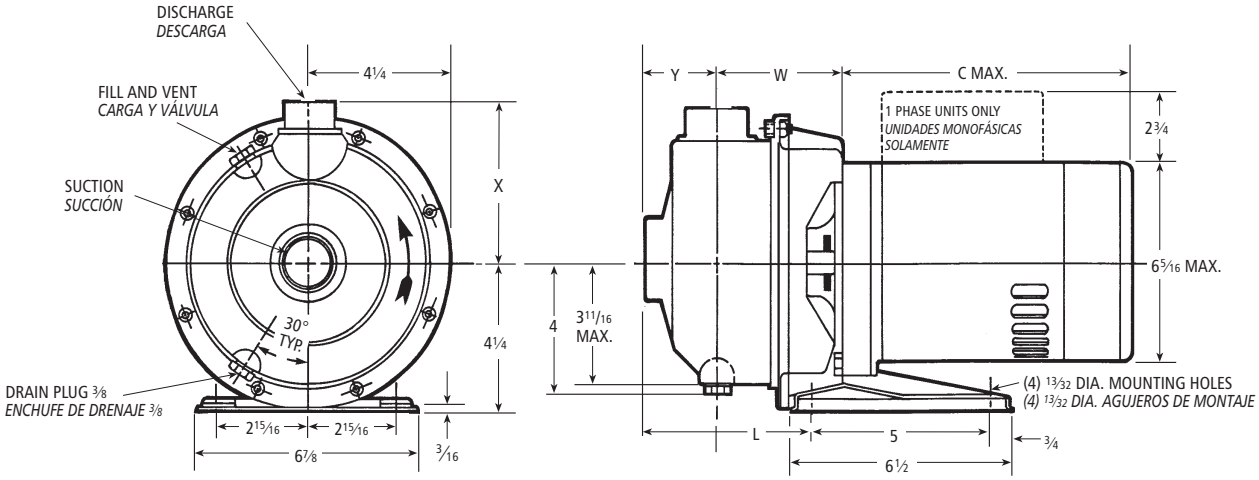
Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	½	4 1/16" spec.
E	¾	4 7/16
D	1	4¾
C	1½	5 3/16
B	2	5¾
A	3	6⅛

NOTE: Although not recommended, the pump may pass a 1/16" sphere.

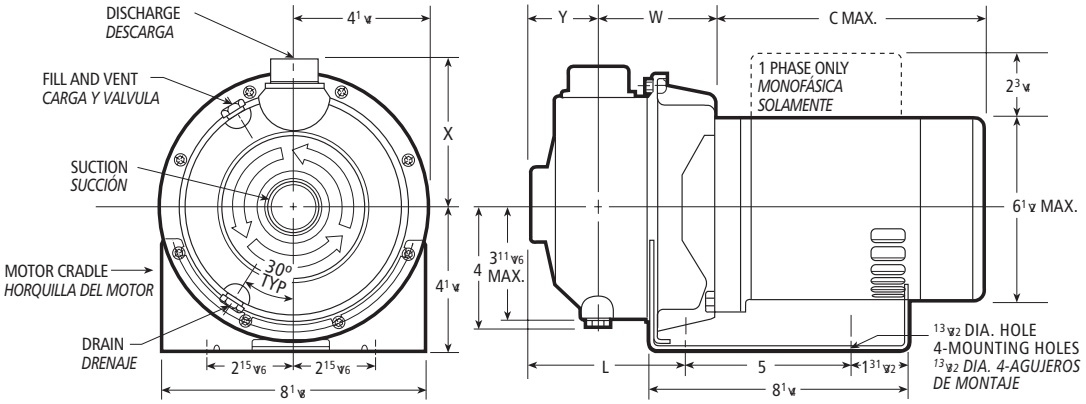
NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de 1/16".*

NPE CLOSE COUPLED – DIMENSIONS, WEIGHTS AND SPECIFICATIONS
NPE ACOPLE CERRADO – DIMENSIONES, PESOS Y ESPECIFICACIONES

Clockwise Rotation Viewed from Drive End
Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor



ODP and TEFC ½, ¾ and 1 HP (standard), *ODP y TEFC ½, ¾ y 1 HP (estándar)*



ODP and TEFC 1½, 2 and 3 HP (standard), *ODP y TEFC 1½, 2 y 3 HP (estándar)*

SPECIFICATIONS - *ESPECIFICACIONES*

Capacities to:
85 GPM (322L/min) at 1750 RPM
170 GPM (643L/min) at 3500 RPM

Heads to:
39 feet (12 m) at 1750 RPM
150 feet (46 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to: 250° F (121° C)

Direction of rotation:
Clockwise when viewed from motor end.

Motor specifications:
NEMA 56J frame, 1750 RPM, ½ HP. 3500 RPM ½ through 5 HP. Open drip-proof, totally enclosed fan-cooled or explosion proof enclosures. Stainless steel shaft with ball bearings.

Single phase: Voltage 115/230 ODP and TEFC. (3 and 5 HP model – 230 V only) Built-in overload with auto-reset provided.

Three phase: Voltage 208-230/460 ODP, TEFC and EX PROOF.

NOTE: For three phase motors, overload protection must be provided in starter unit. Starter and heaters must be ordered separately.

Capacidades:
85 GPM (322L/min) a 1750 RPM
170 GPM (643L/min) a 3500 RPM

Cargas:
39 pies (12 m) a 1750 RPM
150 pies (46 m) a 3500 RPM

Presión de trabajo:
125 PSIG (9 baras)

Temperatura máxima:
250 ° F (121° C)

Dirección de rotación:
En dirección de las agujas del reloj visto desde el extremo final del motor.

Motores:
Armazón 56J NEMA, 1750 RPM ½ HP. 3500 RPM ½ a 5 HP. Cubiertas abiertas resguardadas, totalmente encerradas enfriadas por ventilador o a prueba de explosiones. Eje de acero inoxidable con balineras de bolas.

Monofásicos: *Voltaje 115/230 ODP y TEFC. (modelo 3 y 5 HP – 230 voltios solamente) Se proporciona protección térmica contra sobrecarga construida con reseteo automático.*

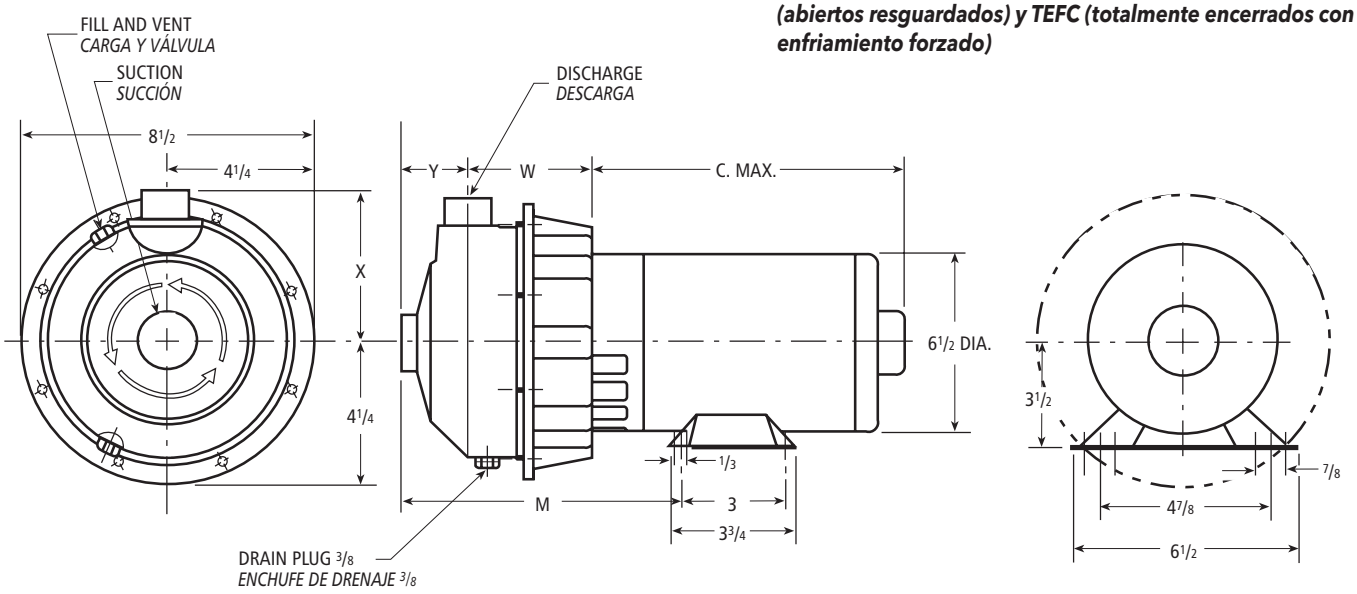
Trifásicos: *Voltaje 208-230/460 ODP, TEFC y EX PROOF.*

NOTA: *Para motores trifásicos se debe de proporcionar la protección térmica contra sobrecarga en la unidad de arranque. El arrancador y los calentadores se deben pedir por separado.*

NPE CLOSE COUPLED WITH FOOTED MOTOR, EXPLOSION-PROOF AND 5 HP MOTORS
NPE ACOPLE CERRADO CON MOTOR CON PATAS, MOTORES A PRUEBA DE EXPLOSIÓN Y 5 HP

All Explosion Proof Motors and 5 HP ODP and TEFC

Todos los motores son a prueba de explosiones, 5 HP, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado)



Dimensions – Determined by Pump,
Dimensiones – Determinadas por la Bomba

Pump, *Bomba*	Suction, *Succión*	Discharge, *Descarga*	HP	W	X	Y	L	M
1ST	1¼	1	½ – 3	3 5/16	4 3/8	2	4 9/16	7 5/16
2ST	1½	1¼	¾ – 5	3¾	4½	2 1/8	5 1/8	7 7/8
3ST	2	1½	1 – 5	3¾	4 5/8	2 1/8	5 1/8	7 7/8

Available Motor Weights and Dimensions
Pesos y Dimensiones Disponibles del Motor

HP	Motor Weights, *Pesos del Motor*						C Max. Length, *(Longitud)*
	1 Phase, *Monofásicos*			3 Phase, *Trifásicos*			
	ODP	TEFC	EXP	ODP	TEFC	EXP	
½	16	21	47	19	18	27	10 3/16
¾	19	24	41	21	21	30	10 7/16
1	22	26	49	23	21	30	11 1/16
1½	28	35	56	27	27	37	11 15/16
2	33	39	60	32	33	44	12 11/16
3	40	43	–	41	37	–	13 9/16
5	42	–	–	42	45	–	13 9/16

Dimensions in inches, weights in pounds.
Dimensiones en pulgadas, pesos en libras.

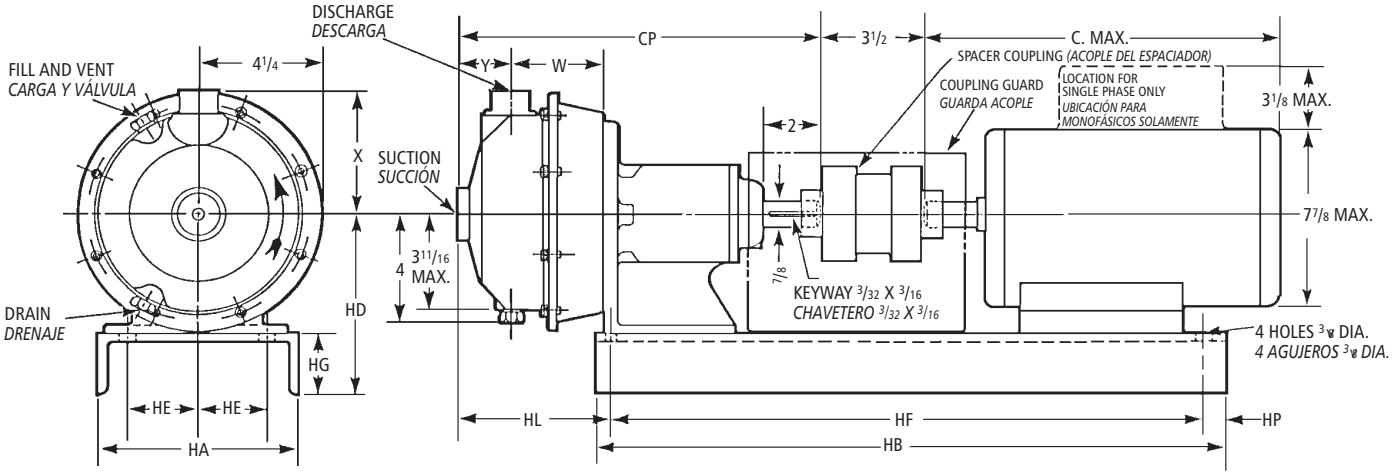
NOTES:

1. Pump will be shipped with top vertical discharge position as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten 6mm bolts to 5 – 6 lbs.-ft.
2. Motor dimensions may vary with motor manufacturers.
3. Dimensions in inches, weights in pounds.
4. For explosion proof motor dimensions consult factory for information.
5. Not to be used for construction purposes unless certified.

NOTAS:

1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y reemplazar y apretar los tornillos de 6mm a 5 – 6 libras-pies.*
2. *Las dimensiones del motor puede que varíen con los fabricantes.*
3. *Dimensiones en pulgadas, pesos en libras.*
4. *Para las dimensiones de los motores a prueba de explosión consultar con la fábrica para información.*
5. *No usar para propósitos de construcción sin certificar.*

NPE FRAME MOUNTED – DIMENSIONS, WEIGHTS AND SPECIFICATIONS
NPE ARMAZÓN MONTADO – DIMENSIONES, PESOS Y ESPECIFICACIONES



SPECIFICATIONS
ESPECIFICACIONES

Capacities to:
85 GPM (322L/min) at 1750 RPM
170 GPM (643L/min) at 3500 RPM

Heads to:
39 feet (12 m) at 1750 RPM
150 feet (47 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to: 250°F (121°C)

Direction of rotation:
Clockwise when viewed from motor end.

Motor specifications:
T-frame single and three phase. Open drip-proof, TEFC or explosion proof enclosures are available for 60 Hz, 3500 and 1750 RPM operation.

For three phase motors, overload protection must be provided in starter unit. Starter and heaters must be ordered separately.

Capacidades:
85 GPM (322L/min) a 1750 RPM
170 GPM (643L/min) a 3500 RPM

Cargas:
39 pies (12 m) a 1750 RPM
150 pies (47 m) a 3500 RPM

Presión de trabajo:
125 PSIG (9 baras)

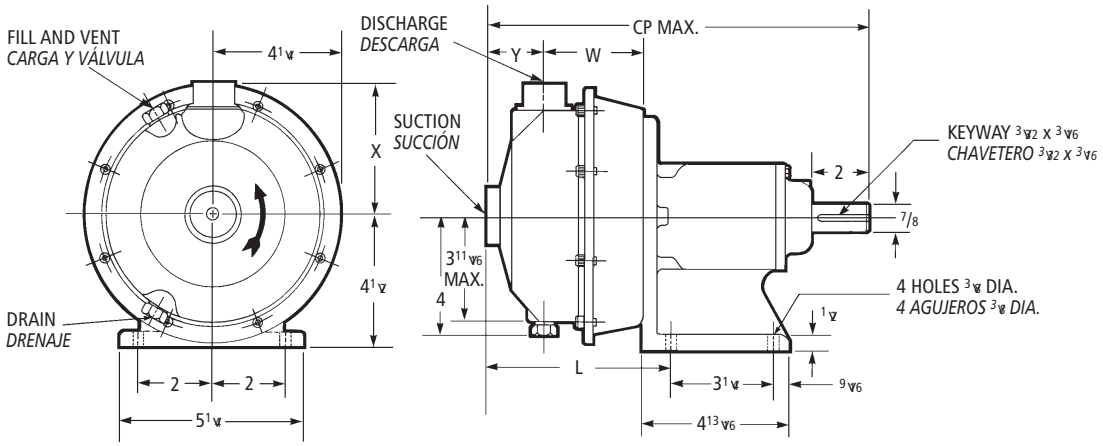
Temperatura máxima:
250°F (121°C)

Dirección de rotación: *En dirección de las agujas del reloj visto desde el extremo final del motor.*

Motores:
Armazón T- monofásico y trifásico. A prueba de goteo, TEFC o recintos a prueba de explosión están disponibles para funcionamiento de 60 Hz, 3500 y 1750 RPM.

Para motores trifásicos se debe de proporcionar la protección térmica contra sobrecarga en la unidad de arranque. El arrancador y los calentadores se deben pedir por separado.

NPE-F



Dimensions and Weights
Dimensiones y Pesos

Dimensions and Weights – Determined by Pump,
Dimensiones y Pesos – Determinados por la Bomba

Pump, *Bomba*	Suct. NPT, *Succión NPT*	Disch. NPT, *Descarga NPT*	CP	L	W	X	Y	Wt., *Peso*	Dim. "HL" Determined by Pump and Motor, *Dim. "HL" Determinadas por la Bomba y el Motor* Frame, *Armazón*		
									56	140	180
1ST	1 1/4	1	12 15/16	6 7/16	3 5/16	4 3/8	2	22 1/2	4 9/16		6 7/16
2ST	1 1/2	1 1/4	13 1/2	7	3 3/4	4 1/2	2 1/8	23	5 1/8		7
3ST	2	1 1/2				4 5/8					

Available Motor and Bedplate Dimensions and Weights,
Pesos y Dimensiones Disponibles de la Fundación y del Motor

Motor Frame, *Armazón del Motor*	HA	HB	HD	HE	HF	HG	HP	Wt. Max., *Peso Máx*	Shims, *Deflector*
56 143T 145T	8	26	6 7/8	3 1/8	22 3/8	2 3/8	1	30	1"
182T 184T	10	26	7 1/4	3 3/4	24	2 3/4	7/8	43	–

Frame Size, *Tamaño del Armazón*	Horsepower, *Fuerza* 3500 RPM				C Max.	Wt. Max., *Peso Máx.*
	Single Phase, *Monofásicos*		Three Phase, *Trifásicos*			
	ODP	TEFC	ODP	TEFC		
56	1/2 – 1 1/2	1/2 – 1 1/2	1/2 – 1	1/2 – 1	13	45
143T	–	–	1 1/2	1 1/2	13 3/8	45
145T	2	2	1 1/2 – 3	1 1/2 – 2	14 1/4	52
182T	3	3	5	3	16 5/8	63
184T	5	5	–	5	18 1/8	112

NOTES:

1. Pump will be shipped with top vertical discharge position as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten 6mm bolts to 5 – 6 lbs.-ft.
2. Motor dimensions may vary with motor manufacturers.
3. Dimensions in inches, weights in pounds.
4. For explosion proof motor dimensions consult factory for information.
5. Not to be used for construction purposes unless certified.

NOTAS:

1. *Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y reemplazar y apretar los tornillos de 6mm a 5 – 6 libras-pies.*
2. *Las dimensiones del motor puede que varíen con los fabricantes.*
3. *Dimensiones en pulgadas, pesos en libras.*
4. *Para las dimensiones de los motores a prueba de explosión consultar con la fábrica para información.*
5. *No usar para propósitos de construcción sin certificar.*

INSTRUCTION MANUAL
IM013

Model NPE/NPE-F

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

GOULDS
WATER TECHNOLOGY
a xylem brand

Table of Contents

Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Dealer: _____

Dealer Phone No.: _____

Date of Purchase: _____

Date of Installation: _____

Current Readings at Startup:

1 Ø	3 Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a **SAFETY ALERT SYMBOL.** When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that **WILL** cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that **CAN** cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠ WARNING

Hazardous fluids can cause fire, burns or death.

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

DESCRIPTION & SPECIFICATIONS:

The Models NPE (close-coupled) and NPE-F (frame-mounted) are end suction, single stage centrifugal pumps for general liquid transfer service, booster applications, etc. Liquid-end construction is all AISI Type 316 stainless steel, stamped and welded. Impellers are fully enclosed, non-trimable to intermediate diameters. Casings are fitted with a diffuser for efficiency and for negligible radial shaft loading.

Close-coupled units have NEMA 48J or 56J motors with C-face mounting and threaded shaft extension. Frame-mounted units can be coupled to motors through a spacer coupling, or belt driven.

1. IMPORTANT:

1.1. Inspect unit for damage. Report any damage to carrier/dealer immediately.

1.2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per national and local electrical codes. Install an all-leg disconnect switch near pump.

⚠ CAUTION **Always disconnect electrical power when handling pump or controls.**

1.3. Motors must be wired for proper voltage. Motor wiring diagram is on motor nameplate. Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.

1.4. Always use horsepower-rated switches, contactor and starters.

1.5. Motor Protection

1.5.1. Single-phase: Thermal protection for single-phase units is sometimes built in (check nameplate). If no built-in protection is provided, use a contactor with a proper overload. Fusing is permissible.

1.5.2. Three-phase: Provide three-leg protection with properly sized magnetic starter and thermal overloads.

1.6. Maximum Operating Limits:

Liquid Temperature:	250° F (120° C)
Pressure:	125 PSI
Starts Per Hour:	20, evenly distributed

1.7. Regular inspection and maintenance will increase service life. Base schedule on operating time. Refer to Section 8.

2. INSTALLATION:

2.1. General

2.1.1. Locate pump as near liquid source as possible (below level of liquid for automatic operation).

2.1.2. Protect from freezing or flooding.

2.1.3. Allow adequate space for servicing and ventilation.

2.1.4. All piping must be supported independently of the pump, and must "line-up" naturally.

⚠ CAUTION **Never draw piping into place by forcing the pump suction and discharge connections.**

2.1.5. Avoid unnecessary fittings. Select sizes to keep friction losses to a minimum.

2.2. Close-Coupled Units

2.2.1. Units may be installed horizontally, inclined or vertically.

⚠ CAUTION **Do not install with motor below pump. Any leakage or condensation will affect the motor.**

2.2.2. Foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration.

2.2.3. Tighten motor hold-down bolts before connecting piping to pump.

2.3. Frame-Mounted Units

2.3.1. It is recommended that the bedplate be grouted to a foundation with solid footing. Refer to Figure 1.

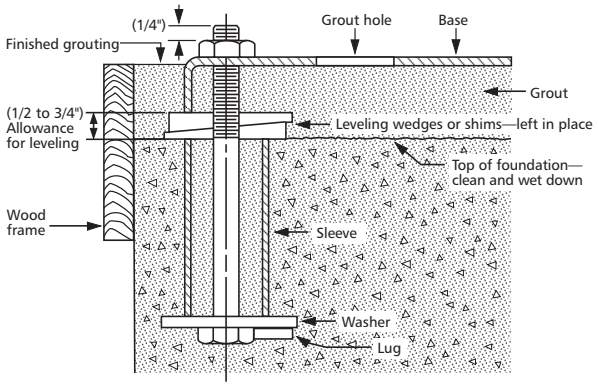


Figure 1

2.3.2. Place unit in position on wedges located at four points (two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit. Level or plumb suction and discharge flanges.

2.3.3. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming, if necessary.

2.3.4. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before fully tightening foundation bolts.

2.3.5. Tighten pump and motor hold-down bolts before connecting the piping to pump.

3. SUCTION PIPING:

3.1. Low static suction lift and short, direct, suction piping is desired. For suction lift over 10 feet and liquid temperatures over 120 F, consult pump performance curve for Net Positive Suction Head Required.

3.2. Suction pipe must be at least as large as the suction connection of the pump. Smaller size will degrade performance.

3.3. If larger pipe is required, an eccentric pipe reducer (with straight side up) must be installed at the pump.

3.4. Installation with pump below source of supply

3.4.1. Install full flow isolation valve in piping for inspection and maintenance.

⚠ CAUTION **Do not use suction isolation valve to throttle pump.**

3.5. Installation with pump above source of supply

3.5.1. Avoid air pockets. No part of piping should be higher than pump suction connection. Slope piping upward from liquid source.

3.5.2. All joints must be airtight.

3.5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.

3.5.4. Suction strainer open area must be at least triple the pipe area.

3.6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump through vortexing. See Figures 2-5.

3.7. Use 3-4 wraps of Teflon tape to seal threaded connections.

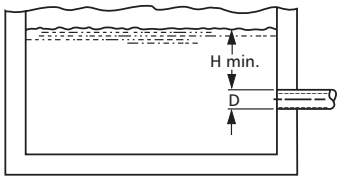


Figure 2

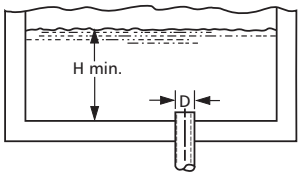


Figure 3

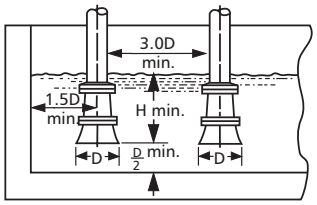


Figure 4

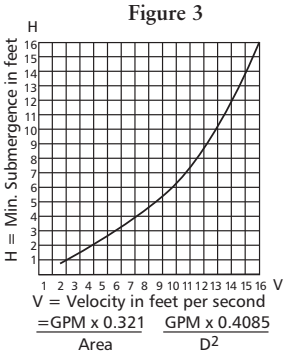


Figure 5

4. DISCHARGE PIPING:

4.1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or for inspection of the pump or check valve.

4.2. If an increaser is required, place between check valve and pump.

4.3. Use 3-4 wraps of Teflon tape to seal threaded connections.

5. MOTOR-TO-PUMP SHAFT ALIGNMENT:

5.1. Close-Coupled Units

5.1.1. No field alignment necessary.

5.2. Frame-Mounted Units

5.2.1. Even though the pump-motor unit may have a factory alignment, this could be disturbed in transit and must be checked prior to running. See Figure 6.

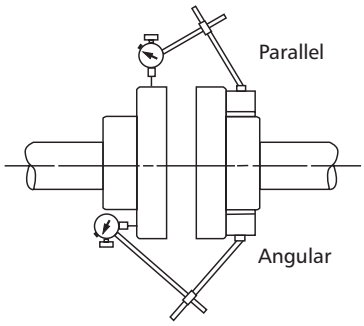


Figure 6

5.2.2. Tighten all hold-down bolts before checking the alignment.

5.2.3. If re-alignment is necessary, always move the motor. Shim as required.

5.2.4. Parallel misalignment - shafts with axis parallel but not concentric. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005", or less.

5.2.5. Angular misalignment - shafts with axis concentric but not parallel. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005", or less.

5.2.6. Final alignment is achieved when parallel and angular requirements are satisfied with motor hold-down bolts tight.

⚠ CAUTION **Always recheck both alignments after making any adjustment.**

6. ROTATION:

6.1. Correct rotation is right-hand (clockwise when viewed from the motor end). Switch power on and off quickly. Observe shaft rotation. To change rotation:

6.1.1. Single-phase motor: Non-reversible.

6.1.2. Three-phase motor: Interchange any two power supply leads.

7. OPERATION:

7.1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

⚠ CAUTION **Pumped liquid provides lubrication. If pump is run dry, rotating parts will seize and mechanical seal will be damaged. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.**

7.2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. On frame-mounted units coupling alignment may have changed due to the temperature differential between pump and motor. Recheck alignment.

8. MAINTENANCE:

8.1. Close-Coupled Unit. Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

8.2. Frame-Mounted Units

8.2.1. Bearing frame should be regreased every 2,000 hours or 3 month interval, whichever occurs first. Use a #2 sodium or lithium based grease. Fill until grease comes out of relief fittings, or lip seals, then wipe off excess.

8.2.2. Follow motor and coupling manufacturers' lubrication instructions.

8.2.3. Alignment must be rechecked after any maintenance work involving any disturbance of the unit.

9. DISASSEMBLY:

Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work needed.

9.1. Turn off power.

9.2. Drain system. Flush if necessary.

9.3. Close-Coupled Units: Remove motor hold-down bolts.

Frame-Mounted Units: Remove coupling, spacer, coupling guard and frame hold-down bolts.

9.4. Disassembly of Liquid End

9.4.1. Remove casing bolts (370).

9.4.2. Remove back pull-out assembly from casing (100).

9.4.3. Remove impeller locknut (304).

⚠ CAUTION **Do not insert screwdriver between impeller vanes to prevent rotation of close-coupled units. Remove cap at opposite end of motor. A screwdriver slot or a pair of flats will be exposed. Using them will prevent impeller damage.**

9.4.4. Remove impeller (101) by turning counter-clockwise when looking at the front of the pump. Protect hand with rag or glove.

⚠ CAUTION **Failure to remove the impeller in a counter-clockwise direction may damage threading on the impeller, shaft or both.**

9.4.5. With two pry bars 180 degrees apart and inserted between the seal housing (184) and the motor adapter (108), carefully separate the two parts. The mechanical seal rotary unit (383) should come off the shaft with the seal housing.

9.4.6. Push out the mechanical seal stationary seat from the motor side of the seal housing.

9.5. Disassembly of Bearing Frame

9.5.1. Remove bearing cover (109).

9.5.2. Remove shaft assembly from frame (228).

9.5.3. Remove lip seals (138 and 139) from bearing frame and bearing cover if worn and are being replaced.

9.5.5. Use bearing puller or arbor press to remove ball bearings (112 and 168).

10. REASSEMBLY:

10.1. All parts should be cleaned before assembly.

10.2. Refer to parts list to identify required replacement items. Specify pump index or catalog number when ordering parts.

10.3. Reassembly is the reverse of disassembly.

10.3.1. Impeller and impeller locknut assembled onto motor shaft with 10 ft-lbs of torque.

10.4. Observe the following when reassembling the bearing frame.

10.4.1. Replace lip seals if worn or damaged.

10.4.2. Replace ball bearings if loose, rough or noisy when rotated.

10.4.3. Check shaft for runout. Maximum permissible is .002" T.I.R.

10.5. Observe the following when reassembling the liquid-end.

10.5.1. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.

It is permissible to use a light lubricant, such as glycerin, to facilitate assembly. Do not contaminate the mechanical seal faces with lubricant.

10.5.2. Inspect casing O-ring (513) and replace if damaged. This O-ring may be lubricated with petroleum jelly to ease assembly.

10.5.3. Inspect guidevane O-ring (349) and replace if worn.

⚠ CAUTION **Do not lubricate guidevane O-ring (349). Insure it is not pinched by the impeller on reassembly.**

10.6. Check reassembled unit for binding. Correct as required.

10.7. Tighten casing bolts in a star pattern to prevent O-ring binding.

11. TROUBLE SHOOTING CHART:

MOTOR NOT RUNNING:
(See causes 1 thru 6)

LITTLE OR NO LIQUID DELIVERED:
(See causes 7 thru 17)

POWER CONSUMPTION TOO HIGH:
(See causes 4, 17, 18, 19, 22)

EXCESSIVE NOISE AND VIBRATION:
(See causes 4, 6, 9, 13, 15, 16, 18, 20, 21, 22)

PROBABLE CAUSE:

1. Tripped thermal protector
2. Open circuit breaker
3. Blown fuse
4. Rotating parts binding
5. Motor wired improperly
6. Defective motor
7. Not primed
8. Discharge plugged or valve closed
9. Incorrect rotation
10. Foot valve too small, suction not submerged, inlet screen plugged
11. Low voltage
12. Phase loss (3-phase only)
13. Air or gasses in liquid
14. System head too high
15. NPSHA too low:
    Suction lift too high or suction losses excessive. Check with vacuum gauge.
16. Impeller worn or plugged
17. Incorrect impeller diameter
18. Head too low causing excessive flow rate
19. Viscosity or specific gravity too high
20. Worn bearings
21. Pump or piping loose
22. Pump and motor misaligned

NPE STANDARD REPAIR PARTS LIST

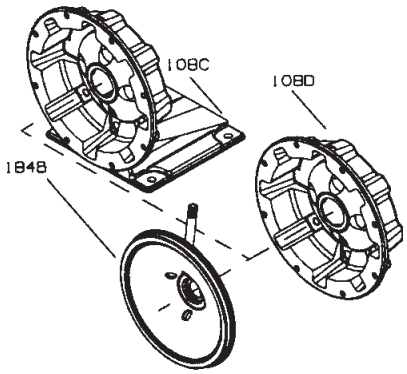
Item No.	Description	Materials of Construction
100	Casing	AISI 316L Stainless Steel
101	Impeller	
108A	Motor adapter with foot	
108B	Motor adapter less foot	
108C	Motor adapter with foot and flush	
108D	Motor adapter less foot with flush	
123	Deflector	BUNA-N
184A	Seal housing std.	AISI 316L S.S.
184B	Seal housing with seal flush	
240	Motor support	300 S.S.
	Rubber channel	Rubber
304	Impeller locknut	AISI 316 S.S.
347	Guidevane	AISI 316L S.S.
349	Seal-Ring, guidevane	Viton (standard)
		EPR
		BUNA
370	Socket head screw, casing	AISI 410 S.S.
371	Bolts, motor	Steel/plated
383	Mechanical seal	
408	Drain and vent plug, casing	AISI 316 S.S.
412B	O-Ring, drain plugs	Viton (standard)
		EPR
		BUNA
513	O-Ring, casing	Viton (standard)
		EPR
		BUNA

MECHANICAL SEAL APPLICATION CHART

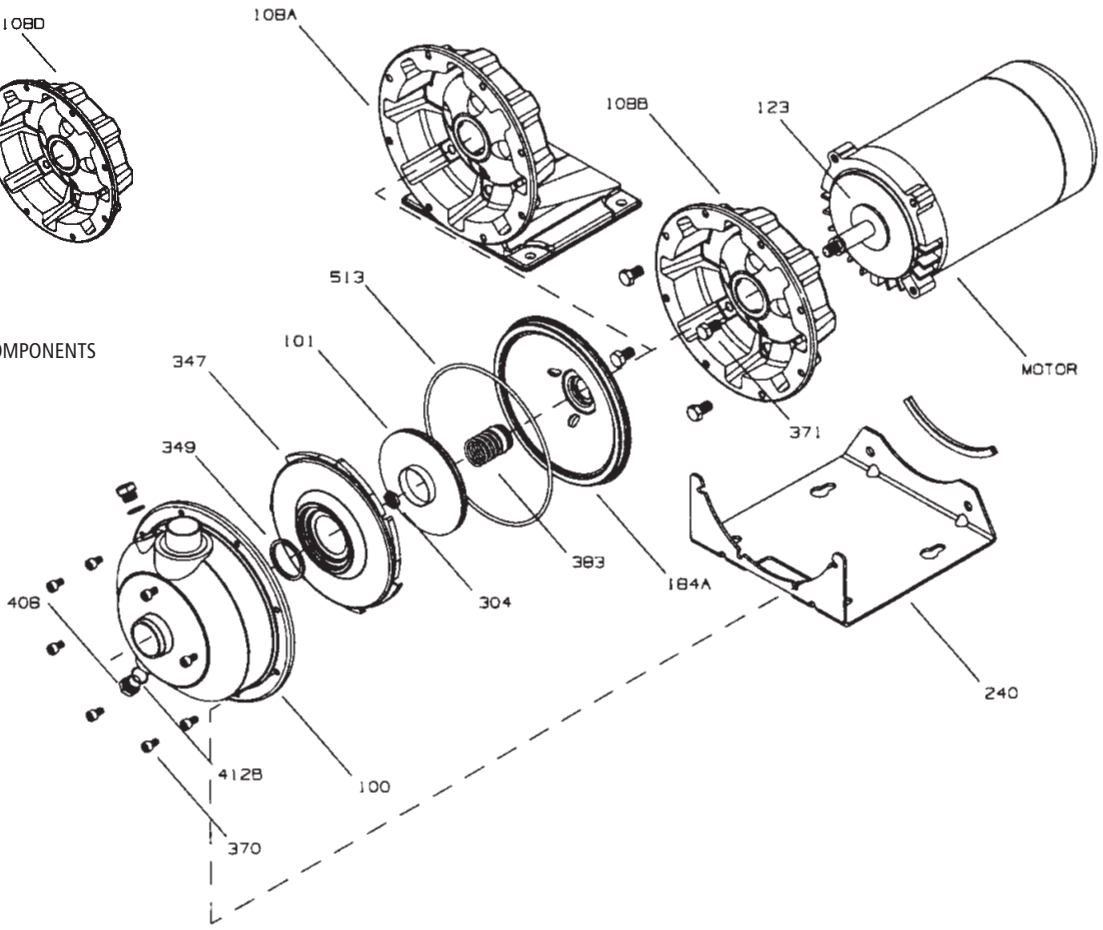
Item 383 Mechanical Seal (⅝" seal)				
Rotary	**Stationary**	**Elastomers**	**Metal Parts**	**Part No.**
Carbon	Sil-Carbide	EPR	316SS	10K18
		Viton		10K55
Sil-Carbide		EPR		10K81
		Viton		10K62

NOTE: Close coupled units supplied with ½ HP 1750 RPM, ½ - 3 HP Explosion Proof or 5 HP motors, utilize motor adapter less foot and a footed motor.

NOTE: Frame mounted units (NPE-F) utilize the XS Power frame and motor adapter less foot. For repair parts for the power frame refer to the XS-Power frame repair parts page in the parts section of your catalog. To order the power frame complete order item 14L61.



NOTE: OPTIONAL SEAL FLUSH COMPONENTS



GOULDS WATER TECHNOLOGY LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Water Technology.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Water Technology distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Water Technology Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Water Technology and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

xylem
Let's Solve Water

Xylem, Inc.
2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
Phone: (800) 453-6777
Fax: (888) 322-5877
www.xyleminc.com/brands/goulds watertechnology

Declaration of Conformity

We at,
Goulds Water Technology / Xylem Inc.
1 Goulds Drive
Auburn, NY 13021
Declare that the following products: NPE, MCS, MCC, 3656, 3656 SP, GB, e-SV, SVI, NPO, Prime Line SP, HB, HMS, LC, NPV, LB, LBS comply with Machine Directive 06/42/EC. This equipment is intended to be incorporated with machinery covered by this directive, but must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the actual provisions of the directive.

Declaración de Conformidad

Nosotros en
Goulds Water Technology / Xylem Inc.
1 Goulds Drive
Auburn, NY 13021
Declaramos que los siguientes productos: NPE, MCS, MCC, 3656, 3656 SP, GB, e-SV, SVI, NPO, Prime Line SP, HB, HMS, LC, NPV, LB, LBS cumplen con las Directivas para Maquinarias 06/42/EC. Este equipo ha sido diseñado para ser incorporado a la maquinaria cubierta por esta directiva pero no debe ponerse en funcionamiento hasta que se declare que la maquinaria en la que será incorporado cumple con las disposiciones reales de la directiva.

Déclaration de Conformité

Nous, à
Goulds Water Technology, Xylem Inc.
1 Goulds Drive
Auburn, NY, U.S.A. 13021,
déclarons que les produits NPE, MCS, MCC, 3656, 3656 SP, GB, e-SV, SVI, NPO, Prime Line SP, HB, HMS, LC, NPV, LB et LBS sont conformes à la directive 06/42/EC (législation relative aux machines). Ils sont destinés à être intégrés dans la machinerie faisant l'objet de ladite directive, mais ne doivent pas être mis en service tant que la machinerie en question ne sera pas déclarée conforme aux stipulations de la directive.

xylem
Let's Solve Water

Xylem, Inc.
2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
Téléphone: (866) 325-4210
Télécopie: (888) 322-5877
www.xyleminc.com/brands/gouldswatertechnology

 IM013 Révision numéro 9 Juillet 2012

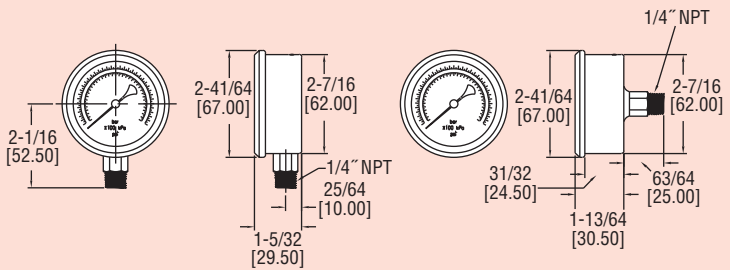
Series SGY

2.5″ Stainless Steel Industrial Pressure Gage

1.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales

SGY Bottom

SGY Back with Accessory Pointers



The Series SGY Gages have dual psi and bar (x100 kPa) scales with ±1.5% full-scale accuracy. The Series SGY gages are designed with 304 SS housings and brass wetted parts for excellent chemical compatibility. These gages cover a wide variety of ranges from full vacuum to 1,000 psi and are available in both bottom or back connections. Series SGY gages employ an easy-open breather plug on top, which allows liquid filled units to breathe, relieving any built up internal pressures. Plug easily pops open and does not need to be entirely removed or cut like a typical gages' rubber plug grommet.

APPLICATIONS

- Vacuums in pneumatic conveying lines
- Positive pressure in compressed air headers

Model	Range	Model	Range
SGY-D10122N	30″ Hg to 0	SGY-D10722N	0 to 200 psi
SGY-D10322N	0 to 30 psi	SGY-D11022N	0 to 300 psi
SGY-D10422N	0 to 60 psi	SGY-D11122N	0 to 500 psi
SGY-D10522N	0 to 100 psi	SGY-D11222N	0 to 1000 psi
SGY-D10622N	0 to 160 psi		

Note: To order with glycerin fill add - GF to the end of the model
For back connect, change ending from 22N to 42N

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Brass connection, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±1.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Weight: 4.9 oz (139 g) bottom, 5.8 oz (164 g) back. Add 2.8 oz (78 g) for fill.

ACCESSORIES

A-445D, U-Bracket Mounting Kit for 2.5″ Gage
A-499R, Red Sliding Color Pointer
A-499Y, Yellow Sliding Color Pointer
A-499G, Green Sliding Color Pointer

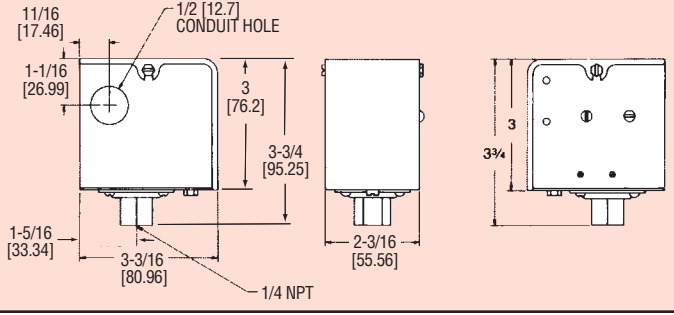
OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

Series CS & CD

Diaphragm Pressure Switches

Visible Set Points, Fixed or Adjustable Deadband



Series CS and CD combine advanced design and precision construction in a small size. Unit is ideal for instrument panels, small compressors and general industrial applications. Visible set point and easy to wire SPDT snap switch reduce installation time. Operates in any position and is vibration resistant.

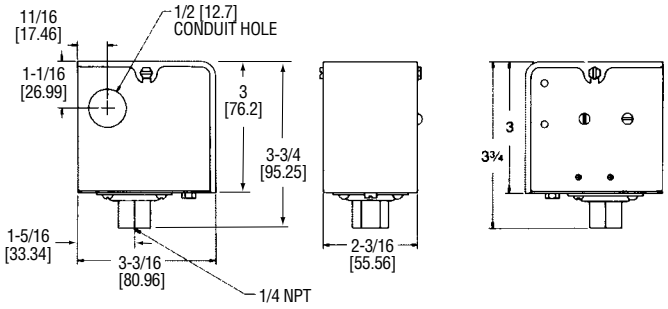
Model	Adjustable Operating Range	Deadband	Deadband Value
CS-1	1-30″ Hg. Vac. (25.4-762 mm Hg)	Fixed	1.5″ Hg. (38 mm Hg)
CS-3	1-100 in w.c. (.25-24.9 kPa)	Fixed	7 in w.c. (1.74 kPa)
CS-10	1-10 psig (.07-.69 bar)	Fixed	0.4 psig (0.03 bar)
CS-30	1-30 psig (.07-2.1 bar)	Fixed	1.0 psig (0.07 bar)
CS-150	10-150 psig (.69-10.3 bar)	Fixed	5 psig (0.35 bar)
CD-10	1-10 psig (.07-.69 bar)	Adjustable	Min: 1.5 psig (.1 bar), Max: 11.5 psig (.79 bar)
CD-30	1-30 psig (.07-2.1 bar)	Adjustable	Min: 2 psig (.14 bar), Max: 12 psig (.83 bar)
CD-150	10-150 psig (.69-10.3 bar)	Adjustable	Min: 14 psig (.97 bar), Max: 24 psig (1.7 bar)

SPECIFICATIONS

Wetted Materials: Nylon reinforced Buna-N and steel.
Temperature Limits: -30 to 150°F (-35 to 66°C).
Pressure Limit: 30 psig (2.1 bar) for ranges 1, 3, and 10; 50 psig (3.5 bar) for range 30; 175 psig (12.1 bar) for range 150.
Enclosure Rating: General purpose.
Switch Type: SPDT snap switch.
Electrical Rating: 15 A @ 120 VAC, 8 A @ 240 VAC.
Electrical Connections: Screw terminal.
Conduit Connection: 1/2″ hole for conduit hub.
Process Connection: 1/4″ female NPT.
Mounting Orientation: Any position.
Set Point Adjustment: Internal screw.
Weight: .5 lb (0.23 kg).
Deadband: See model chart.
Agency Approvals: CE, UL.

Series CS Low Cost Diaphragm Pressure Switches

Specifications – Installation and Operating Instructions



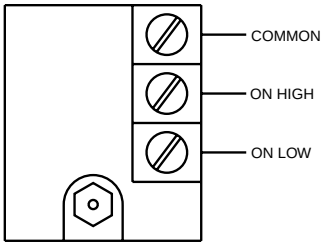
The Series CS Low Cost Diaphragm Pressure Switch is ideal for instrument panels, small compressors and general industrial applications. Visible set point and easy-to-wire SPDT snap switch reduce installation time. This switch operates in any position and is vibration resistant.

INSTALLATION/MOUNTING

The control can be pipe mounted. Do not twist the case when installing. Use wrench on the pressure connection flats.

WIRING

All wiring must conform to the National Electrical code and local regulations. Do not install control to handle loads in excess of electrical rating shown in specifications or as indicated on instructions inside control cover. Connect wiring to screw terminals depending on the action required. Common and High contacts will close and Common and Low contacts will open when increasing pressure (or vacuum) reaches set point. The reverse will occur when pressure (or vacuum) drops below the set point less the deadband.



WIRING DIAGRAM
TOP VIEW

CAUTIONS: Do not oil any parts. Mount control securely. Never exceed electrical rating for switch. Use only with compatible.

WARNING

A failure resulting in injury or damage can be caused by over-pressure, excessive vibration or pressure pulsation, excessive temperature, corrosion of pressure containing parts and movement assembly, electrical overload or other misuse.

PHYSICAL DATA

Temperature Limits: -30 to 150°F (-34.4 to 65.6°C)
Pressure Connections: 1/4″ NPT(F)
Electrical Ratings: 12 A @ 120 VAC; 8 A @ 240 VAC; 7A @ 277 VAC; 1/8 HP @ 120 VAC; 1/4 HP @ 240 VAC
Switch Type: SPDT snap acting
Conduit Opening: 1/2″
Wiring Connections: Three screw type, common, N.O., N.C.
Set Point Adjustment: Screw type, inside cover
Housing: Galvanized steel, NEMA 1
Diaphragm: Buna-N/Nylon
Calibration Spring: Plated steel
Installation: Any position
Weight: 1/2 lb. (0.23 kg)

Model No.	Adjustable Operating Range	Fixed Deadband		Max. Pressure
		Maximum	Minimum	
CS-1	1-30" Hg. Vac. 2.5-75 cm Hg.Vac	1.5" Hg. 3.8 cm Hg. Vac	1" Hg. VAC 2.5 cm Hg. Vac	30 psig
CS-3	10-100" w.c. 2.5-250 cm w.c.	7" w.c. 17.8 cm w.c.	5" w.c. 12.7 cm w.c.	30 psig
CS-10	1-10 psig 0.07-0.7 kg/cm^2	0.4 psig 0.03 kg/cm^2	0.25 psig 0.02 kg/cm^2	30 psig
CS-30	1-30 psig 0.07-2.1 kg/cm^2	1.0 psig 0.07 kg/cm^2	0.5 psig 0.035 kg/cm^2	50 psig
CS-150	10-150 psig 0.07-10.5 kg/cm^2	5 psig 0.35 kg/cm^2	1.5 psig 0.1 kg/cm^2	175 psig

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SECTION 13 - 1000 SERIES PROCESS EQUIPMENT - BAG FILTERS

BAG FILTER HOUSING - FILTER TECHNOLOGIES MODEL 8-30-2P-1-150-AL-VS-PB

Model 8 Bag Filter Housings Sizes #1 & #2

Strainers or Bag Filters: Your Choice!

Model 8 strainer/filter housings are made in 2 sizes and can serve as basket strainers (for particle retention down to 74 micron size) or as bag filters (for particle retention down to 1 micron size). In all cases, covers are easily removed without special tools.

Features

- Low pressure drops
- Permanently-piped housings
- Covers are O-ring sealed
- Carbon steel or stainless steel (304 or 316) and aluminum construction for housings
- Easy to clean!
- Adjustable-height legs, standard
- O-Ring seals: Buna N, EPR, Viton®, teflon®
- Duplex unites are available
- Pipe sizes 3/4 thru 4-inch, NPT or flanged
- Two basket depths: 15 or 30 inches (nominal)

Options

- Sanitary connections
- Different outlet connections
- Extra-length legs
- Liquid displacers for easier servicing

Model shown in Stainless Steel

Model shown in Carbon Steel

Choosing A Basket Strainer or Bag Filter

Choose between straining (removing particles down to 74 micron size) or filtering a fluid (removing particles down to 1 micron size). This will direct you to choose the correct basket when ordering.

Operation

Unfiltered liquide enters the housing above the bag or basket and passes down through them. Solids are contained inside the bag or basket, where they're easily and completely removed when the unit is serviced.

Fluid bypass around the basket is prevented because the outside diameter of the filter bag seals radially against the housing inside diameter. A single cover gasket is used to seal the opening, and covers can be installed and removed without tools.

Model 8 Pressure Drop Data

Basket strainer and bag filters are usually selected so that the pressure drop does not exceed 2 psi, when they are clean. Higher pressure drops may be tolerated, when contaminant loading is low. Bag change out should occur at 15 psid.

The pressure drop data is accurate for all housings with strainer or bag filter baskets. When bag filters are added, total pressure drop becomes the sum of the pressure drop as determined by the steps below.

	Viscosity, cps								
	1 (H_2O)	50	100	200	400	600	800	1000	2000
All unlined baskets	.65	.85	1.00	1.10	1.20	1.40	1.50	1.60	1.80
40-mesh lined	.73	.95	1.20	1.40	1.50	1.80	1.90	2.00	2.30
60-mesh lined	.77	1.00	1.30	1.60	1.70	2.10	2.20	2.30	2.80
80-mesh lined	.93	1.20	1.50	1.90	2.10	2.40	2.60	2.80	3.50
100-mesh lined	1.00	1.30	1.60	2.20	2.40	2.70	3.00	3.30	4.40
200-mesh lined	1.30	1.70	2.10	3.00	3.40	3.80	4.40	5.00	6.80

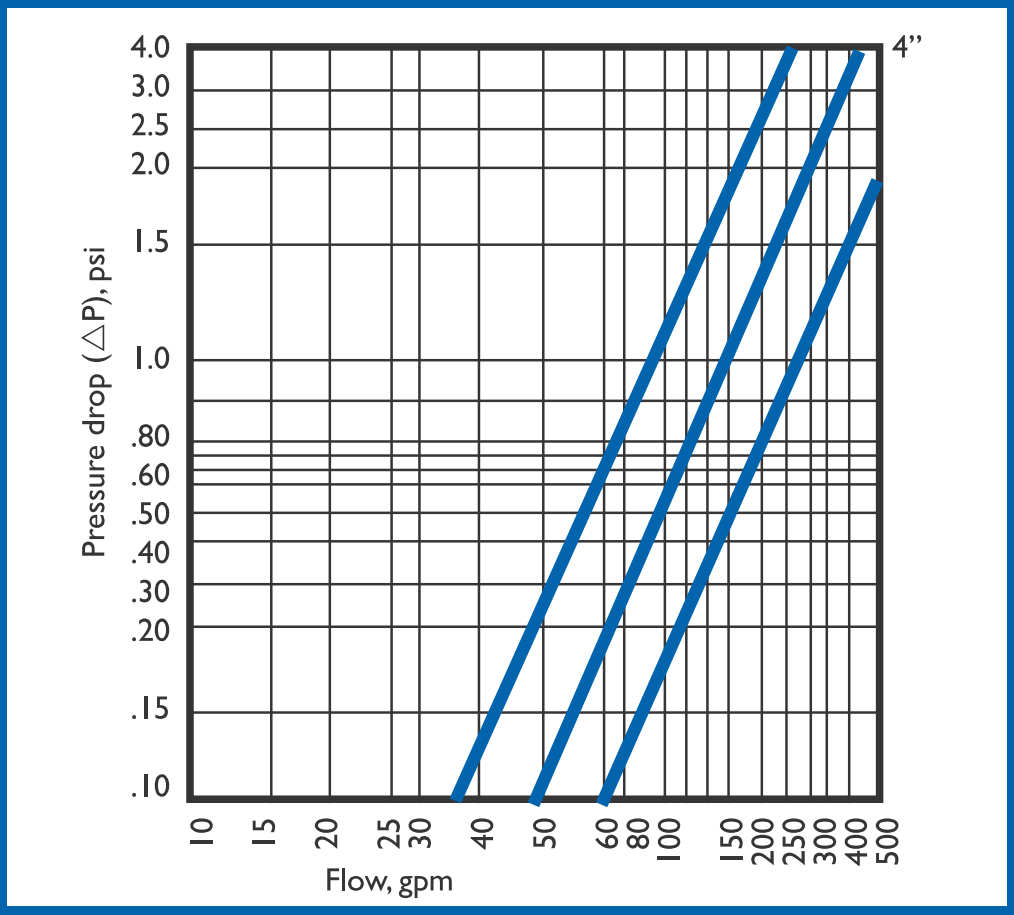
Follow these easy steps:

1) Using the desired pipe size and approximate flow rate, determine the basic pressure drop from the appropriate graph.
2) Multiply the pressure drop obtained in step 1 by the viscosity correction factor found in the accompanying table. This is the adjusted (clean) pressure drop for all baskets, without filter bags.
3) Add the pressure drop for the bag filter.

Basket Data

Depth Nominal (inches)	Diameter (inches)	Surface Area (sq. ft.)	Volume (cu. in.)	Bag Size No.
15	6.7	2.3	500	1
30	6.7	4.4	1000	2

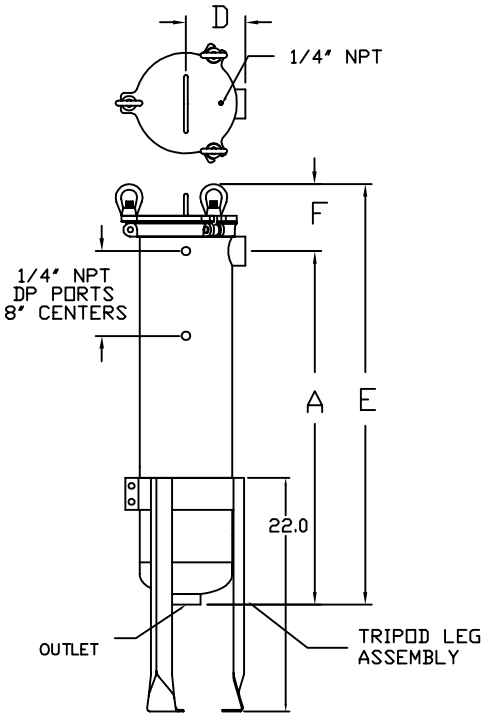
Model 8 — For flow rates to 220 gpm*



* Based on housing only. Fluid viscosity, bag filter used, and expected dirt loading should be considered when sizing a filter.

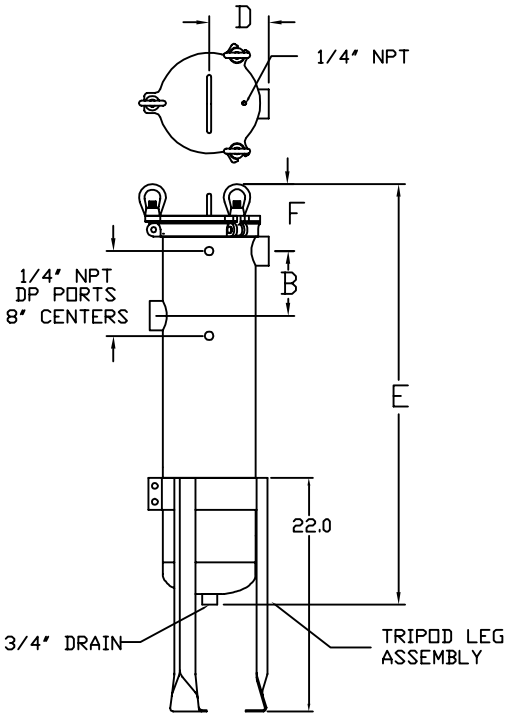
Model 8: Sizes #1 & #2 — Available in four styles and four materials

Carbon Steel



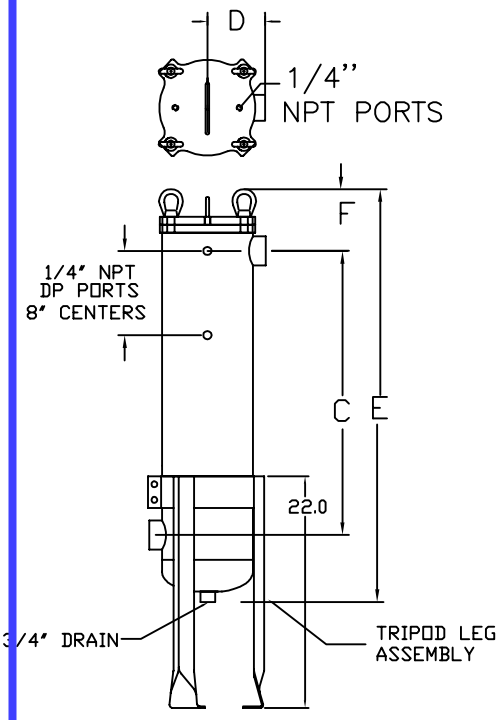
Style 1
Bottom Outlet

304-316 Stainless Steel



Style 2
Side Outlet Top

Aluminum



Style 2B
Side Outlet Bottom

Carbon Steel
304-316 Stainless Steel
Aluminum

Standard Features
- Hinged Eye Bolt Cover (CS & SS)
- Eye Bolt Cover (Aluminum)
- 304 Stainless Basket
- Buna Seal
- 1/4" NPT Gauge Port
- Adjustable C.S. Legs

Options
- 316 Stainless Basket
- DP Ports
- O-Ring Seal Materials
- 304, 316 Adjustable Legs
- Style 3 90 Elbow
- Flange Connections
- Sanitary Connections

#1
SIZE 8-15

Pipe Size In NPT	A	B	C	D	E	F
0.75	30.5	5.6	13	5.3	24.3	5.6
1.00	30.5	5.6	13	5.3	24.5	5.7
1.25	30.5	5.6	13	5.3	24.9	5.9
1.50	30.5	5.6	13	5.3	25.6	6.1
2.00	30.5	6.1	13	5.3	25.7	6.3
3.00	30.5	7.3	13	5.3	26.8	6.9
4.00	30.5	8.3	13	5.3	27.9	7.4

#2
SIZE 8-30

Pipe Size In NPT	A	B	C	D	E	F
0.75	34.5	5.6	27	5.3	38.3	5.6
1.00	34.5	5.6	27	5.3	38.5	5.7
1.25	34.5	5.6	27	5.3	38.9	5.9
1.50	34.5	5.6	27	5.3	39.6	6.1
2.00	34.5	6.1	27	5.3	39.7	6.3
3.00	34.5	7.3	27	5.3	40.8	6.9
4.00	34.5	8.3	27	5.3	41.9	7.4

How To Order Model 8: Size #1 & #2 Filter Bag Housings

HOUSING | OPTIONS

EXAMPLE: 8 - 30 - 2P - 1 - 150 - CS - BS - PB - 200 - D - DP

Model #
#8 - 8

Housing Size
15 inch -15
30 inch -30

Pipe Size NPT / Flange
1" Female NPT -1P
1 1/4" Female NPT - 1 1/4P
1 1/2" Female NPT - 1 1/2P
2" Female NPT - 2P
3" Female NPT - 3P
1" 150 Class ANSI Flange -1F
1 1/4" 150 Class ANSI Flange - 1 1/4F
1 1/2" 150 Class ANSI Flange -1 1/2F
2" 150 Class ANSI Flange - 2F
3" 150 Class ANSI Flange - 3F

Outlet Style
Bottom - 1
Side - 2
Side Bottom - 2B
90 Degree Elbow - 3

Pressure Rating
150 PSI(Flanged or NPT)

Housing Material
Aluminum - AL
Carbon Steel - CS
304 Stainless Steel - 4S
316 Stainless Steel - 6S

DP Ports
DP

Displacer
Displacer - D

Mesh Sizes
20,30,40,50,60,70,80
100,150,200

Basket Type
Standard Basket - PB
Mesh Lined - BM
Perforated Basket - P
1/4,3/16,9/64,3/32,1/16

Basket Seal
Buna Seal - BS
Ethylene Propylene(EPR) - ES
Teflon Encapsulated Viton -TS
Solid Teflon - ST
Viton - VS

* Aluminum Housings only available with Eye Bolt Covers
* Carbon Steel & Stainless Housing only available with Hinged Eye Bolt Covers
* All Filter Bag Housings come with Carbon Steel Legs & Standard 304 SS Basket
* 304 Stainless & 316 Stainless Legs are available & 316 SS Baskets are available

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Model 80 Filter Bag Housing
General Purpose Design

100 psi Maximum Pressure

CONTENTS

IMPORTANT!!

READ AND UNDERSTAND **ENTIRE** MANUAL BEFORE INSTALLING & OPERATING THIS FILTER BAG HOUSING

ISSUE DATE: May 1, 2000	REVISION:	REVISION DATE:

I. INSTALLATION

1. Unpack the filter housing and check for damage which may have occurred during shipping. Report any damage to carrier and vendor.

2. Remove all plastic protective caps from the inlet & outlet.

3. After positioning the housing in the desired location, the adjustable tripod legs should be secured to the floor. Some installations may require a wall mounting bracket. Others may not require either legs or brackets.

4. There are two 1/4" NPT ports on the cover. One can be used for the inlet pressure gauge and the other for the vent valve.

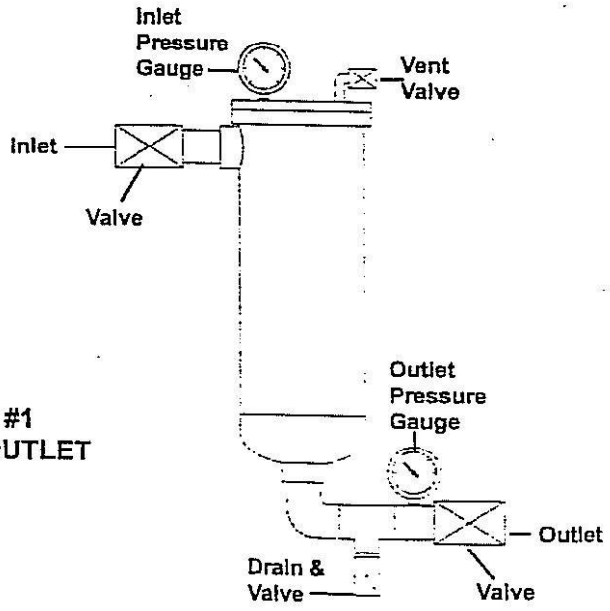
5. Install the filter bag basket in the housing in the basket holder.

6. Insert the filter bag in the basket making sure the bag is firmly sealed in the basket holder.

7. Install the cover gasket.

8. Close the cover and alternately tighten the four speed bar knob assemblies evenly to provide a positive leak proof seal.

TYPICAL INSTALLATION DIAGRAMS



STYLE #1
BOTTOM OUTLET

Note: Speed bar knob bolts on cover and adjustable legs not shown for clarity. Valves, fittings and pressure gauges not provided.

YOUR MODEL 80 FILTER BAG HOUSING IS NOW READY FOR OPERATION.

II. OPERATION

START UP

1. All valves should be closed.
2. Turn the pump on.
3. Open inlet valve slowly.
4. Open vent valve. Close the vent valve as soon as liquid runs out. With hazardous liquids provide proper precautions for operator safety. If the vent valve is not opened, an air pocket could develop in the housing.
5. Slowly open the outlet valve.
6. Once the required flow rate has been established, the filter will operate until dirty.
7. The filter bag should be changed when the differential pressure reaches 15 psi.

CHANGING THE FILTER BAG

1. The pump should be turned off.
2. Close the inlet valve.
3. Close the outlet valve.
4. Relieve the pressure in the housing through the vent valve.

CAUTION: Do not at any time remove or loosen cover bolts before draining. Failure to open the drain valve and vent valve can result in the liquid in the housing being under pressure. Liquid may spray out when bolts are loosened causing personal injury or damage to equipment.

5. Drain the housing by opening the drain valve. Air can be used to facilitate draining if required.
6. Remove the filter bag from the housing and properly discard. A handle is provided on all bags.
7. Remove and clean the filter bag basket if required.
8. With the bag basket in place, install the new filter bag in the basket and properly seat it in the filter bag basket holder.
9. Clean and inspect the cover gasket and groove. Replace the gasket if necessary.
10. Close the cover and alternately tighten the four speed bar knob assemblies evenly to provide a positive leak proof seal.
11. You are now ready to follow the start-up procedure again.

III. REPLACEMENT PARTS

PART NO.	DESCRIPTION
P80CG-B	Buna N Cover Gasket
P80CG-E	Ethylene Propylene Cover Gasket
P80CG-V	Viton Cover Gasket
P80CG-T	Teflon Cover Gasket
P80PF4S-1B	#1 Size (14" Long) 304 S.S. Filter Bag Basket
P80PF4S-2B	#2 Size (28" Long) 304 S.S. Filter Bag Basket
P80PS BK	5/8" Polypropylene Speed Bar Knob Bolt

IMPORTANT NOTICE:
Warranty: In the event any product is found to be defective in material, workmanship, or not in conformance with any express warranty for a specific purpose, the sellers only obligation and your exclusive remedy, shall be to repair, replace or refund the purchase price of such parts or products upon timely notification thereof and substantiation that the product has been stored, maintained and used in accordance with the sellers written instructions.

EXCLUSIONS TO WARRANTY: THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, EXCEPT OF TITLE AND AGAINST PATENT INFRINGEMENT.

LIMITATION OF LIABILITY: Except as provided above, the seller shall not be liable or responsible for any loss or damage, whether direct, indirect, incidental, special or consequential, arising out of sale, use or misuse of the sellers products, or the user's inability to use such products.

THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE.

It is important that you analyze all aspects of your application. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

⚠ WARNING

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

SECTION 14 - 1100 SERIES PROCESS EQUIPMENT - LGAC

LIQUID PHASE CARBON VESSEL, 8x30 VIRGIN MEDIA - TETRASOLV MODEL AF-1000

PRESSURE INDICATOR - DWYER MODEL SGY-D10422N

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Anderson, IN 46013
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www.tetrasolv.com

REGIONAL OFFICE
717 Van Patten
Truth or Consequences, NM 87901
508-448-0256 Fax
jbarbour@tetrasolv.com

8x30 VIRGIN CARBON

GENERAL DESCRIPTION

Select virgin carbon is quality screened during our purchasing process for activity, density and fines. The use of virgin carbon is recommended where drinking water quality is necessary. All carbon either sold by itself or installed in our filtration units is traced by lot number to the installation or sale.

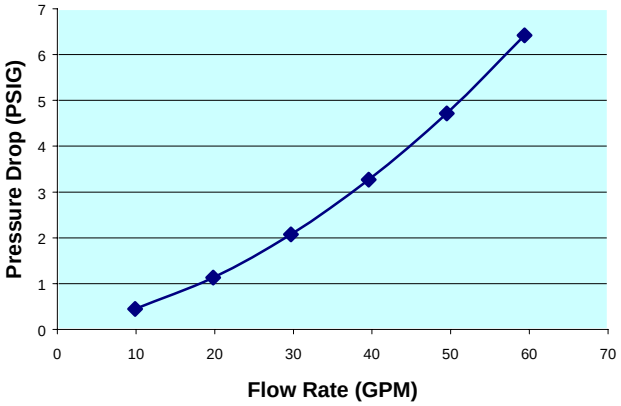
8x30 (Liquid Phase) Standard Specifications:	**Standard**	**Value**
Iodine Number	ASTM D-4607	1200 Minimum
Moisture Content	ASTM D-2867	5% Maximum (as packed)
Particle Size	ASTM D-2862	8x30 US Mesh
Ash		10% Maximum
Total Surface Area (N2BET)		1050 Minimum
Pore Volume (cc/g)		0.75

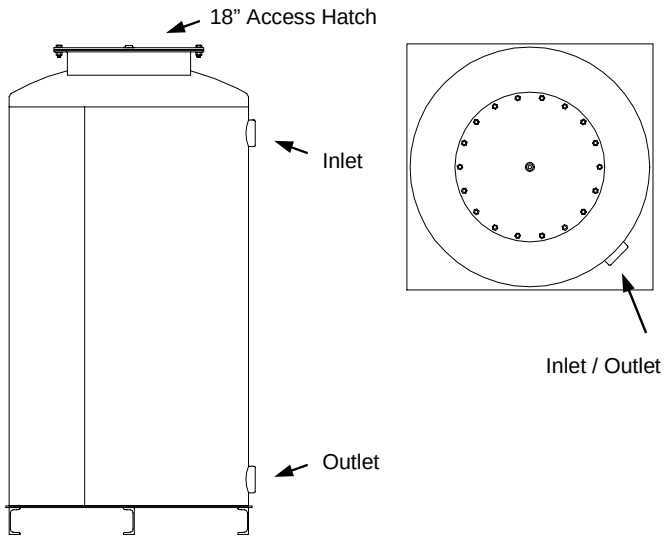
PRODUCT DATA SHEET
AFD SERIES FILTERS
MODEL AF-1000

The AF-1000 filter is a media filter vessel designed to treat liquid streams. While the typical design application is a activated carbon adsorbtion unit, the filter can easily accommodate many medias. Some applications include:

- Dissolved Organic Removal (Activated Carbon)
- Suspended Solids Removal (Sand Filter)
- Dissolved Minerals (Softener Resin)
- Oil and Grease Removal (Organo-Clays)
- Dissolved and Precipitated Metals Removal
- Special Organics (Resin/Carbon Blend)
- Catalytic Reactor (Chlorine and Peroxide Removal)
- Bio-Remediation Contactor Unit

PRESSURE DROP GRAPH
*(As Filled - 8*30 GAC)*





AF-1000 SPECIFICATIONS			
Overall Height	6'2"	Vessel/Internal Piping Materials	CS (SA-36) / SCH 40 PVC
Diameter	36"	Internal Coating	Polyamide Epoxy Resin
Inlet / Outlet (FNPT)	2"	External Coating	Epoxy Mastic
Drain / Vent (FNPT)	OPT / 1/4"	Maximum Pressure / Temp	40 PSIG / 140º F
GAC Fill (lbs)	1,000	Cross Sectional Bed Area	7 FT^2
Shipping / Operational Weight (lbs)	1,500/3,100	Bed Depth/Volume	5 FT / 33 FT^3

Tetrasolv Filtration
1200 East 26th Street - Anderson, Indiana 46016 U.S.A
Phone (765) 643-3941 Fax (765) 643-3949 Email: info@tetrasolv.com

Revised Feb 2004

Operation & Maintenance Manual

AFD ● AF ● HPP ● HPAF SERIES

Tetrasolv Filtration Liquid Filters

Liquid & Vapor Filtration
Remedial • Industrial • Municipal

CONTENTS

1.0 GENERAL DESCRIPTION

The liquid series filters utilize fixed bed filtration to treat water. The filters employ a variety of medias to remove or catalyze contaminants. Flow through the filter may be either up flow or down flow depending upon the media supplied and the operation parameters. Generally inlet and outlet locations are indicated on the filter and or the filter drawings.

Product data sheets, drawings, MSDS, etc are available from www.tetrasolv.com or call the number below or email your request to support@tetrasolv.com.

2.0 SAFETY CONSIDERATIONS

It is important that the entire O&M manual be read prior to set up and operation of the carbon system.

♦ ***WARNING: We strongly recommend the use of a relief device in all installations. Exceeding the maximum pressure of the filter could result in catastrophic failure of the vessel.***

- Always adhere to “lockout/tagout” procedures when servicing the system.
- Wear appropriate safety equipment when operating system.
- Review the MSDS sheet for the installed media prior to working with the installed carbon.

♦ ***WARNING: Wet or dry activated carbon preferentially removes oxygen from air. In closed or partially closed containers, oxygen depletion may reach hazardous levels. If workers must enter a container containing carbon, appropriate sampling and work procedures should be followed for potentially low-oxygen spaces - including all applicable federal and state requirements.***

- Understand the potential hazards of the stream

being treated by the system. The media may contain higher concentrations of the contaminants being adsorbed than is in the influent stream. In addition the media may be considered hazardous material and therefore may require specific handling precautions unknown to Tetrasolv Filtration.

3.0 INSTALLATION

3.1 Shipment

Typically filters are shipped with media installed. However, in certain instances media is shipped to the site to be installed after installation. In very large systems it may be advisable to not install the media until adsorbers have been placed into final position and secured.

3.2 Unloading

Refer to the product data sheet for weight information for appropriate sizing information for the equipment to be used.

All components should be lifted either by crane or forklift as designated by the model.

- ***WARNING: Failure to follow the procedures outlined below can result in catastrophic damage to the system.***

Crane Lift - If a crane lift is to be used we recommend the following method. A "spreader" equaling 75% of the distance between the opposing lifting eyes on each adsorber should be used to insure proper lifting force direction. Attach an appropriately sized spreader beam and lifting cables to each lift eye of the component. The use of an experienced crane operator and quality equipment is highly recommended.

Fork-Lift - When using a forklift we recommend that the fork tubes on the filter be used or a pallet if the unit was shipped on a pallet.

- ***WARNING: Never attempt to pick up an adsorber which has wet carbon installed. The lifting eyes are designed only to lift the adsorber with dry carbon installed.***

3.3 Inspection

Perform the following inspections after un-loading the filter. Note any discrepancies and contact Tetrasolv Filtration immediately.

- Check the vessel exterior for damage which may have occurred during shipment. Inspect the support structures and piping support for damage.
- Inspect the piping system for damage. Insure the valves operate properly. Check installed instruments and instrument installation points for damage.
- Visually inspect the interior (if possible) of the vessel for loose laterals and or internal damage.
- Inspect the carbon discharge, drain and vent valves for damage.

3.4 Set Up

The filter should be placed on a level concrete pad of appropriate thickness to support the system at it's maximum operational weight. The filter should be secured to the pad using appropriately sized anchor bolts.

Connect the site piping to the filter inlet and outlet connection points. It is important that all piping connected to the filter should be self supported. We also recommend in hard pipe installation that a flexible joint be used to further insulate the filter from vibration and stress.

Connect any gauges and instrumentation shipped loose with the system.

The outlet piping should be designed to allow flooded operation of the Adsorber at all times to assure effective operation. If the outlet line does not provide for back pressure on the Adsorber unit, then the discharge piping should include an elevated piping loop to assure flooded operation.

Siphoning can occur when the discharge line allows suction to be placed on the process discharge. Siphoning can cause air pockets to occur in the adsorbers. If channeling is likely to occur we recommend the installation of an appropriately sized vacuum breaker.

If the supply pump is capable of producing pressure greater than the design limitation of the filter it is recommended that a rupture disk or pressure relief valve be installed prior to the influent connection.

If water conditions such as high suspended solids exist a filter should be installed prior to the Adsorber. A simple cartridge or screen filter helps prevent pressure buildup in the media bed. Many other water issues may effect Adsorber operation and we therefore recommend you discuss your specific installation with a representative.

Connect the process inlet and outlet to the site influent and effluent process lines.

3.5 Wetting and Deaeration

Dry carbon and other medias must be wetted and deaerated prior to use. This procedure displaces air from the internal structure of the carbon granule, thus assuring that the liquid to be treated is in contact with the carbon surface.

Prior to operation, the filter must be filled with clean, uncontaminated liquid. The recommended method for filling the vessel is through the outlet line. Open the inlet line to purge air from the system. Feed water into the outlet line until water flows from the inlet line. The wet carbon or media should be allowed to set for a minimum of 1 hours.

This is also a good time to inspect the system for leaks which may have been caused in transit and unloading the system. If leaks are spotted, tighten the fitting or flange bolts carefully until the leak stops. Do not overtighten the bolt or fitting. If the leak persists contact Tetrasolv Filtration for assistance.

After wetting, the carbon bed can be deaerated by draining the adsorber, and again filling the adsorber upflow with uncontaminated water. This procedure will eliminate any air pockets which may have formed between the carbon granules.

After completing the wetting and Dearation it is recommended that a backwash be performed. The backwash will remove media fines which can cause excess pressure drop in the system if not removed. In addition backwashing helps equalize the bed. Follow the directions outlined in Backwashing ***(refer to section 4.2)***.

After backwashing close the system valves and wait 1 hour.

The system is now ready for operation.

4.0 OPERATION

Flowrates to the filter should be determined based upon the required contact time between the liquid and the filtration media. The required contact time normally is determined prior to installation and operation of the filter.

It is important that the filters remain flooded at all times. If it is necessary to drain adsorbers while off-line it is recommend the procedures in section 3.5 “Wetting and Dearation” be repeated.

4.1 Modes of Operation

With certain applications (2) filters in series flow are utilized. Listed below are typical operational modes.

- Shutdown - Both filters completely off-line and isolated.
- Series Flow - Influent enters primary filter and exits through secondary adsorber (this is the preferred method of operation)
- Isolation Flow - Only one filter is receiving influent. This mode is typically used when the operator is maintaining the off-line filter.
- Parallel Flow - Both filters are receiving the influent as the primary. Flow is split equally between the filters. This mode is used when higher flow rates need to be achieved and contact times are not critical.
- Backwash Mode - Used when back-washing either filter.

4.2 Backwashing

IMPORTANT: Backwashing is not advisable with AFD or AF Series Filters. If a backwash is required please contact the number below or support@tetrasolv.com for assistance.

Usually backwashing is only performed in carbon adsorbers after new carbon has been installed or prior to removing the carbon from the adsorber. However, sometimes water conditions necessitate backwashing to remove suspended solids from the top of the carbon bed. Keep in mind that backwashing a carbon bed during normal service runs may cause the transfer zone to be disturbed leading to pre-mature breakthru of the carbon bed. Backwashing helps to reduce and equalize pressure drop across the media bed as well as removes

collected particulate from the top of the bed. Backwash rates for filters typically fall in the 5 to 20 gpm/ft^2. Backwash rates are dependent upon temperature of the backwash water, filter design and the media conditions. Refer to the data sheet for the supplied filter to obtain the cross sectional bed area. Refer to the data sheet for the supplied media to obtain the recommended backwash rate. Backwashing should begin at a low rate and proceed upwards.

Clean, uncontaminated, sediment free water is introduced to the filter through the outlet connection. This liquid flows upwards through the filter and exits through the inlet line - directed to a back-wash water collection point or drain. The flow rate should not be high enough to cause a significant quantity of media to exit.

IMPORTANT: Use only clean un-contaminated water free of sediments. If there is any question that sediments may be present the water should be filters through a 100 micron filter or smaller. Sediments introduced into the lateral system during backwash can cause excessive pressure build-up in the underdrain leading to underdrain failure.

If possible position an observer at the backwash discharge point. The adsorber should note excessive media loss and general appearance of the backwash effluent. If conditions warrant the observer should also instruct that the backwash be stopped.

Monitor the differential pressure for the filter being backwashed during the operation. If the differential pressure exceeds 30 PSIG discontinue the backwash and contact Tetrasolv Filtration.

IMPORTANT: Differential Pressure exceeding 30 PSIG during backwash may damage the vessel underdrain.

4.3 Monitoring

Filter units only require periodic monitoring if properly installed. The following items may be monitored:

- Pressure: Check inlet and outlet pressure. Increase in pressure differential may indicate build-up of filtered solids. Never exceed maximum design pressure of filter. If the differential pressure exceeds 20 PSIG it may become necessary to perform a backwash ***(see Backwashing Section 4.2)***

- Samples: Inlet and outlet sample points if provided for liquid analysis to determine system performance. Before pulling a sample the sample valve should be opened and allowed to flow freely for a few minutes to insure a fresh sample is obtained.

- Air: Check for trapped air by opening upper vent valve and allowing small amount of liquid to flow out. If your system was provided with automatic vent systems it is still necessary to periodically verify their operation.

- Inspect the discharge stream periodically for filtration media. If filter media is present in the exit stream shut down the system and contact Tetrasolv Filtration immediately.

Note: When the system if first started up small amounts of fines may be present. This is normal and should discontinue within a short period of time.

5.0 FILTRATION MEDIA REPLACEMENT

Prior to servicing the unit should be closed off from influent and effluent lines and any electrical devices or connections should be tagged off.

After removal of the filtration media is complete, it is recommended that the inside of the filter be washed to remove all contamination and any trace of spent media. After the filter has been washed, the filter should also be checked thoroughly and any minor maintenance conducted.

5.1 Media Loading - Dry Method

Fill the adsorber 1/4 full of clean water to protect the lower manifold and limit the amount of dust generated.

- ***WARNING - Dry activated carbon generates considerable dust. While activated carbon poses no health risk the dust can cause respiratory irritation and occasional skin rash. Therefore we recommended the use of proper clothing and dust mask during filling operation.***

Super Sacks - Hoist the bag over the manway and untie the outer bag exposing the inner chute. Untie the inner chute while clasping it shut. Remain holding the chute and carefully lower the chute into the manway. Un-clasp the chute and allow the carbon to discharge from the sack. The carbon should flow out very quickly and completely. When finished shake the bag and invert the chute into the bag.

If at any time you wish to stop the flow of carbon simply re-grasp the chute up high and cinch. Re-tie the bag.

5.2 Media Loading - Slurry Method

In this method dry-activated carbon will be delivered to the site in a slurry truck or slurry capable hoppers. To add the carbon to the filters use the following method:

- ***WARNING: Carbon slurry operation is a potentially hazardous operation which should only be performed by experienced operators with prior slurry experience. If you are un-trained do not attempt to perform a slurry without assistance.***

1. Use an appropriate sized hose connected to the carbon supply line for the adsorber. **Be sure the slurry line is adequately secured and the cam-lock mechanism is completely engaged. If the slurry line disconnects or fails large amounts of carbon will be expelled.**

2. Fill the adsorber 1/4 full of water to cushion the vessel internals from the entering carbon.

3. Completely cover the fresh carbon with clean water. Connect air source to the slurry container capable of producing 10 PSIG of air at 175 cfm.

4. Open the adsorber process outlet valve to allow excess water to escape the system (note: depending upon your discharge piping configuration this may not allow sufficient water drainage under non-pressure operation, consult Tetrasolv Filtration). Open the slurry in valve. Fresh carbon should begin flowing quickly into the filter. During this process it may become necessary to stop the slurry and allow excess water to drain from the adsorber.

5. When transfer is complete the transfer hose will begin blowing air only. It may be necessary to inspect the transfer hopper for carbon which did not transfer. If a sufficient quantity is present wash the carbon to the center using clean water and add enough water to re-cover the carbon and repeat the above procedures.

6. Close the valves and proceed to Section 3.5 “Wetting and Deaeration” then perform a backwash.

5.3 Media Removal - Slurry Method

This method can only be used with slurry equiped HPAF Series!

In this method spent activated carbon will be removed from the spent adsorber into a slurry truck or slurry capable hoppers. To remove the carbon from the filter use the following method:

- ***WARNING: Carbon slurry operation is a potentially hazardous operation which should only be performed by experienced operators with prior slurry experience. If you are un-trained do not attempt to perform a slurry without assistance.***

Backwashing the adsorber to be serviced for a few minutes prior to servicing will make the slurry occur more easily. It is important the the adsorber to be backwashed be full of water prior to attempting the slurry.

1. Connect the carbon discharge line to the carbon discharge connection on the adsorber to be emptied.

2. Connect an air source to the carbon fill line capable of producing 50 PSIG of air at 175 cfm.

- ***WARNING - The inlet air should be closely monitored to insure the pressure does not exceed the design pressure leading to rupture disc activation. If this can not be done the use of a pressure limiting device which still allows adequate air flow should be used.***

3. Open the air vent valve and pressurize the adsorber to 15 PSIG.

IMPORTANT: The initial pressure required for slurry transfer will be between 10 and 20 PSIG. Because of the compressibility of air the pressure should be reduced as the adsorber empties. If the operator supplying compressed air into the adsorber cannot see the pressure gauge there must be another operator who can call out the pressure reading during the transfer.

4. Open the slurry out valve. Spent carbon should begin flowing quickly out of the carbon vessel.

5. When transfer is complete the transfer hose will begin blowing air only. Bleed all air from the adsorber, remove the manway and inspect the adsorber for carbon which did not transfer. If a sufficient quantity is present wash the carbon to the center using clean water and add enough water to re-cover the carbon and repeat the above procedures.

6. Inspect the internals prior to refilling the adsorber.

Inspect the interior lining. Do not place the adsorber back into operation if any defects are noted.

6.0 MAINTENANCE

6.1 Extended Shut Down

If the filter will be shutdown for extended periods certain procedures should be taken to protect the filter.

If possible backflush the filter. Drain all water from the adsorber utilizing the effluent connection and the drain port if available. When draining allow air to enter the system by venting the influent line. Store the drained filter with system vented.

Caution should be taken during system startup following exposure to freezing conditions as the media may still be in a frozen state days or weeks after.

Prior to placing the adsorber back into service it is recommended the procedures outlined in section 3.5 "Wetting and Dearation" be followed.

Monitor the filter closely after extended shutdown for signs of potential problems such as interior manifold failure or leaking valves and gaskets.

6.2 Manway Opening & Closing

When it becomes necessary to open a manway the following methods should be closely followed:

- ***WARNING: Opening a manway while a vessel is pressurized can cause serious injury or death. Always verify pressure is relieved before attempting to remove a cover.***

- ***WARNING: Opening the lower manway on an filter which contains media can result in large quantities of media being discharged. Worse still the manway may not be able to be successfully sealed without removal of the media.***

Verify vessel is isolated and relieve pressure using filter vent valve.

Round T-Bolt Closures

1. Carefully loosen retaining nuts around manway ring. If while loosening the bolts you hear a hissing or any other indication of pressure immediately re-tighten the bolts and verify pressure has been relieved.

3. Swing all T-Bolts away from manway cover and slowly open cover. If gasket sticks to manway cover gently pry away to avoid tearing the gasket.

4. Clean O-Ring surface. Lubricate gasket with petroleum jelly.

5. Close manway and tighten bolts. It may be necessary to further tighten bolts after pressure has been applied to filter to prevent leaking.

Elliptical Closures

1. Slip a bent bar between the manway handle and the flange frame. ***This is to insure the manway does not fall into the vessel when the yokes are removed.***

2. Carefully loosen both large nuts holding the yokes to the manway. Remove the yokes.

3. Slide the bar out of the handle while holding it. Push the manway in and tilt to allow the manway to be pulled out of the filter.

Closing the manways:

1. Clean the gasket surface and replace if necessary. Apply tape to the gasket and the cover to hold the gasket in place while it is placed into position.

2. Slip a bent bar between the manway handle and the flange frame. ***This is to insure the manway does not fall into the vessel when the yokes are removed.***

3. Place the yoke into the manway cover slot and hand tighten. Carefully inspect the gasket to be sure it can be seen around the inside surface of the manway opening.

4. Wrench tighten nuts.

7.0 Troubleshooting

The following situations are typical problems which may arise during the operation of filters. If these problems cannot be resolved by using this guide or problems occur which are not addressed in this guide please contact TetraSolv Filtration at the number listed below or e-mail **support@tetrasolv.com**

Situation:

High pressure drop or inadequate flow through filters at expected pressure drop levels.

Probable Cause:

a) Verify effluent and influent lines to and from adsorber are not restricted.

b) Sediments or solids may have clogged the surface of the media. Remove the top manway cover and inspect the surface of the media. Backwashing the media should resolve this issue. Explore the possibility of pre-filtration ahead of the media filter to limit future problems.

c) Air is trapped in the top of the filter or the system piping. Relieve air using vent valves.

d) Underdrain collection baskets clogged. Contact Tetrasolv Filtration for recommendations.

Situation:

Manways failing to seal. Water leaking from.

Probable Cause:

a) Manway not installed properly.

b) Missing or damaged gasket

c) Debris trapped between gasket and ring

Solution:

Tighten the bolts on the manway first. If this does not solve the problem remove and reinstall manway as outlined in 6.4 if possible. If problem persists contact TetraSolv Filtration for further assistance.

Situation:

Premature filter exhaustion.

Probable Cause:

a) Inadequate contact time between the media and the liquid stream.

b) Contaminants in stream not originally accounted for in initial design or higher levels of contaminants than originally accounted for.

c) Trapped air or solids on bed causing channeling.

Solution:

Sample and analyze the influent water stream. Verify proper conditions exist. Also look closely at suspended and dissolved solids.

Verify contact time sufficient for contaminate being adsorbed. Decrease flow rate or install additional media.

Inspect surface of filter for fouling.

Release excess air from top of filter through filter vent line.

Situation:

Activated Carbon bed discharge stream has higher level of contaminants than influent stream.

Probable Cause:

Carbon bed has reached saturation. Carbon beds will often release larger amounts of contaminants than they are adsorbing as the mechanical bonds are broken when the carbon has reached it's saturation point.

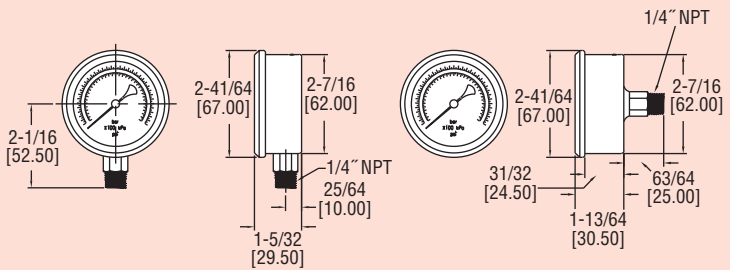
Also, activated carbon will preferentially exchange more easily adsorbed compounds for ones already trapped in the carbon surface releasing the compounds trapped in unpredictable levels.

Series SGY 2.5″ Stainless Steel Industrial Pressure Gage

1.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales

SGY Bottom

SGY Back with Accessory Pointers



The Series SGY Gages have dual psi and bar (x100 kPa) scales with ±1.5% full-scale accuracy. The Series SGY gages are designed with 304 SS housings and brass wetted parts for excellent chemical compatibility. These gages cover a wide variety of ranges from full vacuum to 1,000 psi and are available in both bottom or back connections. Series SGY gages employ an easy-open breather plug on top, which allows liquid filled units to breathe, relieving any built up internal pressures. Plug easily pops open and does not need to be entirely removed or cut like a typical gages' rubber plug grommet.

APPLICATIONS

- Vacuums in pneumatic conveying lines
- Positive pressure in compressed air headers

Model	Range	Model	Range
SGY-D10122N	30″ Hg to 0	SGY-D10722N	0 to 200 psi
SGY-D10322N	0 to 30 psi	SGY-D11022N	0 to 300 psi
SGY-D10422N	0 to 60 psi	SGY-D11122N	0 to 500 psi
SGY-D10522N	0 to 100 psi	SGY-D11222N	0 to 1000 psi
SGY-D10622N	0 to 160 psi		

Note: To order with glycerin fill add - GF to the end of the model
For back connect, change ending from 22N to 42N

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Brass connection, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±1.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Weight: 4.9 oz (139 g) bottom, 5.8 oz (164 g) back. Add 2.8 oz (78 g) for fill.

ACCESSORIES

A-445D, U-Bracket Mounting Kit for 2.5″ Gage
A-499R, Red Sliding Color Pointer
A-499Y, Yellow Sliding Color Pointer
A-499G, Green Sliding Color Pointer

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

SECTION 15 - 1200 SERIES PROCESS EQUIPMENT - LGAC DISCHARGE FLOWMETER

FLOW METER - NEPTUNE MODEL T10-1

FLOW TOTALIZER - NEPTUNE MODEL TRICON / S REGISTER

ARB® UTILITY MANAGEMENT SYSTEMS™

NEPTUNE TECHNOLOGY GROUP

T-10 METER

SIZES: 5/8", 3/4", and 1"

Every T-10 water meter meets or exceeds the latest AWWA C700 Standard. Its nutating disc, positive displacement principle has been time-proven for accuracy and dependability since 1892, ensuring maximum utility revenue.

T-10 water meters are warranted for performance, materials, and workmanship.

CONSTRUCTION

The T-10 water meter consists of three major assemblies: a register, a lead free high copper alloy maincase, and a nutating disc measuring chamber.

The T-10 meter is available with a variety of register types. For reading convenience, the register can be mounted in one of four positions on the meter.

The corrosion-resistant lead free high copper alloy maincase will withstand most service conditions; internal water pressure, rough handling, and in-line piping stress.

The innovative floating chamber design of the nutating disc measuring element protects the chamber from frost damage while the unique chamber seal extends the low flow accuracy by sealing the chamber outlet port to the maincase outlet port. The nutating disc measuring element utilizes corrosion-resistant materials throughout and a thrust roller to minimize wear.

WARRANTY

Neptune provides a limited warranty with respect to its T-10 water meters for performance, materials, and workmanship.

When desired, maintenance is easily accomplished either by replacement of major assemblies or individual components.

GUARANTEED SYSTEMS COMPATIBILITY

All T-10 water meters are guaranteed adaptable to our ARB®V, ProRead™ (ARB VI) AutoDetect, E-Coder® (ARB VII), E-Coder®)R900*i*™, TRICON®/S, TRICON/E®3, and Neptune meter reading systems without removing the meter from service.

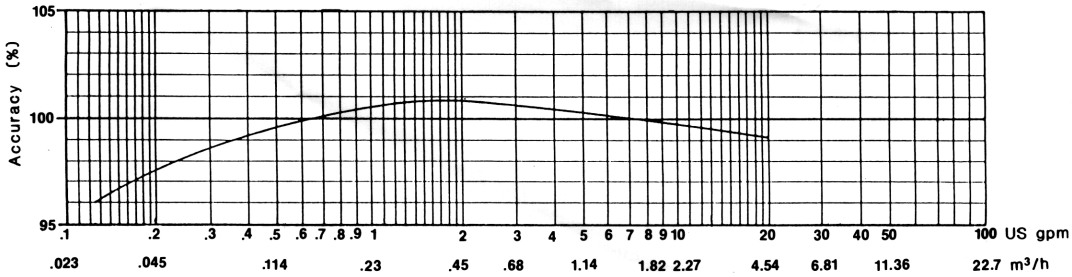
KEY FEATURES

- Register
  - Magnetic drive, low torque registration ensures accuracy
  - Impact-resistant register
  - High resolution, low flow leak detection
  - Bayonet style register mount allows in-line serviceability
  - Tamperproof seal pin deters theft
  - Date of manufacture, size, and model stamped on dial face
- Lead Free Maincase
  - Made from lead free high copper alloy
  - NSF/ANSI 61 certified, Annex F and Annex G compliant
  - Lifetime guarantee
  - Resists internal pressure stresses and external damage
  - Handles in-line piping variations and stresses
  - Lead free high copper alloy provides residual value vs. plastic or composite
  - Electrical grounding continuity
- Nutating Disc Measuring Chamber
  - Positive displacement
  - Widest effective flow range for maximum revenue
  - Proprietary polymer materials maximize long-term accuracy
  - Floating chamber design is unaffected by meter position or in-line piping stresses

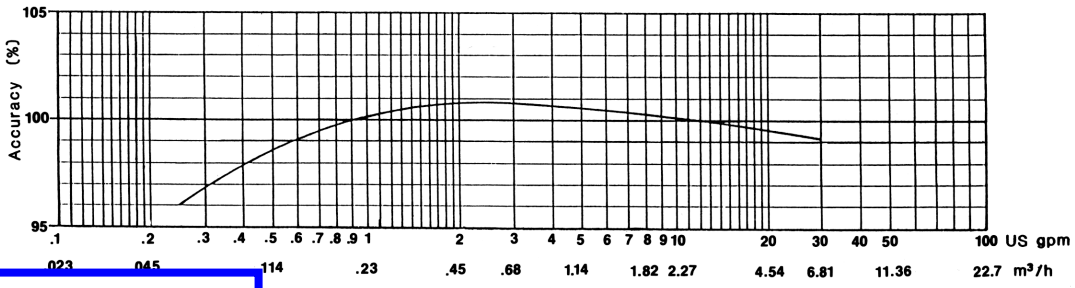
SYSTEMS COMPATIBILITY

Adaptability to all present and future systems for flexibility is available only with Neptune's ARB® Utility Management Systems™.

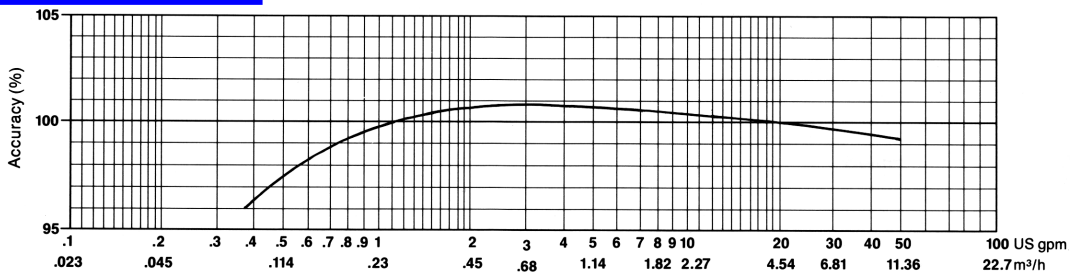
5/8" ACCURACY



3/4" ACCURACY



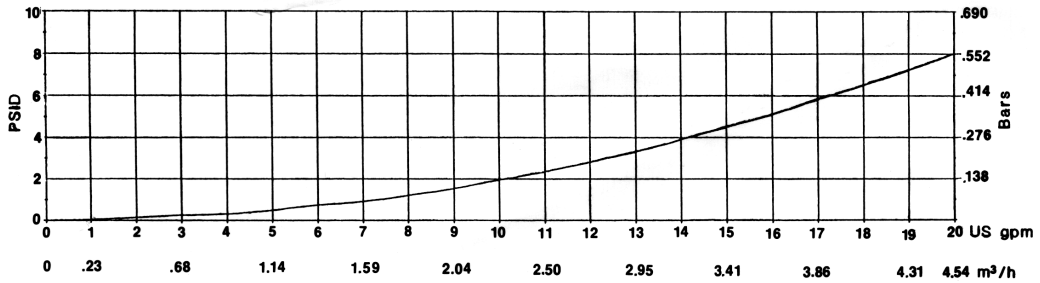
1" ACCURACY



DIMENSIONS

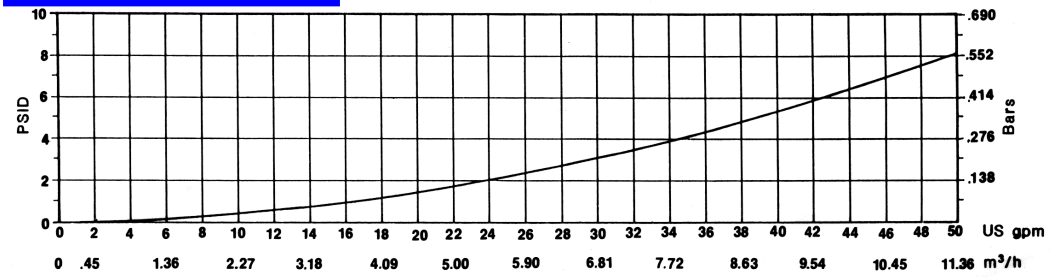
Meter Size	A in/mm	B in/mm	C-Std. in/mm	C-ARB in/mm	C E-Coder) R900*i*	D Threads per inch	D-OD in/mm	E in/mm	F in/mm	Weight lbs/kg
5/8"	7 1/2 191	3 5/8 92	4 3/8 111	5 1/4 133	6 7/8 175	14	1.03 26	1 1/2 38	2 1/2 64	3 1/4 1.4
5/8" x 3/4"	7 1/2 191	3 5/8 92	4 3/8 111	5 1/4 133	6 7/8 175	11 1/2	1.29 33	1 1/2 38	2 5/8 67	3 3/8 1.5
Circa 2011 5/8"	7 1/2 191	3 5/8 92	4 7/8 124	5 3/4 146	7 3/8 187	14	1.03 26	1 5/8 41	2 1/2 64	3 3/4 1.7
Circa 2011 5/8" x 3/4"	7 1/2 191	3 5/8 92	4 7/8 124	5 3/4 146	7 3/8 187	11 1/2	1.29 33	1 5/8 41	2 5/8 67	4 1.8
3/4"	9 229	4 3/8 111	5 1/2 140	6 1/4 159	7 7/8 200	11 1/2	1.29 33	1 7/8 48	2 5/8 67	6 2.7
3/4" SL	7 1/2 911	4 3/8 111	5 1/2 140	6 1/4 159	7 7/8 200	11 1/2	1.29 33	1 7/8 48	2 5/8 67	5 1/2 2.5
3/4" x 1"	9 229	4 3/8 111	5 1/2 140	6 1/4 159	7 7/8 200	11 1/2	1.62 41	1 7/8 48	2 3/4 70	6 1/2 2.9
1"	10 3/4 273	6 1/2 165	6 3/8 162	7 1/8 181	8 3/4 222	11 1/2	1.62 41	2 1/8 54	2 3/4 70	9 3/4 4.4
1" x 1 1/4"	10 3/4 273	6 1/2 165	6 3/8 162	7 1/8 181	8 3/4 222	11 1/2	1.86 47	2 1/8 54	2 13/16 71	10 1/4 4.6

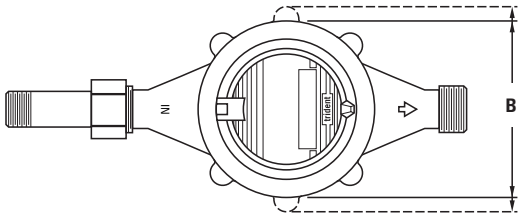
5/8" PRESSURE LOSS

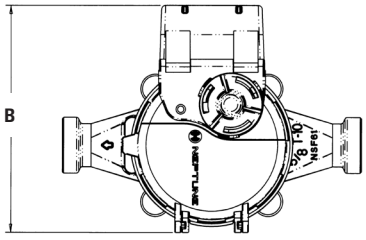


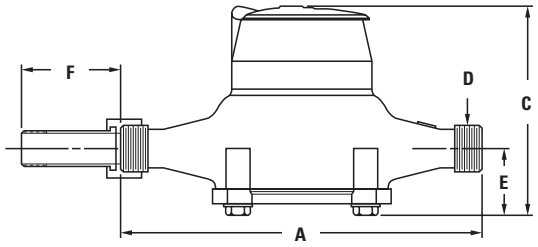
3/4" PRESSURE LOSS

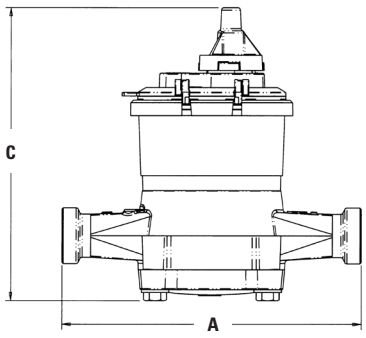
1" PRESSURE LOSS











OPERATING CHARACTERISTICS:

Meter Size	Normal Operating Range @ 100% Accuracy (+/- 1.5%)	AWWA Standard	Low Flow @ 95% Accuracy
5/8"	1/2 to 20 US gpm 0.11 to 4.55 m^3/h	1 to 20 US gpm 0.23 to 4.5 m^3/h	1/8 US gpm 0.03 m^3/h
3/4"	3/4 to 30 US gpm 0.17 to 6.82 m^3/h	2 to 30 US gpm 0.45 to 6.8 m^3/h	1/4 US gpm 0.06 m^3/h
1"	1 to 50 US gpm 0.23 to 11.36 m^3/h	3 to 50 US gpm 0.68 to 11.4 m^3/h	3/8 US gpm 0.09 m^3/h

REGISTRATION:

Pro Read Registration (per sweep hand revolution)		5/8"	3/4" & 1"
10	US Gallons	√	√
10	Imperial Gallons	√	√
1	Cubic Foot	√	√
0.1	Cubic Metre	√	√
0.01	Cubic Metre	√	

Register Capacity ProRead & E-Coder		5/8"	3/4" & 1"
10,000,000	US Gallons	√	√
10,000,000	Imperial Gallons	√	√
1,000,000	Cubic Feet	√	√
100,000	Cubic Metres	√	√
10,000	Cubic Metres	√	

E-Coder High Resolution (8-digit reading)		5/8"	3/4" & 1"
0.1	US Gallons	√	√
0.1	Imperial Gallons	√	√
0.01	Cubic Feet	√	√
0.001	Cubic Metres	√	√

SPECIFICATIONS

- NSF/ANSI 61 certified, Annex F and Annex G compliant
- National Type Evaluation Program (NTEP) certification
- Application: Cold water measurement of flow in one direction in residential service applications
- Maximum operating water pressure: 150 psi (1034 kPa)
- Maximum operating water temperature: 80°F
- Measuring chamber: Nutating disc technology design made from proprietary synthetic polymer

OPTIONS

- Sizes:
  - 5/8", 5/8" x 3/4"
  - 3/4", 3/4" SL, 3/4" x 1"
  - 1", 1" x 1 1/4"
- Units of measure: U.S. gallons, imperial gallons, cubic feet, cubic metres
- Register types:
  - Direct reading: Bronze box and cover (standard)
  - Remote reading: ProRead Encoder, E-Coder, E-Coder)R900*i*, TRICON/S, TRICON/E3
  - Reclaim
- Bottom caps:
  - Synthetic polymer (5/8" only)
  - Cast iron
  - Lead free high copper alloy
- Connections:
  - Lead free high copper alloy, straight or bent
- Environmental conditions:
  - Operating temperature: 33° F to 149° F (0° C to 65° C)
  - Storage temperature: 33° F to 158° F (0° C to 70° C)

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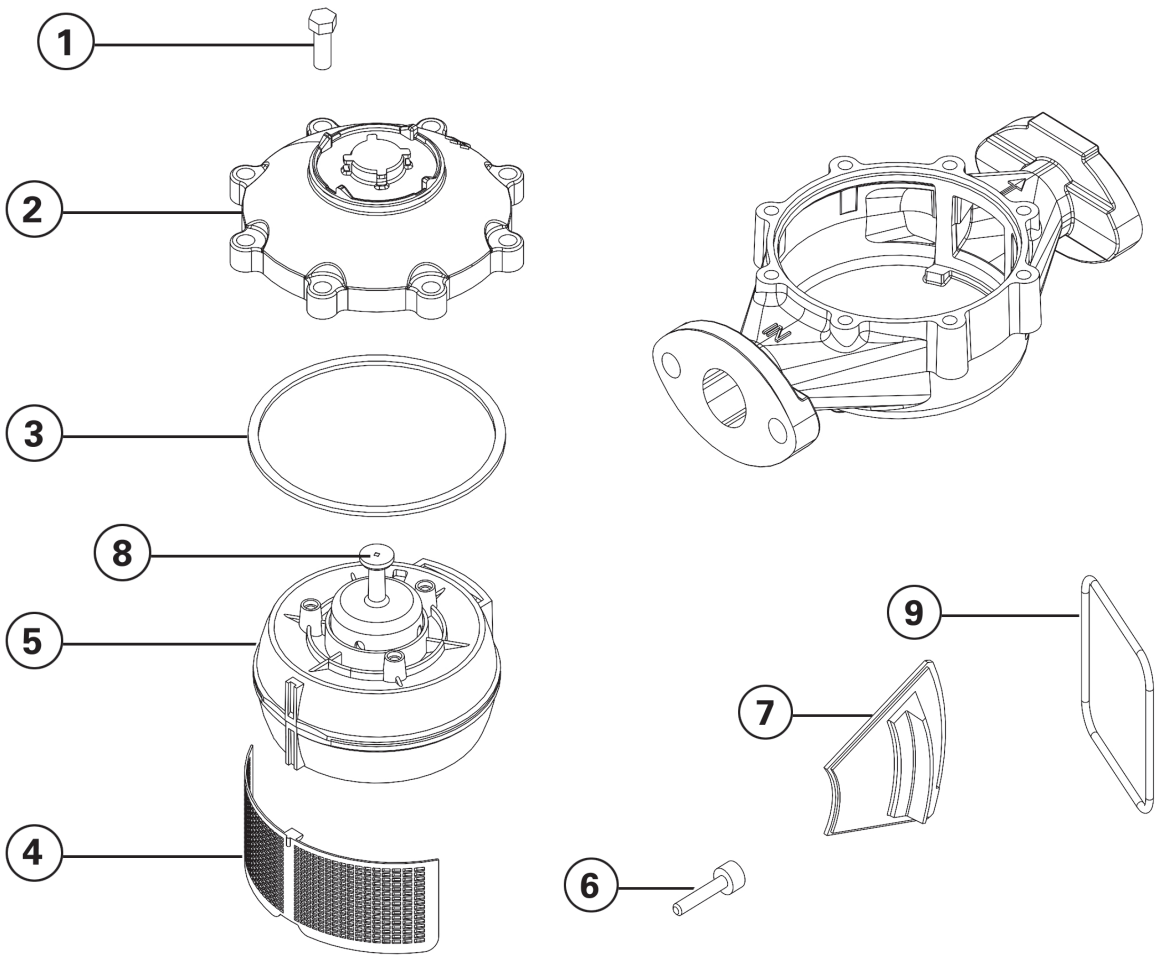
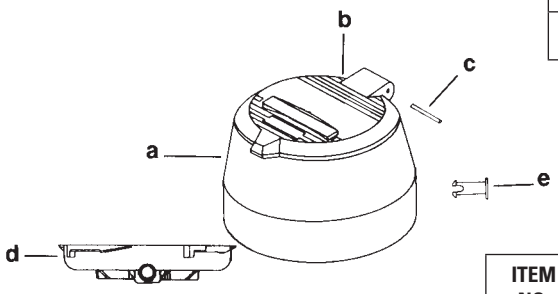
T-10 Parts List



ITEM NO.	DESCRIPTION	PART NUMBER	
		SP CHAMBER	
		1 ½"	2"
1	Bolts	8307-051	8307-051
2	Cover, Maincase	9082-002	9080-002
3	Gasket, Maincase	9083-001	9083-002
4	Strainer	9084-001	9084-002
5	Chamber Complete	9098-600	9098-610
6	Thrust Roller	9850-100	9850-100
7	Diaphragm	9086-101	9086-102
8	Control Block Assembly	9097-000	9097-010
9	O-Ring	8316-607	8316-606

REGISTRATION	5/8"	3/4"	1"	1½"	2"
Cu. Ft.	9107-012	9107-022	9107-032	9107-042	9107-052
Gal.	9107-011	9107-021	9107-031	9107-041	9107-051
M^3	9107-013	9107-023	9107-033	9107-043	9107-053



ITEM NO.	GOLD DESCRIPTION	BRONZE	PLASTIC	COLOR
	Register Box Assembled	9131-100	9131-000	
a	Register Box (Brz Box & Lid only)	9133-202	9133-001	
b	Register Cover	N/A	9132-001	
c	Hinge Pin, Register	N/A	8350-007	
d	Retainer Ring	9105-001	9105-001	
	Seal Pin, D/R Register, ProRead Register	9106-002	9106-001	9106-002
e	Seal Pin, High Profile Reg Box		9309-501	
	Screw, Seal Wire Register	8460-011		
	Seal Pin, Old Direct Read	9309-501		

SIZE	REGISTRATION	DIRECT READ	PROREAD* INSIDE 4-WHEEL ENCODER	PROREAD* INSIDE 6-WHEEL ENCODER	PROREAD* PIT 4-WHEEL ENCODER	PROREAD* PIT 6-WHEEL ENCODER	E-CODER INSIDE	E-CODER PIT	R900*i* INSIDE	R900*i* PIT
5/8"	Cu. Ft.	R82F11	R62F11	R62F12	R72F11	R72F12	RE2F11	RH2F11	RD2F11	RW2F11
	Gal.	R82G11	R62G11	R62G12	R72G11	R72G12	RE2G11	RH2G11	RD2G11	RW2G11
	m^3	R82M11	R62M11	R82M12	R72M11	R72M12	RE2M11	RH2M11	RD2M11	R22M11
3/4"	Cu. Ft.	R82F21	R62F21	R62F22	R72F21	R72F22	RE2F21	RH2F21	RD2F21	RW2F21
	Gal.	R82G21	R62G21	R62G22	R72G21	R72G22	RE2G21	RH2G21	RD2G21	RW2G21
	m^3	R82M21	R62M21	R62M22	R72M21	R72M22	RE2M21	RH2M21	RD2M21	RW2M21
1"	Cu. Ft.	R82F31	R62F31	R62F32	R72F31	R72F32	RE2F31	RH2F31	RD2F31	RW2F31
	Gal.	R82G31	R62G31	R62G32	R72G31	R72G32	RE2G31	RH2G31	RD2G31	RW2G31
	m^3	R82M31	R62M31	R62M32	R72M31	R72M32	RE2M31	RH2M31	RD2M31	RW2M31
1½"	Cu. Ft.	R82F42	R62F41	R62F42	R72F41	R72F42	RE2F41	RH2F41	RD2F41	RW2F41
	Gal.	R82G42	R62G41	R62G42	R72G41	R72G42	RE2G41	RH2G41	RD2G41	RW2G41
	m^3	R82M42	R62M41	R62M42	R72M41	R72M42	RE2M41	RH2M41	RD2M41	RW2M41
2"	Cu. Ft.	R82F52	R62F51	R62F52	R72F51	R72F52	RE2F51	RH2F51	RD2F51	RW2F51
	Gal.	R82G52	R62G51	R62G52	R72G51	R72G52	RE2G51	RH2G51	RD2G51	RW2G51
	m^3	R82M52	R62M51	R62M52	R72M51	R72M52	RE2M51	RH2M51	RD2M51	RW2M51

** Registers do not include ARB® V remote receptacles. When ordering 1" registers for 10 Cu.Ft. registration, add SA68.*

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TRICON®/S REGISTER

The TRICON®/S can be used in applications where a switch closure that is proportional to the flow rate is required.

The TRICON/S register mounts on the meter maincase. The bayonet-type mount allows the TRICON/S to be easily retrofitted to many existing Neptune meters without interruption. The TRICON/S can be used in applications where a switch closure that is proportional to the flow rate is required. Several switch configurations are available.

Every Neptune meter and TRICON/S register meet or exceed the latest standards of the American Water Works Association ensuring accurate, dependable performance.

The TRICON/S register is ideally suited for controlling/monitoring total flow rate data such as:

- Water softening regeneration
- Demineralization reverse osmosis
- Chemical treatment/injection
- Batch processing
- Filtration
- Boiler feed water make-up
- Cooling tower water make-up
- Irrigation

WARRANTY

Neptune provides a limited warranty with respect to its TRICON/S Register System for performance, materials, and workmanship.

KEY FEATURES

- Register
  - Reed switch technology
  - Large, easy-to-read numerals
  - Rugged thermoplastic housing
  - Monitoring capability permits locating registers up to 1,000 feet from controller
  - Wide variety of calibrated switch closures available
  - Tamperproof – only one seal wire screw to secure register and terminal cover
- Readily available for all Neptune meters:
  - T-10 Disc
  - HP Turbine
  - TRU/FLO® Compound
  - HP Fire Service Turbine
  - HP PROTECTUS® III

ELECTRICAL CHARACTERISTICS (at 25°C unless specified)

Switch Ratings	Min	Typ	Max	Units
Operating Temperature	-40		125	°C
Open Circuit Resistance	10			MOhms
Closed Circuit Resistance			0.1	Ohms
Break Down Voltage (DC)	250			Volts
Capacitance		1.5		pF
Actuation Time	0.0005			sec
Shock With No Contact			100	G

AVAILABLE SWITCH CLOSURES (for T-10s and Turbines)

Gal, Imp. Gal, or Litres*/ Contact	5/8-1" T-10	1 1/2-2" T-10	1 1/2-4" HPT	6"-12" HPT	16"-20" HPT	Cubic Feet/ Contact	5/8-1" T-10	1 1/2-2" T-10	1 1/2-4" HPT	6"-12" HPT	16"-20" HPT	Cubic Metres/ Contact	1 1/2-4" HPT	6"-12" HPT	16"-20" HPT
												0.1	✓		
1	✓					1	✓	✓	✓			1	✓	✓	
10	✓	✓	✓			10	✓	✓	✓	✓		10	✓	✓	✓
100	✓	✓	✓	✓		100	✓	✓	✓	✓	✓	100	✓	✓	✓
1000	✓	✓	✓	✓	✓	1000		✓	✓	✓	✓	1000		✓	✓
10,000		✓	✓	✓	✓	10,000				✓	✓	10,000			✓
100,000				✓	✓	100,000					✓	100,000			

METER APPLICATION GUIDE

Meter/Size	Normal Flow Range (GPM)	Max Continuous Flow	Meter Length (in.)
T-10			
5/8"	1/2 - 20	10	7 1/2
5/8" x 3/4"	1/2 - 20	10	7 1/2
3/4"	3/4 - 30	15	9
3/4" x 1	3/4 - 30	15	9
1"	1 - 50	25	10 3/4
1 1/2" Threaded End	2 - 100	50	12 5/8
1 1/2" Flanged End	2 - 100	50	13
2" Threaded End	2 1/2 - 160	80	15 1/4
2" Flanged End	2 1/2 - 160	80	17
Trident Turbine			
3"	5 - 450	450	12
4"	10 - 1000	1000	14
6"	20 - 2000	2000	18
8"	35 - 3500	3500	20
10"	50 - 5500	5500	26
HP Turbine			
1 1/2"	4 - 160	160	10
2"	4 - 160	160	10
3"	5 - 450	450	12
4"	10- 1200	1200	14
6"	20 - 2500	2500	18
8"	35 - 4000	4000	20
10"	50 - 6500	6500	26
12"	120 - 8000	8000	19 11/16
16"	200- 13500	13500	23 5/8
20"	300 - 22000	22000	31 1/2

SPECIFICATIONS

- Sizes:
  - T-10 (5/8"–2")
  - Trident Turbine (3"–10")
  - HP Turbine (1 1/2"–20")
  - TRU/FLO Compound (2"– 6"x8")
  - HP Fire Service (3"– 10")
  - HP PROTECTUS III (4"– 10")
- Units of measure:
  - U.S. gallons
  - Imperial gallons
  - Litres
  - Cubic feet
  - Cubic metres
- Connection wire:
  - Distances up to 300 feet (91 metres) – AWG #22
  - Distances from 300 to 500 feet (91–152 metres) – AWG #20
  - Distances 500–1000 feet* (152–304 metres) – AWG #18
- Electrical characteristics (at 25°C unless specified): Absolute maximums (not to be exceeded without possible damage)
  - Switch power: 10 watts (DC)
  - Switch current: 0.5 amps (DC)
  - Switch voltage: 200 volts (DC)

** Recommended installation: Register should be in an upright position. Not recommended for pit applications.*

Neptune engages in ongoing research and development to improve and enhance its products. Therefore, Neptune reserves the right to change product or system specifications without notice.

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SECTION 16 - 1400 SERIES PROCESS EQUIPMENT - LNAPL PUMPS

SOLENOID VALVE, 2", N.C. - ASCO MODEL 8215B080

SOLENOID VALVE, 1/2", N.O. - ASCO MODEL 8210G034

FLOW METER - OMEGA MODEL FTB-32P

FLOW TOTALIZER - OMEGA MODEL M0505/0300

LEVEL SENSOR (WARNING / ALARM) - FPI SENSORS MODEL LS-500-2 POS

Features

- Lightweight, low-cost valves for air service
- Ideal for low pressure applications
- Provides high flow, Cv up to 138 (Kv 118)
- Air and vacuum service

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals, Diaphragms, Disc	NBR
Disc-Holder	PA (10.1 and 11.6 watt Normally Open only)
Core Guide	CA
Core Tube	305 Stainless Steel
Rider Rings	PTFE
Core and Plugnut	430F Stainless Steel
Springs*	302 Stainless Steel
Shading Coil	Copper
* For 8040H006, 8040H007, 8040H008, spring material is 17-7 PH	

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
B	14.9	-	-	-	-	62691	-	-
F	-	15.4	27	160	99257	-	99257	-
F	-	28.2	50	385	206409	-	206409	-

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz), 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required. (Note: 24 volt AC, 60 Hz not available with 28.2 watt coil)

Solenoid Enclosures

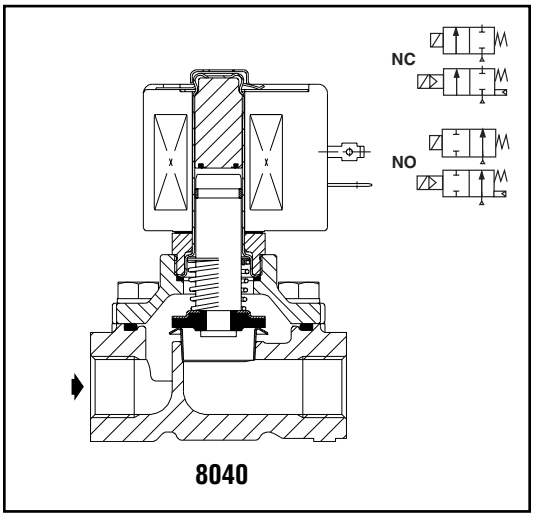
Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; RedHat - Explosionproof and Raintight, Types 3, 7, and 9. (Except EF8215A40 and EF8215A90, which are suitable for Types 3 and 7 (C and D) only and have a T2B temperature rating code.)
To order, add prefix "EF" to catalog number.

See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

Series	AC	DC	
	RedHat II/RedHat	RedHat II	RedHat
8040	-40˚F to 125˚F (-40˚C to 52˚C)	-	-
8215	32˚F to 125˚F (0˚C to 52˚C)	32˚F to 104˚F (0˚C to 40˚C)	32˚F to 77˚F (0˚C to 25˚C) (104˚F/40˚C occasionally)
Refer to Engineering Section for details.			



8040

Approvals:

CSA certified to:

8040 Series:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.
3) Automatic Gas Safety Shutoff Valves C/I (3.9), File 112872.

8215 Series Normally Closed:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.

8215 Series Normally Open:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.

UL listed, as indicated. FM approved (Normally Closed only, except Catalog Numbers 8215A090 and 8215A040). RedHat II meets applicable CE directives.

Refer to Engineering Section for details.

2/2 SERIES 8040 8215

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Gas Capacity Btu/hr ⑥	Operating Pressure Differential (psi)			Max. Fluid Temp. ˚F		Aluminum Body	Const. Ref.		UL ⑤ Listing	Watt Rating/ Class of Coil Insulation ②	
				Min.	Max. AC Air-Fuel Gas	Max. DC Air-Fuel Gas	AC	DC	Catalog Number	AC	DC		AC	DC
NORMALLY CLOSED (Closed when de-energized)														
1/8	5/16	1.0	53,700	0	15	-	125	-	8040H006	11		❍	6.1/F	-
1/4	5/16	1.1	59,000	0	15	-	125	-	8040H007	11		❍	6.1/F	-
3/8	5/16	1.2	64,400	0	15	-	125	-	8040H008	11		❍	6.1/F	-
3/8	3/4	3.4	183,000	0	50	25	125	104	8215G010	2		❍	10.1/F	11.6/F
3/8	3/4	3.5	-	5	125	125	125	104	8215G001 ①	1		❍	6.1/F	11.6/F
1/2	3/4	5.4	291,000	0	2	-	125	-	8040G022	13A		❍	10.1/F	-
1/2	3/4	4.4	238,500	0	50	25	125	104	8215G020	2		❍	10.1/F	11.6/F
1/2	3/4	4.8	-	5	125	125	125	104	8215G002 ①	1		❍	6.1/F	11.6/F
3/4	3/4	9.5	512,000	0	2	-	125	-	8040G023	13B		❍	10.1/F	-
3/4	3/4	5.1	247,500	0	50	25	125	104	8215G030	4		❍	10.1/F	11.6/F
3/4	3/4	5.1	-	5	125	125	125	104	8215G003 ①	3		❍	6.1/F	11.6/F
1	1 5/8	21	1,119,000	0	25	25	125	77	8215B050 ③	6	16	❍	15.4/F	14.9/B
1 1/4	1 5/8	32	1,730,000	0	25	25	125	77	8215B060 ③	6	16	❍	15.4/F	14.9/B
1 1/2	1 5/8	35	1,900,000	0	25	25	125	77	8215B070 ③	6	16	❍	15.4/F	14.9/B
2	2 3/32	60	3,251,000	0	25	15	125	77	8215B080 ③	7	17	❍	15.4/F	14.9/B
2 1/2	3	117	5,821,000	0	5	-	125	-	8215A090 ⑦	8		❍	28.2/F	-
3	3	138	7,430,000	0	5	-	125	-	8215A040 ⑦	8		❍	28.2/F	-
NORMALLY OPEN (Open when de-energized)														
3/8	3/4	3.2	172,500	0	125	125	125	104	8215G013	9		●	10.1/F	11.6/F
1/2	3/4	4	206,250	0	125	125	125	104	8215G023	9		●	10.1/F	11.6/F
3/4	3/4	4.6	247,500	0	125	125	125	104	8215G033	10		●	10.1/F	11.6/F
1	1 5/8	22	1,191,750	0	25	15	125	77	8215C053	12	18	●	15.4/F	14.9/B
1 1/4	1 5/8	33	1,793,250	0	25	15	125	77	8215C063	12	18	●	15.4/F	14.9/B
1 1/2	1 5/8	37	1,988,250	0	25	15	125	77	8215C073	13	19	●	15.4/F	14.9/B
2	2 3/32	58	3,100,000	0	25	15	125	77	8215C083	14	20	●	15.4/F	14.9/B
2 1/2	3	117	6,290,000	0	5	-	125	-	8215B093 ④⑦	15		●	28.2/F	-

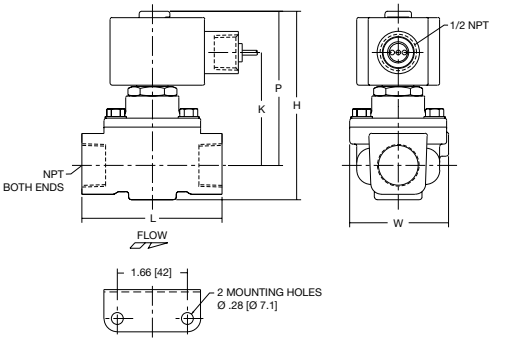
① Do not use for Fuel Gas.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
③ FM Approved Process Control Valves. *See Engineering Section (Approvals) for details.*
④ Type I enclosure only.
⑤ ❍ = Safety Shutoff Valve; ● = General Purpose Valve. *Refer to Engineering Section (Approvals) for details.*
⑥ 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.
⑦ Not available with 24 volt, 60 Hz coil.

Dimensions: inches (mm)

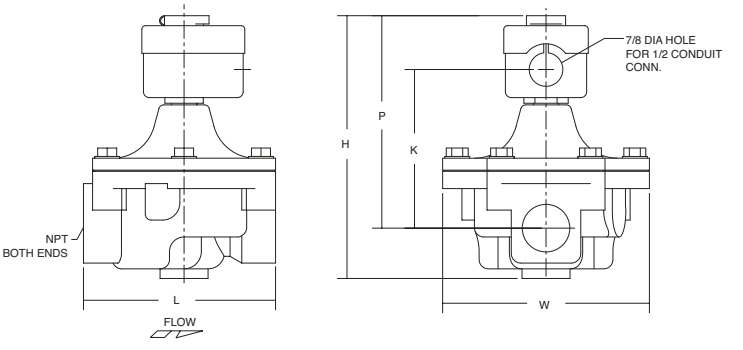
Const. Ref.		H	K	L	P	W
1	ins.	3.42	2.00	2.75	2.87	2.46
	mm	87	51	70	73	63
2	ins	4.02	2.49	2.75	3.46	2.46
	mm	102	63	70	88	63
3	ins.	3.87	2.19	3.31	3.05	2.33
	mm	98	56	84	77	59
4	ins.	4.46	2.68	3.31	3.64	2.33
	mm	113	68	84	92	59
6 ①	ins.	6.84	4.25	5.00	5.59	5.38
	mm	174	108	127	142	137
7 ①	ins.	7.47	4.53	6.09	5.94	6.31
	mm	190	115	155	151	160
8 ①	ins.	10.25	5.75	7.79	7.91	7.94
	mm	260	146	198	201	202
9	ins.	4.42	2.72	2.75	3.86	2.36
	mm	112	69	70	98	60
10	ins.	4.86	2.72	3.31	4.04	2.36
	mm	123	69	84	103	60
11	ins.	2.74	1.44	2.00	2.30	1.69
	mm	69	36	51	58	43
12	ins.	6.84	2.22	5.00	3.63	5.38
	mm	174	56	127	92	137
13	ins.	6.84	2.16	5.00	3.56	5.38
	mm	174	55	127	90	137
13A	ins.	4.05	2.46	2.75	3.44	2.42
	mm	103	63	70	87	62
13B	ins.	4.49	2.65	3.31	3.63	2.39
	mm	114	67	84	92	61
14 ②	ins.	7.44	2.41	6.09	3.81	6.31
	mm	189	61	155	97	160
15 ②	ins.	10.25	3.07	7.80	5.22	7.94
	mm	260	78	198	133	202
16	ins.	7.59	4.03	5.00	6.34	5.38
	mm	193	102	127	161	137
17	ins.	8.19	4.38	6.09	6.69	6.31
	mm	208	111	155	170	160
18	ins.	6.16	2.09	5.00	4.41	5.38
	mm	156	53	127	112	137
19	ins.	7.59	2.03	5.00	4.34	5.38
	mm	193	52	127	110	137
20	ins.	8.19	2.28	6.09	4.59	6.31
	mm	2.08	58	155	117	160

IMPORTANT: Valves may be mounted in any position except all DC constructions and those marked ①, which must be mounted with the solenoid vertical and upright. Constructions marked ② must be mounted with the solenoid vertical and upright or horizontal only.

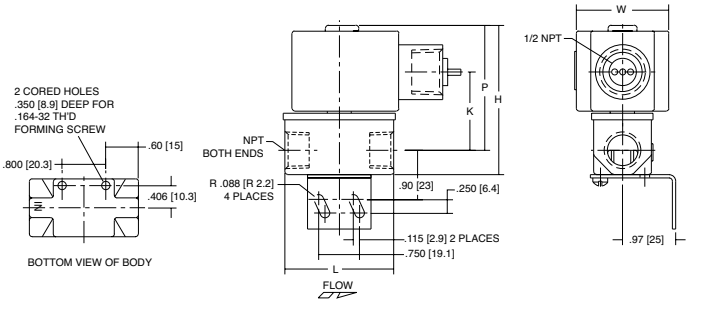
Const. Ref. 1-4, 9, 10, 13A, 13B



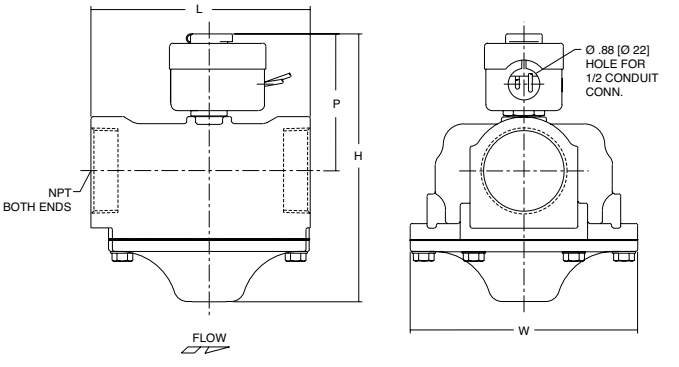
Const. Ref. 6, 7, 8, 16, 17



Const. Ref. 11

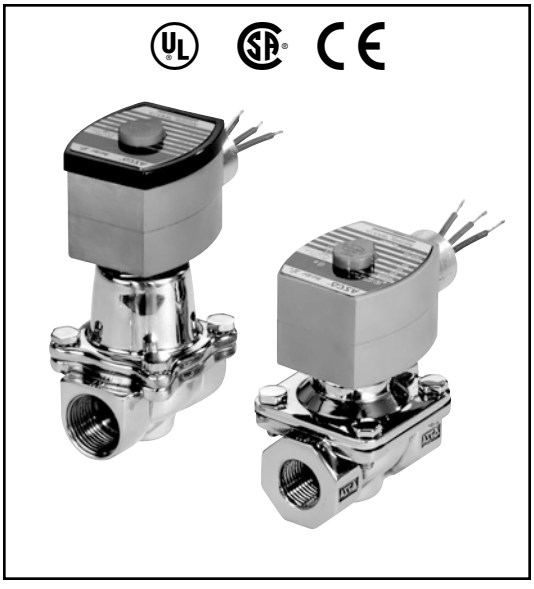


Const. Ref. 12-15, 18-20



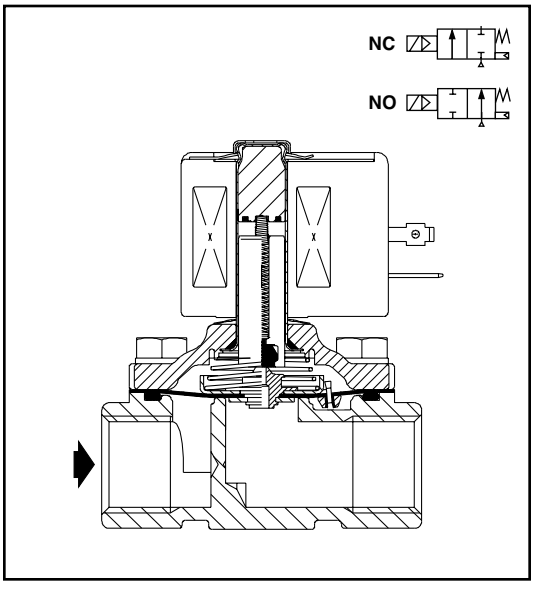
Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage
- High Flow Valves for liquid, corrosive, and air/inert gas service
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps



Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver



Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910	-	238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering.
Other voltages available when required.

Solenoid Enclosures

Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.

(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B057, 8210B058, and 8210B059, which are not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

RedHat II/
RedHat AC: 32˚F to 125˚F (0˚C to 52˚C)

RedHat II DC: 32˚F to 104˚F (0˚C to 40˚C)
RedHat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)

8210G227 AC: 32˚F to 130˚F (0˚C to 54˚C)
DC: 32˚F to 90˚F (0˚C to 32˚C)

Refer to Engineering Section for details.

Approvals

UL listed as indicated. CSA certified.
RedHat II meets applicable CE directives.
Refer to Engineering Section for details.

2/2 SERIES 8210

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. ˚F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Const. Ref. ④	UL ⑤ Listing	Catalog Number	Const. Ref. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G073 ③	1P	●	8210G036 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G093	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G001	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G006	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G015 ③	2P	●	8210G037 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G094	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G087	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G002	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G007	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	130	90	8210G227	5D	❍ †	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G088	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G009	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G095	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G003	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B026 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G026 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B054 ‡	31D	-	8210D089	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G054	41D	●	8210G089	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G004	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G027 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G078 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B055 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G055	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G008	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B056 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G056	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G022	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G033	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G011 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G034	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G030	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G012 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G035	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G038	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C013	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G013	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B057 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D014	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G014	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B058 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D018	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G018	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B059 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D032	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G032	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210 103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210 104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

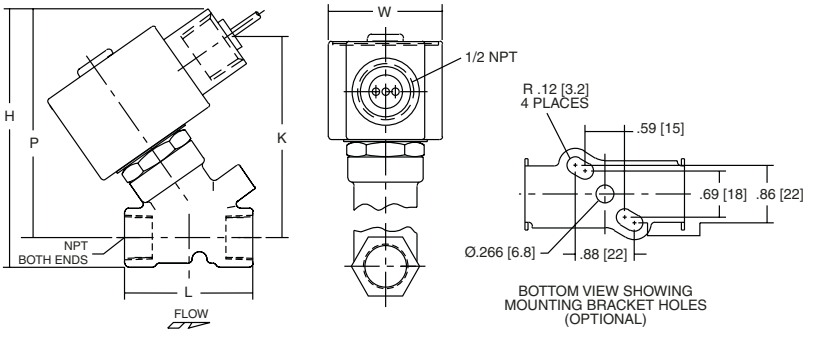
① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless steel disc-holder.
‡ Must have solenoid mounted vertical and upright.
† UL listed for fire protection systems per UL429A.

Dimensions: inches (mm)

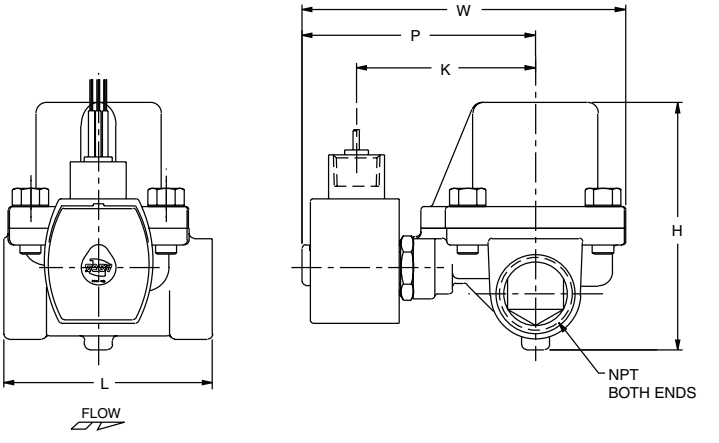
Const. Ref.		H	K	L	P	W
1*	ins.	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	ins.	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
5	ins.	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	ins.	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	ins.	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	ins.	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	ins.	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*	ins.	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	ins.	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	ins.	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
13	ins.	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
15*	ins.	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	ins.	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	ins.	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	ins.	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	ins.	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	ins.	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	ins.	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	ins.	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	ins.	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	ins.	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	ins.	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	ins.	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

* DC dimensions slightly larger.
IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

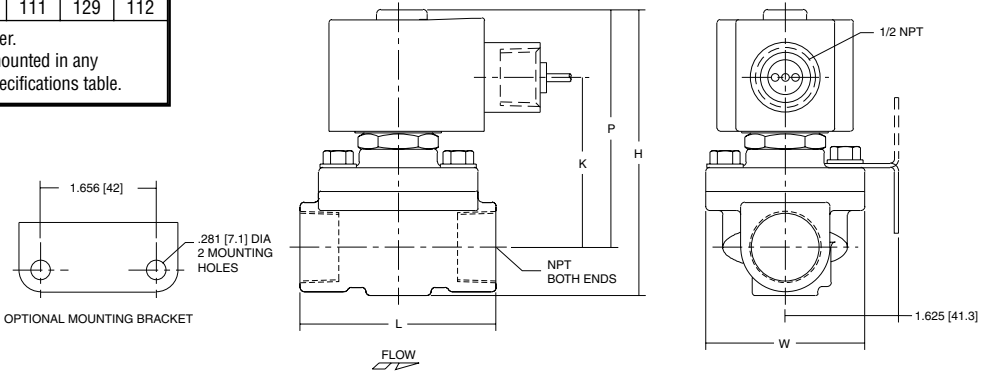
Const. Ref. 1, 2



Const. Ref. 13



Const. Ref. 5-9, 11, 20, 21 23 25, 37,38



POSITIVE-DISPLACEMENT TOTALIZERS
For Oil Flow

FTB-30

All products shown smaller than actual size.

FTB-32

FTB-31P

FTB-30

1 YEAR WARRANTY

- For Flows Down to 0.26 GPH
- For #2, 4, or 6 Oil
- Direct Totalization in Engineering Units
- Scaled Pulse Output Available
- ±1% Rdg Accuracy
- Special Versions Available for Low-Viscosity Fluids, Including Water and Freon

FTB-30 Series totalizers are typically used in applications in which accurate measurement of (#2, 4, or 6) heating oil flow is required. The FTB-32 features a fully rotatable, easy-to-read face.

The FTB-30 is designed to be mounted horizontally; the FTB-30 and FTB-31 come with mounting brackets and compression fittings, while the FTB-32 is supplied with ¾ NPT couplings. All FTB totalizers are non-resettable and have an optional reed relay scaled pulse output [with 3 m (10') of cable] for remote totalization. This output must be specified at the time of the order; it is not field installable.

SPECIFICATIONS

Accuracy: ±1% rdg except ±0.5% rdg for FTB-31
Maximum Pressure: 225 psi for FTB-32 through FTB-35; 350 psi for FTB-30 and FTB-31; 360 psi for FTB-36
Pressure Loss:
FTB-30: 0.14 psi
FTB-31: 0.58 psi
FTB-32: 1.80 psi
Wetted Parts: Brass body and anodized aluminum piston; graphite or synthetic rubber piston optional
PULSE OUTPUT
Maximum Switch Load: 3 VA
Maximum Switch Current: 50 mA
Maximum Switch Voltage: 50 Vac
Output Frequency:
0.1 gal/pulse for FTB-30P, FTB-31P, FTB-32P (total only)

F

To Order

Model No. No Output	Model No. Pulse Output (For Total Only)	Flow Rate Minimum	Flow Rate Cont.	Flow Rate Maximum	Connections	Increments (Gallons)	Max Reading (Gallons)	Weight kg (lb)	Maximum Temperature °C (°F)
FTB-30	FTB-30P	0.26 GPH	6.5 GPH	20 GPH	¼" CF*	0.01	100,000	0.5 (1.1)	60 (140)
FTB-31A	FTB-31P	1.0 GPH	20.0 GPH	50 GPH	¾" CF*	0.01	1,000,000	1.3 (2.8)	60 (140)
FTB-32	FTB-32P	8.25 GPH	265.2 GPH	400 GPH	¾ MNPT	0.1	1,000,000	5.0 (11)	127 (260)
FTB-33	FTB-33P	2.6 GPH	105 GPH	160 GPH	½ NPT	0.1	1,000,000	2.1 (4.7)	127 (260)
FTB-34	FTB-34P	20 GPH	528 GPH	800 GPH	1 NPT	1.0	1,000,000	4.2 (9.3)	127 (260)
FTB-35	FTB-35P	59 GPH	1585 GPH	2375 GPH	1½ NPT	10.0	10,000,000	15.9 (35)	127 (260)
FTB-36	FTB-36P	199 GPH	5285 GPH	7925 GPH	2" flange†	—	100,000,000	40.0 (88)	127 (260)

** CF = Compression fitting*
† FTB-36 has 150 lb flange fittings.
Comes complete with operator's manual.
***Ordering Examples: FTB-30P**, pulse-output totalizer, with 0.26 to 20 GPH range.*
***FTB-33**, mechanical totalizer with 2.6 to 160 GPH range.*

FTB-30 Series

Positive Displacement Oil Flow Meters/Totalizers

INSTRUCTION SHEET

M0505/0300

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For latest product manuals: www.omegamanual.info

GENERAL DESCRIPTION

The FTB-30 Series Totalizers are used in applications where accurate measurement of heating oil (#2, 4, 6) flow is required. The FTB-30 and FTB-31A are used mainly for light heating oil in small burners. The FTB-32 to FTB-36 are for large flow applications and can be used for all types of oil (2-6) including heavy preheated grades.

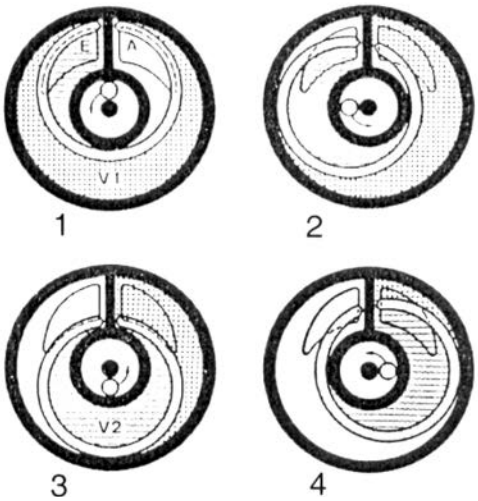
Models FTB-32 to FTB-36 feature fully rotatable, easy-to read faces. The FTB-30 and FTB-31A are shipped with compression fittings, while FTB-32 to FTB-35 are supplied with NPT couplings. All FTB totalizers are non-resettable (counters restart at zero after reaching maximum counting capacity). The FTB-36 has flanges.

The FTB-30 Series meters have an optional reed relay scaled pulse output for remote totalization. This output (option P) must be specified at the time of the order; it is not field installable.

THEORY OF OPERATION

The FTB-30 Series meters come under the category of positive displacement volumetric meters. Their main feature is the division of the measuring chamber into two compartments by the ring piston, which alternately fill and empty. Each cycle thus measures, volumetrically, a definite quantity of liquid. The operation of measurement is thus practically independent of the viscosity and density of the liquid.

Another feature of the volumetric measuring principle of the FTB-30 Series Oil Flowmeter, is the very large measuring range with relatively small metering errors. The range is limited at the highest flows by the maximum permissible cycling speed of the ring piston.

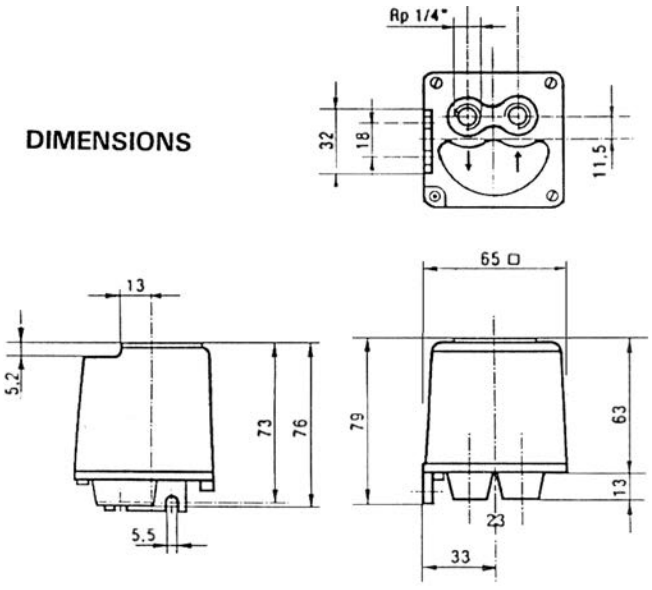


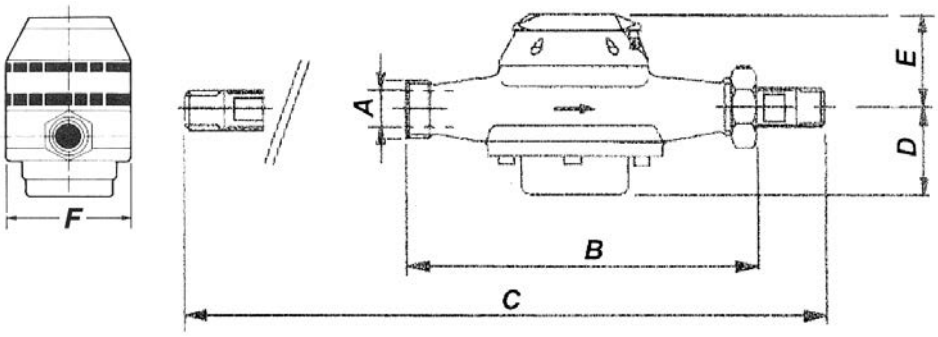
The Construction Diagram shows the measuring chamber with cover removed and the four steps in the metering cycle. In the center of the measuring chamber and top cover lies an annular piston guide. The measuring space is thus a circle, divided by a barrier. The inserted ring piston is guided, on the one hand, by its central spindle following the path of the annular guide; and on the other, by movement of the slit in the piston moving up and down the barrier. The movement is thus oscillatory; the outer diameter of the piston rolling around the inside of the measuring chamber, the inside of the piston around the outer cylindrical face of the annular guide. This creates two measuring chambers, outside (V1) and inside (V2) the piston, the volumes of which change with the piston movement.

The entry port E lies in the base of the measuring chamber and to the left of the barrier. The outlet A is on the opposite side of the barrier, either in the cover or the measuring chamber wall. Thus, there is no direct connection between the inlet and outlet ports. The entry port is so shaped that it feeds either the outer or the inner measuring chamber until both chambers contain the maximum possible volume of liquid. When the second is full, the combined chamber moves towards the outlet port. The chamber volume decreases and discharges the liquid. Thus, with each operating cycle of the piston, two defined and constant volumes V1 and V2 are passed from inlet to outlet. The created pressure differential causes the piston movement.

The drive from the piston to the counter is by means of magnetic coupling.

DIMENSIONS





	FTB-32	FTB-33	FTB-34	FTB-35	FTB-36
A	3/4"	1/2"	1"	1-1/2"	2" flg
B	6.5"	6.5"	7-1/2"	12"	13-3/4"
C	11"	11-1/4"	12"	17"	–
D	2"	2"	3"	4-1/2"	6-1/2"
E	2-3/8"	2-3/8"	2-1/2"	4-1/2"	4-3/4"
F	4-1/8"	4-1/8"	5-1/8"	8-1/4"	–

Model No. No Output	Model No. Pulse Output	Flowrate Min.	Flowrate Cont.	Flowrate Max.	Conn.	Increment Max. Readings-Gals		Weight Lbs.	Max. Temp CF
FTB-30	**FTB-30P**	0.25 gal/h	14.0 gal/h	20.0 gal/h	1/4" CF	0.01	100,000	1.1	60 (140)
FTB-31A	**FTB-31P**	1.0 gal/h	35.0 gal/h	50 gal/h	3/8" CF	0.1	1,000,000	1.1	60 (140)
FTB-32	**FTB-32P**	8 gal/h	265 gal/h	400 gal/h	3/4" mnpt	0.1	1,000,000	5.5	127 (260)
FTB-33	**FTB-33P**	2.6 gal/h	105 gal/h	160 gal/h	1/2" mnpt	0.1	1,000,000	4.7	127 (260)
FTB-34	**FTB-34P**	20 gal/h	528 gal/h	800 gal/h	1" mnpt	1.0	1,000,000	9.3	127 (260)
FTB-35	**FTB-35P**	60 gal/h	1600 gal/h	2400 gal/h	1-1/2"mnpt	10.0	10,000,000	35	127 (260)
FTB-36	**FTB-36P**	200 gal/h	5300 gal/h	8000 gal/h	2" Flg	10.0	10,000,000	88	127 (260)

ACCURACY: ±1% of reading lot
FTB-30; FTB-32-FTB-36
±1/2% of reading for FTB31A

PULSE OUTPUT
MAX. SWITCH LOAD: 3VA
MAX. SWITCH CURRENT: 50mA
MAX. SWITCH VOLTAGE: 50 Vac
OUTPUT FREQUENCY: 0.1 gal/pulse FTB-30P, FTB-31P, FTB-32P, FTB-33P
1.0 gal/pulse FTB-34P,
10.0 gal/pulse FTB-35P, FTB-36P

MAX. PRESSURE: 350 psi for FTB-30 and FTB-31A, 225 psi for FTB-32 thru FTB-34, 150 psi for FTB-35 thru FTB-36

FILTERING REQUIREMENTS:

Model No.	Filter Size or Mesh Width (Size of Opening)	
FTB-30	0.002"	0.05mm
FTB-31A	0.002"	0.05mm
FTB-32	0.004"	0.10mm
FTB-33	0.008"	0.20mm
FTB-34	0.010"	0.25mm
FTB-35	0.012"	0.30mm
FTB-36	0.012"	0.30mm

INSTALLATION AND OPERATION

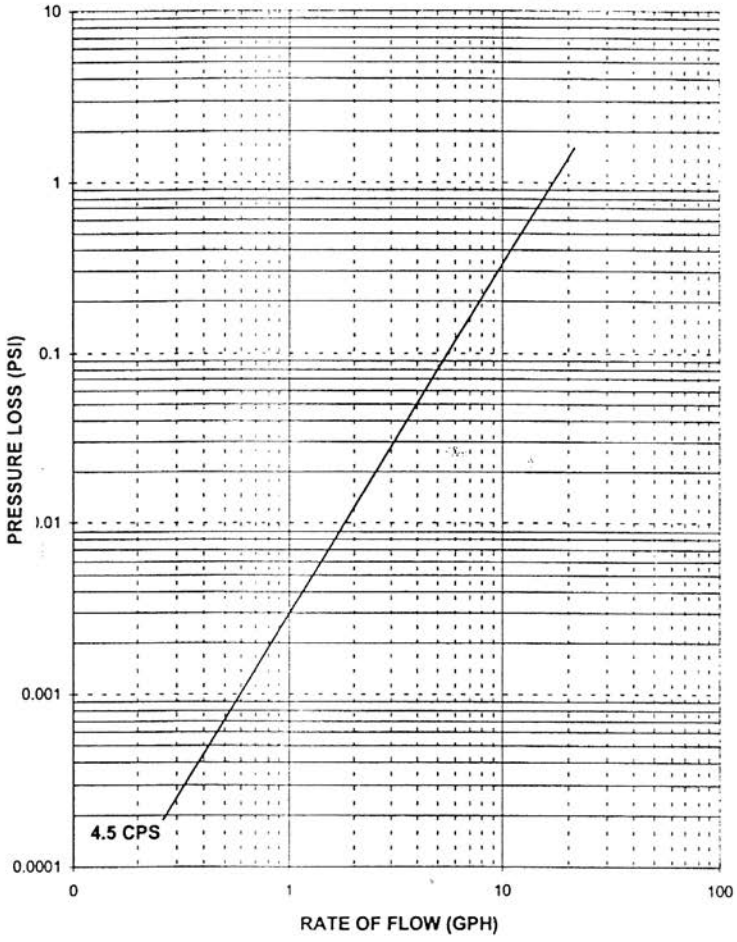
WARNING

THE FTB-30 Series Oil Flowmeters have to be protected against sediments. An oil filter or strainer is essential.

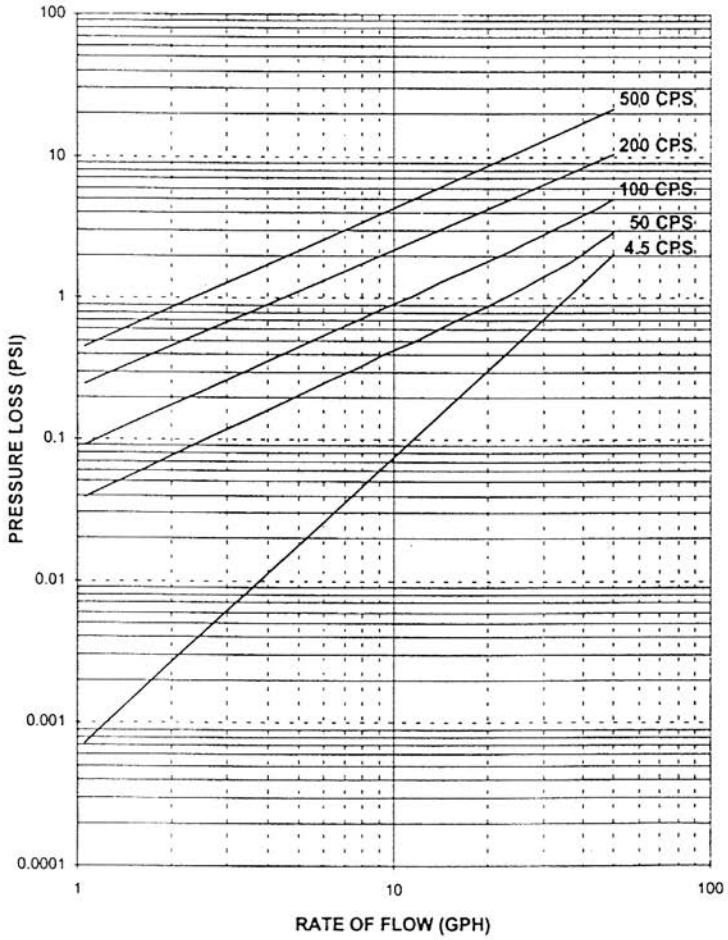
Make sure that the filter is installed upstream of the flowmeter. Remove plastic cover on threads of the flowmeter before installation.

PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-30 AND FTB-31A

1/8" OIL METER #FTB-30

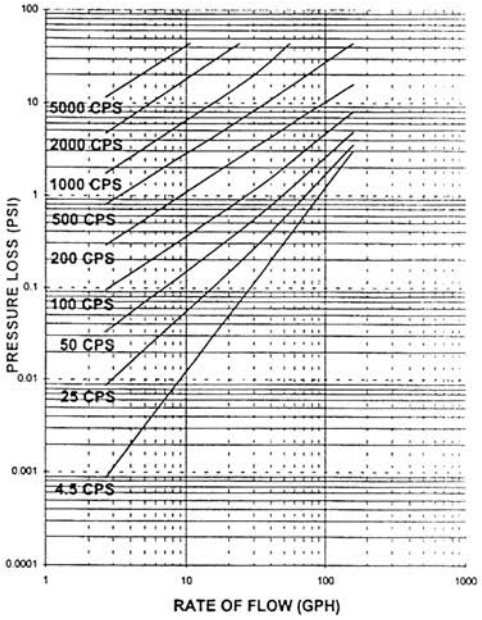


1/4" OIL METER #FTB-31A

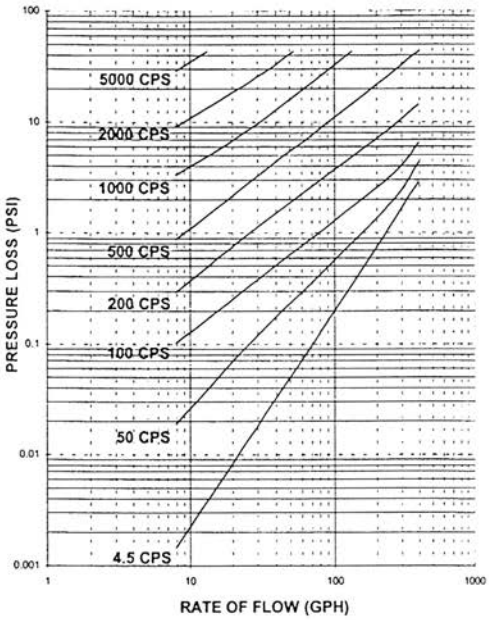


PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-33, FTB-32 AND FTB-34

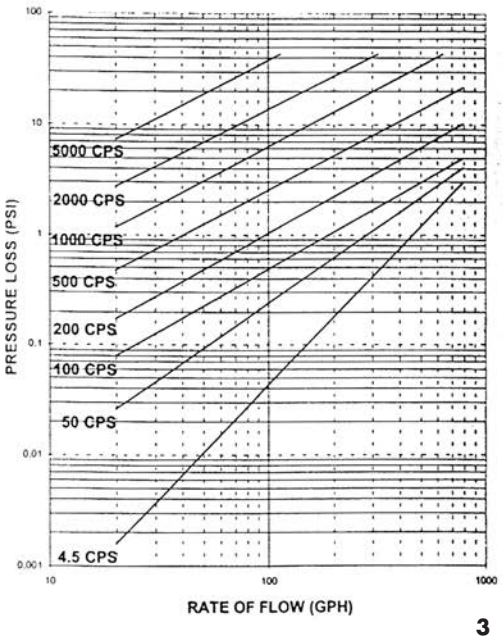
1/2" OIL METER #FTB-33



3/4" OIL METER #FTB-32

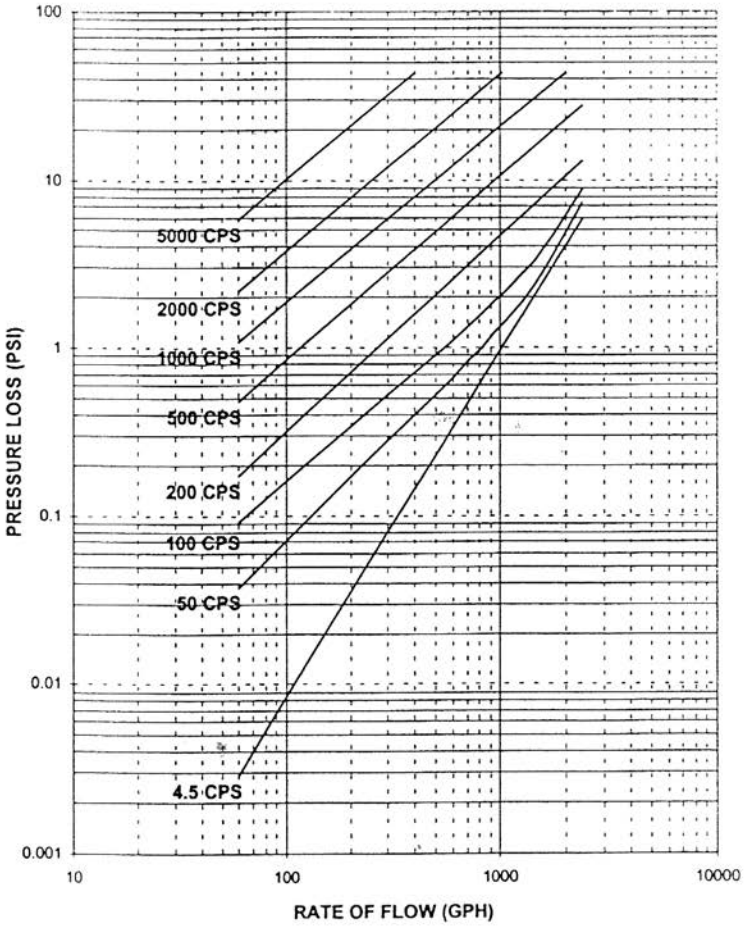


1" OIL METER #FTB-34

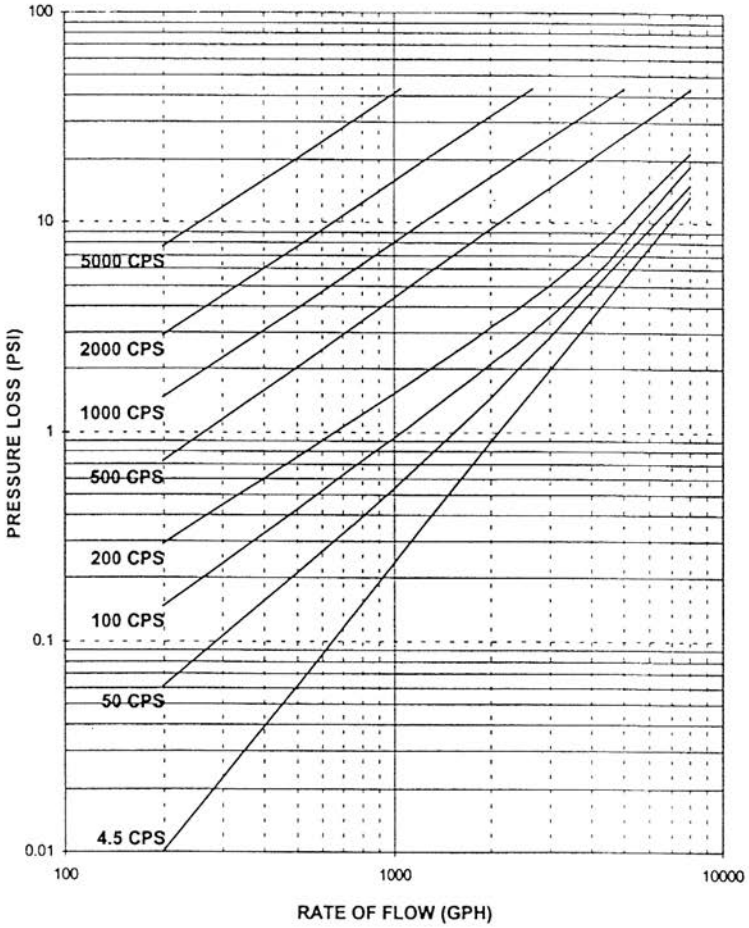


PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-35 AND FTB-36

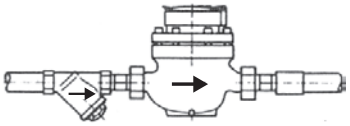
1-1/2" OIL METER #FTB-35



2" OIL METER #FTB-36

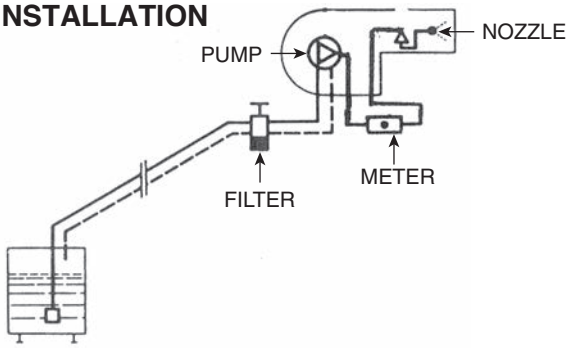


OBSERVE DIRECTION FLOW (ARROW):



STRAINER OR FILTER

TYPICAL INSTALLATION

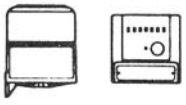


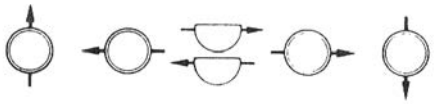
Meter should always be in lower position than the nozzle to prevent the oil from flowing out of the meter.

1. Location of Flowmeter

Because the OMEGA® Oil Flowmeters have high pressure and temperature ratings, they can be installed directly into the nozzle line.

Model	PSI Rating	Temp. Rating
FTB-30	350	140F
FTB-31A	350	140F
FTB-32	225	260F
FTB-33	225	260F
FTB-34	225	260F
FTB-35	150	260F
FTB-36	150	260F





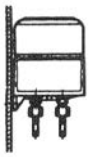
2. Installation Instructions

3. Flushing of Pipes

Make sure all pipes are flushed before installing the FTB-30 Series Flowmeter.

4. Securing Meter

The FTB-30 and FTB-31A should be additionally secured when installed in copper pipes. Use the two openings on the mounting frame.



5. Pressure Fittings & NPT Coupling Pieces

Use the pressure fittings provided for the FTB-30.

Model FTB-30 uses pressure fittings for 1/4" pipe size; the Model FTB-31A uses pressure fittings for 3/8" pipe size. Model FTB-32 - FTB-35 uses NPT fittings. Model FTB-36 has 2" flange (ANSI).

6. Start-up Operation

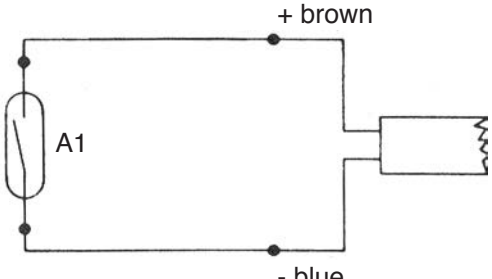
Slowly fill pipe system and carefully vent air in the line. Air trapped in pipes causes incorrect measurements and may damage the meter. Never allow the meter to run dry.

OPTIONAL REED RELAY SCALED PULSE OUTPUT

It is often necessary to transmit measurement parameters from a meter to a distant position. These parameters may also be used as manipulated variable in a regulating or control circuit. In such cases, an electric signal is necessary, which represents the parameter. Ideally this signal will be an impulse that occurs at a given quantity.

The Reed Relay Scaled Pulse Output incorporates a sensing unit. Like the standard counter capsule, it is vacuum sealed and thus protected from all possible foreign matter. One of the pointers is fitted with a small magnet which operates a reed contact inside the sensing unit once per revolution. This establishes an impulse in the control circuit.

WIRING DIAGRAM FOR REED RELAY SCALED PULSE OUTPUT



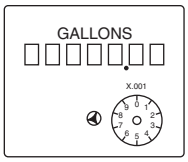
HOW TO READ OIL FLOWMETERS IN U.S. GALLONS

The FTB-30 has five black numbers which represent complete gallons. The last two numbers are red and represent decimals of gallons.

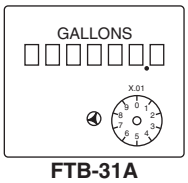
Example: RED RED
0 0 3 6 2. 7 5 = 362.75 Gallons
The round dial in right corner represents 1/1000th of a gallon.

The FTB-31A has six black numbers representing gallons. The last red number indicates 1/10th of a gallon and the dial represents 1/100th of a gallon.

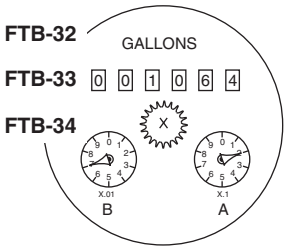
The entire counter unit of the FTB-32-FTB-36 can be rotated 360° to facilitate the reading. The counter FTB-32-FTB-34 has six black numbers representing U. S. gallons.
Dial "A" counts 1/10th of a gallon
Dial "B" counts 1/100th of a gallon



FTB-30



FTB-31A



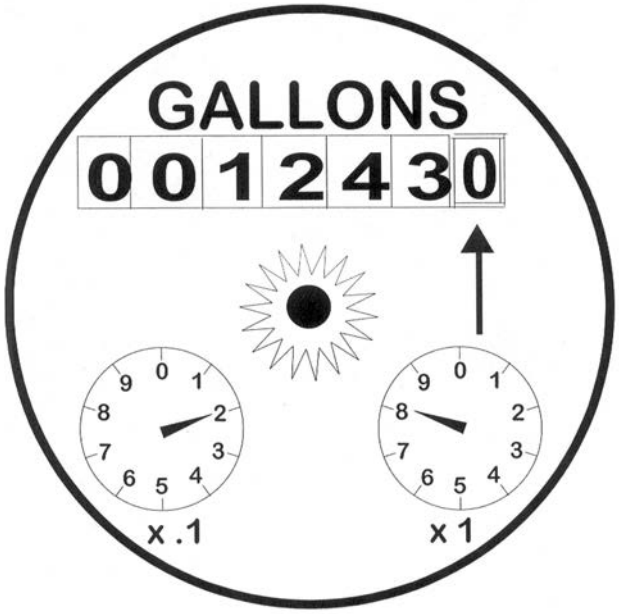
DIAL #FTB-32-FTB-34

Example: Top numbers read
0 0 1 0 6 4
Dial "A" reads 2 = .2
0 0 1 0 6 4. 2
The red dial "B" reads 7 = .07
0 0 1 0 6 4. 2 7 = Total reading

TRICKLE FLOW INDICATOR

All flowmeters can indicate even the smallest liquid movements with this indicator. (X)

How to read the oil meter FTB-35 (1-1/2") and FTB-36 (2")



The sample meter reading is 12438.2 gallons. The single gallon counter is on the right hand corner (small dial) and shows indication x1. The fraction of gallons is indicated on the left side of the dial indication that each number adds .1 gallon.

The counter is non-resettable and counts to 9 999 990 before it restarts to count up from zero.

omega.com info@omega.com

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U.S.A.: Omega Engineering, Inc., One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047 USA
Toll-Free: 1-800-826-6342 (USA & Canada only)
Customer Service: 1-800-622-2378 (USA & Canada only)
Engineering Service: 1-800-872-9436 (USA & Canada only)
Tel: (203) 359-1660 Fax: (203) 359-7700
e-mail: info@omega.com

For Other Locations Visit omega.com/worldwide

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

SECTION 16 - 1400 SERIES PROCESS EQUIPMENT - LNAPL PUMPS

SOLENOID VALVE, 2", N.C. - ASCO MODEL 8215B080

SOLENOID VALVE, 1/2", N.O. - ASCO MODEL 8210G034

FLOW METER - OMEGA MODEL FTB-32P

FLOW TOTALIZER - OMEGA MODEL M0505/0300

Features

- Lightweight, low-cost valves for air service
- Ideal for low pressure applications
- Provides high flow, Cv up to 138 (Kv 118)
- Air and vacuum service

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals, Diaphragms, Disc	NBR
Disc-Holder	PA (10.1 and 11.6 watt Normally Open only)
Core Guide	CA
Core Tube	305 Stainless Steel
Rider Rings	PTFE
Core and Plugnut	430F Stainless Steel
Springs*	302 Stainless Steel
Shading Coil	Copper
* For 8040H006, 8040H007, 8040H008, spring material is 17-7 PH	

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
B	14.9	-	-	-	-	62691	-	-
F	-	15.4	27	160	99257	-	99257	-
F	-	28.2	50	385	206409	-	206409	-

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz), 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required. (Note: 24 volt AC, 60 Hz not available with 28.2 watt coil)

Solenoid Enclosures

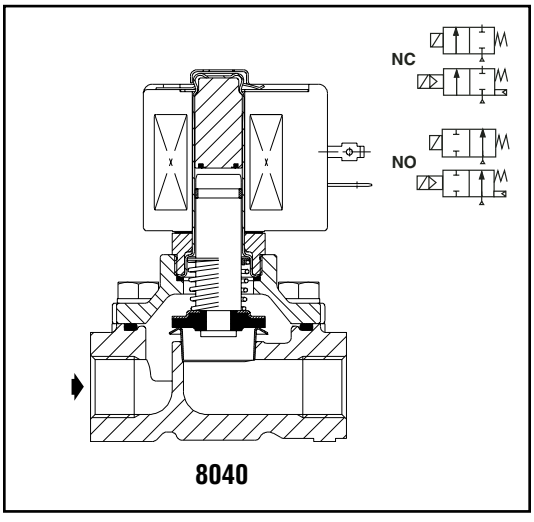
Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; RedHat - Explosionproof and Raintight, Types 3, 7, and 9. (Except EF8215A40 and EF8215A90, which are suitable for Types 3 and 7 (C and D) only and have a T2B temperature rating code.)
To order, add prefix "EF" to catalog number.

See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

Series	AC	DC	
	RedHat II/RedHat	RedHat II	RedHat
8040	-40˚F to 125˚F (-40˚C to 52˚C)	-	-
8215	32˚F to 125˚F (0˚C to 52˚C)	32˚F to 104˚F (0˚C to 40˚C)	32˚F to 77˚F (0˚C to 25˚C) (104˚F/40˚C occasionally)
Refer to Engineering Section for details.			



8040

Approvals:

CSA certified to:

8040 Series:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.
3) Automatic Gas Safety Shutoff Valves C/I (3.9), File 112872.

8215 Series Normally Closed:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.

8215 Series Normally Open:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.

UL listed, as indicated. FM approved (Normally Closed only, except Catalog Numbers 8215A090 and 8215A040). RedHat II meets applicable CE directives.

Refer to Engineering Section for details.

2/2 SERIES 8040 8215

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Gas Capacity Btu/hr ⑥	Operating Pressure Differential (psi)			Max. Fluid Temp. ˚F		Aluminum Body	Const. Ref.		UL ⑤ Listing	Watt Rating/ Class of Coil Insulation ②	
				Min.	Max. AC Air-Fuel Gas	Max. DC Air-Fuel Gas	AC	DC	Catalog Number	AC	DC		AC	DC
NORMALLY CLOSED (Closed when de-energized)														
1/8	5/16	1.0	53,700	0	15	-	125	-	8040H006	11		❍	6.1/F	-
1/4	5/16	1.1	59,000	0	15	-	125	-	8040H007	11		❍	6.1/F	-
3/8	5/16	1.2	64,400	0	15	-	125	-	8040H008	11		❍	6.1/F	-
3/8	3/4	3.4	183,000	0	50	25	125	104	8215G010	2		❍	10.1/F	11.6/F
3/8	3/4	3.5	-	5	125	125	125	104	8215G001 ①	1		❍	6.1/F	11.6/F
1/2	3/4	5.4	291,000	0	2	-	125	-	8040G022	13A		❍	10.1/F	-
1/2	3/4	4.4	238,500	0	50	25	125	104	8215G020	2		❍	10.1/F	11.6/F
1/2	3/4	4.8	-	5	125	125	125	104	8215G002 ①	1		❍	6.1/F	11.6/F
3/4	3/4	9.5	512,000	0	2	-	125	-	8040G023	13B		❍	10.1/F	-
3/4	3/4	5.1	247,500	0	50	25	125	104	8215G030	4		❍	10.1/F	11.6/F
3/4	3/4	5.1	-	5	125	125	125	104	8215G003 ①	3		❍	6.1/F	11.6/F
1	1 5/8	21	1,119,000	0	25	25	125	77	8215B050 ③	6	16	❍	15.4/F	14.9/B
1 1/4	1 5/8	32	1,730,000	0	25	25	125	77	8215B060 ③	6	16	❍	15.4/F	14.9/B
1 1/2	1 5/8	35	1,900,000	0	25	25	125	77	8215B070 ③	6	16	❍	15.4/F	14.9/B
2	2 3/32	60	3,251,000	0	25	15	125	77	8215B080 ③	7	17	❍	15.4/F	14.9/B
2 1/2	3	117	5,821,000	0	5	-	125	-	8215A090 ⑦	8		❍	28.2/F	-
3	3	138	7,430,000	0	5	-	125	-	8215A040 ⑦	8		❍	28.2/F	-
NORMALLY OPEN (Open when de-energized)														
3/8	3/4	3.2	172,500	0	125	125	125	104	8215G013	9		●	10.1/F	11.6/F
1/2	3/4	4	206,250	0	125	125	125	104	8215G023	9		●	10.1/F	11.6/F
3/4	3/4	4.6	247,500	0	125	125	125	104	8215G033	10		●	10.1/F	11.6/F
1	1 5/8	22	1,191,750	0	25	15	125	77	8215C053	12	18	●	15.4/F	14.9/B
1 1/4	1 5/8	33	1,793,250	0	25	15	125	77	8215C063	12	18	●	15.4/F	14.9/B
1 1/2	1 5/8	37	1,988,250	0	25	15	125	77	8215C073	13	19	●	15.4/F	14.9/B
2	2 3/32	58	3,100,000	0	25	15	125	77	8215C083	14	20	●	15.4/F	14.9/B
2 1/2	3	117	6,290,000	0	5	-	125	-	8215B093 ④⑦	15		●	28.2/F	-

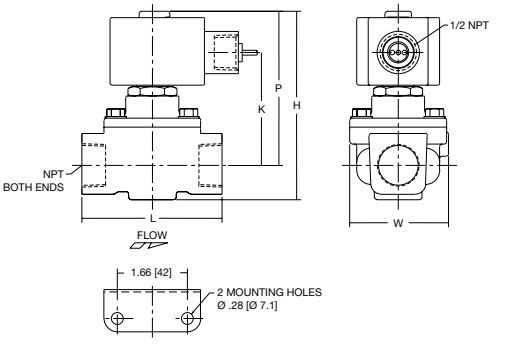
① Do not use for Fuel Gas.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
③ FM Approved Process Control Valves. *See Engineering Section (Approvals) for details.*
④ Type I enclosure only.
⑤ ❍ = Safety Shutoff Valve; ● = General Purpose Valve. *Refer to Engineering Section (Approvals) for details.*
⑥ 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.
⑦ Not available with 24 volt, 60 Hz coil.

Dimensions: inches (mm)

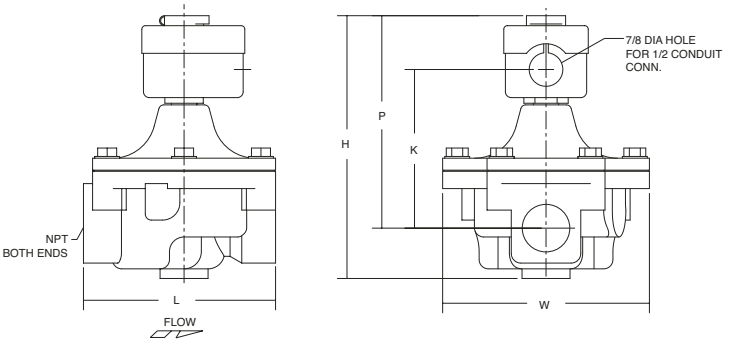
Const. Ref.		H	K	L	P	W
1	ins.	3.42	2.00	2.75	2.87	2.46
	mm	87	51	70	73	63
2	ins	4.02	2.49	2.75	3.46	2.46
	mm	102	63	70	88	63
3	ins.	3.87	2.19	3.31	3.05	2.33
	mm	98	56	84	77	59
4	ins.	4.46	2.68	3.31	3.64	2.33
	mm	113	68	84	92	59
6 ①	ins.	6.84	4.25	5.00	5.59	5.38
	mm	174	108	127	142	137
7 ①	ins.	7.47	4.53	6.09	5.94	6.31
	mm	190	115	155	151	160
8 ①	ins.	10.25	5.75	7.79	7.91	7.94
	mm	260	146	198	201	202
9	ins.	4.42	2.72	2.75	3.86	2.36
	mm	112	69	70	98	60
10	ins.	4.86	2.72	3.31	4.04	2.36
	mm	123	69	84	103	60
11	ins.	2.74	1.44	2.00	2.30	1.69
	mm	69	36	51	58	43
12	ins.	6.84	2.22	5.00	3.63	5.38
	mm	174	56	127	92	137
13	ins.	6.84	2.16	5.00	3.56	5.38
	mm	174	55	127	90	137
13A	ins.	4.05	2.46	2.75	3.44	2.42
	mm	103	63	70	87	62
13B	ins.	4.49	2.65	3.31	3.63	2.39
	mm	114	67	84	92	61
14 ②	ins.	7.44	2.41	6.09	3.81	6.31
	mm	189	61	155	97	160
15 ②	ins.	10.25	3.07	7.80	5.22	7.94
	mm	260	78	198	133	202
16	ins.	7.59	4.03	5.00	6.34	5.38
	mm	193	102	127	161	137
17	ins.	8.19	4.38	6.09	6.69	6.31
	mm	208	111	155	170	160
18	ins.	6.16	2.09	5.00	4.41	5.38
	mm	156	53	127	112	137
19	ins.	7.59	2.03	5.00	4.34	5.38
	mm	193	52	127	110	137
20	ins.	8.19	2.28	6.09	4.59	6.31
	mm	2.08	58	155	117	160

IMPORTANT: Valves may be mounted in any position except all DC constructions and those marked ①, which must be mounted with the solenoid vertical and upright. Constructions marked ② must be mounted with the solenoid vertical and upright or horizontal only.

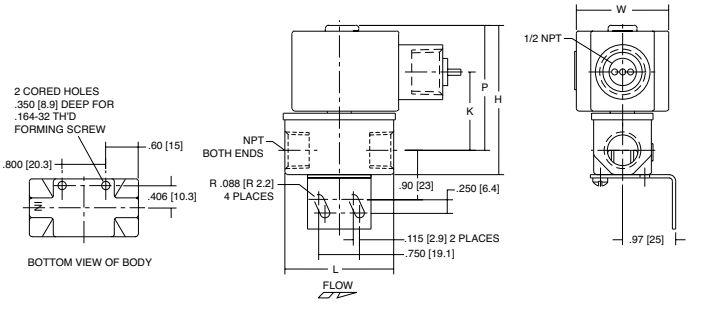
Const. Ref. 1-4, 9, 10, 13A, 13B



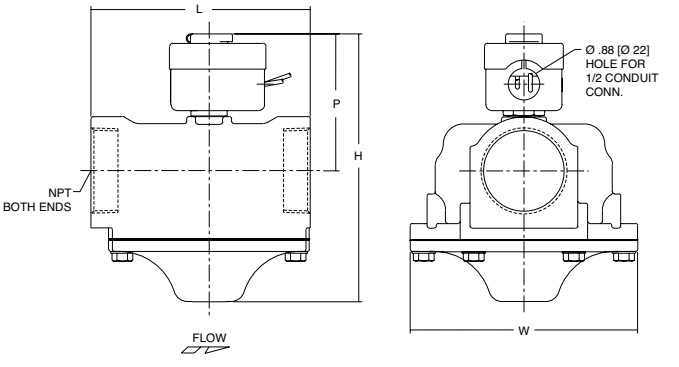
Const. Ref. 6, 7, 8, 16, 17



Const. Ref. 11

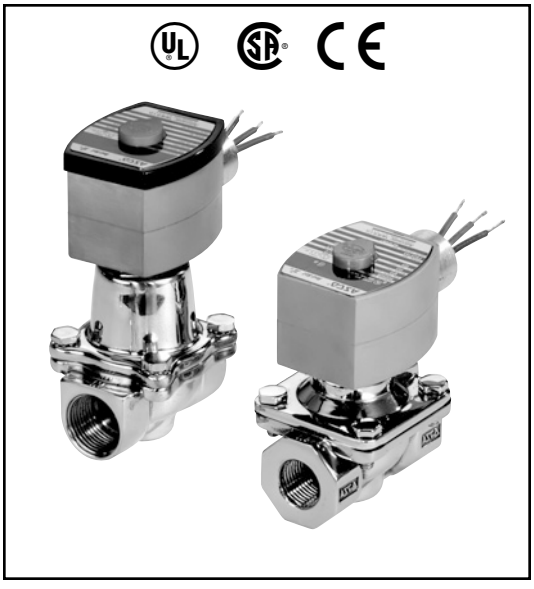


Const. Ref. 12-15, 18-20



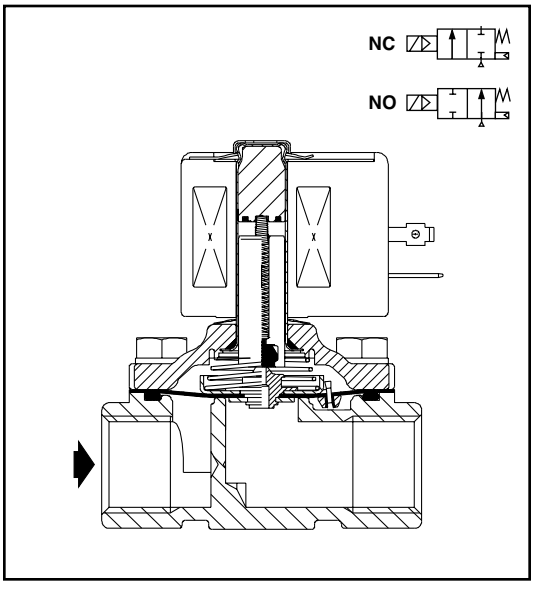
Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage
- High Flow Valves for liquid, corrosive, and air/inert gas service
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps



Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver



Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910	-	238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering.
Other voltages available when required.

Solenoid Enclosures

Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.

(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B057, 8210B058, and 8210B059, which are not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

RedHat II/
RedHat AC: 32˚F to 125˚F (0˚C to 52˚C)

RedHat II DC: 32˚F to 104˚F (0˚C to 40˚C)
RedHat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)

8210G227 AC: 32˚F to 130˚F (0˚C to 54˚C)
DC: 32˚F to 90˚F (0˚C to 32˚C)

Refer to Engineering Section for details.

Approvals

UL listed as indicated. CSA certified.
RedHat II meets applicable CE directives.
Refer to Engineering Section for details.

2/2 SERIES 8210

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. ˚F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Const. Ref. ④	UL ⑤ Listing	Catalog Number	Const. Ref. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G073 ③	1P	●	8210G036 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G093	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G001	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G006	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G015 ③	2P	●	8210G037 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G094	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G087	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G002	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G007	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	130	90	8210G227	5D	❍ †	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G088	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G009	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G095	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G003	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B026 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G026 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B054 ‡	31D	-	8210D089	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G054	41D	●	8210G089	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G004	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G027 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G078 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B055 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G055	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G008	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B056 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G056	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G022	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G033	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G011 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G034	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G030	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G012 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G035	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G038	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C013	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G013	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B057 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D014	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G014	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B058 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D018	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G018	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B059 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D032	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G032	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210 103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210 104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

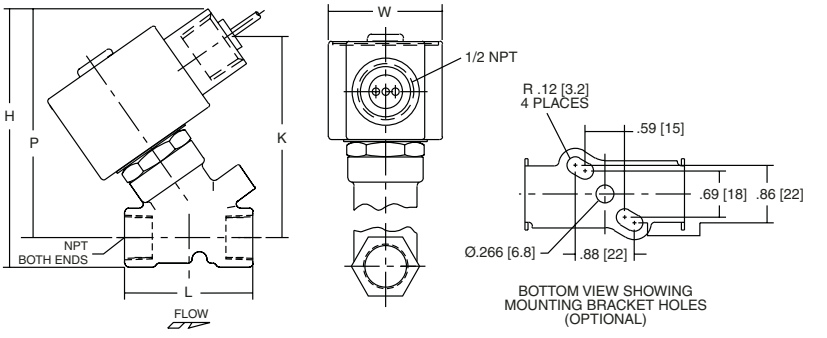
① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless steel disc-holder.
‡ Must have solenoid mounted vertical and upright.
† UL listed for fire protection systems per UL429A.

Dimensions: inches (mm)

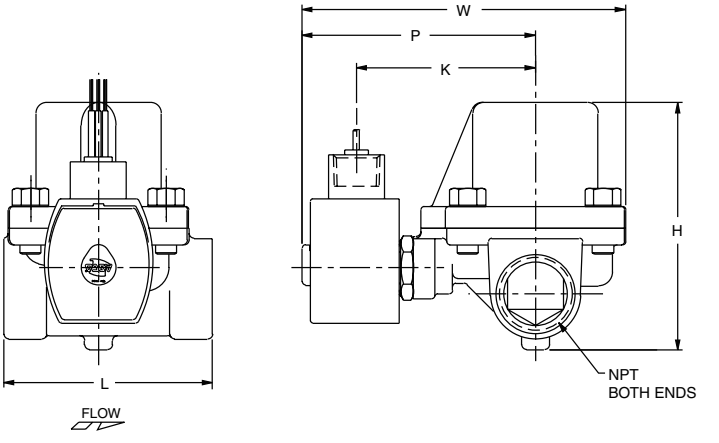
Const. Ref.		H	K	L	P	W
1*	ins.	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	ins.	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
5	ins.	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	ins.	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	ins.	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	ins.	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	ins.	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*	ins.	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	ins.	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	ins.	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
13	ins.	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
15*	ins.	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	ins.	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	ins.	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	ins.	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	ins.	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	ins.	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	ins.	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	ins.	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	ins.	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	ins.	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	ins.	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	ins.	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

* DC dimensions slightly larger.
IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

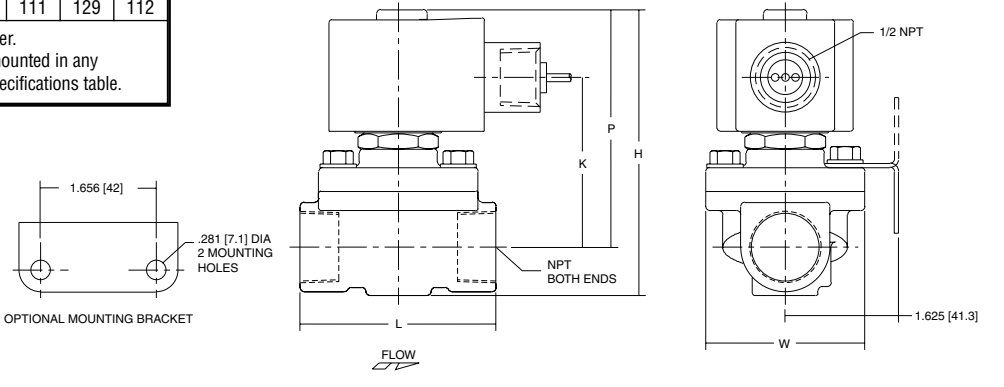
Const. Ref. 1, 2



Const. Ref. 13



Const. Ref. 5-9, 11, 20, 21 23 25, 37,38



POSITIVE-DISPLACEMENT TOTALIZERS
For Oil Flow

FTB-30

All products shown smaller than actual size.

FTB-32

FTB-31P

FTB-30

1 YEAR WARRANTY

- For Flows Down to 0.26 GPH
- For #2, 4, or 6 Oil
- Direct Totalization in Engineering Units
- Scaled Pulse Output Available
- ±1% Rdg Accuracy
- Special Versions Available for Low-Viscosity Fluids, Including Water and Freon

FTB-30 Series totalizers are typically used in applications in which accurate measurement of (#2, 4, or 6) heating oil flow is required. The FTB-32 features a fully rotatable, easy-to-read face.

The FTB-30 is designed to be mounted horizontally; the FTB-30 and FTB-31 come with mounting brackets and compression fittings, while the FTB-32 is supplied with ¾ NPT couplings. All FTB totalizers are non-resettable and have an optional reed relay scaled pulse output [with 3 m (10') of cable] for remote totalization. This output must be specified at the time of the order; it is not field installable.

SPECIFICATIONS

Accuracy: ±1% rdg except ±0.5% rdg for FTB-31
Maximum Pressure: 225 psi for FTB-32 through FTB-35; 350 psi for FTB-30 and FTB-31; 360 psi for FTB-36
Pressure Loss:
FTB-30: 0.14 psi
FTB-31: 0.58 psi
FTB-32: 1.80 psi
Wetted Parts: Brass body and anodized aluminum piston; graphite or synthetic rubber piston optional
PULSE OUTPUT
Maximum Switch Load: 3 VA
Maximum Switch Current: 50 mA
Maximum Switch Voltage: 50 Vac
Output Frequency:
0.1 gal/pulse for FTB-30P, FTB-31P, FTB-32P (total only)

F

To Order

Model No. No Output	Model No. Pulse Output (For Total Only)	Flow Rate Minimum	Flow Rate Cont.	Flow Rate Maximum	Connections	Increments (Gallons)	Max Reading (Gallons)	Weight kg (lb)	Maximum Temperature °C (°F)
FTB-30	FTB-30P	0.26 GPH	6.5 GPH	20 GPH	¼" CF*	0.01	100,000	0.5 (1.1)	60 (140)
FTB-31A	FTB-31P	1.0 GPH	20.0 GPH	50 GPH	¾" CF*	0.01	1,000,000	1.3 (2.8)	60 (140)
FTB-32	FTB-32P	8.25 GPH	265.2 GPH	400 GPH	¾ MNPT	0.1	1,000,000	5.0 (11)	127 (260)
FTB-33	FTB-33P	2.6 GPH	105 GPH	160 GPH	½ NPT	0.1	1,000,000	2.1 (4.7)	127 (260)
FTB-34	FTB-34P	20 GPH	528 GPH	800 GPH	1 NPT	1.0	1,000,000	4.2 (9.3)	127 (260)
FTB-35	FTB-35P	59 GPH	1585 GPH	2375 GPH	1½ NPT	10.0	10,000,000	15.9 (35)	127 (260)
FTB-36	FTB-36P	199 GPH	5285 GPH	7925 GPH	2" flange†	—	100,000,000	40.0 (88)	127 (260)

** CF = Compression fitting*
† FTB-36 has 150 lb flange fittings.
Comes complete with operator's manual.
***Ordering Examples: FTB-30P**, pulse-output totalizer, with 0.26 to 20 GPH range.*
***FTB-33**, mechanical totalizer with 2.6 to 160 GPH range.*

FTB-30 Series

Positive Displacement Oil Flow Meters/Totalizers

INSTRUCTION SHEET

M0505/0300

Shop online at: www.omega.com e-mail: info@omega.com
For latest product manuals: www.omegamanual.info

GENERAL DESCRIPTION

The FTB-30 Series Totalizers are used in applications where accurate measurement of heating oil (#2, 4, 6) flow is required. The FTB-30 and FTB-31A are used mainly for light heating oil in small burners. The FTB-32 to FTB-36 are for large flow applications and can be used for all types of oil (2-6) including heavy preheated grades.

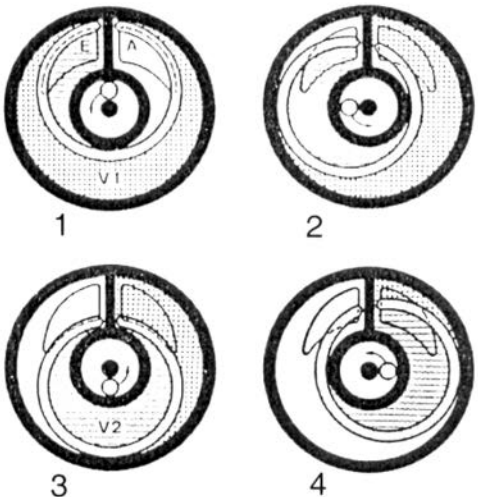
Models FTB-32 to FTB-36 feature fully rotatable, easy-to read faces. The FTB-30 and FTB-31A are shipped with compression fittings, while FTB-32 to FTB-35 are supplied with NPT couplings. All FTB totalizers are non-resettable (counters restart at zero after reaching maximum counting capacity). The FTB-36 has flanges.

The FTB-30 Series meters have an optional reed relay scaled pulse output for remote totalization. This output (option P) must be specified at the time of the order; it is not field installable.

THEORY OF OPERATION

The FTB-30 Series meters come under the category of positive displacement volumetric meters. Their main feature is the division of the measuring chamber into two compartments by the ring piston, which alternately fill and empty. Each cycle thus measures, volumetrically, a definite quantity of liquid. The operation of measurement is thus practically independent of the viscosity and density of the liquid.

Another feature of the volumetric measuring principle of the FTB-30 Series Oil Flowmeter, is the very large measuring range with relatively small metering errors. The range is limited at the highest flows by the maximum permissible cycling speed of the ring piston.

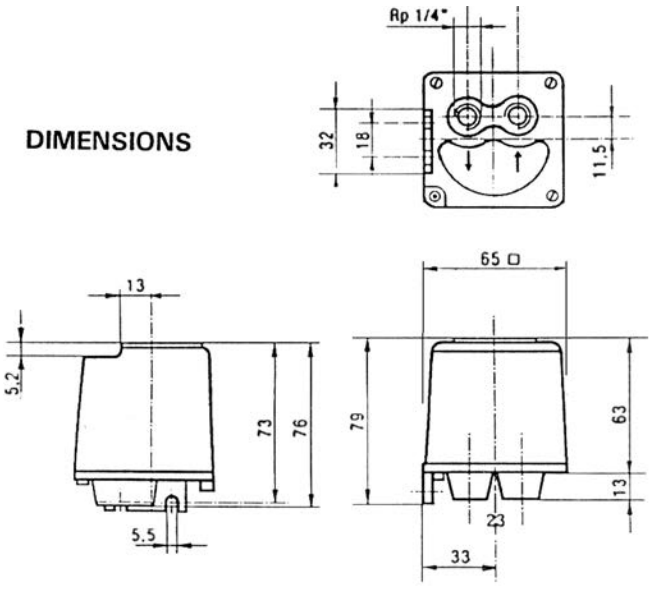


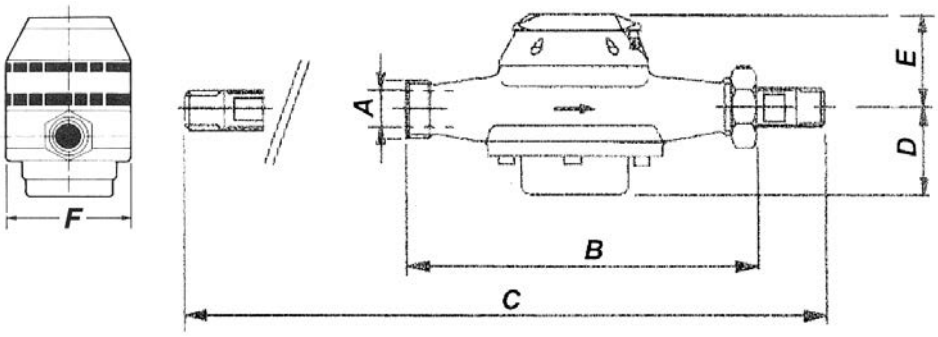
The Construction Diagram shows the measuring chamber with cover removed and the four steps in the metering cycle. In the center of the measuring chamber and top cover lies an annular piston guide. The measuring space is thus a circle, divided by a barrier. The inserted ring piston is guided, on the one hand, by its central spindle following the path of the annular guide; and on the other, by movement of the slit in the piston moving up and down the barrier. The movement is thus oscillatory; the outer diameter of the piston rolling around the inside of the measuring chamber, the inside of the piston around the outer cylindrical face of the annular guide. This creates two measuring chambers, outside (V1) and inside (V2) the piston, the volumes of which change with the piston movement.

The entry port E lies in the base of the measuring chamber and to the left of the barrier. The outlet A is on the opposite side of the barrier, either in the cover or the measuring chamber wall. Thus, there is no direct connection between the inlet and outlet ports. The entry port is so shaped that it feeds either the outer or the inner measuring chamber until both chambers contain the maximum possible volume of liquid. When the second is full, the combined chamber moves towards the outlet port. The chamber volume decreases and discharges the liquid. Thus, with each operating cycle of the piston, two defined and constant volumes V1 and V2 are passed from inlet to outlet. The created pressure differential causes the piston movement.

The drive from the piston to the counter is by means of magnetic coupling.

DIMENSIONS





	FTB-32	FTB-33	FTB-34	FTB-35	FTB-36
A	3/4"	1/2"	1"	1-1/2"	2" flg
B	6.5"	6.5"	7-1/2"	12"	13-3/4"
C	11"	11-1/4"	12"	17"	–
D	2"	2"	3"	4-1/2"	6-1/2"
E	2-3/8"	2-3/8"	2-1/2"	4-1/2"	4-3/4"
F	4-1/8"	4-1/8"	5-1/8"	8-1/4"	–

Model No. No Output	Model No. Pulse Output	Flowrate Min.	Flowrate Cont.	Flowrate Max.	Conn.	Increment Max. Readings-Gals		Weight Lbs.	Max. Temp CF
FTB-30	**FTB-30P**	0.25 gal/h	14.0 gal/h	20.0 gal/h	1/4" CF	0.01	100,000	1.1	60 (140)
FTB-31A	**FTB-31P**	1.0 gal/h	35.0 gal/h	50 gal/h	3/8" CF	0.1	1,000,000	1.1	60 (140)
FTB-32	**FTB-32P**	8 gal/h	265 gal/h	400 gal/h	3/4" mnpt	0.1	1,000,000	5.5	127 (260)
FTB-33	**FTB-33P**	2.6 gal/h	105 gal/h	160 gal/h	1/2" mnpt	0.1	1,000,000	4.7	127 (260)
FTB-34	**FTB-34P**	20 gal/h	528 gal/h	800 gal/h	1" mnpt	1.0	1,000,000	9.3	127 (260)
FTB-35	**FTB-35P**	60 gal/h	1600 gal/h	2400 gal/h	1-1/2"mnpt	10.0	10,000,000	35	127 (260)
FTB-36	**FTB-36P**	200 gal/h	5300 gal/h	8000 gal/h	2" Flg	10.0	10,000,000	88	127 (260)

ACCURACY: ±1% of reading lot
FTB-30; FTB-32-FTB-36
±1/2% of reading for FTB31A

PULSE OUTPUT
MAX. SWITCH LOAD: 3VA
MAX. SWITCH CURRENT: 50mA
MAX. SWITCH VOLTAGE: 50 Vac
OUTPUT FREQUENCY: 0.1 gal/pulse FTB-30P, FTB-31P, FTB-32P, FTB-33P
1.0 gal/pulse FTB-34P,
10.0 gal/pulse FTB-35P, FTB-36P

MAX. PRESSURE: 350 psi for FTB-30 and FTB-31A, 225 psi for FTB-32 thru FTB-34, 150 psi for FTB-35 thru FTB-36

FILTERING REQUIREMENTS:

Model No.	Filter Size or Mesh Width (Size of Opening)	
FTB-30	0.002"	0.05mm
FTB-31A	0.002"	0.05mm
FTB-32	0.004"	0.10mm
FTB-33	0.008"	0.20mm
FTB-34	0.010"	0.25mm
FTB-35	0.012"	0.30mm
FTB-36	0.012"	0.30mm

INSTALLATION AND OPERATION

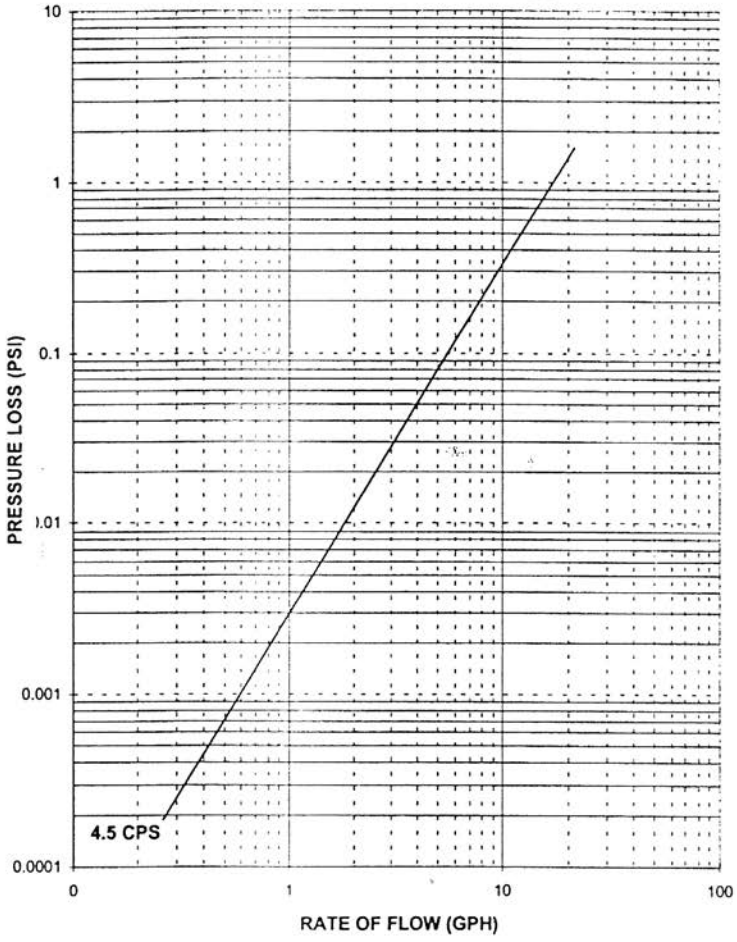
WARNING

THE FTB-30 Series Oil Flowmeters have to be protected against sediments. An oil filter or strainer is essential.

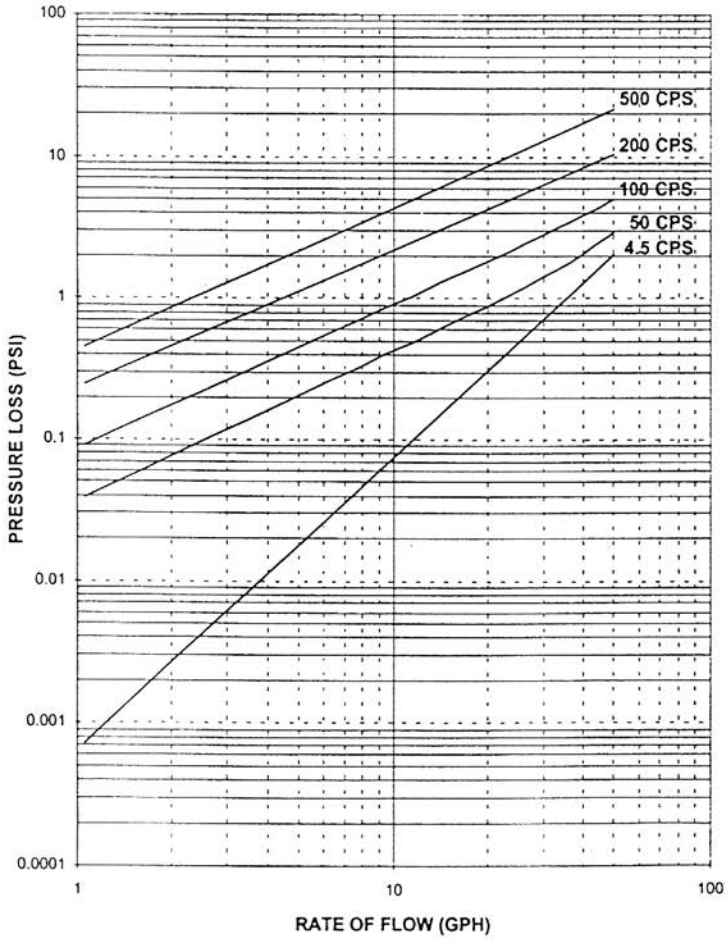
Make sure that the filter is installed upstream of the flowmeter. Remove plastic cover on threads of the flowmeter before installation.

PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-30 AND FTB-31A

1/8" OIL METER #FTB-30

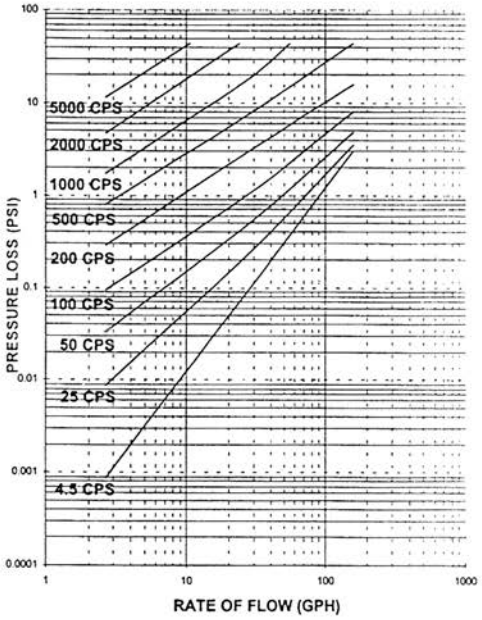


1/4" OIL METER #FTB-31A

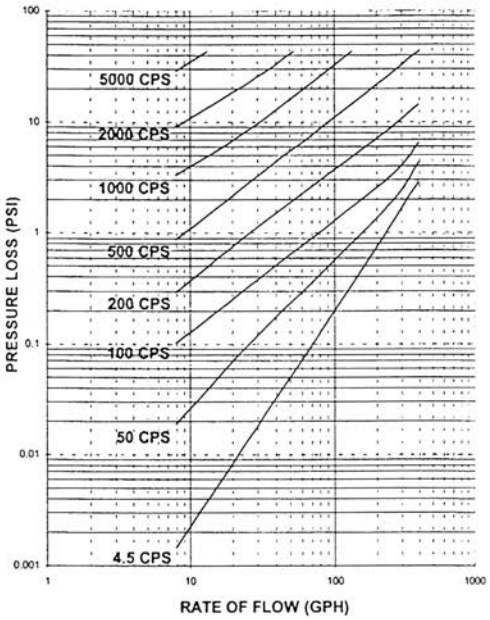


PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-33, FTB-32 AND FTB-34

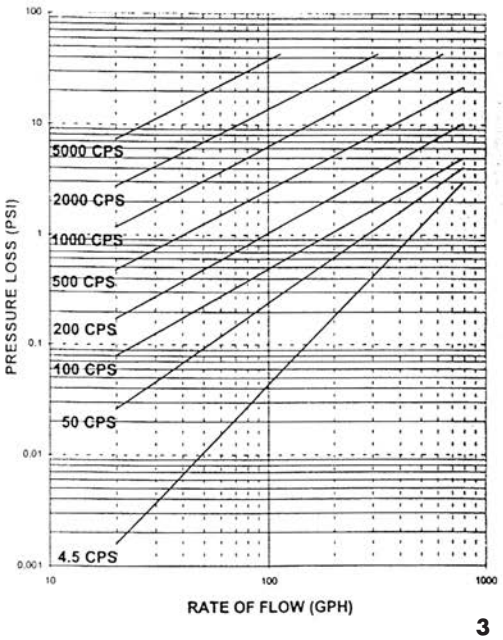
1/2" OIL METER #FTB-33



3/4" OIL METER #FTB-32

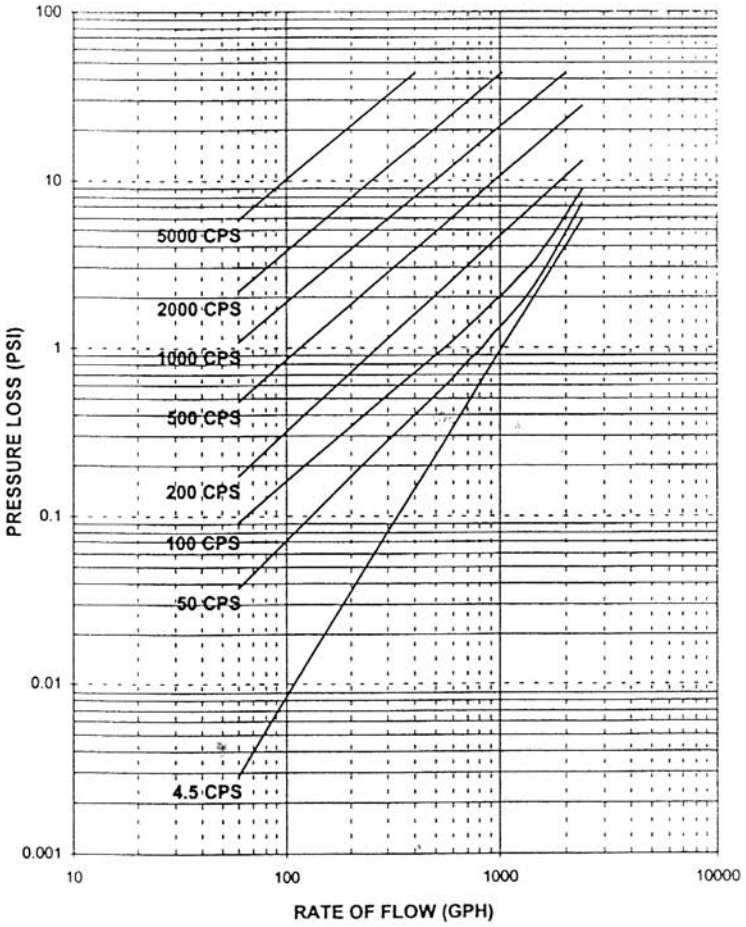


1" OIL METER #FTB-34

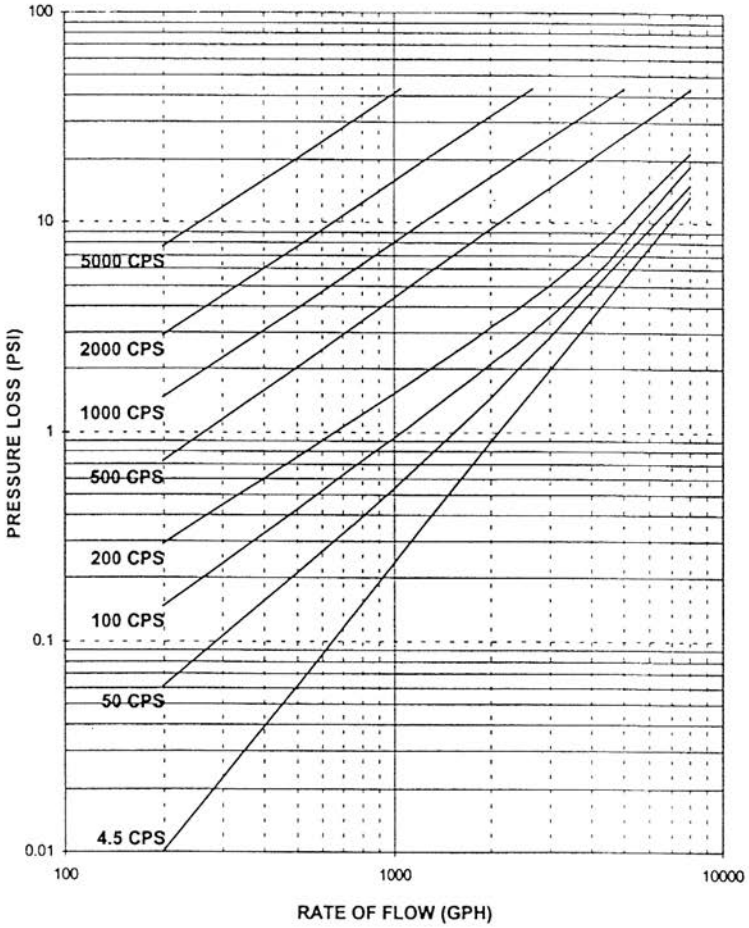


PRESSURE LOSS CHART FOR POSITIVE DISPLACEMENT METER MODEL #FTB-35 AND FTB-36

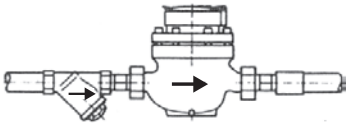
1-1/2" OIL METER #FTB-35



2" OIL METER #FTB-36

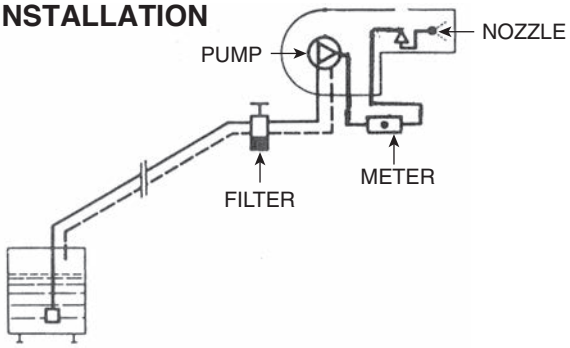


OBSERVE DIRECTION FLOW (ARROW):



STRAINER OR FILTER

TYPICAL INSTALLATION

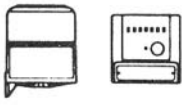


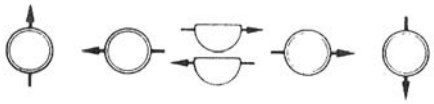
Meter should always be in lower position than the nozzle to prevent the oil from flowing out of the meter.

1. Location of Flowmeter

Because the OMEGA® Oil Flowmeters have high pressure and temperature ratings, they can be installed directly into the nozzle line.

Model	PSI Rating	Temp. Rating
FTB-30	350	140F
FTB-31A	350	140F
FTB-32	225	260F
FTB-33	225	260F
FTB-34	225	260F
FTB-35	150	260F
FTB-36	150	260F





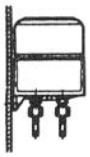
2. Installation Instructions

3. Flushing of Pipes

Make sure all pipes are flushed before installing the FTB-30 Series Flowmeter.

4. Securing Meter

The FTB-30 and FTB-31A should be additionally secured when installed in copper pipes. Use the two openings on the mounting frame.



5. Pressure Fittings & NPT Coupling Pieces

Use the pressure fittings provided for the FTB-30.

Model FTB-30 uses pressure fittings for 1/4" pipe size; the Model FTB-31A uses pressure fittings for 3/8" pipe size. Model FTB-32 - FTB-35 uses NPT fittings. Model FTB-36 has 2" flange (ANSI).

6. Start-up Operation

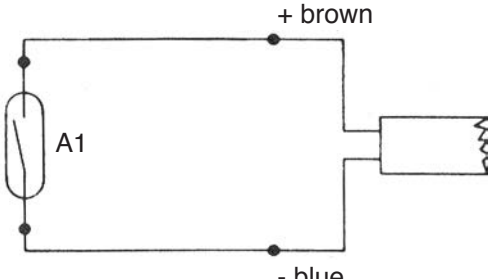
Slowly fill pipe system and carefully vent air in the line. Air trapped in pipes causes incorrect measurements and may damage the meter. Never allow the meter to run dry.

OPTIONAL REED RELAY SCALED PULSE OUTPUT

It is often necessary to transmit measurement parameters from a meter to a distant position. These parameters may also be used as manipulated variable in a regulating or control circuit. In such cases, an electric signal is necessary, which represents the parameter. Ideally this signal will be an impulse that occurs at a given quantity.

The Reed Relay Scaled Pulse Output incorporates a sensing unit. Like the standard counter capsule, it is vacuum sealed and thus protected from all possible foreign matter. One of the pointers is fitted with a small magnet which operates a reed contact inside the sensing unit once per revolution. This establishes an impulse in the control circuit.

WIRING DIAGRAM FOR REED RELAY SCALED PULSE OUTPUT



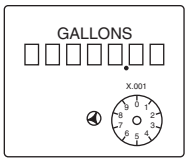
HOW TO READ OIL FLOWMETERS IN U.S. GALLONS

The FTB-30 has five black numbers which represent complete gallons. The last two numbers are red and represent decimals of gallons.

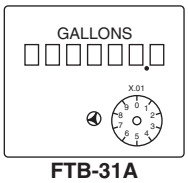
Example: RED RED
0 0 3 6 2. 7 5 = 362.75 Gallons
The round dial in right corner represents 1/1000th of a gallon.

The FTB-31A has six black numbers representing gallons. The last red number indicates 1/10th of a gallon and the dial represents 1/100th of a gallon.

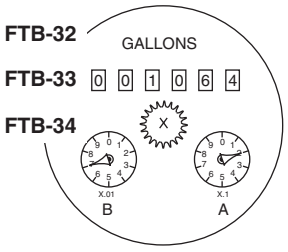
The entire counter unit of the FTB-32-FTB-36 can be rotated 360° to facilitate the reading. The counter FTB-32-FTB-34 has six black numbers representing U. S. gallons.
Dial "A" counts 1/10th of a gallon
Dial "B" counts 1/100th of a gallon



FTB-30



FTB-31A



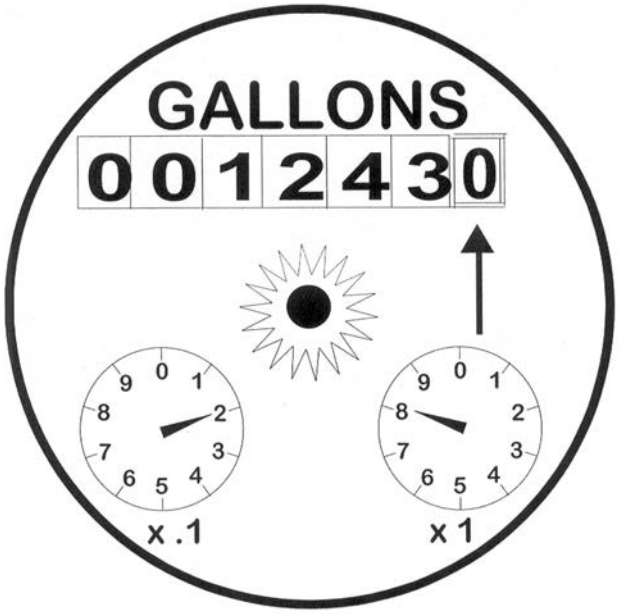
DIAL #FTB-32-FTB-34

Example: Top numbers read
0 0 1 0 6 4
Dial "A" reads 2 = .2
0 0 1 0 6 4. 2
The red dial "B" reads 7 = .07
0 0 1 0 6 4. 2 7 = Total reading

TRICKLE FLOW INDICATOR

All flowmeters can indicate even the smallest liquid movements with this indicator. (X)

How to read the oil meter FTB-35 (1-1/2") and FTB-36 (2")



The sample meter reading is 12438.2 gallons. The single gallon counter is on the right hand corner (small dial) and shows indication x1. The fraction of gallons is indicated on the left side of the dial indication that each number adds .1 gallon.

The counter is non-resettable and counts to 9 999 990 before it restarts to count up from zero.

omega.com info@omega.com

Servicing North America:

U.S.A.: Omega Engineering, Inc., One Omega Drive, P.O. Box 4047
Stamford, CT 06907-0047 USA
Toll-Free: 1-800-826-6342 (USA & Canada only)
Customer Service: 1-800-622-2378 (USA & Canada only)
Engineering Service: 1-800-872-9436 (USA & Canada only)
Tel: (203) 359-1660 Fax: (203) 359-7700
e-mail: info@omega.com

For Other Locations Visit omega.com/worldwide

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS / INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

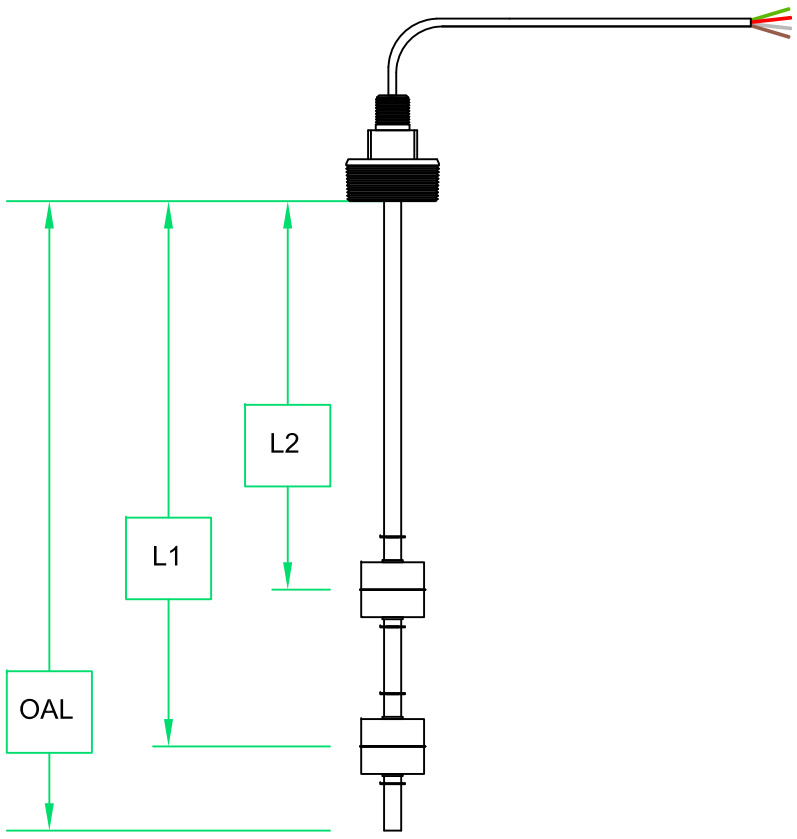
1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

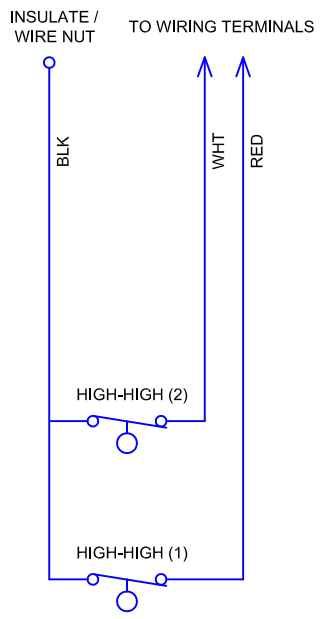
FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. OMEGA is a registered trademark of OMEGA ENGINEERING, INC.

L2	WHITE	NORMALLY CLOSED	HIGH-HIGH (2)
L1	RED	NORMALLY CLOSED	HIGH-HIGH (1)
	BLACK		COMMON





UL LISTED	
HOUSING	N/A
CONDUIT CONNECTION	$\frac{1}{2}$ NPT
FITTING AND STEM MATERIAL	STAINLESS STEEL
STEM DIAMETER	$\frac{1}{2}$ INCH
FITTING SIZE	2 INCH NPT
FLOAT STOP	SNAP RING
FLOAT MATERIAL	STAINLESS STEEL
SWITCH TYPE	SPST
SWITCH RATING	50 WATT
SPECIFIC GRAVITY	0.6

OAL - 21 INCHES
L1 - 19 INCHES
L2 - 13.25 INCHES
CABLE LENGTH - 288 INCHES

GENERAL NOTES:

1. FOR TERMINAL BLOCK LOCATION SEE DRAWING (I-1)
2. FOR WIRING TERMINAL DESIGNATION SEE DRAWING (I-2)

REV	DESCRIPTION	DATE	APPROVED
A	AS BUILT	06-02-15	RB

REVISIONS

DRWN BY	DATE
JAD	05-27-15
CHK BY	DATE
APPR BY	DATE

NATIONAL ENVIRONMENTAL SYSTEMS
84 DUNHAM STREET / ATTLEBORO, MA 02703
508-226-1100 (Phone) / 508-226-1180 (Fax)
WWW.NES-INC.BIZ

TITLE: 2 POSITION LEVEL SENSOR
LSH & LSHH-801 / LSH & LSHH-1401

AMEC / REVIEW AVE DEVELOPMENT
SITES C241005 & C241089 / QUEENS COUNTY, NY

JOB NO. 13-214

SCALE	SIZE	DWG NO.	SHEET	REV
NTS	B	M-10	1 OF 1	A

SECTION 17 - 1500 SERIES PROCESS EQUIPMENT - AIR COMPRESSOR

AIR COMPRESSOR, 20 HP, 460 VAC, 3 PH, TEFC - KAESER MODEL AIR CENTER SK 20

PARTICULATE FILTER - KAESER MODEL USKPF100BF

COALESCING FILTER WITH INDICATOR, 1" - KAESER MODEL USKOR100

PRESSURE REGULATOR WITH GAUGE, 1" - KAESER MODEL ANR119-08C

PRESSURE INDICATOR - DWYER MODEL SGY-D10722N

AUTOMATIC DRAIN VALVE - KAESER MODEL ECO DRAIN 30

PRESSURE SWITCH - ASHCROFT MODEL B424V

SOLENOID VALVE, 2", N.C. - ASCO MODEL 8215B080

SOLENOID VALVE, 1/2", N.O. - ASCO MODEL 8210G034

KAESER COMPRESSORS

Built for a lifetime.™

Screw Compressors

SX, SM, and SK Series

Capabilities from: 8.8 to 89 cfm
Pressures from: 80 to 217 psig

SX, SM, and SK Series

Built for a lifetime.™

Kaeser Compressors' SX, SM, and SK series of rotary screw compressors are the perfect solution for smaller compressed air systems. Not only do these compressors deliver more compressed air for sustainable energy savings, they also combine ease of use with exceptional reliability and simple maintenance.

Innovation you can trust

With a cutting edge research and development team committed to building industry-leading products, Kaeser continues to deliver better solutions to meet our customers' compressed air needs. Kaeser's expertise and world-wide reputation for superior reliability and efficiency offer great performance and peace of mind.

Kaeser reliability

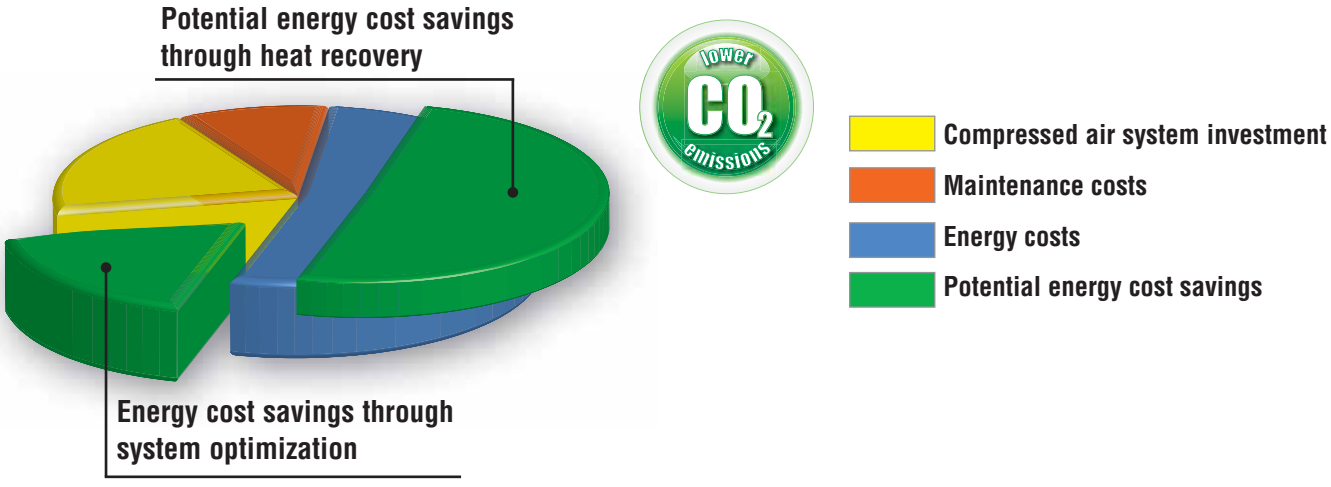
Kaeser's screw compressors meet our rigorous "built for a lifetime" standard. Designed and built with Kaeser's generations of compressed air experience, you can rest assured that these compressors will continue to deliver the air you need with the exceptional reliability you expect from a Kaeser compressor.

Service-friendly

From the ground up, these compressors have been designed with the user in mind. Fewer wearing parts and using premium quality materials ensure reduced maintenance requirements, longer service intervals, and extended service life. A smarter component layout with easy, single panel access simplify service and lower your operating costs.

Kaeser efficiency

In our systems design approach, Kaeser chooses the components that work together in the most energy efficient way possible. Each and every component — from inlet filter to discharge pipe connection — has been carefully selected with performance in mind. In fact, the SX, SM, and SK series are up to 30% more efficient than the competition. With Kaeser's superior system controls, we guarantee an efficient compressor with lower operating costs.



Service-friendly Design

The SX, SM, and SK series rotary screw compressors feature an open package layout. All of the major components are easily accessible reducing preventive maintenance time by as much as 50% when compared to other similarly sized units.

When you consider the energy efficiency savings and the maintenance costs savings, it's clear that owning a *Built for a lifetime™* Kaeser compressor will save you money, year after year.

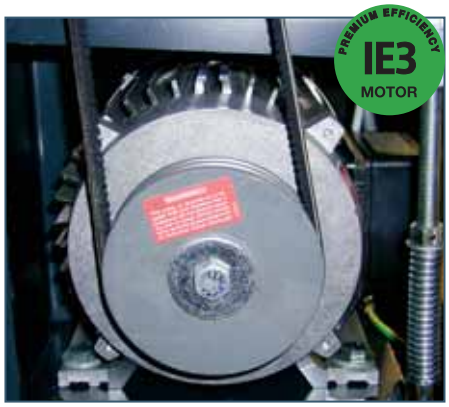
Ease of Maintenance

1. Easy single panel access for routine service
2. Maintenance reminders on controller
3. Single piece, multi-ribbed belt. SM and SK units also include an automatic tensioner
4. Spin-on 10 micron fluid filter
5. Cartridge style 1 micron inlet filter*
6. Quick fluid change system with drain hose (hose not shown)
7. Side panel windows to view fluid level and test the auto drain (on T versions and AirCenters)
8. Cleanable filter mat on coolers (not shown)

Designed for Reliability, Simplicity, and Performance

Sigma Profile™ Airend

Our power-saving, proprietary airend design delivers pressures up to 217 psig. It is precision-machined to close tolerances and optimized in size and profile to match the low airend speeds with their best specific performance.



TEFC Motor with Reduced Voltage Starter

Premium-efficiency, totally enclosed, fan cooled (TEFC) motors with Class F insulation provide long life in harsh environments. Magnetic Wye-Delta reduced voltage starters ensure low starting current and smooth acceleration. Tri-voltage 208-230/460 or 575 V, 3-phase, 60 Hz is standard. Other voltages are available.

Sigma Control™ Basic

A simple and reliable interface offers convenient pressure control and system monitoring with status display and maintenance reminders. Displays include discharge pressure and temperature, load and service hours, as well as fault indicators. Sigma Control 2 is optional (see facing page).

Belt Drive with Automatic Tensioning

A ribbed single belt drive efficiently transfers power from motor to airend. The SM and SK series feature our unique automatic tensioning device that maintains proper tension to maximize energy efficiency, prolong belt life, and simplify routine maintenance. The belt tension can easily be verified through a window in the service panel.

High-Efficiency Coolers with Filter Mat

Conveniently located on the outside of the unit, our standard high-efficiency coolers provide maximum cooling resulting in approach temperatures as low as 11°F for more moisture separation at the compressor discharge and better air quality. A filter mat simplifies cooler maintenance. Dirt and dust build up on the outside of the filter, where it is easily seen and removed. This extends cooler service intervals and increases thermal reserve for harsher conditions.

Efficient Separator System

A three-stage separator (ASME or CRN) combines centrifugal action and a 2-stage coalescing filter to reduce fluid carry over to 2 ppm or less. Quick release fittings, drain and fill ports are arranged for fast and easy fluid changes from sump and cooler without any pumping device. The easy-to-read fluid level indicator can be safely checked through a window in the service panel while the compressor is running.

Double-flow Cooling Fan

Our patent-pending double-flow fan design increases air flow through the unit while reducing overall power requirements and sound levels.

Enclosure

Our superior cabinet design reduces noise and footprint while offering easy access for service. A heavy-duty metal enclosure with a durable powder-coated finish keeps noise in but dirt and dust out. Thick sound insulation keeps sound levels as low as 61 dB(A), up to 10 dB(A) quieter than comparable units.

Lockable panels provide easy access to all maintenance items. Electrical components are housed in a spacious, ventilated control cabinet. Wiring is neatly arranged and terminals are clearly identified.

Internal and external vibration isolators eliminate stress on piping and wire connections, further increasing reliability.

Fluid Cooling System

All units are filled with Kaeser Premium Fluid to cool, clean, and lubricate the airend. A thermostatically controlled combination valve ensures perfect fluid temperature regulation and incorporates a cooler by-pass and spin-on fluid filter. Main air and fluid lines are made of rigid pipe with flexible connections. A 10 micron spin-on fluid filter is within easy reach of the front cover. This filter extends fluid life and protects the airend.

Optimized Air Flow Design

Air is drawn into separate cooling zones for the drive motor and coolers. This "split cooling" design eliminates preheating, increasing cooling efficiency without increasing power consumption. Cooler temperatures also promote longer lubricant and motor life. Cooling air is exhausted through a single port at the top of the cabinet. Ducting this air enables heat recovery and further reduces noise.

Air for compression enters through a separate grill on the right side of the cabinet. It is then filtered through a two-stage air intake filter. This filter protects the airend and extends fluid change intervals.

Fresh cooling air

Recirculated air

Exhaust air

The SX, SM, and SK units can be installed in a corner and still provide easy access for maintenance.

Intelligent control and protection

To protect your investment and ensure the most efficient operation possible, these compressors are available with our Sigma Control 2™ as an option. This intelligent controller comes standard with multiple pre-programmed control profiles so you can select the one that best fits your application. Sigma Control 2 monitors more than 20 critical operating parameters, shuts the unit down to prevent damage, and signals if immediate service is required. It also tracks preventive maintenance intervals and provides notice when PMs are due. An RFID sensor provides secure access and simplifies managing maintenance intervals. A SD card slot with included SD card enables fast, easy software updates, storing key operational parameters, and offers long-term data storage for analyzing energy consumption and compressor operation.

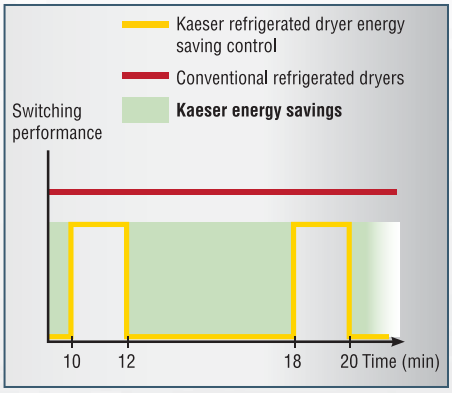
Sigma Control 2 has superior communications capabilities. An Ethernet port and built-in web-server enable remote viewing. ModBus, Profinet, Profibus, Devicenet, and other industrial communications interfaces are also available as plug in options for seamless integration into plant control/monitoring systems.

See our Sigma Control 2 brochure for more information.

Integrated Dryer Option

Premium compressed air quality

The integrated dryer is perfectly sized for the full flow of the compressor. The dryer is located in a separate cabinet so it is not exposed to preheated air or contaminants from the compressor package.



Energy-saving control

The integrated refrigerated dryer in Kaeser units provides high efficiency performance thanks to its energy-saving control. The dryer is active only when compressed air actually needs to be dried. This approach achieves the required compressed air quality with maximum efficiency.

Stainless steel plate heat exchanger

The dryer's stainless steel plate heat exchanger is corrosion and contamination-resistant. The stainless moisture separator reliably removes the accumulating condensate from the air, even with fluctuating airflow.

Eco-Drain

The integrated refrigerated dryer also features a zero loss Eco-Drain. The advanced level-controlled condensate drain eliminates the compressed air losses associated with solenoid valve control. This saves energy and considerably enhances the reliability of the compressed air supply.

Complete Compressed Air Systems

Life Just Got Easier

Whether you prefer separate components or fully integrated packages, Kaeser offers everything for a complete, high-quality air system.

The AirCenter™

To simplify your compressed air system, Kaeser offers the AirCenter. This unit combines essential system components in one easy-to-install package. AirCenters come completely assembled and include a refrigerated dryer with automatic condensate drain, receiver tank, and an optional filtration package. These super quiet and energy efficient units are compact and perfect for installations where space is limited.

Duplex AirCenter

SM AirCenter

Technical Specifications

Model	Operating Pressure (psig)	Capacity at Operating Pressure (cfm) (1)	Motor (hp)	Dimensions L x W x H (in)	Weight (lb) (2)	Sound Level dB(A) (3)
SX 3* SX 3T* SX 3 AirCenter*	125	12	3	23 1/4 x 24 7/8 x 38 1/8 23 1/4 x 36 x 38 1/8 23 1/4 x 42 3/4 x 61 1/2	309 408 628	61
	160*	9				
SX 4 SX 4T SX 4 AirCenter	125	16	4	23 1/4 x 24 7/8 x 38 1/8 23 1/4 x 36 x 38 1/8 23 1/4 x 42 3/4 x 61 1/2	309 408 628	62
	160	13				
	217	9				
SX 5 SX 5T SX 5 AirCenter	125	21	5	23 1/4 x 24 7/8 x 38 1/8 23 1/4 x 36 x 38 1/8 23 1/4 x 42 3/4 x 61 1/2	320 419 639	63
	160	17				
	217	13				
SX 7.5 SX 7.5T SX 7.5 AirCenter	125	28	7.5	23 1/4 x 24 7/8 x 38 1/8 23 1/4 x 36 x 38 1/8 23 1/4 x 42 3/4 x 61 1/2	342 441 661	66
	160	24				
	217	19				
SM 7.5 SM 7.5T SM 7.5 AirCenter	125	32	7.5	24 3/4 x 30 x 43 3/8 24 3/4 x 42 1/4 x 43 3/8 24 3/4 x 47 1/4 x 67 1/2	440 606 886	66
	160	27				
	217	19				
SM 10 SM 10T SM 10 AirCenter	125	42	10	24 3/4 x 30 x 43 3/8 24 3/4 x 42 1/4 x 43 3/8 24 3/4 x 47 1/4 x 67 1/2	460 628 882	67
	160	35				
	217	27				
SM 15 SM 15T SM 15 AirCenter	125	53	15	24 3/4 x 30 x 43 3/8 24 3/4 x 42 1/4 x 43 3/8 24 3/4 x 47 1/4 x 67 1/2	490 650 904	68
	160	44				
	217	34				
SK 15 SK 15T SK 15 AirCenter	125	71	15	29 1/2 x 35 1/4 x 49 5/8 29 1/2 x 49 x 49 5/8 29 1/2 x 53 7/8 x 74	688 853 1276	67
	160	59				
	217	46				
SK 20 SK 20T SK 20 AirCenter	125	88	20	29 1/2 x 35 1/4 x 49 5/8 29 1/2 x 49 x 49 5/8 29 1/2 x 53 7/8 x 74	705 871 1294	68
	160	77				
	217	63				

CAGI Certified Performance

Our compressors' energy efficiency has been tested and confirmed by an independent laboratory as part of the Compressed Air and Gas Institute's Rotary Screw Compressor Performance Verification Program. CAGI data sheets for our screw compressor units can be found at www.kaeser.com/cagi

**SX 3 pressure limited to 160 psig.*
(1) Performance rated in accordance with CAGI/ISO 1217 test code. (2) Weights may vary slightly depending on airend model.
(3) Per ISO 2151 using ISO 9614-2.
***Note:** Other pressures available from 80 to 217 psig.*

Specifications are subject to change without notice.

KAESER COMPRESSORS

Built for a lifetime.™

www.kaeser.com

Kaeser Compressors, Inc.
511 Sigma Drive
Fredericksburg, VA 22408 USA
Telephone: 540-898-5500
Toll Free: 800-777-7873
info.usa@kaeser.com

Kaeser Compressors Canada Inc.
3760 La Verendrye Street
Boisbriand, QC J7H 1R5 CANADA
Telephone: (450) 971-1414
Toll free: (800) 477-1416
info.canada@kaeser.com

Kaeser Compresores de México S de RL de CV
Calle 2 #123
Parque Industrial Juríca
76100 Querétaro, Qro.
Telephone: 01 (442) 218 64 48
sales.mexico@kaeser.com

Kaeser Compresores de Guatemala y Cia. Ltda.
Calz. Atanasio Tzul 21-00, zona 12
El Cortijo II, Bodega 501
01012–Guatemala City
Telephone: +502 2412-6000
info.guatemala@kaeser.com

Operator Manual

Screw Compressor

AIRCENTER SK Tri-Voltage, SIGMA CONTROL BASIC

9_9460 10 USE

Manufacturer:

KAESER KOMPRESSOREN SE

96410 Coburg • PO Box 2143 • GERMANY • Tel. +49-(0)9561-6400 • Fax +49-(0)9561-640130

http://www.kaeser.com

Original instructions
/KKW/SSK 2.10 en Z1 SBA-SCHRAUBEN-TRI-VOLTAGE-AC-SCB

20140903 130349

KAESER KOMPRESSOREN

Contents

Contents

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1 Regarding this Document

1.1 Using this document

The operator manual is a component of the product. It describes the machine as it was at the time of first delivery after manufacture.

- ➢ Keep the operator manual in a safe place throughout the life of the machine.
- ➢ Supply any successive owner or user with this operator manual.
- ➢ Please insert any amendment or revision of the operator manual sent to you.
- ➢ Enter details from the machine nameplate and individual items of equipment in the table in chapter 2.

1.2 Further documents

Further documents included with this operator manual are:

- ■ Certificate of acceptance / operating instructions for the pressure vessel

Missing documents can be requested from KAESER.

- ➢ Make sure all documents are complete and observe the instructions contained in them.
- ➢ Make sure you provide the data from the nameplate when ordering documents.

1.3 Copyright

1.4 Symbols and labels

- ➢ Please note the symbols and labels used in this document.

1.4.1 Warnings

Warning notices indicate dangers that may result in injury when disregarded.

Warning notices indicate three levels of danger identified by the corresponding signal word:

Signal term	Meaning	Consequences of disregard
DANGER	Warns of an imminent danger	Will result in death or severe injury
WARNING	Warns of a potentially imminent danger	May result in death or severe injury
CAUTION	Warns of a potentially dangerous situation	May result in a moderate physical injury

Tab. 1 Danger levels and their definition (personal injury)

Warning notices preceding a chapter apply to the entire chapter, including all sub-sections.
Example:

⚠ DANGER

The type and source of the imminent danger is shown here!
The possible consequences of ignoring a warning are shown here.
If you ignore the warning notice, the "DANGER" signal word indicates a lethal or severe injury will occur.

➢ *The measures required to protect yourself from danger are shown here.*

Warning notes referring to a sub-section or the subsequent action are integrated into the procedure and numbered as an action.

Example:

1. **⚠ WARNING** *The type and source of the imminent danger is shown here!*
   The possible consequences of ignoring a warning are shown here.
   If you ignore the warning notice, the "WARNING" signal word indicates that a lethal or severe injury may occur.
   ➢ *The measures required to protect yourself from danger are shown here.*
2. Always read and comply with warning instructions.

1.4.2 Potential damage warnings

Contrary to the warnings shown above, damage warnings do not indicate a potential personal injury.

Warning notices for damages are identified by their signal term.

Signal term	Meaning	Consequences of disregard
NOTE	Warns of a potentially dangerous situation	Damage to property is possible

Tab. 2 Danger levels and their definition (damage to property)

Example:

NOTICE

The type and source of the imminent danger is shown here!
Potential effects when ignoring the warning are indicated here.

➢ *The protective measures against the damages are shown here.*

➢ Carefully read and fully comply with warnings against damages.

1.4.3 Other alerts and their symbols

This symbol identifies particularly important information.

Material — Here you will find details on special tools, operating materials or spare parts.

Precondition — Here you will find conditional requirements necessary to carry out the task.
The conditions relevant to safety shown here will help you to avoid dangerous situations.

Option H1 — ➢ This symbol denotes lists of actions comprising one stage of a task.
Operating instructions with several steps are numbered in the sequence of the operating steps.
Information relating to one option only are marked with an option code (e.g., H1 indicates that this section applies only to machines with machine mountings). Option codes used in this operator manual are explained in chapter 2.2.

Information referring to potential problems are identified by a question mark.
The cause is named in the help text ...
➢ ... as is a solution.

This symbol identifies important information or measures regarding the protection of the environment.

Further information — Further subjects are introduced here.

2 Technical Data

2.1 Nameplate

The machine's nameplate provides the model designation and important technical information.

The nameplate is located on the outside of the machine:

- above the cooler,
  or
- on the rear of the machine.

➢ Enter here the nameplate data as a reference:

Characteristic	Value
Screw Compressor	
Part no.	
Year	
Serial no.	
psig	
cfm	
Voltage	
Hz/RPM	
Package FLA	
Phase	
HP	
Wiring Diagram	
FOR SERVICE, REFER TO EQUIPMENT NUMBER	

Tab. 3 Nameplate

2.2 Options

The table contains a list of possible options.

➢ Enter options here as a reference:

Option	Option code	Available?
MODULATING control	C1	
IT-three-phase network	C35	—
KAESER FILTER KE	F1	
KAESER FILTER KEA	F7	
Bolt-down machine feet	H1	
Air-cooling	K1	✓

available: ✓
not available: —

Option	Option code	Available?
Transformer power supply for refrigerated dryer	T2	
Refrigerated dryer	T3	✓
Prepared for heat recovery	W1	
available: ✓ not available: —		

Tab. 4 Options

2.3 Weight

The weight given is the maximum. Actual weights of individual machines are dependent on equipment fitted.

	SK 15	SK 20	—
Weight [lb]	1276	1294	—

Tab. 5 Machine weight

2.4 Temperature

	SK 15	SK 20	—
Minimum cut-in temperature [°F]	40	40	40
Typical airend discharge temperature during operation [°F]	149 – 200	149 – 200	149 – 200
Maximum. airend discharge temp. (automatic shut-down) [°F]	230	230	230

Tab. 6 Temperature

2.5 Ambient conditions

	SK 15	SK 20	—
Maximum elevation amsl [ft]	3000	3000	3000
Permissible ambient temperature [°F]	40 – 115	40 – 115	40 – 115
Cooling air temperature [°F]	40 – 115	40 – 115	40 – 115
Intake air temperature [°F]	40 – 115	40 – 115	40 – 115
* Higher altitudes are permissible only after consultation with the manufacturer.			

Tab. 7 Ambient conditions

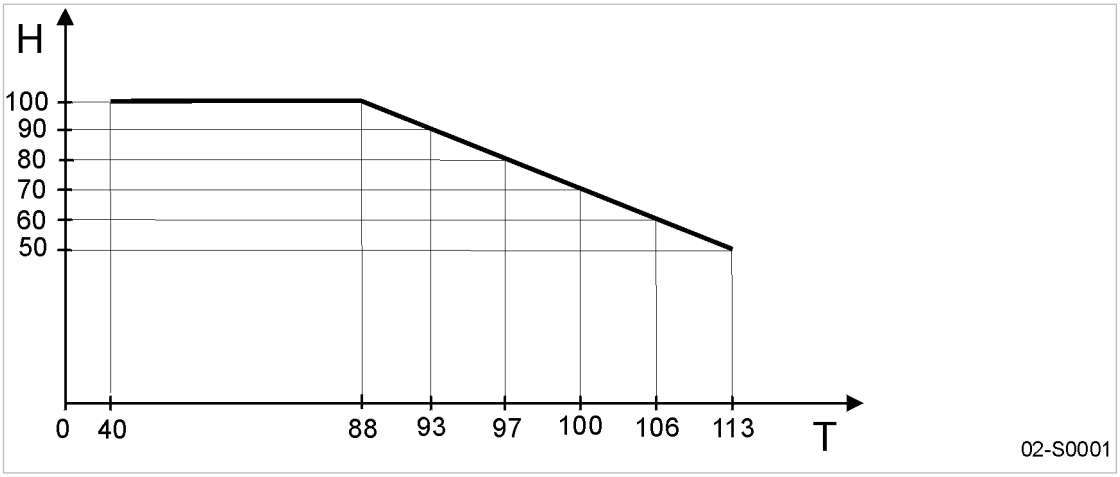


Fig. 1 Maximum relative humidity of intake air

(T) Intake air temperature [°F]
(H) Maximum relative humidity of intake air [%]

2.6 Ventilation

The values given are minimum guide values.

	SK 15	SK 20	—
Inlet aperture (Z) see figure 14 [ft²]	4.8	5.4	—
Forced ventilation with exhaust fan: Flow rate [cfm] at 0.0145 psi	3237	3826	—

Tab. 8 Overview Ventilation

2.7 Pressure

Maximum working pressure: see nameplate

Safety relief valve activating pressure [psig]:

Maximum working pressure [psig]	SK 15	SK 20	—
125	155	155	155
160	230	230	230
217	232	232	232

Tab. 9 Safety relief valve activating pressure

2.8 Air receiver

Volume

	SK 15	SK 20	—
Volume [gal]	92.5	92.5	92.5

Tab. 10 Air receiver: Volume

Safety relief valve activating pressure [psig]

Maximum working pressure: See air receiver nameplate

Maximum working pressure [psig]	SK 15	SK 20	—
160	160	160	160
217	217	217	217

Tab. 11 Safety relief valve: Activating pressure

2.9 Delivery

Delivery [cfm]

Maximum working pressure [psig]	SK 15	SK 20	—
125	71	88	—
160	59	77	—
217	46	63	—

Tab. 12 Delivery

2.10 Cooling Oil Recommendation

A sticker showing the type of oil filled is located near the oil separator filler.

Information for ordering cooling oil can be found in chapter 11.

2.10.1 Basic Information

Lubrication of an air compressor is essential to reliable operation. Carbon and varnish can form in compressor cooling oils. These deposits block the flow of lubricant and cause excessive wear and failure of moving parts. Contamination of the lubricant can allow the formation of acids, causing extensive internal corrosion. Water may be condensed decreasing the lubricity.

Lubricants in rotary compressors do much more than lubricate. During the compression process, it acts as a sealant in the airend which is important for maximum efficiency. The lubricant also absorbs much of the heat of compression to cool the airend and reduce the temperature of the compressed air. It’s not enough that a compressor cooling oil lubricates well, it must stand up to the heat, pressure and contaminants that are present in every air compressor.

2.10.2 KAESER Lubricants

KAESER synthetic lubricants should be stored in a protected location to prevent contamination. Do not re-use drums; flush and send to reconditioner.

Although the KAESER synthetic is not highly flammable, it will burn. While KAESER synthetic compressor cooling oil is less flammable than equal viscosity mineral oils, it cannot be classified as a fire-resistant fluid. It has a flash point above 460 °F. Since the user has total control over the conditions of the compressor lubricant, he assumes total responsibility for its safe usage.

Material Safety Data Sheets are available for each lubricant from your authorized KAESER Service representative.

Regardless of the lubricant selected, the KAESER SIGMA lubricants will separate readily from water. If condensate occurs it can easily be removed. Let the compressor sit so that any water can drain back to the separator tank and separate to the bottom. See chapter 10.16 proper draining procedure.

KAESER has several lubricants available that are specially formulated to match these demands. They feature excellent lubricity, outstanding demulsibility (ability to separate from water), and long life.

M-SERIES:

- M-Series SIGMA compressor cooling oils are **semi-synthetic** lubricants.
- M-Series SIGMA compressor cooling oils are the highest quality petroleum lubricants. M–460 is specially blended to provide reliable performance in KAESER screw compressors.

S-SERIES:

- S-Series SIGMA compressor cooling oils are **synthetic** lubricants.
- S-Series SIGMA compressor cooling oils are formulated from the most advanced synthetic lubricants. These ”synthetic” lubricants begin as high quality petroleum feed stock. They are then refined, processed and purified into fluids with very consistent molecular structure. These oils are carefully blended to produce extremely consistant lubricants with superior properties. SIGMA synthetic lubricants feature all the advantages of both PAO and diester fluids.
- S-460 lubricant is recommended for compressors operating in ambient temperatures between 40 °F and 105 °F.

Specialty KAESER LUBRICANTS:

- S-680 lubricant may be used when ambient temperatures are always between 70 °F and 105 °F.
- FG-460 synthetic hydrocarbon based food grade lubricant is designed for use in rotary screw compressors in the application where incidental food contact may occur with the discharge air. This lubricant meets the requirements of the FDA Regulation 21 CFR §178.3570 and is USDA H-1approved and NSF certified. FG-460 is approved for canning, food packing, meat and poultry processing and other applications where incidental food contact may occur.

2.11 Cooling oil charge

For machines with the Option W1, the volume required additionally for the heat recovery must be added to the charge.

	SK 15	SK 20	—
Fluid volume* [qt]	7.4	7.4	—

* Plus the oil volume of the heat recovery system.

	SK 15	SK 20	—
Topping up volume [qt] (minimum–maximum)	0.3	0.3	—
* Plus the oil volume of the heat recovery system.			

Tab. 13 Cooling oil charge (Option K1)

Option W1 Heat recovery

The additional volume corresponds to the oil volume of the heat exchanger and the connecting lines:

	SK 15	SK 20	—
Additional charge volume [qt]*			
* Enter the volume required by your heat recovery system.			

Tab. 14 Cooling oil charge (Option W1)

2.12 Motors and power

2.12.1 Compressor motor

	SK 15	SK 20	—
Rated power [hp]	15	20	—
Enclosure protection	TEFC	TEFC	TEFC

Tab. 15 Compressor motor

Rated speed [rpm]:

Maximum working overpressure [psig]	SK 15	SK 20	—
125	3565	3565	—
160	3565	3565	—
217	3565	3565	—

Tab. 16 Compressor motor: Rated speed

2.13 Noise emission

	SK 15	SK 20	—
Noise emission [dB(A)]	67	68	—
Noise pressure level in operation at maximum air delivery as per ISO 2151 and the basic standard ISO 9614-2, uncertainty: ±3 dB(A)			

Tab. 17 Noise emission

2.14 Power Supply

Basic requirements

The machine is designed for an electrical supply according to National Electric Code (NEC) NEC-670, particulary NFPA 79, edition 2012 , section 4.3. In the absence of any user-specified alternatives, the limits given in these standards must be adhered to. Consult manufacturer for any other specific power supply.

Three-phase

Do **NOT** operate package on any unsymmetrical power supply. Also do **NOT** operate package on power supplies like, for example, a three-phase (open) delta or three-phase star with non-grounded neutral.

The machine requires a symmetrical three-phase power supply transformer with a WYE configuration output as shown in Figure 2 and Figure 3. In a symmetrical three phase supply the phase angles and voltages are all the same.

Other power supplies are not suitable.

Fig. 2 Three-phase star (wye); 4 wire; grounded neutral

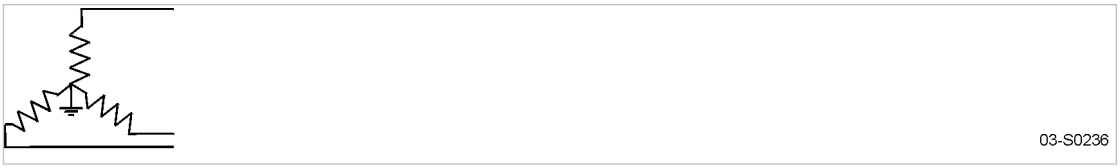


Fig. 3 Three-phase star (wye); 3 wire; grounded neutral

Further information Please contact an authorized KAESER service representative for options.

The electrical diagram 13.4 contains further specifications for electrical connection.

2.15 Power supply specifications

The following multi-strand copper core wires are given according to 2012 NEC 310.15, Table 310.16 for 104°F ambient temperature.

If other local conditions prevail, like for example high temperature, the cross section should be checked and adjusted according to 2012 NEC 110.14©, 220.3, 310.15, Table 310.16, 430.6, 430.22, 430.24 and other local codes.

Dual element time delay fuses are selected according to 2012 NEC 240.6, 430.52 and tables 430.52, 430.248 and 430.250.

We strongly suggest using a separate copper conductor for the equipment GROUNDING. NEC Table 250.122 will point out the ”minimum size”, however, we recommend a ground conductor the same size as the power leads, if local codes allow.

Rated power supply 208V ±10%, 3-ph, 60Hz

	SK 15	SK 20	—
Pre-fuse [A]	70	90	—
Supply	4xAWG3	4xAWG2	—
Consumption [A]	49	61	—

Tab. 18 Supply details 208V/3ph/60Hz

Rated power supply 230V ±10%, 3-ph, 60Hz

	SK 15	SK 20	—
Pre-fuse [A]	70	80	—
Supply	4xAWG3	4xAWG2	—
Consumption [A]	47	58	—

Tab. 19 Supply details 230V/3ph/60Hz

Rated power supply 460V ±10%, 3-ph, 60Hz

	SK 15	SK 20	—
Pre-fuse [A]	35	40	—
Supply	4xAWG8	4xAWG6	—
Consumption [A]	24	29	—

Tab. 20 Supply details 460V/3ph/60Hz

2.16 Option W1 Available heat capacity

The quality of the heat transfer medium and its required flow rate depend on the type of heat exchanger used.

Maximum permissible pressure loss in the cooling oil circuit: 9 psi.

Maximum heat capacity available	SK 15	SK 20	—
[kW]	8.8	11.0	?
[MJ/h]	32	40	?
[kcal/h]	7573	9467	?

Tab. 21 Heat capacity (option W1)

2.17 Refrigerated dryer

Model

	SK 15	SK 20	—
Model *			

* Read off the dryer model from the dryer nameplate and enter it in the table.

Tab. 22 Refrigerated dryer: Model

Compressed air system

	ABT 25	—
Pressure drop [psi] (referred to 100 psig working pressure)	3	—
Maximum permissible working pressure [psig]	232	—

Tab. 23 Refrigerated dryer: Compressed air system

Refrigerant circuit

The refrigerated dryer contains a refrigerant that is classified by the Kyoto Protocol as a fluorinated global warming gas.

	ABT 25	—
Refrigerant	R 134a	—
Global warming potential (GWP)	1300	—
Charge quantity* [ls]		
Maximum permitted working pressure [psig] (high pressure end)	305	—
Maximum permitted working pressure [psig] (low pressure end)	305	—
Safety pressure switch: Cut-out pressure [psig]	260	—

* Read off the charge quantity from the dryer nameplate and enter it in the table.

Tab. 24 Refrigerated dryer: Refrigerant circuit

3 Safety and Responsibility

3.1 Basic instructions

The machine is manufactured to the latest engineering standards and acknowledged safety regulations. Nevertheless, dangers can arise through its operation:

- danger to life and limb of the operator or third parties,
- damages to the machine and other material assets.

⚠ Disregard of warning or safety instructions can cause serious injuries!

➢ Use this machine only if it is in a technically perfect condition and only for the purpose for which it is intended; observe all safety measures and the instructions in the operator manual.

➢ Immediately rectify (have rectified) any faults that could be detrimental to safety!

3.2 Specified use

The machine is intended solely for generating compressed air for industrial use. Any other use is considered incorrect. The manufacturer is not liable for any damages that may result from incorrect use. The user alone is liable for any risks incurred.

➢ Keep to the specifications listed in this operator manual.

➢ Operate the machine only within its performance limits and under the permitted ambient conditions.

➢ Do not use compressed air for breathing purposes unless it is specifically treated.

➢ Do not use compressed for any application that will bring it into direct contact with food products unless it is specifically treated.

3.3 Improper use

Improper usage can cause damage to property and/or (severe) injuries.

➢ Only use the machine as intended.

➢ Never direct compressed air at persons or animals.

➢ Use hot cooling air for heating purposes only if there is no risk to the health of humans or animals. If necessary, hot cooling air should be treated by suitable means.

➢ Do not allow the machine to take in toxic, acidic, flammable of explosive gases or vapors.

➢ Do not operate the machine in areas in which specific requirements with regard to explosion protection are in force.

3.4 User's Responsibilities

3.4.1 Observe statutory and universally accepted regulations

This is, for example, nationally applied European directives and/or valid national legislation, safety and accident prevention regulations.

➢ Observe relevant statutory and accepted regulations during installation, operation and maintenance of the machine.

3.4.2 Qualified personnel

These are people who, by virtue of their training, knowledge and experience as well as their knowledge of relevant regulations can assess the work to be done and recognize the possible dangers involved.

Authorized operators possess the following qualifications:

- are of legal age,
- are conversant with and adhere to the safety instructions and sections of the operator manual relevant to operation,
- have received adequate training and authorization to operate electrical and compressed air devices.
- Additional qualifications for compressors with refrigerated dryers:
  - Adequate training and authorization on refrigeration devices.

Authorized installation and maintenance personnel have the following qualifications:

- are of legal age,
- have read, are conversant with and adhere to the safety instructions and sections of the operator manual applicable to installation and maintenance,
- are fully conversant with the safety concepts and regulations of electrical and compressed air engineering,
- are able to recognize the possible dangers of electrical and compressed air devices and take appropriate measures to safeguard persons and property,
- have received adequate training and authorization for the safe installation and maintenance on this equipment.
- Additional qualifications for compressors with refrigerated dryers:
  - fully conversant with the safety concepts and regulations concerning refrigeration devices,
  - must be able to recognize the possible dangers of refrigeration devices and take appropriate measures to safeguard persons and property.

➢ Ensure that operating, installation and maintenance personnel are qualified and authorized to carry out their tasks.

3.4.3 Adherence to inspection schedules and accident prevention regulations

The machine may be subject to local inspection schedules.

3.5 Dangers

Basic instructions

The following describes the various forms of danger that can occur during machine operation.

Basic safety instructions are found in this operator manual at the beginning of each chapter in the section entitled 'Safety'.

Warning instructions are found before a potentially dangerous task.

3.5.1 Safely dealing with sources of danger

The following describes the various forms of danger that can occur during machine operation.

Electricity

Touching voltage carrying components can result in electric shocks, burns or death.

- ➢ Allow only qualified and authorized electricians or trained personnel under the supervision of a qualified and authorized electrician to carry out work on electrical equipment according to electrical engineering regulations.
- ➢ Before commissioning or re-commissioning the machine, the user must ensure adequate protection against electric shock from direct or indirect contact.
- ➢ Before starting any work on electrical equipment:
  Switch off and lock out the power supply isolator and verify the absence of any voltage.
- ➢ Switch off any external power sources.
  These could be connections to floating relay contacts or the electrical machine heating, for example.
- ➢ Use fuses corresponding to machine power.
- ➢ Check regularly that all electrical connections are tight and in proper condition.

Forces of compression

Compressed air is contained energy. Uncontrolled release of this energy can cause serious injury or death. The following information concerns work on components that could be under pressure.

- ➢ Close shut-off valves or otherwise isolate the machine from the distribution network to ensure that no compressed air can flow back into the machine.
- ➢ Depressurize all pressurized components and enclosures.
- ➢ Do not carry out welding, heat treatment or mechanical modifications on pressurized components (e.g. pipes and vessels) as this influences the component's resistance to pressure.
  The safety of the machine is then no longer ensured.

Compressed air quality

The composition of the compressed air must be suitable for the actual application in order to preclude health and life-threatening dangers.

- ➢ Use appropriate systems for air treatment before using the compressed air from this machine as breathing air and/or for the processing of food products.
- ➢ Use food-grade cooling oil whenever compressed air is to come into contact with food products.

Spring forces

Springs under tension or compression store energy. Uncontrolled release of this energy can cause serious injury or death.
Minimum pressure / check valves, safety relief valves and inlet valves are powerfully spring-loaded.

- ➢ Do not open or dismantle any valves.

Rotating components

Touching the fan wheel, the coupling or the belt drive while the machine is switched on can result in serious injury.

- ➢ Do not open the enclosure while the machine is activated.
- ➢ Switch off and lock out the power supply disconnecting device and verify the absence of any voltage.

➢ Wear close-fitting clothes and a hair net if necessary.
➢ Make sure all covers and safety guards are in place and secured before re-starting.

Temperature

High temperatures are generated during compression. Touching hot components may cause injuries.

➢ Avoid contact with hot components.
These include, for example, compressor airends or blocks, oil and compressed air lines, coolers, oil separator tanks, motors and machine heaters.
➢ Wear protective clothing.
➢ If welding is carried out on or near the machine, take adequate measures to prevent sparks or heat from igniting oil vapors or parts of the machine.

Noise

The enclosure absorbs the machine noise to a tolerable level. This function will be effective only if the enclosure is closed.

➢ Operate the machine only with intact sound insulation.
➢ Wear hearing protection if necessary.
The blowing-off of the safety relief valve can be particularly loud.

Operating fluids/materials

The used operating fluids and materials can cause adverse health effects. Suitable safety measures must be taken in order to prevent injuries.

➢ Strictly forbid fire, open flame and smoking.
➢ Follow safety regulations when dealing with oils, lubricants and chemical substances.
➢ Avoid contact with skin and eyes.
➢ Do not inhale oil mist or vapor.
➢ Do not eat or drink while handling cooling and lubricating fluids.
➢ Keep suitable fire extinguishing agents ready for use.
➢ Use only KAESER approved operating materials.

Unsuitable spare parts

Unsuitable spare parts compromise the safety of the machine.

➢ Use only spare parts approved by the manufacturer for use in this machine.
➢ Use only genuine KAESER replacement parts on pressure bearing parts.

Conversion or modification of the machine

Modifications, additions to and conversions of the machine or the controller can result in unpredictable dangers.

➢ Do not convert or modify the machine!
➢ Obtain written approval by the manufacturer prior to any technical modification or expansion of the machine, the controller, or the control programs.

Extending or modifying the compressor station

If dimensioned appropriately, safety relief valves reliably prevent an impermissible rise in pressure. New dangers may arise if you modify or extend the compressed air station.

- ➢ When extending or modifying the compressed air system:
  Check the blow-off capacity of safety relief valves on air receivers and compressed air lines before installing a new machine.
- ➢ If the blow-off capacity is insufficient:
  Install safety relief valves with larger blow-off capacity.

3.5.2 Safe machine operation

The following is information supporting you in the safe handling of the machine during individual product life phases.

Personal protective equipment

When working on the machine you may be exposed to dangers that can result in accidents with severe adverse health effects.

- ➢ Wear protective clothing as necessary.

Suitable protective clothing (examples):

- Safety workwear
- Protective gloves
- Safety boots
- Eye protection
- Ear protection

Transporting

The weight and size of the machine require safety measures during its transport to prevent accidents.

- ➢ Use suitable lifting gear that conforms to local safety regulations.
- ➢ Allow transportation only by personnel trained in the safe movement of loads.
- ➢ Attach lifting gear only to suitable lifting points.
- ➢ Be aware of the center of gravity to avoid tipping.
- ➢ Make sure the danger zone is clear of personnel.
- ➢ Do not step onto machine components to climb up the machine.

Assembly

- ➢ Only use only electrical cables that are suitable and approved for the surroundings and electrical loads applied.
- ➢ Never dismantle compressed air pipes until they are fully vented.
- ➢ Only use pressure lines that are suitable and approved for the maximum working pressure and the intended medium.
- ➢ Do not allow connection pipes to be placed under mechanical stress.
- ➢ Do not induce any forces into the machine via the connections, so that the compressive forces must be balanced by bracing.

Positioning

A suitable installation location for the machine prevents accidents and faults.

- ➢ Install the machine in a suitable compressor room.
- ➢ Ensure sufficient and suitable lighting such that the display can be read and work carried out comfortably and safely.
- ➢ Ensure accessibility so that all work on the machine can be carried out without danger or hindrance.
- ➢ If installed outdoors, the machine must be protected from frost, direct sunlight, dust, rain and splashing water.
- ➢ Do not operate in areas in which specific requirements regarding explosion protection are in force.
- ➢ Ensure adequate ventilation.
- ➢ Place the machine in such a manner that the working conditions in its environment are not impaired.
- ➢ Comply with limit values for ambient temperature and humidity.
- ➢ The intake air must not contain any damaging contaminants,
  Damaging contaminants are for instance: explosive or chemically instable gases and vapors, acid or base forming substances such as ammonia, chlorine or hydrogen sulfide.
- ➢ Do not position the machine in warm cooling outlet air from other machines.
- ➢ Keep suitable fire extinguishing agents ready for use.

Commissioning, operation and maintenance

During commissioning, operation and maintenance you may be exposed to dangers resulting from, e.g., electricity, pressure and temperature. Careless actions can cause accidents with severe adverse effects for your health.

- ➢ Allow maintenance work to be carried out only by authorized personnel.
- ➢ Wear close-fitting, flame-resistant clothing. Wear protective clothing as necessary.
- ➢ Switch off and lock out the power supply isolating device and verify the absence of voltage.
- ➢ Check that there is no voltage on floating relay contacts.
- ➢ Close shut-off valves or otherwise isolate the machine from the compressed air network to ensure that no compressed air can flow back into the machine.
- ➢ De-pressurize all pressurized components and enclosures.
- ➢ Allow the machine to cool down.
- ➢ Do not open the cabinet while the machine is switched on.
- ➢ Do not open or dismantle any valves.
- ➢ Use only spare parts approved by KAESER for use in this machine.
- ➢ Carry out regular inspections:
  for visible damages,
  of safety installations,
  of the EMERGENCY STOP command device,
  of any components requiring monitoring.
- ➢ Pay particular attention to cleanliness during all maintenance and repair work. Cover components and openings with clean cloths, paper or tape to keep them clean.
- ➢ Do not leave any loose components, tools or cleaning rags on or in the machine.
- ➢ Components removed from the machine can still be dangerous.
  Do not attempt to open or destroy any components taken from the machine.

De-commissioning, storage and disposal

Improper handling of old operating fluids and components represent a danger for the environment.

- ➢ Drain off fluids and dispose of them according to environmental regulations. These include, for example, compressor oil and cooling water.
- ➢ Have refrigerant disposed of by authorized bodies only.
- ➢ Dispose of the machine in accordance with local environmental regulations.

3.5.3 Organizational Measures

- ➢ Designate personnel and their responsibilities.
- ➢ Give clear instructions on reporting faults and damage to the machine.
- ➢ Give instructions on fire reporting and fire-fighting measures.

3.5.4 Danger Areas

The table gives information on the areas dangerous to personnel.

Only authorized personnel may enter these areas.

Activity	Danger area	Authorized personnel
Transport	Within a 10 ft radius of the machine.	Installation personnel for transport preparation. No personnel during transport.
	Beneath the lifted machine.	No personnel!
Installation	Within the machine. Within 3 ft radius of the machine and its supply cables.	Installation personnel
Operation	Within a 3 ft radius of the machine.	Operating personnel
Maintenance	Within the machine. Within a 3 ft radius of the machine.	Maintenance personnel

Tab. 25 Danger Areas

3.6 Safety devices

Various safety devices ensure safe working with the machine.

- ➢ Do not change, bypass or disable safety devices.
- ➢ Regularly check safety devices for their correct function.
- ➢ Do not remove or obliterate labels and notices.
- ➢ Ensure that labels and notices are clearly legible.

Further information More information on safety devices is contained in chapter 4, section 4.10.

3.7 Working life of safety functions

Pursuant to ISO 13849-1:2008 , Category and Performance Level (PL) of the machine's safety functions have been analyzed and assessed:

Safety function	Category	Performance Level
Safety shut-down at high temperature	2	c
EMERGENCY STOP push button	1	c
Safety shutdown when opening the machine	1	c

Tab. 26 Category and Performance Level

The safety-relevant components of the safety functions are designed for a working life of 20 years. The working life starts with original machine commissioning, and is not extended by times during which the machine is not in use.

The following components are affected:

- Resistance thermometer (Pt100 sensor for measuring the compression discharge temperature)
- EMERGENCY STOP push button
- Main contactor
- Door interlock switch

1. The components of the safety functions must be replaced by an authorized KAESER service representative after a working life of 20 years.
2. Have an authorized KAESER service representative check the reliability of the safety functions.

3.8 Safety signs

The figure shows the position of the safety signs on the machine. The table lists the various safety signs used and their meanings.

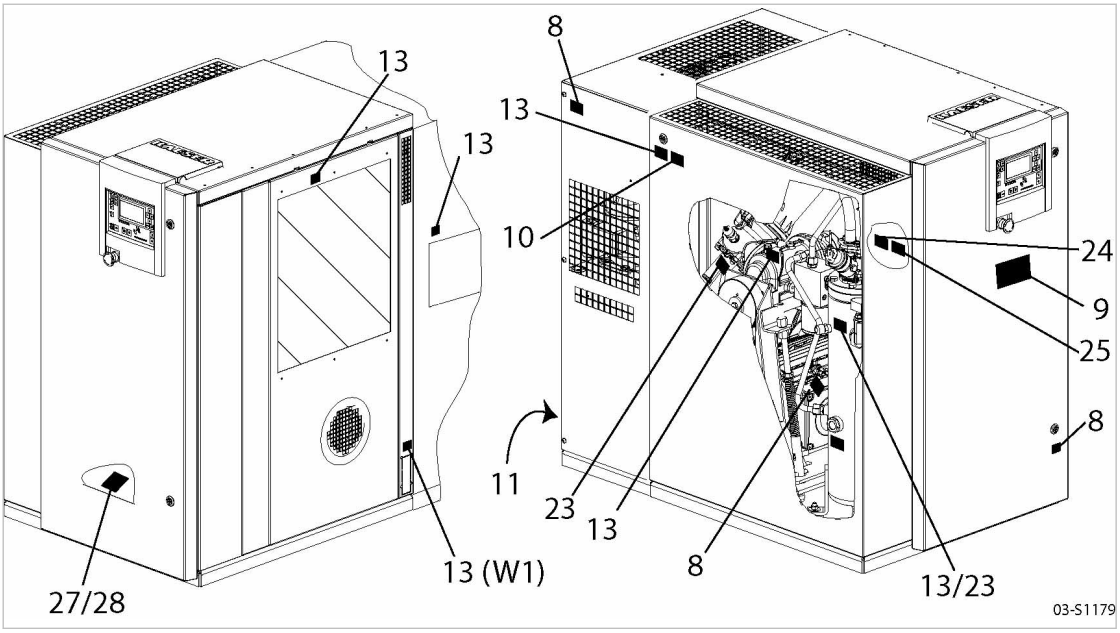


Fig. 4 Location of safety signs

Item	Symbol	Meaning
8		Danger of fatal injury from touching electrically live components! ➢ Switch off and lock out the power supply disconnecting device and check that no voltage is present.
9		Personal injury or damage to the machine by incorrect operation! ➢ Read and understand the service manual and all safety signs before switching on this machine.
		Machine starts automatically! Severe injury could result from rotating components, electrical voltage and air pressure. ➢ Switch off and lock out the power supply disconnecting device and check that no voltage is present before opening any machine enclosure or guard.
10		Rotating parts! Severe injury could result from touching the v-belt drive while it is rotating. ➢ Never switch the machine on without guard in place. ➢ Switch off and lock out the power supply disconnecting device and check that no voltage is present.
11		Injury and/or contamination can result from breathing compressed air! Contamination of food can result from using untreated compressed air for food processing! ➢ Never breathe untreated compressed air. ➢ Air from this compressor must meet OSHA 29CFR1910.134 and FDA 21CFR178.3570 standards, if used for breathing or food processing. Use proper compressed air treatment.

Item	Symbol	Meaning
13		Hot surface can cause burns! ➢ Let the machine cool down. ➢ Wear long-sleeved garments (not synthetics such as polyester) and protective gloves.
23		Serious injury or death can result from loosening or opening component that is under pressure and heavily spring loaded! ➢ Do not open or dismantle the valve. ➢ Call an authorized KAESER service representative if a fault occurs.
24		Serious injury or death can result from loosening or opening component under pressure! ➢ De-pressurize all pressurized components and enclosures. ➢ Secure so that machine stays de-pressurized. ➢ Check that machine is de-pressurized.
25		Ear damage and burns can result from loud noise and/or oil mist when the safety relief valve opens! ➢ Wear ear protection and protective clothing. ➢ Close all access doors and cover panels.
27		Risk of electric shock! If the interrupter has tripped, current-carrying components of the controller should be examined and replaced if damaged to reduce the risk of fire or electric shock.
28		Risk of electric shock! To maintain overcurrent short-circuit, and ground-fault protection, the manufacturer's instructions for setting the interrupter must be followed to reduce the risk of fire or electric shock.

Tab. 27 Safety signs

3.9 Emergency situations

3.9.1 Correct fire fighting

Suitable measures

Calm and prudent action can safe lives in the event of a fire.

- ➢ Keep calm.
- ➢ Give the alarm.
- ➢ Shut off supply lines if possible.
  Mains disconnecting device (all poles)
  Cooling water (if present)
  Heat recovery (if present)
- ➢ Warn and move endangered personnel to safety.
- ➢ Help incapacitated persons.
- ➢ Close the doors.
- ➢ When trained accordingly: Attempt to extinguish the fire.

Extinguishing substances

- ➢ Suitable extinguishing media:
  Foam
  Carbon dioxide
  Sand or soil
- ➢ Unsuitable extinguishing media:
  Strong jet of water

3.9.2 Treating injuries from handling cooling oil

Eye contact:

Cooling oil can cause irritation.

- ➢ Rinse open eyes thoroughly for a few minutes under running water.
- ➢ Seek medical help if irritation persists.

Skin contact:

Cooling oil may irritate after prolonged contact.

- ➢ Wash thoroughly with skin cleaner, then with soap and water.
- ➢ Contaminated clothing should be dry-cleaned before reuse.

Inhalation:

Cooling oil mist may make breathing difficult.

- ➢ Clear air passages of oil mist.
- ➢ Seek medical help if difficulty with respiration continues.

Ingestion

- ➢ Wash out the mouth immediately.
- ➢ Do not induce vomiting.
- ➢ Seek medical aid.

3.9.3 Injury from Handling Refrigerant

Eye contact:

Severe eye irritation, watering, reddening and swelling of the eyelids.
Risk of caustic burns and frostbite.

- ➢ Open eyelids wide to allow product to evaporate.
- ➢ Hold the eyelid wide and rinse the eye with running water.
- ➢ Consult an ophthalmologist if you experience lasting pains.

Skin contact:

Initially a sensation of chill, skin may redden subsequently.
Risk of frostbite.

- ➢ Allow the product to evaporate.

➢ Rinse with lukewarm water.
➢ Consult a physician if experiencing lasting pain or reddened skin.

Inhalation:

At high concentrations, risk of cardiac irregularity (arrhythmia).
At very high concentration, risk of asphyxia caused by oxygen deficiency.

➢ Remove victim to the fresh air.
➢ If necessary Respiration with respirator or administration of oxygen.
➢ Consult a physician if experiencing breathing or nerve complaints.

3.10 Warranty

This operator manual contains no independent warranty commitment. Our general terms and conditions of business apply with regard to warranty.

A condition of our warranty is that the machine is used for the purpose for which it is intended under the conditions specified.
Due to the multitude applications for which the machine is suitable the obligation lies with the user to determine its suitability for his specific application.

In addition, we accept no warranty obligation for:

- the use of unsuitable parts or operating materials,
- unauthorized modifications,
- incorrect maintenance,
- incorrect repair.

Correct maintenance and repair includes the use of original spare parts and operating materials.

➢ Obtain confirmation from KAESER that your specific operating conditions are suitable.

3.11 Environmental protection

The operation of this machine may cause dangers for the environment.

➢ Do not allow cooling oil to escape to the environment or into the sewage system.
➢ Store and dispose of operating materials and replaced parts in accordance with local environmental protection regulations.
➢ Observe national regulations.
This applies particularly to parts contaminated with compressor cooling oil.

4 Design and Function

4.1 Enclosure

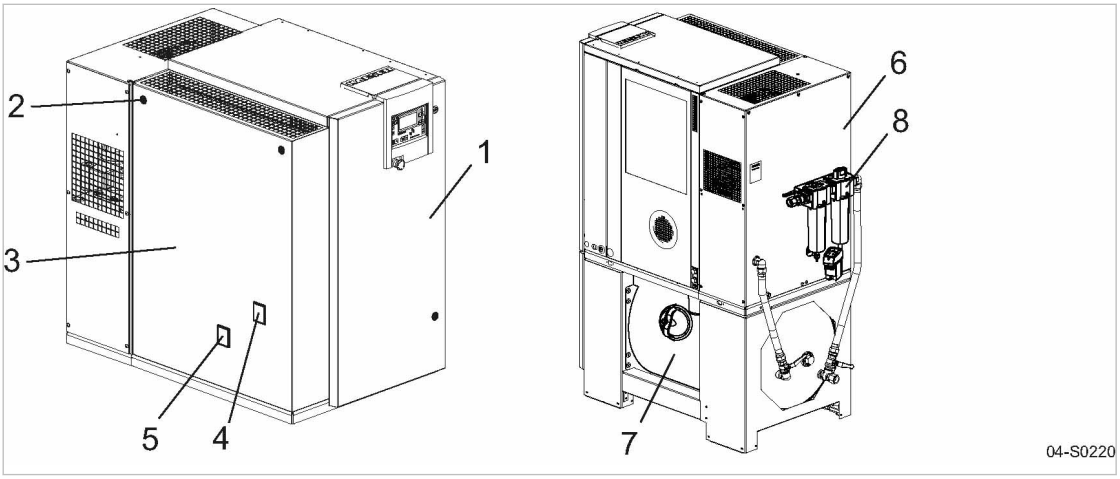


Fig. 5 Enclosure overview

1	Control cabinet door	5	Sight glass: V-belt tension
2	Latch	6	Add-on cabinet: Refrigerated dryer
3	Panel (removable)	7	Air receiver
4	Sight glass: Oil level indicator	8	Compressed air filter (optionally)

When closed, the enclosure serves various functions:

- Sound insulation
- Protection against contact with components
- Cooling air flow

The enclosure is not suitable for the following uses:

- Walking on, standing or sitting on.
- As resting place or storage of any kind of load.

Safe and reliable operation is only assured with the enclosure closed.

Access doors are hinged to swing open and removable panels can be lifted off.
The latches should be opened using the supplied key.

4.2 Machine function

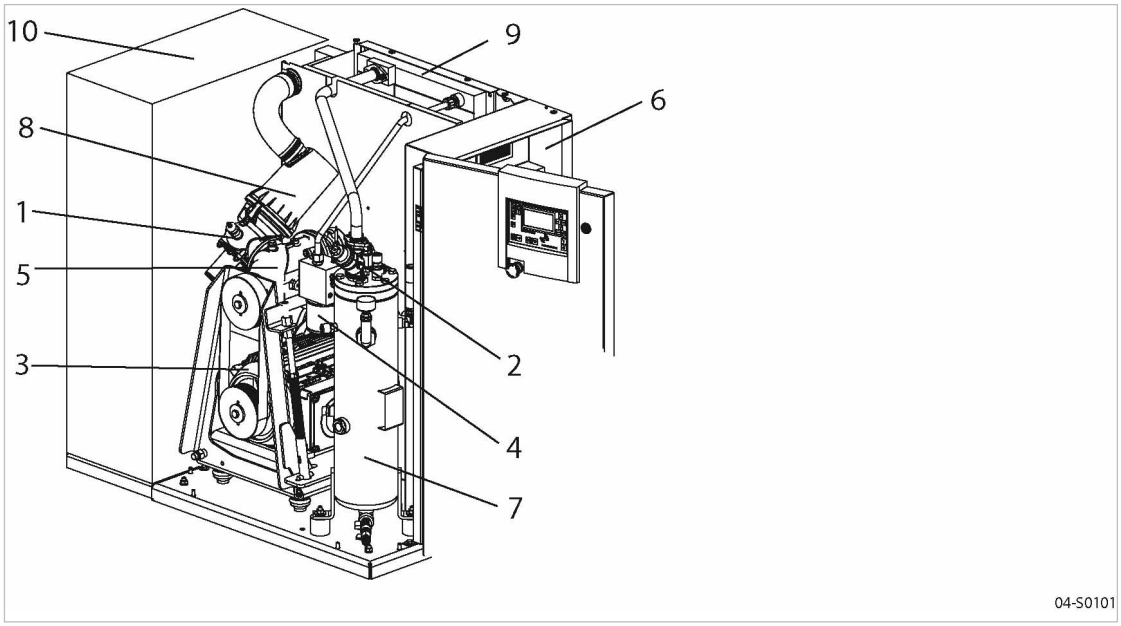


Fig. 6 Machine layout

[1]	Inlet valve	[6]	Control cabinet
[2]	Minimum pressure/check valve	[7]	Oil separator tank
[3]	Compressor motor	[8]	Air filter
[4]	Oil filter	[9]	Oil/air cooler
[5]	Airend	[10]	Add-on cabinet for refrigerated dryer

Ambient air is cleaned as it is drawn in through the filter [8].

The air is then compressed in the airend [5].

The airend is driven by an electric motor [3].

Cooling oil is injected into the airend. It lubricates moving parts and forms a seal between the rotors themselves and between them and the airend casing. This direct cooling in the compression chamber ensures a very low airend discharge temperature.

Cooling oil recovered from the compressed air in the oil separator tank [7] gives up its heat in the oil cooler [9]. The oil then flows through the oil filter [4] and back to the point of injection. Pressure within the machine keeps the oil circulating. A separate pump is not necessary. A thermostatic valve maintains optimum cooling oil temperature.

Compressed air, freed of cooling oil in the oil separator tank [7], flows through the minimum pressure / check valve [2] into the air cooler [9]. The minimum pressure / check valve ensures that there is always a minimum internal pressure sufficient to maintain cooling oil circulation in the machine.

The aftercooler brings down the compressed air temperature to 9 to 18 °F above ambient. Most of the moisture carried in the air is removed in the aftercooler.

4.3 Refrigerated dryer

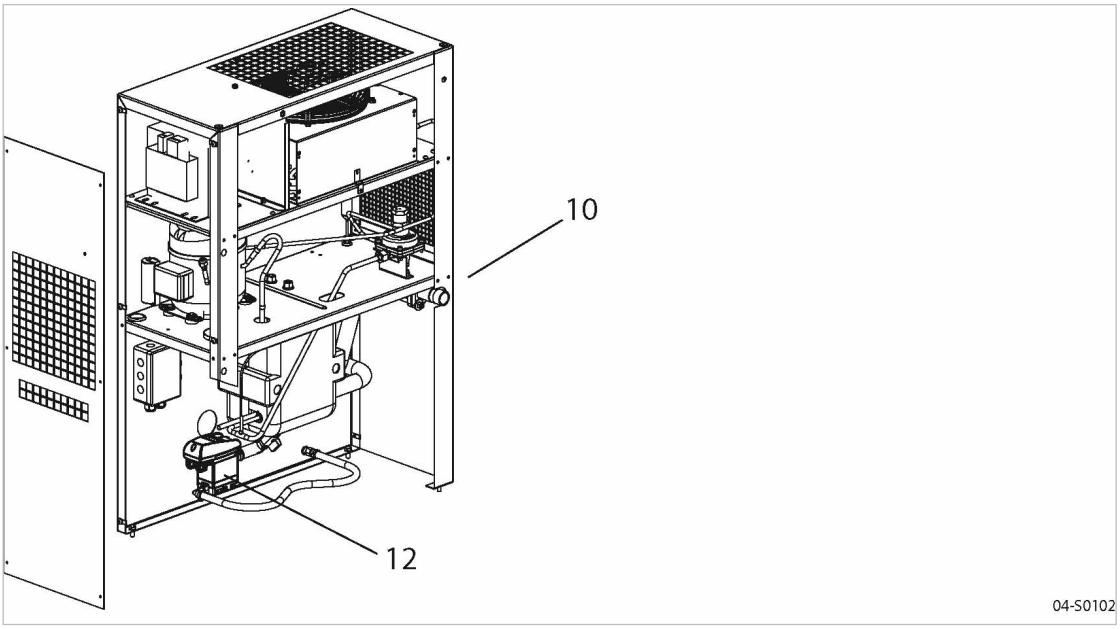


Fig. 7 Refrigerated dryer

[10] Refrigerated dryer
[12] Condensate drain

The downstream refrigerated dryer removes moisture from the compressed air.
The condensate drain ejects the precipitate.

4.4 Air receiver

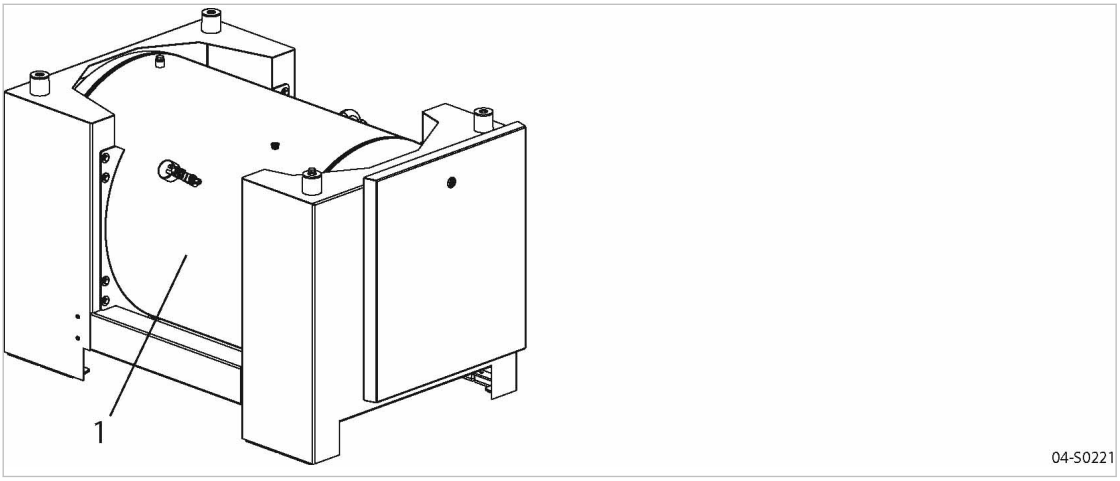


Fig. 8 Air receiver

[1] Air receiver

The compressed air stored in the air receiver offsets peaks in air consumption.
Use a manual condensate drain to drain the condensate.

4.5 Floating relay contacts

Floating relay contacts are provided for the transfer of signals, messages.
Information on location, loading capacity and type of message or signal is found in the electrical diagram.

If the floating relay contacts are connected to an external voltage source, voltage may be present even when the machine is isolated from the power supply.

4.6 Remote LOAD / IDLE switching

The controller enables the remote control of the LOAD phase by an external floating relay contact.

Connections

Delivery condition

- The connections in the controller are provided with a jumper.
- With the jumper in place, the controller toggles the machine between LOAD and IDLE.

➢ Re-instate this delivery condition when the machine is not to be controlled remotely.

Function

- Contact closed: LOAD
- Contact open: IDLE

When the contact closes the machine switches to LOAD. When the contact opens the machine switches to IDLE.

At the end of the idling period, the machine switches to READY and is in stand-by. The length of the idling period depends on the control mode selected.

If the «ON» key is pressed while the remote contact is open, the machine remains in stand-by and starts as soon as the remote contact closes.

4.7 Options

The options available for your machine are described below.

4.7.1 Option H1 Machine mountings

These mountings allow the machine to be anchored firmly to the floor.

Fig. 9 Machine mountings

4.7.2 Option W1 Prepared for external heat recovery

The cooling oil circuit includes 2 valves regulating the cooling oil temperature.

- Combination valve: Oil cooler temperature regulator
- Thermostatic valve: Heat recovery system oil temperature regulator

The oil temperature regulators ensure that the cooling oil is kept at the ideal temperature for machine operation.
The thermostatic valve opens first so that surplus heat is released into the heat recovery system. If the heat recovery system cannot remove sufficient heat, the combination valve opens to additionally release the cooling circuit via the oil cooler.

Condition:
Combination valve opening temperature = thermostatic valve opening temperature

The heat available for recovery depends on the individual operating conditions of the machine.

Connections are provided for an external system to recover surplus heat.

The thermostatic valve is deactivated when the machine is delivered. The necessary operating element must be installed when installing the heat recovery system.

If necessary, the operating element in the combination valve can be exchanged for one with higher opening temperature. The opening temperature depends on operating and ambient conditions. Operating elements are marked with their opening temperature [°C].

If the cooling oil temperature is too low, condensate can form and damage the machine.

➢ Consult an authorized KAESER service representative on components and layout to ensure proper functioning of the cooling and heat recovery systems.

4.7.3 Option F1 KAESER FILTER KE

➢ Comply with the specifications provided in the operating manual for the compressed air filter (see chapter 13.5).

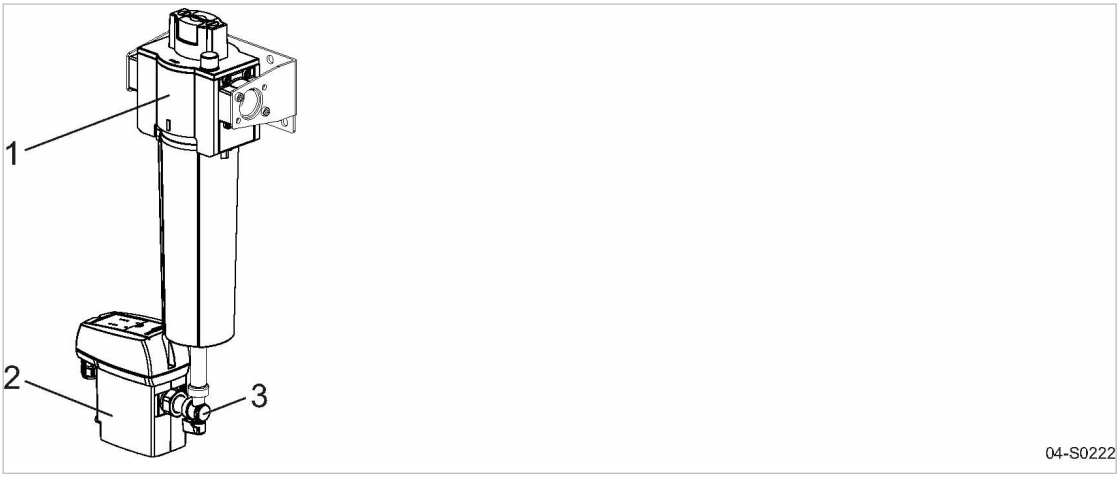


Fig. 10 KAESER FILTER KE

[1] KAESER FILTER KE
[2] Electronic condensate drain
[3] Shut-off valve

KAESER FILTER KE removes aerosols and solid particles from the compressed air.

The condensate is removed by an electronic condensate drain. A hose coupling is provided for the connection of a flexible condensate line.

Further information The information provided in chapter 6.4 is to be used additionally for the condensate drain.

4.7.4 Option F7 KAESER FILTER KEA

KAESER FILTER KEA is a filter combination from KAESER FILTER KE and KAESER FILTER KA .

➢ Comply with the specifications provided in the operating manual for the compressed air filter (see chapter 13.5).

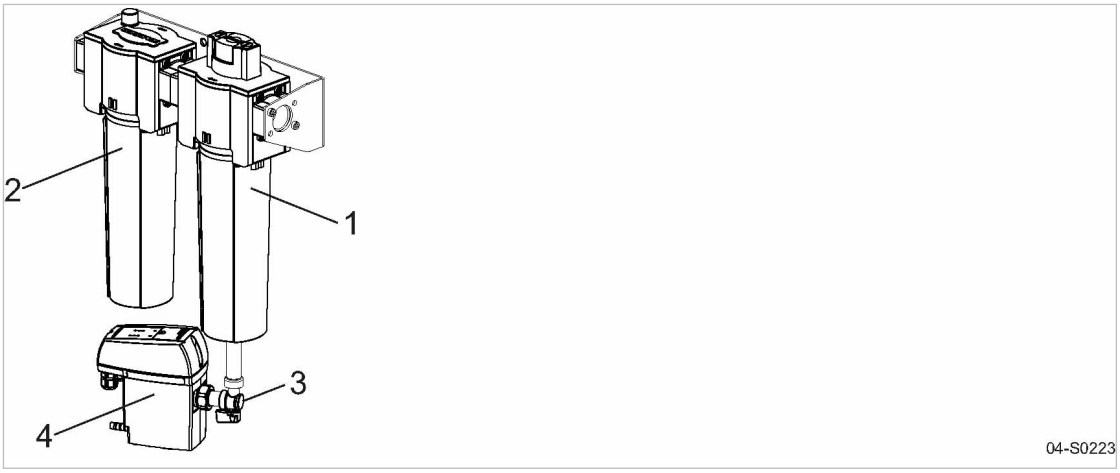


Fig. 11 KAESER FILTER KEA

1 KAESER FILTER KE
2 KAESER FILTER KA
3 Shut-off valve
4 Electronic condensate drain

KAESER FILTER KA removes oil and hydrocarbon mists from the compressed air which can be adsorbed by activated carbon.
KAESER FILTER KA is always used downstream of KAESER FILTER KE .

The condensate is removed by an electronic condensate drain. A hose coupling is provided for the connection of a flexible condensate line.

Further information The information provided in chapter 6.4 is to be used additionally for the condensate drain.

4.8 Operating modes and control modes

4.8.1 Machine operating modes

STOP

The machine is connected to the power supply.
The *Controller voltage* LED lights green.
The machine is switched off. The *ON* LED is extinguished.

READY

The machine has been activated with «ON»:

- The *ON* LED lights green.
- The drive motor is stopped.
- The inlet valve is closed.
- The minimum pressure/check valve shuts off the oil separator from the air distribution network.
- The venting valve is open.

The compressor motor starts as soon as pressure is demanded.

In addition, timer and/or remote control may affect the start of the compressor drive motor.

LOAD

The compressor motor runs under load.

- The inlet valve is open.
- The airend delivers compressed air to the system.

IDLE

The compressor motor runs unloaded with low power consumption.

- The inlet valve is closed.
- The minimum pressure/check valve shuts off the oil separator from the distribution network.
- The venting valve is open.

A small volume of air circulates through the bleed hole in the inlet valve, through the airend and back to the inlet valve via the venting line.

4.8.2 Control modes

Using the selected control mode, the controller switches the machine between its various operational states in order to compensate for air being drawn by consumers, and to maintain the system pressure between the set minimum and maximum values. The control mode also rules the degree of energy efficiency of the machine.

The machine-dependant venting phase between the LOAD and READY operating modes ensures load changes at minimum material stresses.

The controller SIGMA CONTROL BASIC can operate in the following modes:

- DUAL
- QUADRO

Option C1

- MODULATING control

Energy-efficient control modes for various applications:

Application	Recommended control mode
Compressed air station with one machine or several machines with comparable delivery	QUADRO
Machine for peak load in a compressed air station	DUAL
Machine for intermediate load in a compressed air station	QUADRO

Application	Recommended control mode
Machine for basic load in a compressed air station	QUADRO

Tab. 28 Energy-efficient control modes

The SIGMA CONTROL BASIC controller is factory set to QUADRO control mode unless specifically ordered otherwise.

DUAL

In the DUAL control mode, the machine is switched back and forth between LOAD and IDLE to maintain the machine working pressure between the preset minimum and maximum values. When maximum pressure is reached, the machine switches to IDLE. When the preset *idling time* has elapsed, the machine switches to READY.

The *idling time* is factory preset according to the maximum starting frequency of the compressor motor. The shorter the *idling time* setting, the sooner (and more frequently) the drive motor is stopped.

QUADRO

Unlike the DUAL regulating mode, the machine will switch from LOAD to READY in QUADRO mode after periods with low compressed air consumption.

After periods with a high compressed air consumption, the machine will switch from LOAD to READY after passing through IDLE.

In this control mode, the controller requires two specified times: The *running time* and the *idling/ standstill time*.

The shorter these times are set, the sooner (and more frequently) the motor is stopped.

Option C1 MODULATING control

The MODULATING control is an additional mechanical regulation. It continuously changes the delivery volume within the machine's control range.

A control valve, the proportional controller, changes the degree of opening of the inlet valve when the machine transports compressed air into the air network (LOAD)

The load and power consumption of the drive motor rises and falls with the air demand.

4.9 Refrigerated Dryer Control Modes

The controller can operate in the following modes:

- CONTINUOUS
- TIMER

CONTINUOUS

The refrigerated dryer will remain activated even when the machine is in standby.

This mode of control is set up at the factory.

TIMER

The refrigerated dryer is switched on and off by a timer when the machine is in standby. In this mode, the operating temperature is held within tight limits.

Which control mode is the most practical, and when?

Control mode	Advantage	Disadvantage
CONTINUOUS	Constant dew point.	Higher power consumption when the machine is in standby mode.
TIMER	Lower power consumption when the machine is in standby mode.	Brief increase in dew point when the compressor re-starts

Tab. 29 Refrigerated dryer control modes

4.10 Safety devices

The following safety devices are provided and may not be modified in any way.

- EMERGENCY STOP control device:
  The EMERGENCY STOP button shuts down the compressor immediately. The motor is stopped. The pressure system is vented.
- Safety relief valve:
  The safety relief valve protects the system against excessive pressure. It is factory set.
- Safety pressure monitor (Machine with refrigerated dryer):
  The safety pressure monitor protects the refrigerant circuit against excessive pressure. It cannot be set.
- Door interlock switch:
  The machine will stop automatically if a safety interlocked door or panel is opened or removed.
- Housing and covers for moving parts and electrical connections:
  Protect against accidental contact.

4.11 Operating panel SIGMA CONTROL BASIC

Keys

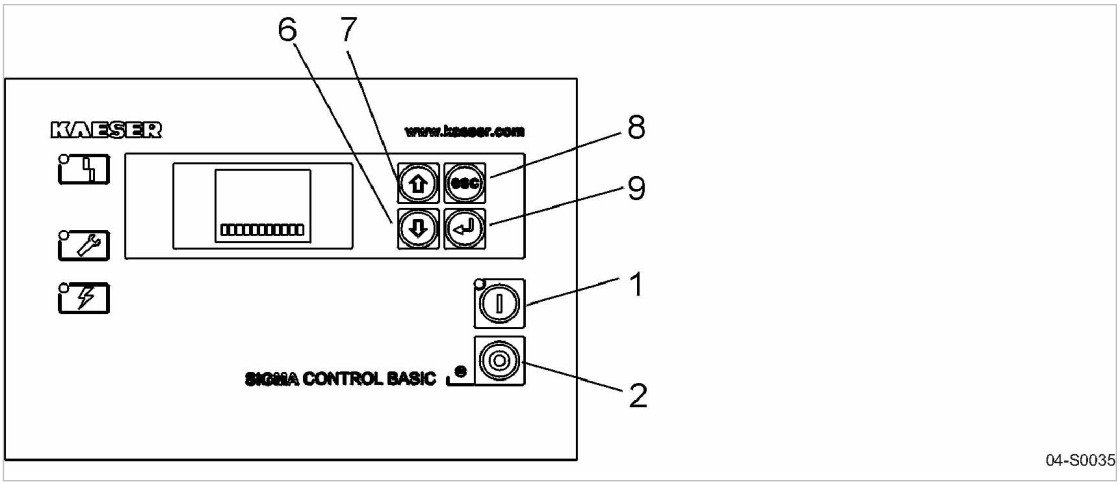


Fig. 12 Keys – overview

Position	Name	Function
1	«ON»	Switch on the machine.
2	«OFF»	Switches the machine off. Resets alarms (acknowledge). Resets the maintenance interval counter.
6	«Down»	Scrolls down the parameter list. Reduces a parameter value.
7	«Up»	Scrolls up the parameter list. Increases a parameter value.
8	«Cancel»	Exits the edit mode without saving.
9	«Accept»	Enters edit mode. Exits the edit mode and saves. Acknowledge the message. Only affects the value in the third line of the display.

Tab. 30 Keys

Indicators

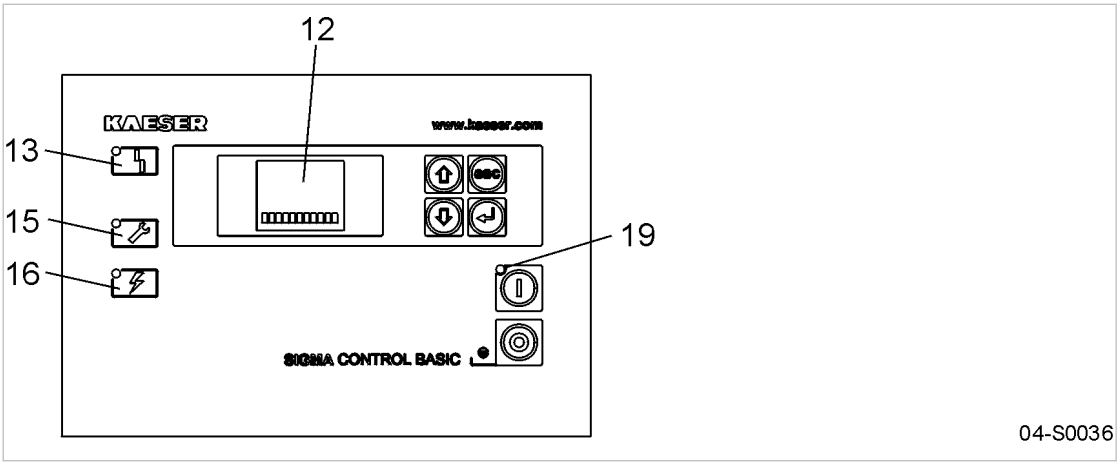


Fig. 13 Indicators – overview

Position	Name	Function
12	Display	Alphanumeric display with 4 lines.
13	*Fault*	Flashes red when an alarm occurs. Lights continuously when acknowledged.
15	*Warning*	Lights yellow for: ■ maintenance work due, ■ Warning messages
16	*Controller voltage*	Lights green when the power supply is switched on.
19	*ON*	Lights green when the machine switched on.

Tab. 31 Indicators

4.12 Functional description – SIGMA CONTROL BASIC

4.12.1 Display layout

x x . x b a r	Line 1
y y ° C	Line 2
z 0 0 0 0 h	Line 3
1 2 3 4 5 6 7 8 S p T i	Line 4

Line	Indication	Meaning
1	xx.x	Current system pressure in bar, psi or MPa.
2	yy	Current airend discharge temperature (ADT) in °C or °F.
3	z	Display of parameters and their settings (see table 33)
4	1, 2, ...	Error code for alarm and warning messages (see table 43 and table 44).
	➡	Operating state: LOAD
	⇨	Operating state: IDLE

Tab. 32 Display

4.12.2 Parameters

Parameter	Meaning
0	**Operating hours counter** Displays the total time the drive motor was switched on. Only KAESER Service has the right to change this parameter.
1	**Load hours counter** Shows the total time the drive motor has run under LOAD. Only KAESER Service has the right to change this parameter.
2	**Maintenance counter** Displays the number of operating hours until the next scheduled maintenance is due. SIGMA CONTROL BASIC counts down the operating hours from a default value. The warning message *S* is displayed when the counter reaches zero. The maintenance interval counter must be reset to its default value after the maintenance work has been carried out. The interval starts anew. A password is required to change this parameter.
3	**Relief valve test mode** This function switches the activating pressure check mode for the safety relief valve on and off. The warning message *i* is displayed when the check mode is switched on. A password is required to change this parameter. See chapter10.10 for the password and to carry out the check.
4	**Temperature display unit** The airend outlet temperature can be displayed in either °C or °F.
5	**Pressure display unit** The current working pressure can be displayed in bar, psi or MPa.
6	**Control modes** Factory setting: OFF This parameter changes the control mode: ■ OFF: QUADRO ■ ON: DUAL
7	**Refrigerated dryer control mode** Factory setting: OFF This parameter changes the dryer control mode: ■ OFF: TIMER ■ ON: CONTINUOUS

Parameter	Meaning
8	**Switching the refrigerated dryer on/off** Factory setting: ON (Option T3) This parameter switches the dryer permanently on or off: ■ OFF: refrigerated dryer off ■ ON: refrigerated dryer on A password is required to change this parameter. In machines without a refrigerated dryer, the parameter is factory set to OFF.
C	**System set point pressure: Switching differential** The switching differential determines the distance between cut-in and cut-out pressure (system set point pressure: switching point) and thus the switching frequency from LOAD to IDLE. Setting range [psi]: -1.5 to -72.5
D	**System set point pressure: Switching point** The switching point corresponds to the working pressure of the air system and the cut-out pressure of the machine. Setting range [psi]: 80 to maximum operating pressure
E	**Maximum possible set point pressure setting** Only KAESER Service has the right to change this parameter.
F	**Main contactor: Maximum permitted number of switching cycles reached** This parameter (value: OFF) and the *S* warning message are displayed as soon as the maximum permitted number of switching cycles is reached. A password is required to change this parameter. Replace the main contactor and reset the parameter: ■ OFF: Maximum permitted number of switching cycles reached ■ ON: The counter is reset and the *S* warning message is acknowledged.
G	**Options** The displayed values inform KAESER Service concerning the controller's internal machine configuration.

Tab. 33 Parameters

Further information For changing or adjusting parameters, please see chapter 8.3.

4.12.3 Messages

Alarm message

An alarm shuts the machine down automatically. The red LED [13] (Fig. 13) flashes.

Warning message

The yellow LED [15] (Fig. 13) lights up to issue a warning.

5 Installation and Operating Conditions

5.1 Ensuring safety

The conditions in which the machine is installed and operated have a decisive effect on safety.

Warning instructions are located before a potentially dangerous task.

Disregard of warning instructions can cause serious injuries!

Complying with safety notes

Disregard of safety notes can cause unforeseeable dangers!

- ➢ Strictly forbid fire, open flame and smoking.
- ➢ If welding is carried out on or near the machine, take adequate measures to prevent sparks or heat from igniting oil vapours or parts of the machine.
- ➢ Do not store inflammable material in the vicinity of the machine.
- ➢ The machine is not explosion-proof!
  Do not operate in areas in which specific requirements with regard to explosion protection are in force.
- ➢ Ensure sufficient and suitable lighting such that the display can be read and work carried out comfortably and safely.
- ➢ Keep suitable fire extinguishing agents ready for use.
- ➢ Ensure that required ambient conditions are maintained.

Required ambient conditions may be:

- Maintain ambient temperature and humidity
- Ensure the appropriate composition of the air within the machine room:
  - clean with no damaging contaminants (e.g., dust, fibers, fine sand)
  - free of explosive or chemically unstable gases or vapors
  - free of acid/alkaline forming substances, particularly ammonia, chlorine or hydrogen sulfide.

5.2 Installation conditions

5.2.1 Determining location and clearances

The machine is intended for installation in an appropriate machine room. Information on distances from walls and ventilation is given below.

The distances quoted are recommended distances and ensure unhindered access to all machine parts.

- ➢ Please consult KAESER if you cannot comply with these recommendations.

Precondition The floor must be level, firm and capable of bearing the weight of the machine.

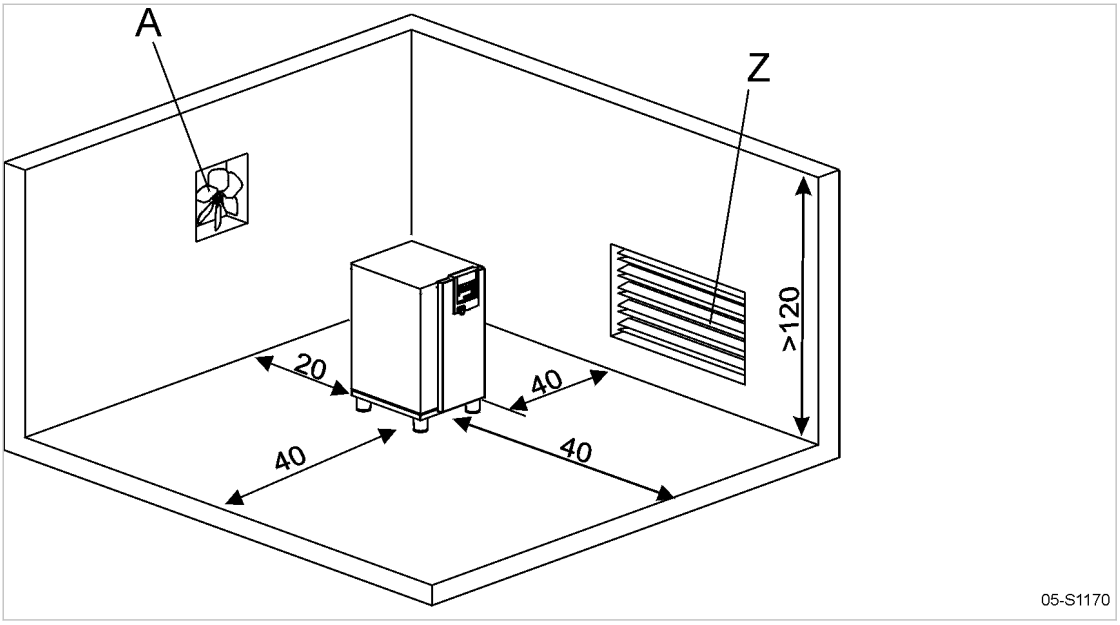


Fig. 14 Recommended machine placement and dimensions [in]

[A] Exhaust fan
[Z] Air inlet aperture

1. **NOTICE** *Ambient temperature too low!*
   Frozen condensate and highly viscous cooling oil can cause damage when starting the machine.
   - ➢ *Make sure that the temperature of the machine is at least +37 °F before starting.*
   - ➢ *Heat the machine room adequately or install an auxiliary heater.*
2. Ensure adequate lighting so that all work on the machine can be carried out without danger or hindrance.
3. Ensure that the indicators can be read without glare and that the controller display cannot be damaged by direct sunlight (UV radiation).
4. If installed outdoors, the machine must be protected from frost, direct sunlight, dust and rain.

5.2.2 Ensuring the machine room ventilation

Adequate ventilation of the machine room has several tasks:

- It prevents subatmospheric pressure in the machine room.
- It evacuates the exhaust heat of the machine and thus ensures the required operating conditions.

➢ Consult with KAESER if you cannot ensure the conditions for an adequate ventilation of the machine room.

1. Ensure that the volume of air flowing into the machine room is at least equivalent to that being removed from it by the machine and exhaust fan.
2. Make sure that the machine and exhaust fan can only operate when the inlet aperture is actually open.
3. Keep the inlet and exhaust openings free of obstructions so that the cooling air can flow freely through the room.
4. Ensure clean air in order to support the proper functioning of the machine.

5.2.3 Exhaust duct design

At the cooling air inlet and exhaust, the machine can only overcome the air resistance resulting from the duct design. Any additional air resistance will reduce airflow and deteriorate machine cooling.

➢ Consult the authorized KAESER service representative before deciding on:

- Design of the exhaust air ducting
- Transition between the machine and the exhaust air duct
- Length of the ducting
- Number of duct bends
- Design of flaps or shutters

Use only motorized ventilation flaps and louvres on variable frequency drive (SFC) machines. Flaps or shutters that are opened by the action of airflow against the force of gravity do not open sufficiently at low cooling fan speeds.

Further information

Further information on the design of exhaust air ducts can be found in chapter 13.3.

5.3 Operating the machine in a compressed air system

When the machine is connected to a compressed air system, the system operating pressure must not exceed 232 psig.

Initial charging of a fully vented air system creates a very high rate of airflow through the air treatment devices. These conditions are detrimental to correct air treatment. Air quality suffers. To ensure the desired air quality when charging a vented air system, we recommend the installation of an air main charging system.

➢ Consult an authorized KAESER service representative for advice on this subject.

6 Installation

6.1 Ensuring safety

Follow the instructions below for safe installation.
Warning instructions are located before a potentially dangerous task.

⚠ Disregard of warning instructions can cause serious injuries!

Complying with safety notes

Disregard of safety notes can cause unforeseeable dangers!

- ➢ Follow the instructions in chapter 3 'Safety and Responsibility'.
- ➢ Installation work may only be carried out by authorized personnel.
- ➢ Make sure that no one is working on the machine.
- ➢ Ensure that all service doors and panels are locked.

When working on live components

Touching voltage carrying components can result in electric shocks, burns or death.

- ➢ Work on electrical equipment may only be carried out by authorized electricians.
- ➢ Switch off and lock out the power supply isolating device and verify the absence of voltage.
- ➢ Check that there is no voltage on floating relay contacts.

When working on the compressed air system

Compressed air is contained energy. Uncontrolled release of this energy can cause serious injury or death. The following safety concerns relate to any work on components that could be under pressure.

- ➢ Close shut-off valves or otherwise isolate the machine from the compressed air network to ensure that no compressed air can flow back into the machine.
- ➢ Depressurize all pressurized components and enclosures.
- ➢ Check all hose couplings in the compressed air system with a hand-held pressure gauge to ensure that they all read 0 psig.
- ➢ Do not open or dismantle any valves.

When working on the drive system

Touching voltage carrying components can result in electric shocks, burns or death.
Touching the fan wheel, the coupling or the belt drive while the machine is switched on can result in serious injury.

- ➢ Switch off and lock out the power supply isolating device and verify the absence of voltage.
- ➢ Do not open the cabinet while the machine is switched on.

Further information Details of authorized personnel are found in chapter 3.4.2.
Details of dangers and their avoidance are found in chapter 3.5.

6.2 Reporting Transport Damage

1. Check the machine for visible and hidden transport damage.
2. Inform the carrier and the manufacturer in writing of any damage without delay.

6.3 Connecting the machine with the compressed air network

On the AIRCENTER the user's shut-off valve is already fitted to the machine.

Precondition The compressed air system is vented completely to atmospheric pressure.

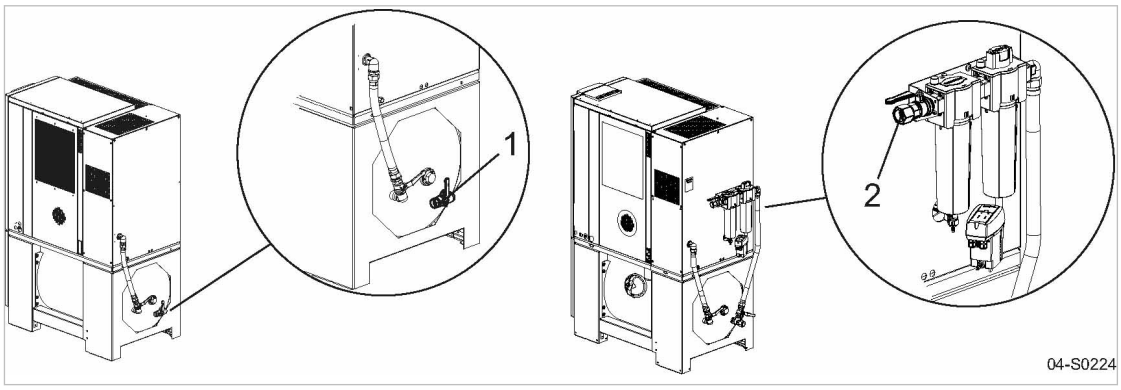


Fig. 15 Compressed air connection

[1] Compressed air connection
[2] Compressed air connection (option F1/F7)

1. **⚠ WARNING** *Serious injury or death can result from loosening or opening components under pressure.*
   ➢ *Vent all pressurized components and enclosures.*
2. Connect a flexible pressure hose.

Further information The dimensional drawing in chapter 13.3 provides the size and position of the compressed air connection.

6.4 Connecting the condensate drain

A threaded hose connection is provided to attach a condensate drain hose.

The condensate must be able to drain freely.

➢ Only machines with 232 psig maximum permissible working pressure may be connected to the condensate collecting line.

Fig. 16 illustrates the recommended installation.
Condensate flows downward in the collecting line. This prevents condensate flowing back to the compressor.

If condensate flows at several points into the condensate collecting line, you must install shut-off valves in the condensate lines to shut the condensate line off before commencing maintenance work.

Condensate line

Feature	Value
Max. length[1)] [ft]	50
Max. delivery head [ft]	16
Material (pressure-resistant, corrosion-proof)	Copper Stainless steel Plastics Hose line
[1)] For longer lengths, please contact KAESER before installation.	

Tab. 34 Condensate line

Condensate collecting line

Feature	Value
Gradient [%]	>1
Max. length[1)] [ft]	65
Material (pressure-resistant, corrosion-proof)	Copper Stainless steel Plastics Hose line
[1)] For longer lengths, please contact KAESER before installation.	

Tab. 35 Condensate collecting line

Compressed air flow rate[1)] [cfm]	Line diameter ["]
<350	3/4
350 – 730	1
731 – 1410	1 1/2
>1410	2
[1)] Compressed air flow rate as guide for the condensate volume to be expected	

Tab. 36 Condensate collecting line: Line diameter

Connecting the condensate drain

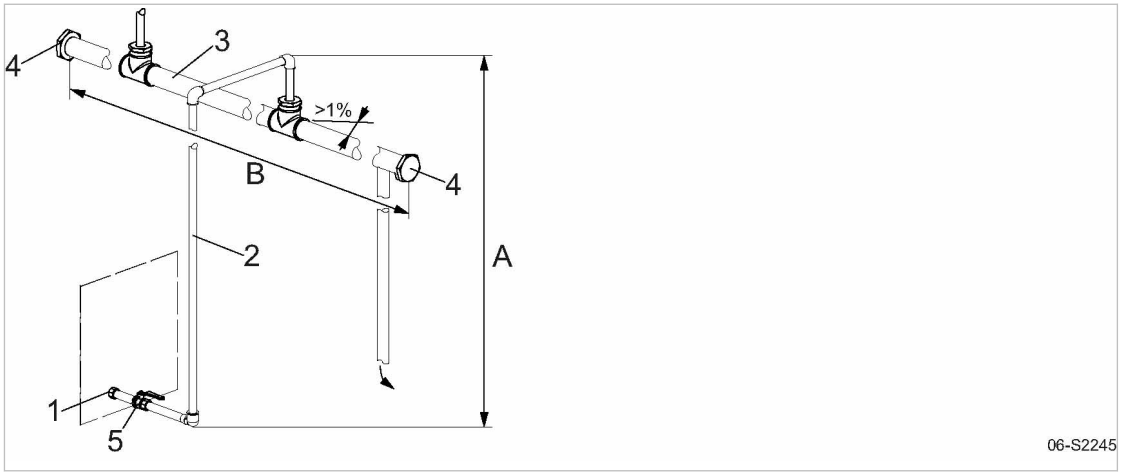


Fig. 16 Connecting the condensate drain

1	Threaded connection	5	Shut-off valve
2	Condensate line	A	Delivery head
3	Condensate collecting line	B	Length of the condensate collecting line
4	Screw plug		

Depending on the machine model, you may have several condensate drains.

➢ Directly connect every condensate drain to the condensate collecting line.

➢ Collect the condensate in a suitable container and dispose of in accordance with environmental regulations.

Further information The dimensional drawing in chapter 13.3 provides the size and position of the connection port.

6.5 Connecting the remote LOAD-IDLE control

Material Screwdriver: DIN 5264 A – 0.4x2.5 mm
Flexible conductor: 0.5–1.5 mm² (maximum length 330 ft; recommended: NYSLYÖ 2x1.0 mm²)

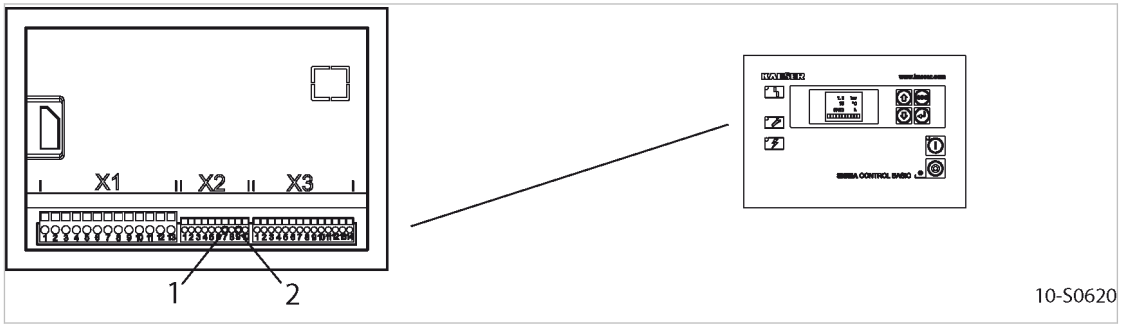


Fig. 17 Connections SIGMA CONTROL BASIC

1	Input I4: Pin 7
2	Supply 24 VDC: Pin 9

1. Lay the cable in a manner that it is not stressed when the control cabinet door is opened.
2. Strip 8 mm of insulation from the ends of the conductors.

3. Use a screwdriver to open the spring-loaded terminals and insert the ends of the conductors in the square openings above the corresponding terminals.
4. Secure the cable so there is no tension on the X2 plug.
5. Seal the cable gland against ingress of dirt or moisture.

6.6 Option T2
Refrigeration dryer: Connecting the transformer according to the power supply.

The refrigeration dryer transformer has tappings for various power supply voltages.

1. Check that the correct connections are made for the supply voltage provided for the machine.
2. If necessary, re-connect the transformer to match the power supply voltage.

Further information — The electrical diagram in chapter 13.4 contains further details of the power supply connection.

6.7 Making the Power Supply Connection

The machine is **not** wired ready for operation!

This is a Tri-Voltage machine.

The machine can be set up to one of the following supply voltages:

- 208V
- 230V
- 460V

Precondition — The power supply disconnecting device is switched off.
The disconnecting device is locked in the off position.
A check has been made to ensure no voltage is present.

1. Have the electrical connections carried out by authorized personnel only.
2. Carry out protection measures as stipulated in relevant regulations (IEC 364 for example) and in national accident prevention regulations. In addition, the regulations of the local electricity supplier must be observed.
3. Test the overcurrent protection cut-out to ensure that the time it takes to disconnect in response to a fault is within the permitted limit.
4. Use supply conductors and fuses in accordance with local regulations.
5. The user must provide the machine with a lockable supply disconnecting device.
   This could be, for example, a switch-disconnector with fuses. If a circuit breaker is used it must be suitable for the motor starting characteristics.
6. Check that the correct taps on the control voltage transformer are connected according to the supply voltage.
   If this is not correct, change the connection to suit the power supply voltage.
7. **⚠ DANGER** *Danger of fatal injury from electric shock!*
   ➢ *Switch off and lock out the supply disconnecting device and check that no voltage is present.*

8. Set up the machine for the correct power supply voltage as described in chapter 6.7.1.
9. Connect the power supply.

Further information The electrical diagram 13.4 contains further specifications for electrical connection.

6.7.1 Changing main voltage connections

Machine set up for [V]	208	230	460
Machine may be modified [V]	230	208	208
	460	460	230

Tab. 37 Voltage selection

The following parts have to be considered for making the change:

- Jumpers in the drive motor terminal box
- Drive motor overload protection relay
- Control transformer
- Transformer for the refrigerated dryer (only if present).

Material The required jumpers (also known as 'bridges' or 'links') are provided in the control cabinet.

Precondition A check has been made to ensure no voltage is present.

Changing the jumpers in the drive motor terminal box

➢ Open the terminal box and change the jumpers in accordance with the electrical diagram.

Adjusting the overload protection cutout

➢ Check the overload protection relay setting.

	SK 15	SK 20
208V, 3-ph, 60Hz [A]	28	35
230V, 3-ph, 60Hz [A]	27	34
460V, 3-ph, 60Hz [A]	14	17

Tab. 38 Overload protection cutout settings.

Connecting the control transformer

The pimary winding of the control transformer is not connected. The machine will not run without connecting the control transformer according to the power supply.

➢ Open the control cabinet and connect the control transformer in accordance with the electrical diagram.

Connecting the dryer transformer (option T2) for models equipped with a refrigerated dryer only

Power for the refrigerated dryer (if one is present) is provided by a transformer.

The pimary winding of the dryer transformer is not connected. The refrigerated dryer will not run without connecting the control transformer according to the power supply.

Do only use terminal 0V–208V–230V–460V (primary winding of the transformer) for changing the main voltage connection. Do not change the terminal 0V–230V. This terminal is readily wired.

➢ Open the control cabinet and connect the transformer in accordance with the electrical diagram.

6.8 Options

6.8.1 Option H1
Anchoring the machine

➢ Use appropriate fixing bolts to anchor the machine.

Further information Details of the fixing holes are contained in the dimensional drawing in chapter 13.3.

6.8.2 Option W1
Connecting the external heat recovery system

An unsuitable heat exchanger or incorrect installation may influence the cooling oil circuit within the compressor. Damage to the machine will follow.

➢ Consult KAESER on a suitable heat exchanger and have an authorized KAESER service representative do the installation.

7 Initial Start-up

7.1 Ensuring safety

Here you will find instructions for a safe commissioning of the machine.
Warning instructions are located before a potentially dangerous task.

⚠ Disregard of warning instructions can cause serious injuries!

Complying with safety notes

Disregard of safety notes can cause unforeseeable dangers!

- ➢ Follow the instructions in chapter 3 'Safety and Responsibility'.
- ➢ Commissioning tasks may only be carried out by authorized personnel!
- ➢ Make sure that no one is working on the machine.
- ➢ Ensure that all service doors and panels are locked.

When working on live components

Touching voltage carrying components can result in electric shocks, burns or death.

- ➢ Work on electrical equipment may only be carried out by authorized electricians.
- ➢ Switch off and lock out the power supply isolating device and verify the absence of voltage.
- ➢ Check that there is no voltage on floating relay contacts.

When working on the compressed air system

Compressed air is contained energy. Uncontrolled release of this energy can cause serious injury or death. The following safety concerns relate to any work on components that could be under pressure.

- ➢ Close shut-off valves or otherwise isolate the machine from the compressed air network to ensure that no compressed air can flow back into the machine.
- ➢ De-pressurize all pressurized components and enclosures.
- ➢ Check all hose couplings in the compressed air system with a hand-held pressure gauge to ensure that they all read 0 psig.
- ➢ Do not open or dismantle any valves.

When working on the drive system

Touching voltage carrying components can result in electric shocks, burns or death.
Touching the fan wheel, the coupling or the belt drive while the machine is switched on can result in serious injury.

- ➢ Switch off and lock out the power supply isolating device and verify the absence of voltage.
- ➢ Do not open the cabinet while the machine is switched on.

Further information

Details of authorized personnel are found in chapter 3.4.2.
Details of dangers and their avoidance are found in chapter 3.5.

7.2 Instructions to be observed before commissioning or re-commissioning

Incorrect or improper commissioning can cause injury to persons and damage to the machine.

➢ Commissioning may only be carried out by authorized installation and service personnel who have been trained on this machine.

Special measures for re-commissioning after storage

Storage period longer than:	Remedy
3 months	➢ Manually fill the airend with cooling oil.
12 months	➢ Change the oil filter. ➢ Change the oil separator cartridge. ➢ Change the cooling oil. ➢ Have the motor bearings checked by an authorized KAESER service representative.
36 months	➢ Have the overall technical condition checked by an authorized KAESER service representative.

Tab. 39 Re-commissioning after storage

7.3 Checking installation and operating conditions

➢ Check and confirm all the items in the checklist before starting the machine.

To be checked	See chapter	Confirmed?
➢ Are the operators fully conversant with safety regulations?	–	
➢ Have all the positioning conditions been fulfilled?	5	
➢ Is a user's lockable power supply disconnecting device installed?	6.7	
➢ Are the tolerance limits of the mains voltage (power supply) within the permissible tolerance limits of the rated voltage (machine)? (see nameplate in the control cabinet)	13.4	
➢ Are the power supply cable conductor cross-sections and fuse ratings adequate?	2.15	
➢ Drive motor overload protection switch set according to the mains voltage?	7.4	
➢ Option T2: Check that the correct connections are made for the supply voltage provided for the machine.	6.6	
➢ Have all electrical connections been checked for tightness? ➢ Has the inspection been repeated after 50 operating hours following the initial commissioning?	–	
➢ Has the connection to the air system been made with a shut-off valve and a flexible hose?	6.3	
➢ Condensate drain connected?	6.4	

To be checked	See chapter	Confirmed?
➢ Is there sufficient cooling oil in the airend?	7.5	
➢ Is the machine firmly anchored to the floor? (Option H1)	6.8.1	
➢ Are door interlock switches aligned and their function checked?	7.9	
➢ Are all access doors closed and latched and removable panels in place and secured?	–	

Tab. 40 Installation conditions checklist

7.4 Setting the overload protection relay

Electrical diagram 13.4 gives the location of the overload protection relay.

With star-delta starting, the phase current is fed via the overload protection relay. This phase current is 0.58-times the rated motor current.

To prevent the overload protection relay from being triggered by voltage fluctuations, temperature influences or component tolerances, the setting can be higher than the arithmetical phase current.

➢ Check the overload protection relay setting.

The overload protection relay shuts the machine down despite being correctly set?

➢ Contact an authorized KAESER service representative.

7.5 Pouring cooling oil into the airend

Before starting the compressor for the very first time and before re-starting after a shutdown period of more than 3 months it is necessary to manually add a quantity of cooling oil into the airend. In order to avoid that the cooling oil exceeds the permissible level, drain the required quantity from the de-pressurized oil separator tank.
Chapter 10.16 provides detailed information on how to drain cooling oil from the oil separator tank.

Material 0.5 qt. cooling oil

Precondition The supply disconnecting device is switched off,
the device is locked off,
the absence of voltage has been verified.

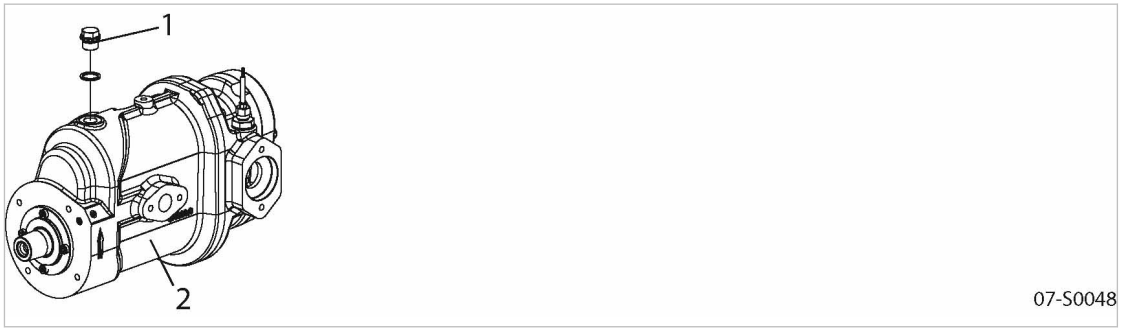


Fig. 18 Inlet valve filling port

[1] Screw plug
[2] Inlet valve

1. Unscrew the filler plug from the inlet valve.
2. Pour the stipulated amount of cooling oil into the airend and replace the filler plug.
3. Turn the airend manually by means of the belt pulley to distribute the oil.

7.6 Option C1
Activating and deactivating the MODULATING control

Use a shut-off valve to activate and deactivate the MODULATING control. If the MODULATING control is deactivated, the machine always delivers the maximum possible compressed air quantity in LOAD mode.

MODULATING control	Shut-off valve
Switch on	open
Switch off	close

Tab. 41 MODULATING control: Setting the shut-off valve

Precondition The power supply disconnecting device is switched off,
the device is locked off,
the absence of any voltage has been verified.

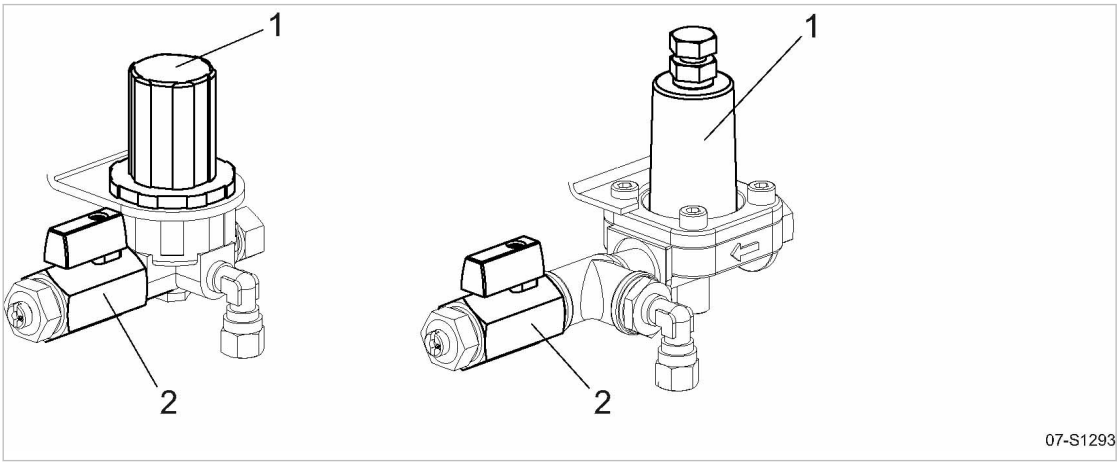


Fig. 19 MODULATING control: Setting the shut-off valve
[1] Control valve (proportional control)
[2] Shut-off valve

➢ Open or close the control valve, depending on the required control mode.

The regulating valve is factory set. The setting should not be changed without consultation with an authorized KAESER service representative.

7.7 Starting the machine for the first time

Precondition No personnel are working on the machine.
All access doors are closed.
All removable panels are in place and secured.

1. Open the user's shut-off valve to the air network.
2. Switch on the power supply disconnecting device.
   After the controller has carried out a self-test, the green *Controller On* LED is lit continuously.
3. Press the «ON» key.
   The green *ON* LED lights continuously.
   The compressor motor runs up and after a short time the machine switches to LOAD and delivers compressed air.

- ➢ Watch for any faults occurring in the first hour of operation.
- ➢ After the first 50 operating hours, check all electrical connections and tighten where necessary.

Does the machine stop when the compressor motor rotates in the wrong direction?

- ➢ Switch off and lock out the power supply disconnecting device and verify the absence of voltage.
- ➢ Changeover phase lines L1 and L2.
- ➢ Acknowledge any existing alarm messages and switch the machine on again.

7.8 Setting the network set point pressure

The set point pressure (cut-out pressure) is factory set at the maximum permissible working pressure of the compressor.

Adjustment is necessary for individual operating conditions.

Do not set the set point pressure of the machine higher than the maximum working pressure of the compressed air system.

The machine may not toggle more than twice per minute between LOAD and IDLE.

To improve the switching frequency:

- ➢ Increase the difference between cut-in and cut-out pressure.
- ➢ Add a larger air receiver downstream to increase buffer capacity.

System set point pressure: Switching point

1. Scroll with the arrow keys until the parameter D "set point pressure: switch point" is displayed in line 3.
2. Press and hold «Enter» for at least 3 seconds until the cursor flashes.
3. Use the arrow keys to set the desired switching point and confirm with the «Enter» key.

System set point pressure: Switching differential

This switching differential is factory set. Adjust this parameter if the motor starting frequency is too high.

1. Scroll with the arrow keys until the parameter C "set point pressure: switching differential" is displayed in line 3.
2. Press and hold «Enter» for at least 3 seconds until the cursor flashes.
3. Use the arrow keys to set the desired differential and confirm with «Enter».

7.9 Checking the Door Interlock Switch

The interlock switch stops the machine as soon as a door or access panel is opened.
Check the interlock switch function on commissioning.

The door interlock switch is an important safety device.
The machine may only be operated with a correctly functioning interlock switch.

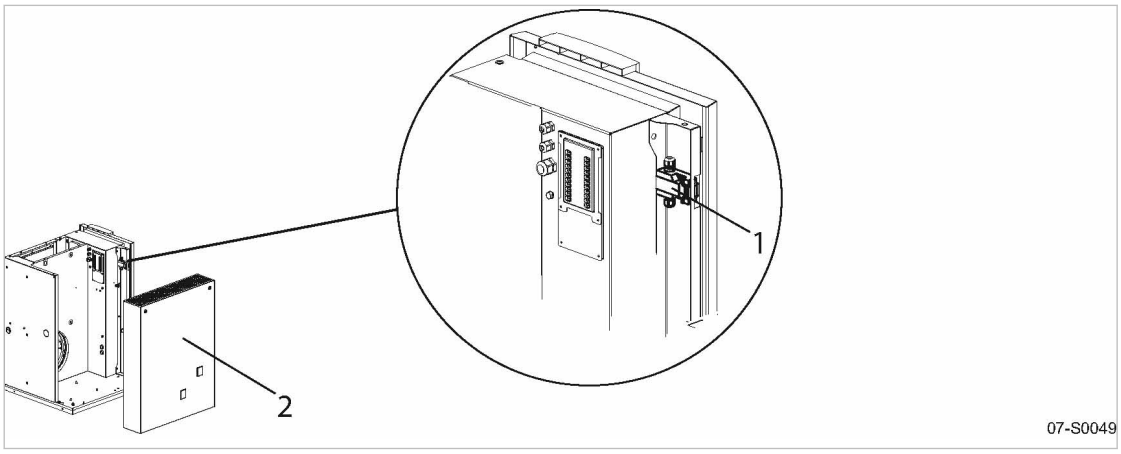


Fig. 20 Interlock switch position

[1] Door interlock switch
[2] Panel

1. Open the access panel [2] while the machine is running.
   The machine switches off automatically. The controller displays an alarm message.
2. Close the panel and acknowledge the alarm.

The machine does not switch off automatically?.

➢ Have the interlock switch checked by an authorized KAESER service representative.

8 Operation

8.1 Switching on and off

Always switch the machine on with the «ON» key and off with the «OFF» key.

A power supply disconnecting device needs to be installed by the user.

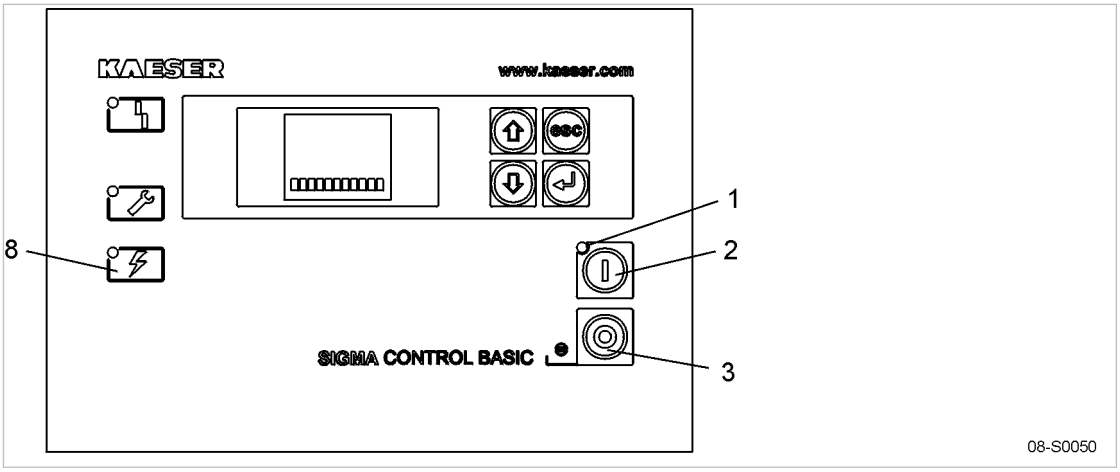


Fig. 21 Switching on and off

1 *ON* LED (green)
2 «ON» key
3 «OFF» key
8 *Controller on* LED (green)

8.1.1 Switching on

Precondition No personnel are working on the machine.

All access doors and panels are closed and secure.

1. Switch on the power supply disconnecting device.
   After the controller has carried out a self-test, the green *Controller on* LED is lit continuously.
2. Press the «ON» key.
   The green *ON* LED lights continuously.

If a power failure occurs, the machine is **not** prevented from restarting automatically when power is resumed.
It can restart automatically as soon as power is restored.

Result The compressor motor starts as soon as system pressure is lower than the set point pressure (cut-off pressure).

8.1.2 Switching off

Depending on current operating condition, the machine shuts down after a protective run-on period.

LOAD	IDLE
The machine switches to IDLE. The *Machine ON* LED flashes. The drive motor comes to a stop after about 15 seconds. The *ON* LED extinguishes.	The motor stops immediately. The *ON* LED extinguishes.

Tab. 42 Switching off with/without run-on time

1. Press the «OFF» key.
   The machine is ready to operate as soon as the *ON* LED is extinguished. The machine can be restarted.
2. Switch off and lock out the power supply disconnecting device.
   The machine is switched off and disconnected from the power supply supply. The *Controller on* LED extinguishes.

8.2 Switching off in an emergency and switching on again

The EMERGENCY STOP control device is located below the control panel.

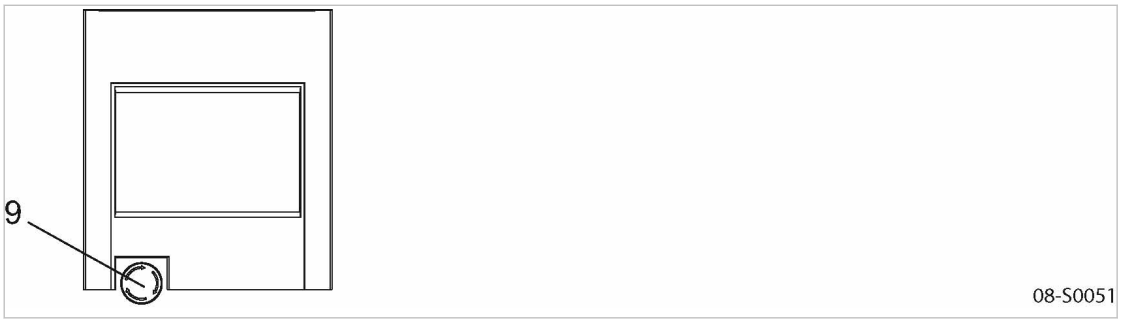


Fig. 22 Switching off in an emergency
9 EMERGENCY STOP control device

Switching off

➢ Press the EMERGENCY STOP control device.

Result The EMERGENCY STOP button remains latched after actuation.
The compressor's pressure system is vented and the machine is prevented from automatically restarting.

Switching on

Precondition The fault has been rectified

1. Turn the EMERGENCY STOP button in the direction of the arrow to unlatch it.
2. Acknowledge any existing alarm messages.

Result The machine can now be started again.

8.3 Setting parameters

If a password is needed it is requested automatically.

Every action can be cancelled with the «escape» key.

If no key is pressed for ten seconds in the edit mode, the display automatically returns to the previous mode.

Restarting the controller is not necessary. Edited parameters are immediately effective.

Network pressure and airend discharge temperature are neither updated nor displayed while in the edit mode.

Entering the edit mode

1. Scroll with the «UP»/«DOWN» keys until the desired parameter appears in line 3.
2. Depress the «enter» key for at least 3 seconds.

Result Depending on the parameter, either the displayed value or the first character of the required password flashes.

Changing a parameter that is not password protected

Precondition The current parameter setting flashes.

➢ Use the «UP»/«DOWN» keys to change the value of the parameter and confirm with «enter».

Changing a password protected parameter

Some parameters can only be edited after a password has been entered.

Password: BASIC

This password will be automatically reset if no key is pressed within 5 minutes.

Precondition The first character flashes.

1. Select the first character with the «UP»/«DOWN» key and confirm with «enter».
   The next character flashes.
2. Repeat until all characters have been entered.
   When the correct password is entered the parameters are displayed.
3. Use the «UP»/«DOWN» keys to change the value of the parameter and confirm with «enter».

8.4 Acknowledging alarm and warning messages

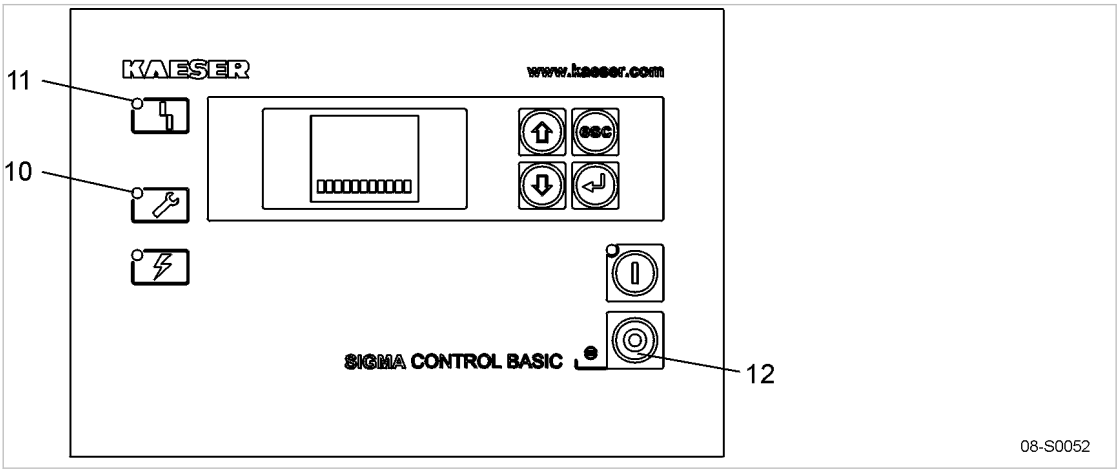


Fig. 23 Acknowledging messages

[10] *Warning* LED (yellow)
[11] *Alarm* LED (red)
[12] «Acknowledge» key

Alarm message

Messages are displayed on the "new value" principle:

- Message received: LED flashes
- Message acknowledged: LED lights
- Message gone: LED extinguished

or

- Message received: LED flashes
- Message gone: LED flashes
- Message reset: LED extinguished

➢ Rectify the fault and acknowledge the message with the «acknowledge» key.
alarm LED extinguishes.
The machine is now ready to start again.

Warning message

- Message coming: LED flashes
- Message gone: LED extinguished

➢ Rectify fault or carry out maintenance.
The *Warning* LED extinguishes as soon as the cause of the warning is rectified.

9 Fault Recognition and Rectification

9.1 Basic instructions

The following tables are intended to assist in locating faults.

There are 4 types of fault:

- Fault on the machine: red LED flashes - see chapter 9.2.
- Warning: yellow LED lights- see chapter 9.3.
- Other faults: no indication - see chapter 9.4.

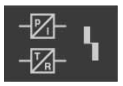
The messages valid for your machine are dependent on the controller and individual equipment.

1. Do not attempt fault rectification measures other than those given in this manual!
2. In all other cases:
   Have the fault rectified by an authorized KAESER service representative.

9.2 Alarm messages (machine shut down)

The fault code appears in the 4th line of the display field.
A sticker with symbols on the machine explains the fault code.

Fault code	Symbol	Meaning	Remedy
1		EMERGENCY STOP push-button pressed. Interlocked access door open or panel (if present) removed.	➢ Unlatch the EMERGENCY STOP push-button ➢ Close the access door or fit the panel.
2		Motor alarm Overload protection of drive or fan motor (if fitted). On machine with frequency-controlled drive: Alarm in the frequency converter.	➢ Check the setting of the overload protection cut-out / motor overload protection switch. ➢ Change the oil separator cartridge. ➢ Check minimum pressure/check valve. ➢ Have the frequency converter checked by an authorized KAESER service representative.
3		There is build-up of back pressure: ■ incorrect direction of motor rotation ■ drive belts parted ■ Compressor not venting correctly at STANDSTILL ■ Back-pressure switch defective Brief interruption of power supply.	➢ Changeover phase lines L1 and L2. ➢ Replace drive belts. ➢ Have the frequency converter checked by an authorized KAESER service representative.

Fault code	Symbol	Meaning	Remedy
4		Maximum permissible airend discharge temperature exceeded.	➢ Clean the radiator. ➢ Maintain sufficient distance between the cooling air inlet and exhaust openings and any wall. Check the cooling oil level. ➢ Ensure that the permissible room temperature is not exceeded. ➢ Change the oil filter.
5		Fault in the refrigeration dryer.	➢ Clean the refrigerant condenser. ➢ Ensure adequate ventilation. ➢ Install an extractor fan.
6		Defective analog input (pressure or temperature sensor).	➢ Check lines and connections.
7		Maximum permissible temperature of the controller housing exceeded.	➢ Ensure adequate ventilation. ➢ Ensure that the permissible room temperature is not exceeded.
8	–	Reserve	–

Tab. 43 Alarm indications

9.3 Warning messages

The fault code appears in the 4th line of the display field.
An adhesive label at the machine explains the fault code using symbols.

Fault code	Symbol	Meaning	Remedy
S		Maintenance counter has elapsed.	➢ Carry out maintenance.
p		Back pressure present.	➢ Check direction of drive motor rotation.
T		Machine below minimum permissible starting temperature.	➢ Increase room temperature.
i		Safety relief valve check mode switched on.	➢ Check safety relief valve. ➢ Deactivate check mode.

Tab. 44 Warning messages

9.4 Other Faults

Fault	Possible cause	Remedy
Machine runs but produces no compressed air.	Inlet valve not opening or only opening partially.	Call authorized KAESER service representative.
	Venting valve not closing.	Call authorized KAESER service representative.
	Leaks in the pressure system.	Check pipework and connections for leaks and tighten any loose fittings.
	Air consumption is greater than the capacity of the compressor.	Check the air system for leaks. Shut down some air consumer(s).
	Hose coupling or maintenance hose still plugged into the quick-release coupling on the oil separator tank.	Remove coupling or maintenance hose.
Cooling oil runs out of the air filter.	Oil level in the oil separator tank too high.	Drain off oil until the correct level is reached.
	Inlet valve defective.	Call authorized KAESER service representative.
Compressor switches between LOAD and IDLE more than twice per minute.	Air receiver too small.	Increase size of air receiver.
	Airflow into the compressed air network restricted.	Increase air pipe diameters. Check filter elements.
	The differential between cut-in and cut-out pressure too is small.	Check switching differential.
Cooling oil leaking into the floor pan.	Hose coupling or maintenance hose still plugged into the quick-release coupling on the oil separator tank.	Remove coupling or maintenance hose.
	Oil cooler leaking.	Call authorized KAESER service representative.
	Leaking joints.	Tighten joints. Replace seals.
Cooling oil consumption too high.	Unsuitable oil is being used.	Use SIGMA FLUID cooling oil.
	Oil separator cartridge split.	Change the oil separator cartridge.
	Oil level in the oil separator tank too high.	Drain off oil until the correct level is reached.
	Oil return line clogged.	Check dirt trap in the return line.

Tab. 45 Other faults and remedies

10 Maintenance

10.1 Ensuring safety

Follow the instructions below to ensure safe machine maintenance.
Warning instructions are located before a potentially dangerous task.

⚠ Disregard of warning instructions can cause serious injuries!

Complying with safety notes

Disregard of safety notes can cause unforeseeable dangers!

- ➢ Follow the instructions in chapter 3 “Safety and Responsibility”.
- ➢ Maintenance work may only be carried out by authorized personnel.
- ➢ Use the safety sign below to advise others that the machine is currently being serviced:

Sign	Meaning
	**⚠ WARNING** Serious injury or death can result from activating the machine during service! ➢ Do **not** activate the machine.

Tab. 46 Warn others that the machine is being serviced.

- ➢ Before switching on, make sure that nobody is working on the machine and all access doors and panels are closed and locked.

When working on live components

Touching voltage-carrying components can result in electric shocks, burns, or death.

- ➢ Work on electrical equipment may only be carried out by authorized electricians.
- ➢ Switch off and lock out the power supply disconnecting device and verify the absence of voltage.
- ➢ Check that there is no voltage on floating relay contacts.

When working on the compressed air system

Compressed air is contained energy. Uncontrolled release of this energy can cause serious injury or death. The following safety concerns relate to any work on components that could be under pressure.

- ➢ Close shut-off valves or otherwise isolate the machine from the compressed air network to ensure that no compressed air can flow back into the machine.
- ➢ Depressurize all pressurized components and enclosures.
- ➢ Check all hose couplings in the compressed air system with a hand-held pressure gauge to ensure that they all read 0 psig.
- ➢ Do not open or dismantle any valves.

When working on the drive system

Touching voltage-carrying components can result in electric shocks, burns, or death.

Touching the fan wheel, the coupling, or the drive while the machine is switched on can result in serious injury.

➢ Switch off and lock out the power supply disconnecting device and verify the absence of voltage.

➢ Do not open the cabinet while the machine is switched on.

Further information Details of authorized personnel are found in chapter 3.4.2.

Details of dangers and their avoidance are found in chapter 3.5.

10.2 Following the maintenance plan

10.2.1 Logging maintenance work

The maintenance intervals given are those recommended for average operating conditions.

➢ In adverse conditions, perform maintenance work at shorter intervals.

Adverse conditions are, e.g.:

- high temperatures
- too much dust
- high number of load changes
- low load

➢ Adjust the maintenance intervals with regard to local installation and operating conditions.

➢ Documenting all maintenance and service work

This enables the frequency of individual maintenance tasks and deviations from our recommendations to be determined.

Further information A prepared list is provided in chapter 10.21.

10.2.2 Resetting maintenance interval counters

SIGMA CONTROL BASIC is equipped with a maintenance interval counter. The maintenance interval counter counts down the operating hours to the next maintenance task.

The counting down of the maintenance interval indicator shows when the next maintenance action is due.

Reset the counter to the original value once the task has been carried out.

1. Select parameter 2 (maintenance interval counter) with the «UP»/«DOWN» keys.
2. Depress the «Enter »key for at least 3 seconds.
3. When the cursor flashes, confirm the offered value with the «Enter» key.

10.2.3 Regular maintenance tasks

The table below lists maintenance tasks required.

The refrigeration circuit is a closed system. Repairs may only be carried out by certified personnel.

➢ Take note of the controller's service messages and carry out tasks punctually, taking ambient and operating conditions into account.

Interval	Maintenance task	see chapter
Weekly	Check the cooling oil level.	10.13
	Cooler: Check the filter mat	10.3
	Control cabinet: Check the filter mat	10.4
	Check the condensate drain.	10.19.2
	Air receiver: Drain condensate manually.	10.20
up to 1 000 h	Maintain the drive belt.	10.9
	Check the air filter.	10.7
	Cooler: Clean the filter mat.	10.3
	Control cabinet: Clean the filter mat.	10.4
	Clean the cooler.	10.5
	Clean the refrigerant condenser.	10.19.1
Display: SIGMA CONTROL BASIC	Cooler: Change the filter mat	10.5
	Control cabinet: Change the filter mat	10.4
	Change the air filter.	10.7
Display: SIGMA CONTROL BASIC at least annually	Change the oil filter.	10.17
	Changing the oil separator cartridge	10.18
Variable, see table 48	Change the cooling oil.	10.16
Variable	Service compressed air filter. (Option: F1/F7)	13.5
up to 12 000 h	Replace the drive belt.	10.9
Annually	Check that all electrical connections are tight.	–
	Machine: Check the safety relief valve.	10.10
	Air receiver: Check the safety relief valve.	10.20.2
	Check the overheating safety shutdown function.	10.11
	Test the EMERGENCY STOP device.	10.12
	Check safety shutdown when opening the machine.	7.9
	Check the cooler for leaks.	10.5
	Maintain the heat recovery system.	10.6
h = operating hours		

Tab. 47 Regular maintenance tasks

10.2.4 Cooling oil changing interval

Machine utilization and ambient conditions are important criteria for the number and length of the change intervals.

An authorized KAESER service representative will support you in determining appropriate intervals and provide information on the possibilities of oil analysis.

➢ Please observe national regulations regarding the use of cooling oil in oil-injected screw compressors.

➢ Check operating conditions and adjust intervals as necessary.

KAESER LUBRICANTS			
SIGMA Lubricant	Description	Maximum Recommended Change Interval	
		First oil change	Subsequent oil change
M–460	ISO 46 Semi-Synthetic Lubricant	2,000 Hours	3,000 Hours
S–460	ISO 46 Synthetic Lubricant	6,000 Hours	8,000 Hours
S–680	ISO 68 Synthetic Lubricant	6,000 Hours	8,000 Hours
FG–460	ISO 46 Food Grade Synthetic Fluid	2,000 Hours	3,000 Hours

Tab. 48 Oil change intervals lubricants

10.2.5 Regular service tasks

The table below lists service tasks required.

➢ Only an authorized KAESER service representative should carry out service work.

➢ Have service tasks carried out punctually, taking ambient and operating conditions into account.

Interval	Service task
Up to 12 000 h	Valve maintenance.
Up 12 000 h, every 4 years at the latest	Replace the compressor drive motor bearings.
Up to 36 000 h Every 6 years at the latest.	Replace the hose lines: ■ Pressure pipes ■ Control air lines
Up to 36 000 h	Replace the control cabinet fan.
After 20 years at the latest	Replace safety-relevant components of the safety devices.
h = operating hours	

Tab. 49 Regular service tasks

10.3 Cooler: Cleaning or Renewing the Filter Mats

The filter mats help to keep the cooler clean. If the filter mats are clogged, adequate cooling of the components is no longer ensured.

Material
Filter mats:
Warm water and household detergent
Spare parts (as required)

Precondition
The machine is switched off.

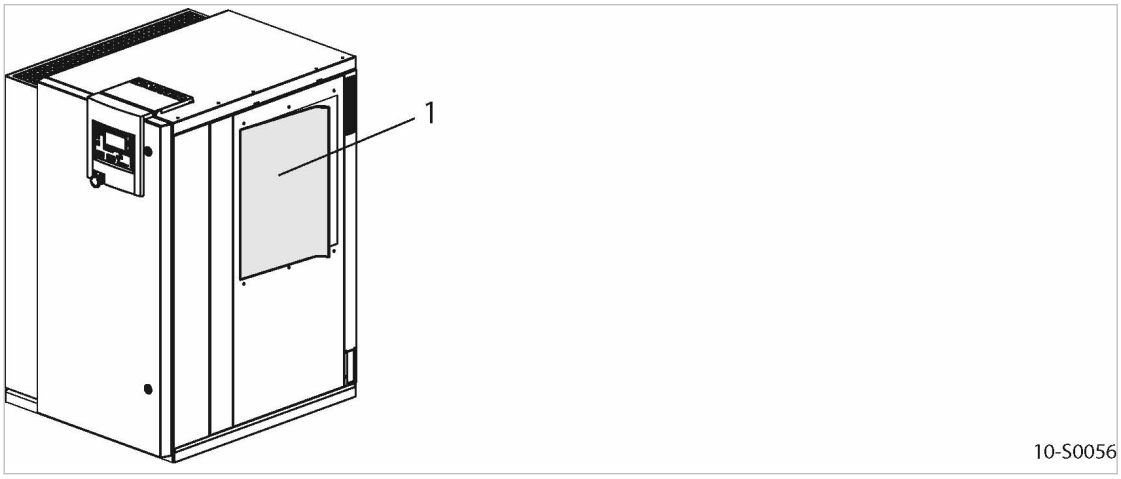


Fig. 24 Filter mat for the air and oil cooler
[1] Filter mat

No tools are needed to remove the filter mat.

1. Carefully remove the filter mat from the retaining frame.
2. Beat the mat or use a vacuum cleaner to remove loose dirt. If necessary, wash with lukewarm water and household detergent.
3. Change the filter mat if cleaning is not possible or if the change interval has expired.
4. Carefully insert the filter mat in the retaining frame.

10.4 Control cabinet: Clean or renew the filter mat

A filter mat is placed behind every ventilation grill. Filter mats protect the control cabinet from ingress of dirt. If the filter mats are clogged, adequate cooling of the components is no longer ensured. In such a case, clean or replace the filter mats.

Material
Warm water and household detergent
Spare parts (as required)

Precondition
The power supply isolating device is switched off,
the device is locked off,
the absence of any voltage has been verified.
The machine has cooled down.

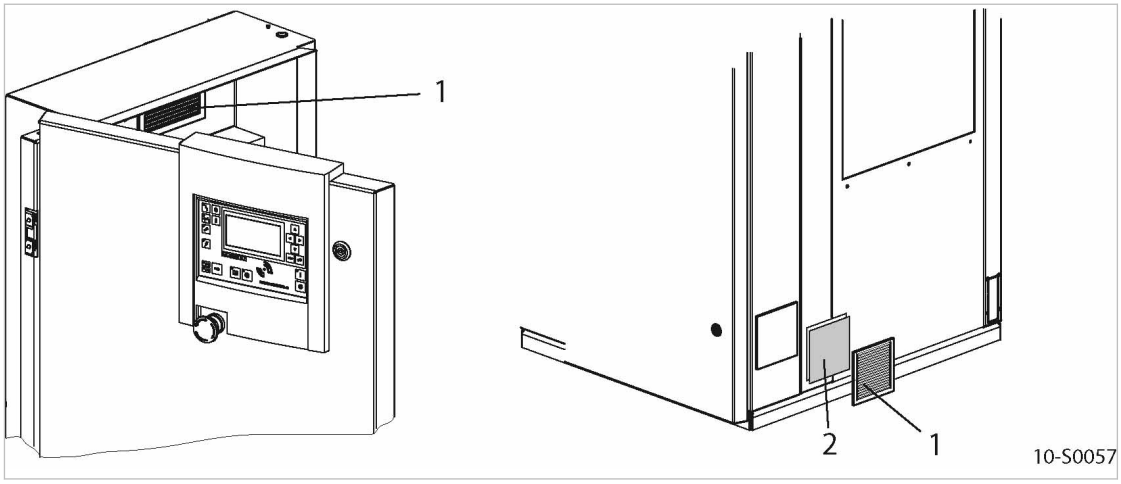


Fig. 25 Switching cabinet ventilation

[1] Ventilation grill
[2] Filter mat

1. Carefully remove the ventilation grill and take out the filter mat.
2. Beat the mat or use a vacuum cleaner to remove loose dirt. If necessary, wash with lukewarm water and household detergent.
3. Change the filter mat if cleaning is not possible or if the change interval has expired.
4. Insert the filter mat in the frame and latch in the ventilation grill.

10.5 Cooler maintenance

Regular cleaning of the cooler ensures reliable cooling of the machine and the compressed air. The frequency is mainly dependent on local operating conditions.

A leaking cooler results in loss of cooling oil and compressed air.

Clogged coolers are indicative of unfavorable ambient conditions. Such ambient conditions clog the cooling air ducts in the machine's interior and the engines resulting in increased wear and tear.

➢ Have the authorized KAESER service representative clean the cooling air ducts.

Material Brush and vacuum cleaner
Face mask (as required)

Precondition The power supply isolating device is switched off,
the device is locked off,
the absence of any voltage has been verified.

The machine has cooled down.

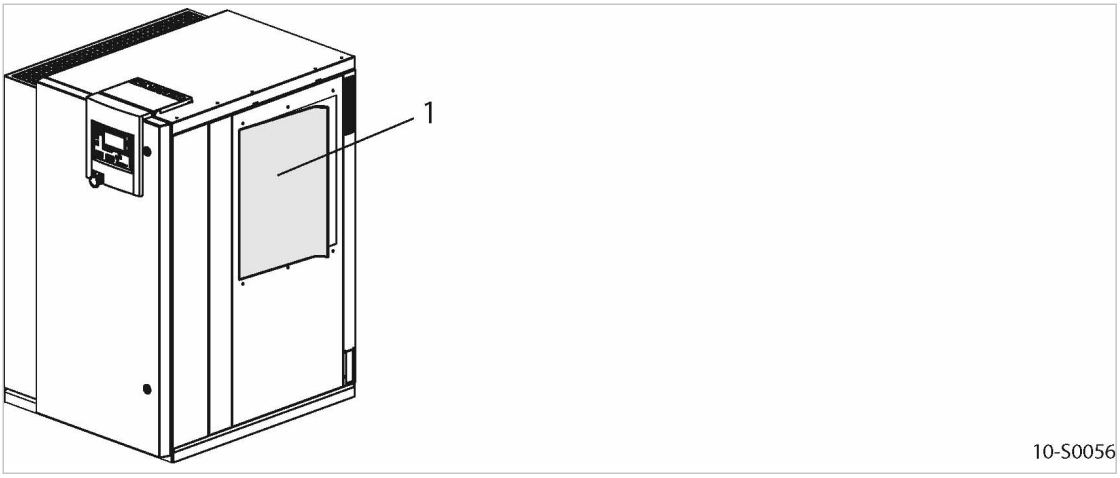


Fig. 26 Filter mat for the air and oil cooler

[1] Filter mat

Cleaning the cooler

A filter mat helps to keep the cooler clean. Despite this fact, the cooler will clog over a period of time.

Do not use sharp objects to clean the cooler. It could be damaged.

Avoid creating clouds of dust.

1. Carefully remove the filter mat from the retaining frame.
2. Dry brush the oil and air coolers and use a vacuum cleaner to suck up the dirt.
3. Carefully insert the filter mat in the retaining frame.

The air and oil coolers can no longer be properly cleaned?

➢ Have severe clogging removed by an authorized KAESER service representative.

Checking the cooler for leaks

➢ Visual inspection: Did cooling oil escape?

Is a cooler leaking?

➢ Have the defective cooler repaired immediately by an authorized KAESER service representative.

10.6 Option W1 Maintaining the external heat recovery system

Deposits in the heat exchanger can significantly reduce its capacity to transfer heat.

Check the heat exchanger regularly for leaks and contamination. Frequency of checking is dependant on the characteristics of the heat transfer medium.

➢ Have the external heat recovery system checked annually by an authorized KAESER service representative.

10.7 Air Filter Maintenance

Check that all sealing surfaces match each other. The use of an unsuitable air filter element can permit dirt to ingress the pressure system and cause damage to the machine.

The air filter element cannot be cleaned.

Material Replacement part

Precondition The power supply disconnecting (isolating) device is switched off,
the disconnect device is locked in the off position,
a check has been made that no voltage is present.

The machine has cooled down.

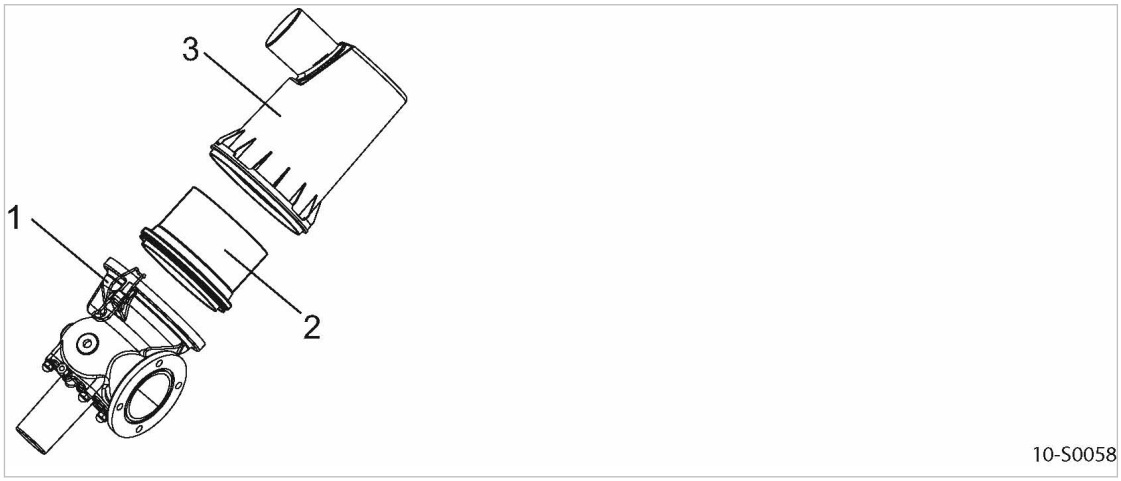


Fig. 27 Air filter maintenance

1. Snap fastener
2. Air filter element
3. Air filter housing

1. Release the spring clips and remove the element.
2. Clean all parts and sealing surfaces.
3. Insert the new element in the housing.
4. Clip the air filter housing onto the inlet valve.

10.8 Compressor motor maintenance

The drive motor bearings are permanently greased. Re-greasing is not necessary.

➢ Have the motor bearings checked by an authorized KAESER service representative.

10.9 Drive belt maintenance

Material Spare parts (if required)

Precondition The power supply isolating device is switched off,
the device is locked off,
the absence of any voltage has been verified.

The machine has cooled down.

⚠ WARNING

Touching the moving drive belt may result in severe bruising or even loss of limb or extremities.

➢ *Switch off and lock out the power supply isolating device and verify the absence of voltage.*

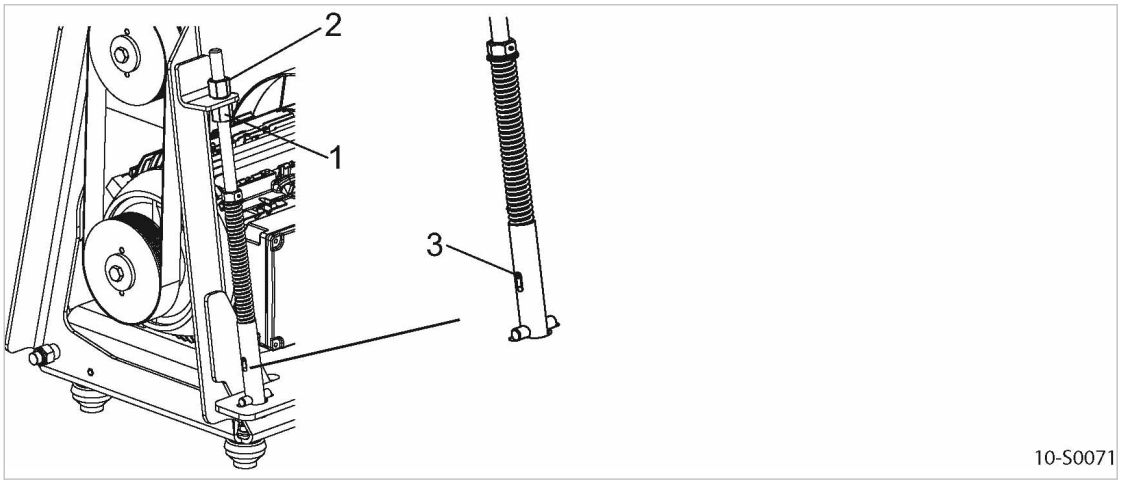


Fig. 28 Drive belt maintenance

[1] Clamping nut
[2] Clamping nut
[3] Marker pin (shown as: belt tensioning required)

Checking the belt tension and adjustment

The tensioning device uses spring force to apply correct tension to the belt.

Adjust the tension when the marker pin reaches the **top** end of the elongated hole.
The marker pin can be seen through a viewing window from outside. This means that belt tension can be checked without opening the machine.

1. Loosen the locking nut [2].
2. Use the adjusting nut [1] to adjust the spring tension until the marker pin reaches the lower end of the elongated hole.
3. Tighten the locking nut [2].

Visually check for damages.

1. Turn the pulley by hand so that all of the belt can be inspected for damage.
2. In case of damage: Replace the drive belt immediately.

Changing the belt

1. Loosen the locking nut [2].
2. Turn adjusting nut [1] to loosen the tension on the belt until it can be removed from the pulley.
3. Install the new belt and use the adjusting nut [1] to adjust tension until the marker pin reaches the lower end of the elongated hole.
4. Tighten the locking nut [2].

10.10 Testing the safety relief valve

In order to check the activating pressure of the safety relief valve, the machine's working pressure is raised above the set activating pressure of the valve.

The controller is switched to safety relief valve checking mode to carry out this check. This checking mode is intended for machines with maximum permissible working pressure less than 217 psig. Safety relief valves in machines with permissible working pressures higher than 217 psig must be removed from the machine and tested on a special rig.

➢ Safety relief valves on machines with maximum permissible working pressure of 217 psig should be tested only by an KAESER service representative.

Blow off protection and air system pressure monitoring are switched off during the test.

The machine must be isolated from the compressed air network and completely vented before undertaking any work on the pressure system.

➢ Never operate the machine without correctly functioning safety relief valves.

Preparing the test

Precondition The machine is switched off.

1. Close the shut-off valve between the machine and the air receiver.
2. Read off the activating pressure on the valve.
   (the activating pressure is usually to be found at the end of the part identification)
3. Scroll to parameter 3 "Pressure relief valve check mode" with the arrow keys and confirm by depressing the «Enter» key for at least three seconds.
4. Enter the password "BASIC" and confirm with the «enter» key.
5. Use the arrow keys to select parameter "on" and confirm.

Performing the test

The machine starts in IDLE as soon as it is switched on.
As long as the «ON» key is depressed and held, the machine will run in LOAD operating mode and pressure builds up in the oil separator tank. As soon as the «ON» key is released, the machine switches back to IDLE and switches automatically to STANDSTILL when the idling period has elapsed.

Precondition The machine is switched off.

1. **⚠ WARNING** *The safety relief valve may blow off at any time!*
   Excessive noise is caused when the safety relief valve blows off!
   There is danger of scalding from hot oil.
   There is danger of injury from bursting components and compressed air!
   - ➢ *Close all access doors and replace and secure all removable panels.*
   - ➢ *Wear ear and eye protection.*
   - ➢ *Abort the test if the working pressure rises 10% above the activating pressure of the valve.*
2. Press the «ON» key for short time.
   The machine starts in IDLE.
3. Observe the display of pressure on SIGMA CONTROL BASIC while depressing and holding the «ON» key.

4. Stop the test as soon as the safety relief valve blows off or working pressure rises by more than 10% above the activating pressure of the safety relief valve.
5. If necessary, vent the machine and replace the defective safety relief valve.

Returning the machine to operational

1. Call up the edit mode again and enter the password "BASIC".
2. Use the arrow keys to set the parameter to "off" and confirm with the enter key.
3. Open the shut-off valve between the machine and the air receiver.

10.11 Checking the Overheating Safety Shutdown Function

The machine should shut down if the airend discharge temperature reaches a maximum of 230 °F.

➢ Have the safety shutdown function checked by an authorized KAESER service representative.

10.12 Testing the EMERGENCY STOP button

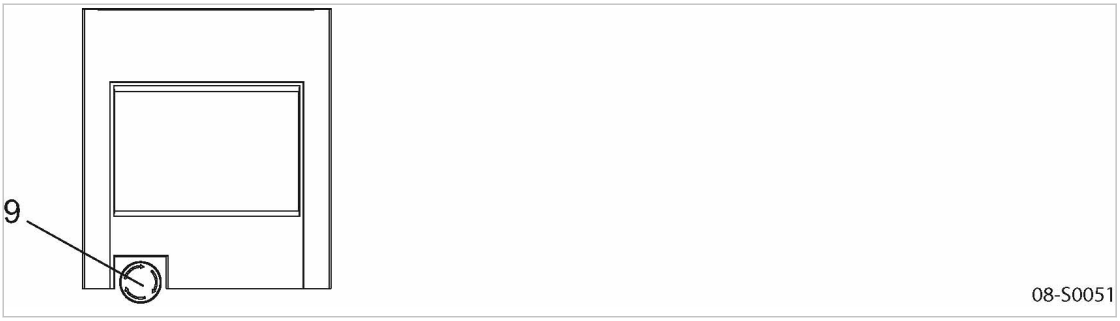


Fig. 29 Testing the EMERGENCY STOP button
[9] EMERGENCY STOP button

Precondition The compressor motor is running.

1. Press the EMERGENCY STOP button.
   The compressor motor stops, the pressure system is vented, and the machine is prevented from automatically restarting.

The compressor motor does not stop?
The safety function of the EMERGENCY STOP button is no longer ensured.
➢ Shut down the machine immediately and call KAESER Service.

2. Turn the EMERGENCY STOP button in the direction of the arrow to unlatch it.
3. Acknowledge the alarm message.

10.13 Checking the cooling oil level

The sightglass allows a risk-free reading of the cooling oil level. The oil indicator should be fully filled with oil when the machine is at standstill. The correct oil level cannot be seen.

The ideal situation is with the oil level around the optimum mark when the machine is running.

Operating state	Minimum oil level	Maximum oil level
LOAD		

Tab. 50 Permissible cooling oil level under LOAD

In frequency-controlled compressors (SFC) the oil level indicator is only accurate when the machine is running at or near maximum speed.
The lower the pressure at the compressed air outlet, the higher the speed.

Precondition The machine has been running at least 5 minutes under LOAD.

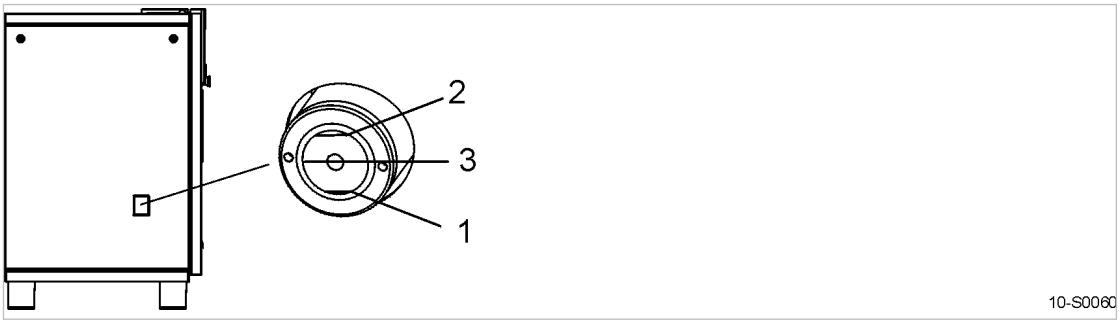


Fig. 30 Checking the cooling oil level

1 Minimum oil level
2 Maximum oil level
3 Optimum oil level

➢ Check the oil level with machine running under LOAD.

Result As soon as the minimum level is reached: Replenish the cooling oil.

10.14 Venting the machine (de-pressurizing)

Venting takes place in three stages:

- Isolate the compressor from the air system.
- Vent the oil separator tank.
- Manually vent the air cooler.

The machine must be isolated from the compressed air network and completely vented before undertaking any work on the pressure system.

Material The maintenance hose with hose coupling and shut-off valve needed for venting is stowed beneath the oil separator tank.

Precondition The power supply disconnecting device is switched off,
The device is locked off,
A check has been made that no voltage is present.

⚠ CAUTION

Escaping oil mist is damaging to health.

- ➢ *Do not direct the maintenance hose at persons while venting.*
- ➢ *Do not inhale the oil mist.*

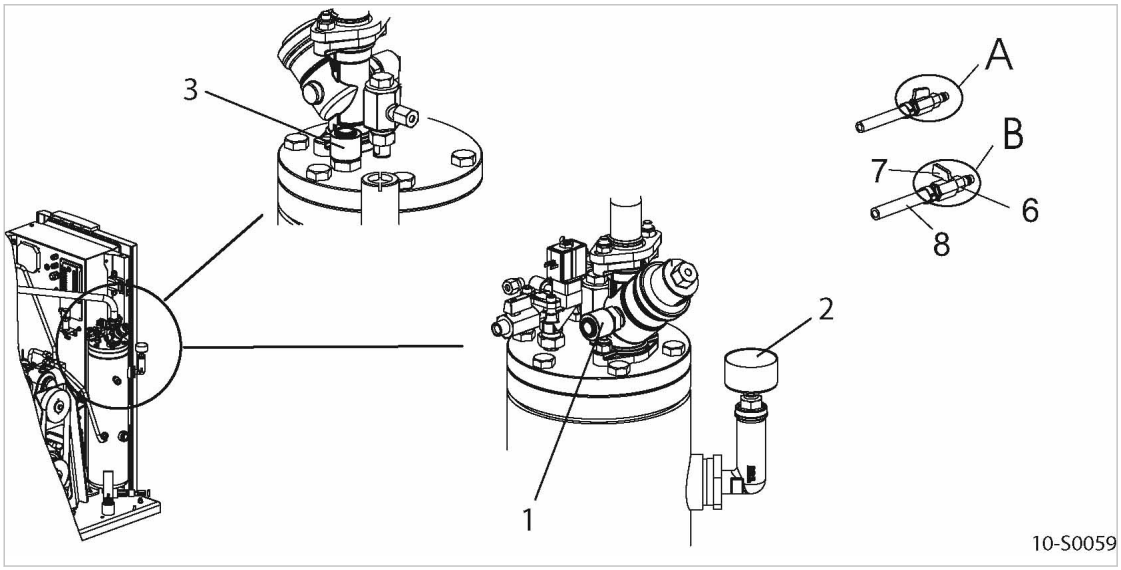


Fig. 31 Venting the machine

[1]	Hose coupling (air cooler venting)	[7]	Shut-off valve
[2]	Pressure gauge	[A]	Shut-off valve open
[3]	Hose coupling (oil separator tank venting)	[B]	Shut-off valve closed
[6]	Male hose fitting	[8]	Maintenance hose

Isolating the machine from the air system

- ➢ Close the user's shut-off valve between the machine and the air distribution network.

If no shut-off valve is provided by the user, the complete air distribution network must be vented.

Venting the oil separator tank

The oil circulation vents automatically as soon as the machine is stopped.

- ➢ Check that the oil separator tank pressure gauge reads 0 psig.

The pressure gauge does not read 0 psig after automatic venting?

- ➢ Make sure that the user's shut-off valve is closed or that the complete air system is vented.
- ➢ With the shut-off valve closed, insert the male hose fitting [6] into the hose coupling [3].
- ➢ Slowly open the shut-off valve [7] to release pressure.
- ➢ Disconnect the male hose fitting [6] and close the shut-off valve [7].
- ➢ If manual venting does **not** bring the oil separator tank pressure gauge to zero: Contact an authorized KAESER service representative.

Manually venting the air cooler

After shutting down the compressor and venting the oil separator tank, the machine is still under pressure from the air system or the section from the shut-off valve to the minimum pressure/check valve.

1. With the shut-off valve closed, insert the male hose fitting [6] into the hose coupling [1].
2. Slowly open the shut-off valve [7] to release pressure.
3. Disconnect the male hose fitting [6] and close the shut-off valve [7].

10.15 Replenishing the cooling oil

The machine must be isolated from the compressed air network and completely vented before undertaking any work on the pressure system.

Material The maintenance hose with hose coupling and shut-off valve needed for venting is stowed beneath the oil separator tank.

Precondition The power supply disconnecting device is switched off,
The device is locked off,
A check has been made that no voltage is present.

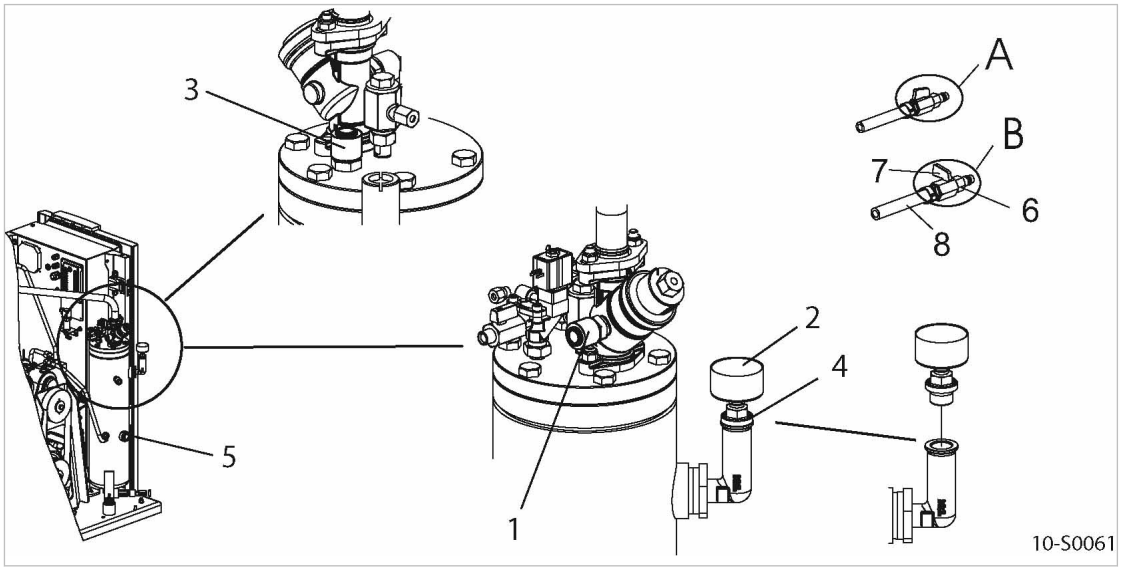


Fig. 32 Replenishing the cooling oil

[1]	Hose coupling (air cooler venting)	[6]	Male hose fitting
[2]	Pressure gauge	[7]	Shut-off valve
[3]	Hose coupling (oil separator tank venting)	[A]	Shut-off valve open
[4]	Oil filler port with plug	[B]	Shut-off valve closed
[5]	Cooling oil level indicator	[8]	Maintenance hose

1. Vent the machine as described in section 10.15.1.
2. Fill with cooling oil and test run as described in section 10.15.2.

10.15.1 Venting the machine (de-pressurizing)

Venting takes place in three stages:

- Isolate the compressor from the air system.
- Vent the oil separator tank.
- Manually vent the air cooler.

⚠ CAUTION

Escaping oil mist is damaging to health.

➢ *Do not direct the maintenance hose at persons while venting.*

➢ *Do not inhale the oil mist.*

Isolating the machine from the air system

➢ Close the user's shut-off valve between the machine and the air distribution network.

If no shut-off valve is provided by the user, the complete air distribution network must be vented.

Venting the oil separator tank

The oil circulation vents automatically as soon as the machine is stopped.

➢ Check that the oil separator tank pressure gauge reads 0 psig.

The pressure gauge does not read 0 psig after automatic venting?

➢ Make sure that the user's shut-off valve is closed or that the complete air system is vented.

➢ With the shut-off valve closed, insert the male hose fitting [6] into the hose coupling [3].

➢ Slowly open the shut-off valve [7] to release pressure.

➢ Disconnect the male hose fitting [6] and close the shut-off valve [7].

➢ If manual venting does **not** bring the oil separator tank pressure gauge to zero: Contact an authorized KAESER service representative.

Manually venting the air cooler

After shutting down the compressor and venting the oil separator tank, the machine is still under pressure from the air system or the section from the shut-off valve to the minimum pressure/check valve.

1. With the shut-off valve closed, insert the male hose fitting [6] into the hose coupling [1].
2. Slowly open the shut-off valve [7] to release pressure.
3. Disconnect the male hose fitting [6] and close the shut-off valve [7].

10.15.2 Topping off with cooling oil and trial run

Replenishing the cooling oil

A sticker on the oil separator tank specifies the type of oil used.

1. **⚠ WARNING** *Compressed air!*
   Compressed air and devices under pressure can injure or cause death if the contained energy is released suddenly.
   ➢ *De-pressurize all pressurized components and enclosures.*
2. **NOTICE** *The machine could be damaged by unsuitable oil!*
   ➢ *Never mix different types of oil.*
   ➢ *Never top off with a different type of oil than has already been used in the machine.*
3. Slowly unscrew the filler plug [4].
4. Top off to bring the oil to the correct level.
5. Replace the filler plug's sealing ring if necessary and screw the plug into the filler neck.

Starting the machine and carrying out a trial run

1. Close all access doors, replace and secure all removable panels.
2. Open the user's shut-off valve between the machine and the air distribution network.
3. After approx. 10 minutes of operation: Check the cooling oil level and top off if necessary.
4. Switch off the machine and check for leaks.

10.16 Changing the cooling oil

Drain the oil completely from the following components:
- Oil separator tank
- Thermostatic valve (Option W1)

Always change the oil filter and oil separator cartridge when changing the oil.

Compressed air helps to expel the oil. This compressed air can be taken either from the compressor itself or from an external source.

An external source of compressed air is necessary in the following cases:
- The machine is not operational.
- The machine is to be restarted after a long period of standstill.

⚠ The machine must be isolated from the compressed air network and completely vented before undertaking any work on the pressure system.

Material Cooling oil

Oil receptacle

The maintenance hose with hose coupling and shut-off valve is stowed beneath the oil separator tank.

⚠ CAUTION
There is risk of burns from hot components and oil!
➢ *Wear long-sleeved clothing and protective gloves.*

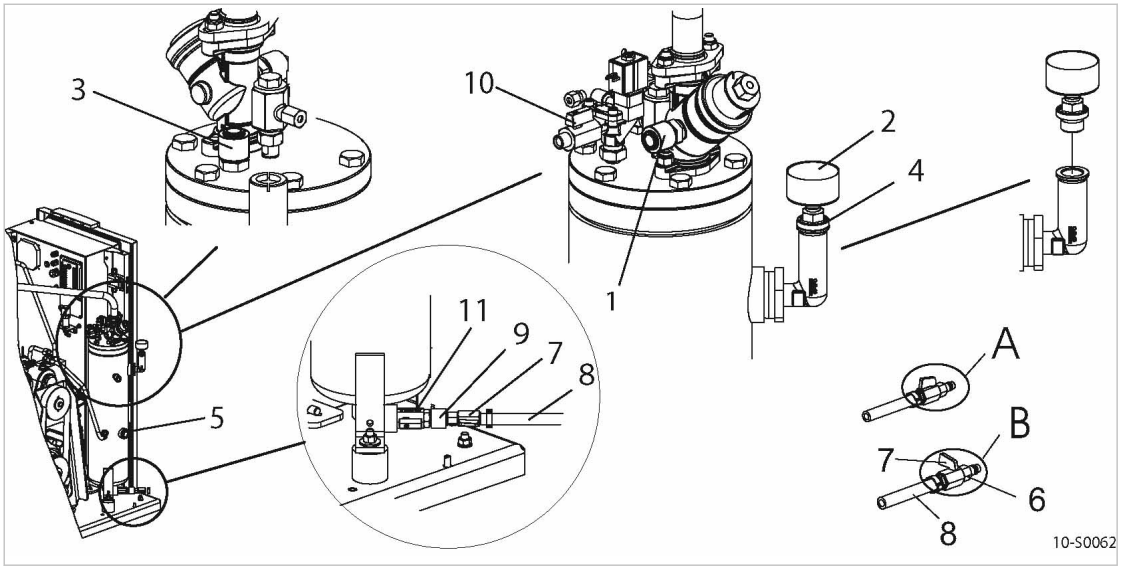


Fig. 33 Changing the cooling oil, oil separator tank

[1] Hose coupling (air cooler venting)
[2] Pressure gauge
[3] Hose coupling (oil separator tank venting)
[4] Oil filler port with plug
[5] Cooling oil level indicator
[6] Male hose fitting
[7] Shut-off valve
[A] Shut-off valve (open)
[B] Shut-off valve (closed)
[8] Maintenance hose
[9] Hose coupling (oil drainage)
[10] Shut-off valve (venting line)
[11] Shut-off valve (oil drainage)

Changing the oil with internal pressure	Oil change with an external compressed air source
The machine has been running at least 5 minutes in LOAD mode. The machine is fully vented, the pressure gauge on the oil separator tank reads 0 psig. 1. Close the shut-off valve [10] in the venting line. 2. Start the machine and watch the oil separator tank pressure gauge [2] until it reads 43–73 psig. 3. Switch off the machine. 4. Wait at least 2 minutes to allow the oil to flow back to the separator tank.	The power supply disconnecting device is switched off, the device is locked off, the absence of any voltage has been verified. The machine is fully vented, the pressure gauge on the oil separator tank reads 0 psig. An external source of compressed air is available. 1. Close the shut-off valve [10] in the venting line. 2. With the shut-off valve closed, insert the male hose fitting [6] into the hose coupling [3]. 3. Connect the maintenance hose to the external air supply. 4. Open the shut-off valve [7] until the pressure gauge on the oil separator tank reads 43–73 psig. 5. Close the shut-off valve [7] and remove the male hose fitting from the coupling.

Draining the oil from the separator tank

Contact KAESER Service if condensate is detected in the cooling oil.
It is necessary to adapt the airend discharge temperature to individual ambient conditions.

Precondition The power supply disconnecting device is switched off,
the device is locked off,
the absence of any voltage has been verified.

1. Have an oil receptacle ready.
2. With the shut-off valve closed, insert the male hose fitting [6] into the hose coupling [9].
3. Place the other end of the maintenance hose in the oil receptacle and secure it in place.
4. Open the shut-off valve [11].
5. Slowly open the shut-off valve [7] in the maintenance hose and allow oil and air to drain completely.
   Pressure gauge on the oil separator tank indicates 0 psig.
6. Close the shut-off valve [11] and unplug the male hose fitting.

➢ Dispose of used oil in accordance with environmental protection regulations.

Option W1 Draining the oil from the thermostatic valve

A drain plug is provided to drain oil from the thermostatic valve. If the machine is connected to an external heat recovery system, oil should also be drained from the heat exchanger at a suitable point.

Precondition The external heat recover system is depressurized.

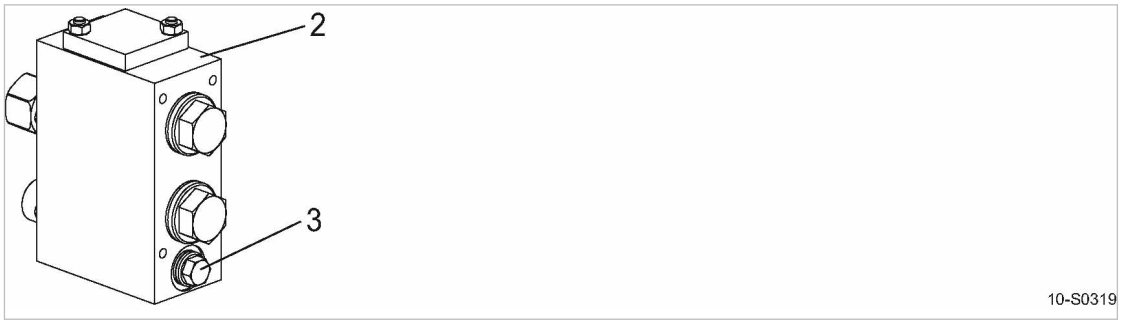


Fig. 34 Changing the cooling oil, heat recovery system
[2] Thermostatic valve
[3] Screw plug

1. Have an oil receptacle ready.
2. Remove the drain plug [3] and allow the oil to drain completely.
3. Replace the plug [3].

Filling with cooling oil

1. **⚠ WARNING** *Compressed air!*
   Compressed air and devices under pressure can injure or cause death if the contained energy is released suddenly.
   ➢ *Vent all pressurized components and enclosures.*

2. Slowly unscrew the filler plug [4] (see illustration 33).
3. Fill with cooling oil.
4. Check the filler plug and ring seal for damage and screw the plug back in again.

Starting the machine and performing a trial run

1. Close all access doors, replace and secure all removable panels.
2. Open the user's shut-off valve between the machine and the air distribution network.
3. Switch on the power supply and reset the maintenance interval counter.
4. Start the machine and check the oil level again after about 10 minutes, topping off if necessary.
5. Switch off the machine and check for leaks.

10.17 Changing the oil filter

⚠ The machine must be isolated from the compressed air network and completely vented before undertaking any work on the pressure system.

Material: Spares

Cooling oil receptacle

Precondition: The power supply isolating device is switched off,
the device is locked off,
the absence of any voltage has been verified.

The machine is fully vented,
the pressure gauge on the oil separator tank reads 0 psig.

⚠ CAUTION

There is risk of burns from hot components and oil!

➢ *Wear long-sleeved clothing and gloves.*

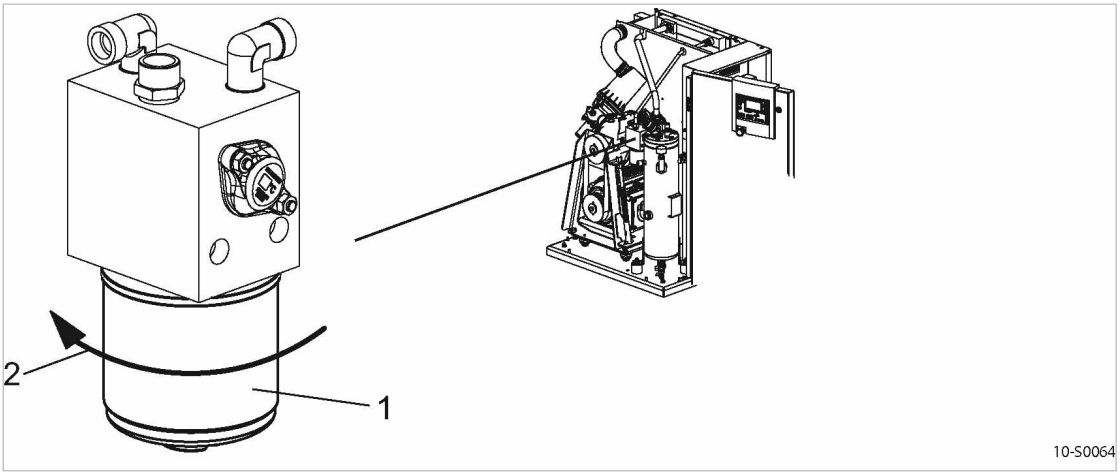


Fig. 35 Changing the oil filter

[1] Oil filter
[2] Direction to unscrew

Changing the oil filter

1. **⚠ WARNING** *Compressed air!*
   Compressed air and devices under pressure can injure or cause death if the contained energy is released suddenly.
   ➢ *Depressurize all pressurized components and enclosures.*
2. Unscrew the oil filter anti-clockwise, catch oil spillage and dispose of in accordance with environmental protection regulations.
3. Lightly oil the new filter's gasket.
4. Turn the oil filter clockwise by hand to tighten.

➢ Dispose of parts and materials contaminated with oil in accordance with environmental protection regulations.

Starting the machine and carrying out a trial run

1. Close all access doors, replace and secure all removable panels.
2. Open the user's shut-off valve between the machine and the air distribution network.
3. Switch on the power supply and reset the maintenance interval counter.
4. After approx. 10 minutes of operation: Check the cooling oil level and top up if necessary.
5. Switch off the machine and check visually for leaks.

10.18 Changing the oil separator cartridge

The oil separator cartridge cannot be cleaned.

The life of the oil separator cartridge is influenced by:

- contamination in the air drawn into the compressor,
- Adherence to the changing intervals for:
  - Cooling oil
  - Oil filter
  - Air filter

The machine must be isolated from the compressed air network and completely vented before undertaking any work on the pressure system.

Material: Spares
Cleaning cloth

Precondition: The supply disconnecting device is switched off.
The disconnecting device is locked in the off position.
A check has been made that no voltage is present.
The machine is fully vented,
the pressure gauge on the oil separator tank reads 0 psi.

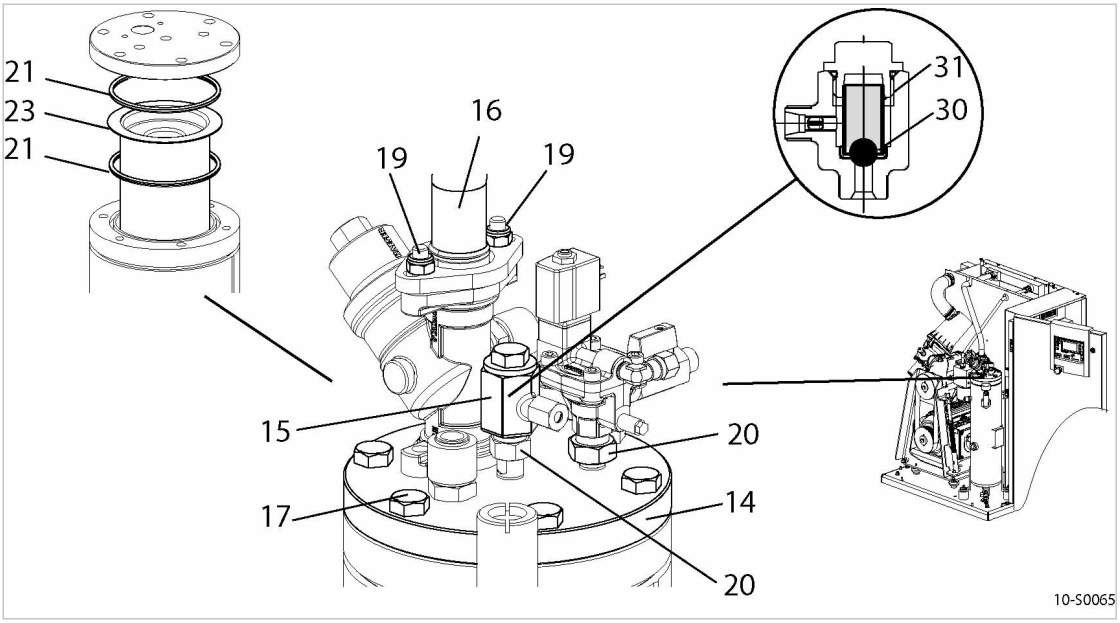


Fig. 36 Changing the oil separator cartridge

14	Cover	20	Screw connection
15	Dirt trap	21	seal
16	Air pipe	23	Oil separator cartridge
17	Retaining screw	30	Ball (functioning as a check valve)
19	Self-locking nut	31	Strainer

Changing the oil separator cartridge

1. **⚠ WARNING** *Compressed air!*
   Compressed air and pressurized devices can cause serious injury or death if the contained energy is suddenly released.
   ➢ *Vent all pressurized components and chambers completely.*
2. Unscrew the fitting 20 and carefully put the parts to one side, then pull out the copper pipe at item 15.
3. Unscrew the nut 19 and turn the air pipe 16 to one side.
4. Remove the cover fixing screws 17 and carefully remove the cover 14.
5. Take out the old oil separator cartridge 23 together with the gaskets 21 and dispose of according to environmental protection regulations.
6. Clean all sealing faces.
7. Insert the new oil separator cartridge with gaskets and refix the cover.
8. Renew the O-ring and strainer in the dirt trap 15.

ⓘ ➢ Make sure the ball 30 is properly seated.
The ball prevents cooling oil being pressed into the separator cartridge.

9. Attach the air pipe to the cover 14 with a new, self-locking nut.
10. Replace and tighten all fittings.

➢ Dispose of parts and materials contaminated with oil in accordance with environmental protection regulations.

Start the machine and carry out a trial run

1. Close all access doors, replace and secure all removable panels.
2. Open the user's shut-off valve between the machine and the air distribution network.
3. Switch on the power supply and reset the maintenance interval counter.
4. After approx. 10 minutes of operation: Switch off the machine and check visually for leaks.

10.19 Refrigerated dryer maintenance

The refrigeration circuit is a closed unit. Repairs may only be carried out by certified personnel.

Material
Compressed air for blowing out
Cleaning cloth
Vacuum cleaner

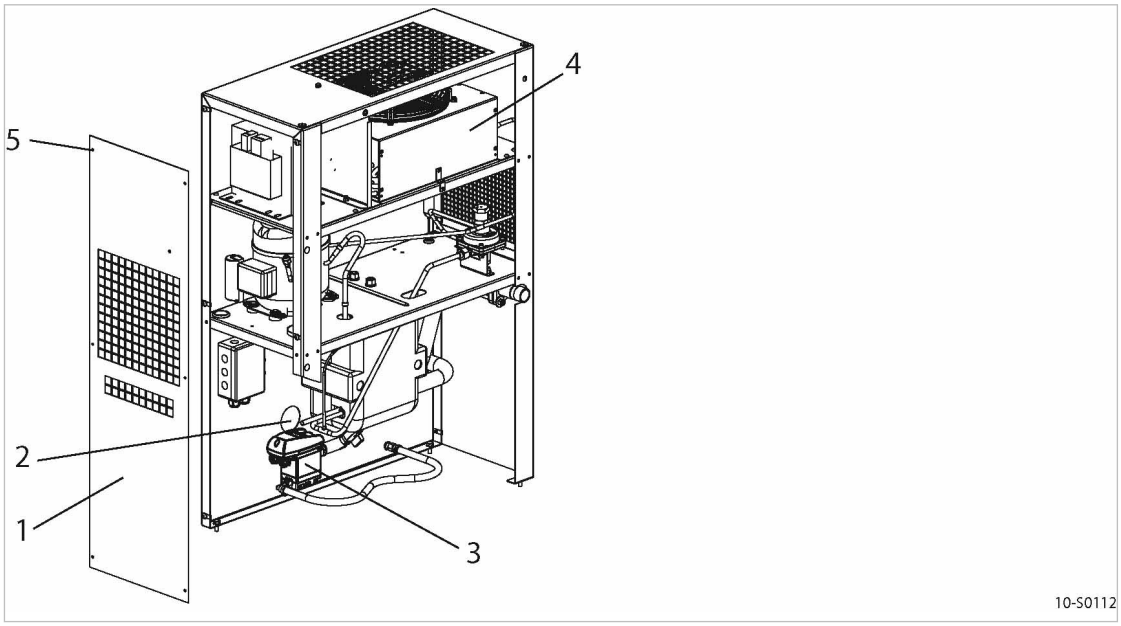


Fig. 37 Refrigerated dryer

1 Access panel
2 Sight glass: Condensate drain
3 Condensate drain
4 Refrigerant condenser
5 Latch

10.19.1 Cleaning the refrigerant condenser

Do not use sharp objects to clean the refrigerant condenser. The refrigerant condenser could be damaged.

Avoid creating clouds of dust.

Precondition
The power supply disconnecting device is switched off,
The device is locked off,
A check has been made that no voltage is present.

1. Undo the latch 5 and remove the panel 1.

2. Use compressed air (<72 psig) to blow the condenser [4] through from outside to inside and then vacuum up the dirt.
3. Replace the panel again.

The refrigerant condenser can no longer be cleaned?

➢ Have stubborn clogging removed by an authorized KAESER service representative.

10.19.2 Maintaining the condensate drain

10.19.2.1 Checking the condensate drain

Precondition The machine is switched off.

The *Power* LED lights.

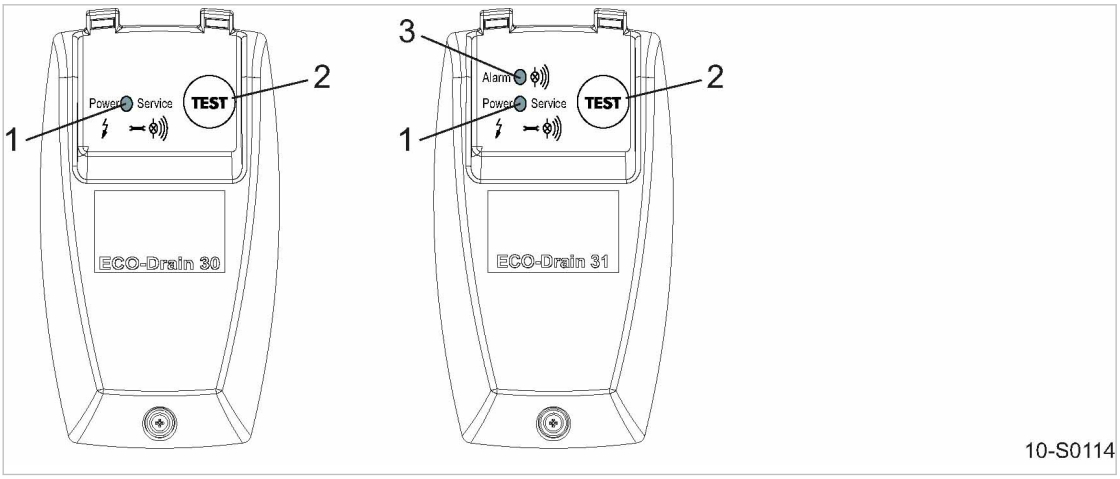


Fig. 38 Checking the condensate drain

[1] *Power* LED
[2] «TEST» key
[3] *Alarm* LED

1. **⚠ CAUTION** *Danger of burns from hot components near the condensate drain!*
   ➢ *Work with caution.*
2. With one hand, lightly touch the condensate drain hose at the condensate drain.
3. With your other hand, push and hold the «TEST» key at the condensate drain for at least 2 seconds.

Result As soon as the condensate drain opens, you will feel a short burst at the condensate drain hose.

Service the condensate drain if you do **not** experience a burst.

10.19.2.2 Changing the service unit

The condensate drain cannot be cleaned. The service unit must be changed if condensate does not drain.

Precondition The power supply disconnecting device is switched off,
The device is locked off,
A check has been made that no voltage is present.

The *Power* LED is off (see Fig. 38).

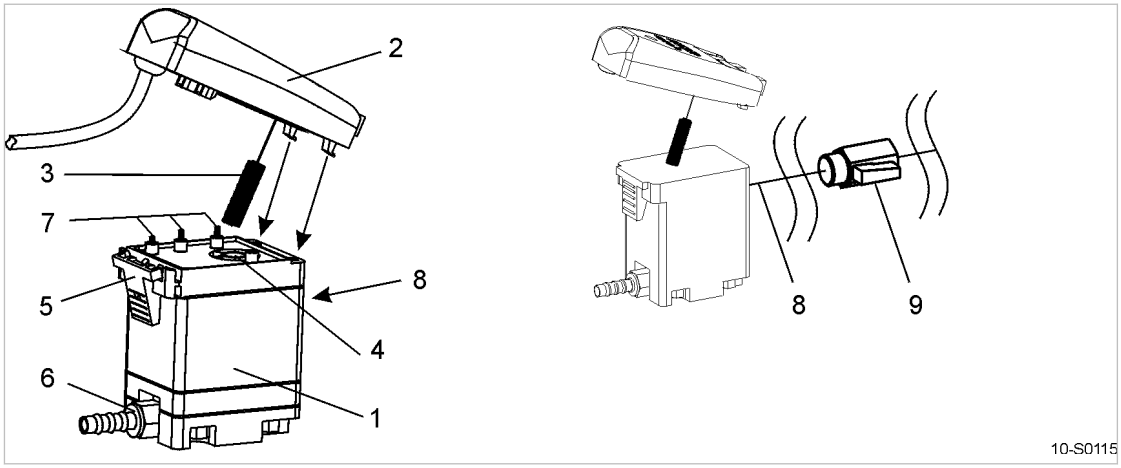


Fig. 39 Changing the service unit

1. Service unit
2. Control module
3. Sensor
4. Sensor opening
5. Snap fastener
6. Condensate drain hose fitting
7. Contact spring
8. Inlet
9. Shut-off valve

Removing the service unit

1. Close the shut-off valve 9 upstream of the condensate drain.
2. Unscrew the drain hose fitting.
3. Press the snap fastener 5 and remove the control module carefully from the service unit.
4. Carefully unscrew the service unit from the inlet pipe.

Fitting the service unit

Use only a KAESER service unit to ensure correct function of the condensate drain.

Precondition Make sure the top of the service unit and the contact spring are clean and dry.

1. Screw the service unit to the inlet pipe.
2. Carefully insert the control module sensor 3 in the opening 4 in the new service unit.
3. Place the hook of the control module into the service module eye and press until the snap fastener can be heard to click into place.
4. Fit the drain hose and open the shut-off valve 9 upstream of the condensate drain.
5. Close all access doors, replace and secure all removable panels.

10.20 Air receiver maintenance

10.20.1 Drain condensate

Fig. 40 Drain condensate

[1] Condensate drain

1. Undo the knurled screw on the condensate drain and drain the condensate into a suitable canister.
2. Close the condensate drain.

➢ Dispose of the condensate according to valid environmental regulations.

10.20.2 Checking the safety relief valve

Precondition The machine is switched off.
Always wear eye and ear protection.

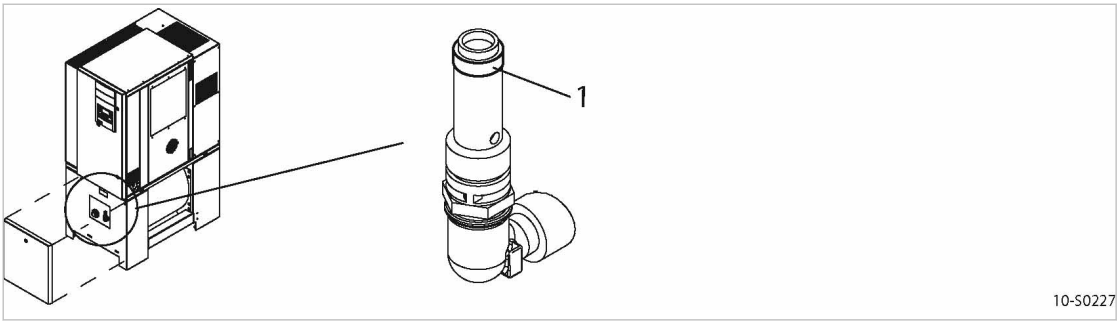


Fig. 41 Checking the safety relief valve

[1] Pull ring

1. Close the user's shut-off valve between the machine and the compressed air system.
2. Switch the machine on until the air receiver is full.
   Machine switches to IDLE running.
3. Shut down the machine and remove the panel on the air receiver.
4. Turn the ring counter-clockwise until the safety relief valve opened.
5. Turn the ring back completely.
6. Open the user's shut-off valve between the machine and the compressed air system.

The safety relief valve does not open?

➢ De-commission the machine until the defect safety relief valve is replaced.

10.21 Documenting maintenance and service work

Equipment number:

➢ Enter maintenance and service work carried out in the checklist below.

Date	Maintenance task carried out	Operating hours	Signature

Tab. 51 Logged maintenance tasks

11 Spares, Operating Materials, Service

11.1 Note the nameplate

The nameplate contains all information to identify your machine. This information is essential to us in order to provide you with optimal service.

➢ Please give the information from the nameplate with every inquiry and order for spares.

11.2 Ordering consumable parts and operating fluids/materials

KAESER consumable parts and operating materials are original KAESER products. They are specifically selected for use in KAESER machines.

Unsuitable or poor quality consumable parts and operating fluids/materials may damage the machine or impair its proper function.

Personal injury may result from machine damage.

⚠ WARNING

There is risk of personal injury or damage to the machine resulting from the use of unsuitable spares or operating fluids/materials.

➢ *Use only original KAESER parts and operating fluids/materials.*

➢ *Have an authorized KAESER service representative carry out regular maintenance.*

Machine

Name	Number
Air filter element	1250
Filter mat (option K3)	1050
Filter mat (control cabinet)	1100
Oil filter	1200
Oil separator cartridge	1450
Cooling oil	1600
Drive belt	1801
Condensate drain: Service unit	9602

Tab. 52 Consumable parts

11.3 KAESER AIR SERVICE

KAESER AIR SERVICE offers:

- authorized KAESER service representatives with KAESER factory training,
- increased operational reliability ensured by preventive maintenance,
- energy savings achieved by avoidance of pressure losses,
- optimum conditions for operation of the compressed air system,

- the security of genuine KAESER spare parts,
- increased legal certainty as all regulations are kept to.

➢ Why not sign a KAESER AIR SERVICE maintenance agreement!

Result Your advantage:
lower costs and higher compressed air availability.

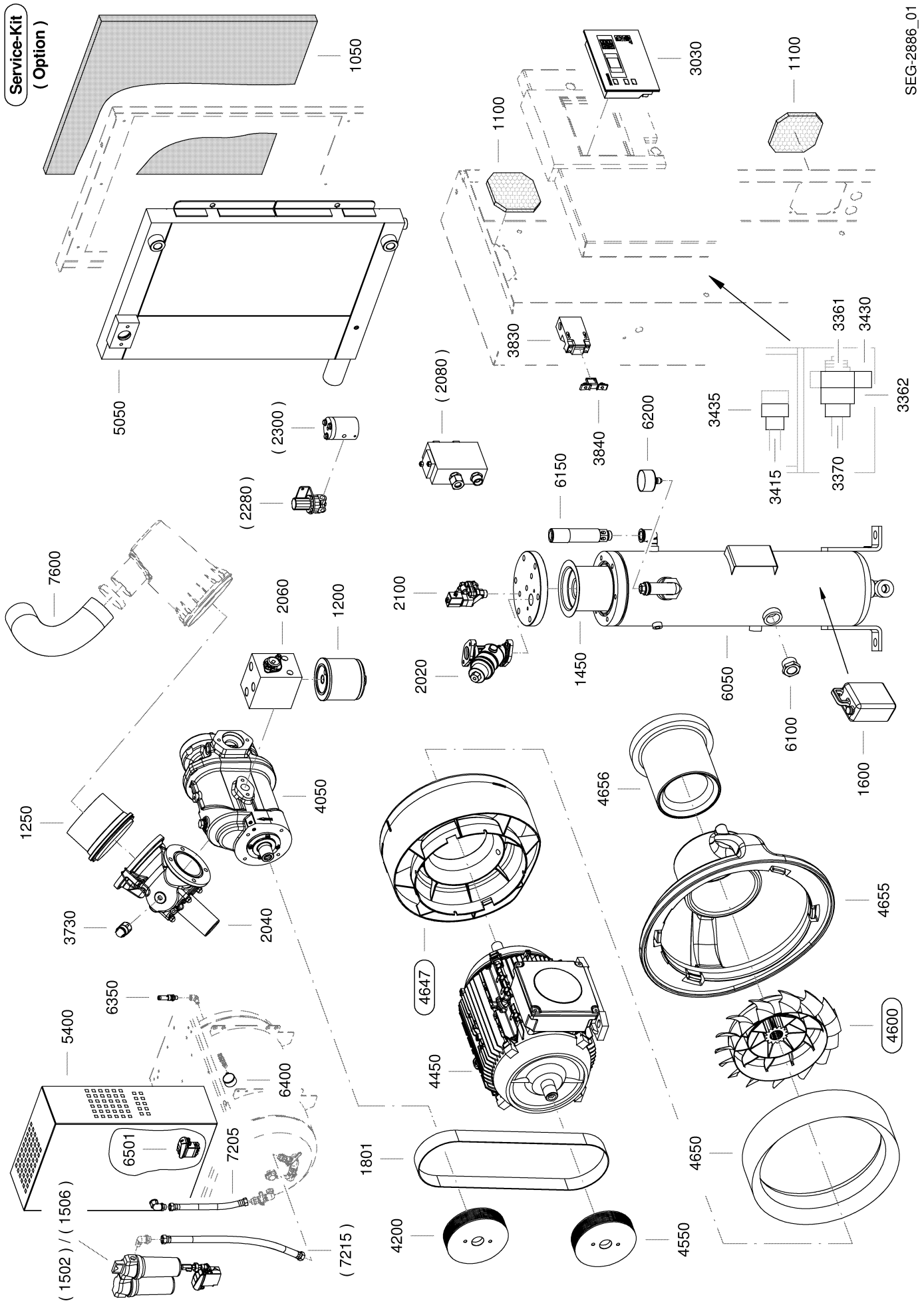
11.4 Service Addresses

Addresses of KAESER representatives are given at the end of this manual.

11.5 Replacement parts for service and repair

Use these parts lists to plan your material requirement according to operating conditions and to order the required spare parts.

➢ Make sure that any service or repair tasks not described in this manual are carried out by an authorized KAESER Service represenstative.


Service-Kit
(Option)
SEG-2886_01
1050
5050
3030
1100
1100
3830
3840
(2080)
6200
3435
3361
3430
3362
3370
3415
(2300)
(2280)
6150
7600
2060
1200
2100
2020
1450
6050
6100
1600
4050
1250
3730
2040
4656
4655
4647
4600
4450
6350
5400
6400
6501
7205
1801
4650
(1502) / (1506)
(7215)
4200
4550

Legend	KAESER
Aircenter SK.2	SEL-2254_01E

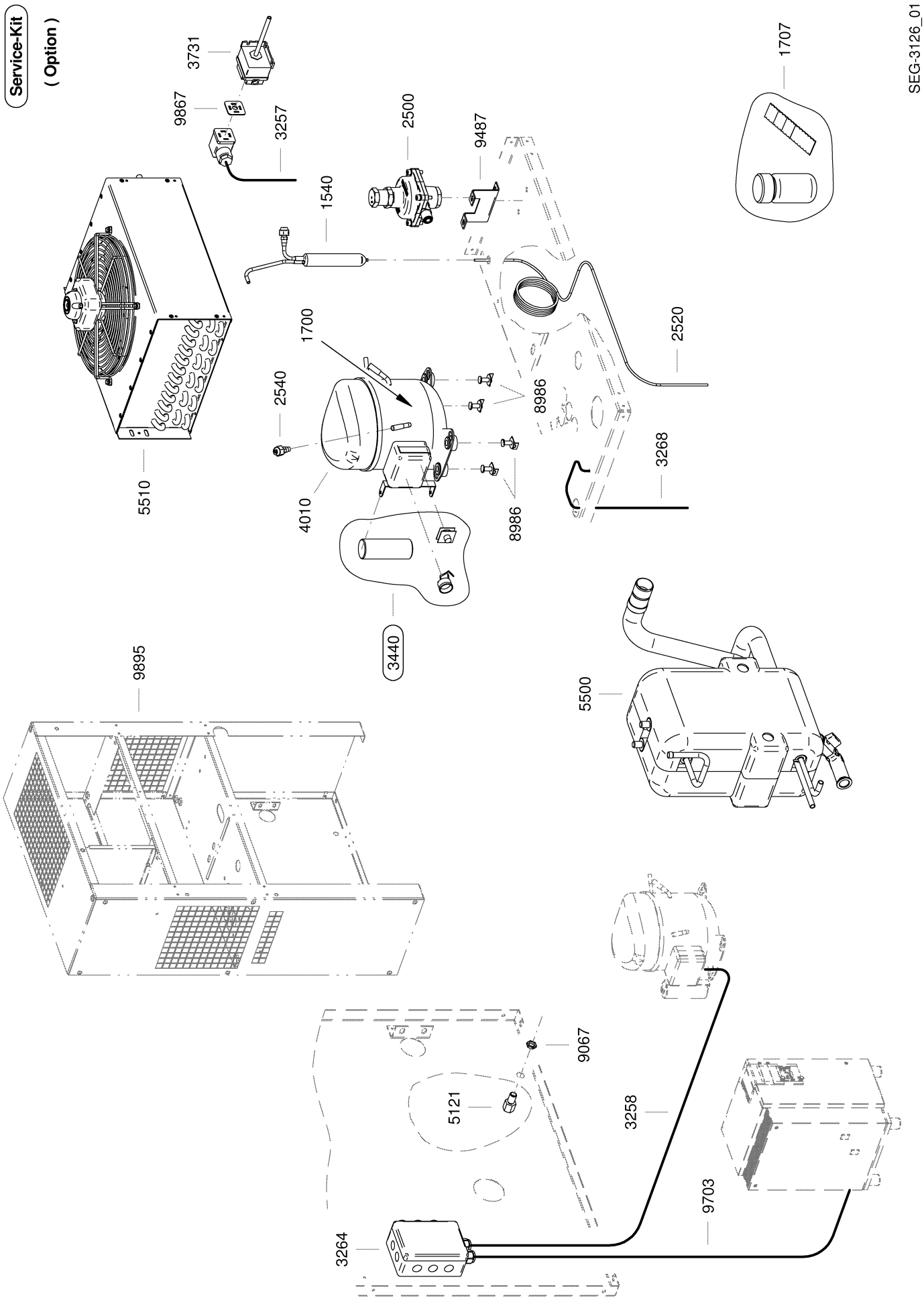
Item	Description	Option
1050	Filter mat, cooling air	
1100	Filter mat, control cabinet	
1200	Oil filter	
1250	Air filter element	
1450	Oil separator cartridge	
1502	Compressed air filter	x
1506	Compr. air filter combination	x
1600	SIGMA FLUID	
1801	Drive belt	
2020	Minimum pressure/check valve	
2022	Maintenance kit, MP/CV	
2024	Overhaul kit, MP/CV	
2040	Inlet valve	
2042	Maintenance kit, inlet valve	
2044	Overhaul kit, inlet valve	
2060	Combination valve	
2062	Maintenance kit, combi. Valve	
2064	Overhaul kit, combination valve	
2080	Thermostatic valve (heat rec.)	x
2082	Maintenance kit, thermostatic valve	
2084	Overhaul kit, thermostatic valve	
2100	Venting and control valve	
2102	Maintenance kit, VC valve	
2104	Overhaul kit, VC valve	
2280	Proportional controller	x
2282	Maintenance kit, prop. Ctr.	
2300	Pneumatic valve	x
2302	Maintenance kit, pneumatic valve	
3030	SIGMA controller	
3361	Mains contactor	
3362	Delta contactor	
3370	Star contactor	
3415	Contactor, dryer	
3430	Overload protection cutout	
3435	Dryer protect switch	
3730	Rotating direction breaker	
3830	Safety interlock switch	
3840	Actuator (interlock switch)	
4050	SIGMA exchange airend	
4200	Crankshaft pulley	
4450	Drive motor	
4451	Drive motor bearing kit	
4550	Drive motor pulley	
4600	Drive motor blower wheel	
4647	Air guiding ring, fan wheel	
4650	Fan spacer ring	
4655	Motor cooling air flow guide	
4656	Foam roller	
5050	Cooler	
5400	Refrigeration dryer	
6050	Oil separator tank	
6100	Oil level indicator	
6150	OST pressure relief valve	
6200	Oil sep. tank pressure gauge	
6350	Air tank safety valve	
6400	Air tank pressure gauge	
6501	Condensate drain, dryer	
9602	Condensate drain service-unit	
7205	Hose line	
7215	Hose line	x
7600	Inlet hose	

Please quote the part number and serial number of the machine together with the item number and the description of the part when ordering.

Before and during all work, be sure to read and follow the safety and service instructions in the machine's service manual.

Maintenance intervals under good ambient and operating conditions, such as low to moderate ambient temperature and dry, clean inlet air.

Maintenance intervals may decrease due to ambient and operating conditions.


Service-Kit
(Option)
SEG-3126_01
3731
9867
3257
2500
9487
1707
1540
1700
2520
2540
8986
3268
5510
4010
8986
3440
9895
5500
9067
5121
3258
9703
3264

Legend	KAESER
Refrigeration dryer ABT	SEL-2346_01E

Item		Description	Option
1540	*	Service cartridge	
1700	*	Refrigerant	
1707		Acid test, refrigerant	
2500	*	Hot gas bypass regulator	
2520	*	Capillary tube	
2540	*	Refrigerant filling port	
3257		Pressure switch cable set	
3258		Refr.compress.connecting cable	
3264		Terminal box cpl.	
3268		Earth cable	
3440		Switch set	
3731	*	Safety pressure switch	
4010	*	Refrigerant compressor	
5121		Double nipple	
5500	*	Heat exchanger	
5510	*	Refrigerant condenser cpl.	
8986		Fixing kit	
9067		Locknut	
9487		Bracket	
9703		Connecting cable	
9867		Gasket	
9895		Dryer paneling	

Please quote the part number and serial number of the machine together with the item number and the description of the part when ordering.

Before and during all work, be sure to read and follow the safety and service instructions in the machine's service manual.

* The replacement of the spare parts described requires an authorized and certified refrigerant technician.

12 Decommissioning, Storage and Transport

12.1 Decommissioning

Decommissioning is necessary, for example, under the following circumstances:

- The machine is (temporarily) not needed.
- The machine is to be moved to another location.
- The machine is to be scrapped.

Temporary decommissioning

Precondition The machine can be started at regular intervals.

➢ Run the machine once a week for at least 30 minutes under LOAD to ensure sufficient protection against corrosion.

Long-term decommissioning

Precondition Immediately prior to decommissioning, run the machine under LOAD for at least 30 minutes.

The power supply disconnecting device is switched off,
the device is locked off,
the absence of voltage has been verified,

the machine is fully vented (no pressure).

1. Allow the machine to completely cool down.
2. Disconnect all air and electrical connections.

12.2 Packing

A wooden crate is required for overland transport to protect the machine from mechanical damage.

Other measures must be taken for the transport of machines by sea or air. Please contact an authorized KAESER service representative for more information.

Material Desiccant
Plastic sheeting
Wooden crate

Precondition The machine is decommissioned.

The machine is dry and cooled down.

1. Place sufficient desiccant silica gel or desiccant clay) in the machine.
2. Wrap the machine fully in plastic sheeting.
3. Protect the machine in a wooden crate against mechanical damages.

12.3 Storage

Moisture can lead to corrosion, particularly on the surfaces of the airend and in the oil separator tank.

Frozen moisture can damage components, valve diaphragms and gaskets.

The following measures also apply to machines not yet commissioned.

Please consult with KAESER if you have questions to the appropriate storage and commissioning.

1. **NOTICE** *Moisture and frost can damage the machine!*
   - ➢ *Prevent ingress of moisture and formation of condensation.*
   - ➢ *Maintain a storage temperature of >32 °F.*
2. Store the machine in a dry, frost-proof room.

12.4 Transport

12.4.1 Safety

Weight and center of gravity determine the most suitable method of transportation. The center of gravity is shown in the drawings in chapter 13.3.

- ➢ Please consult with KAESER if you intend to transport the machine in freezing temperatures.

Precondition Transport only by forklift truck or lifting gear only by personnel trained in the safe transportation of loads.

- ➢ Make sure the danger area is clear of personnel.

12.4.2 Transport with a forklift truck

Precondition The forks are fully under the machine.

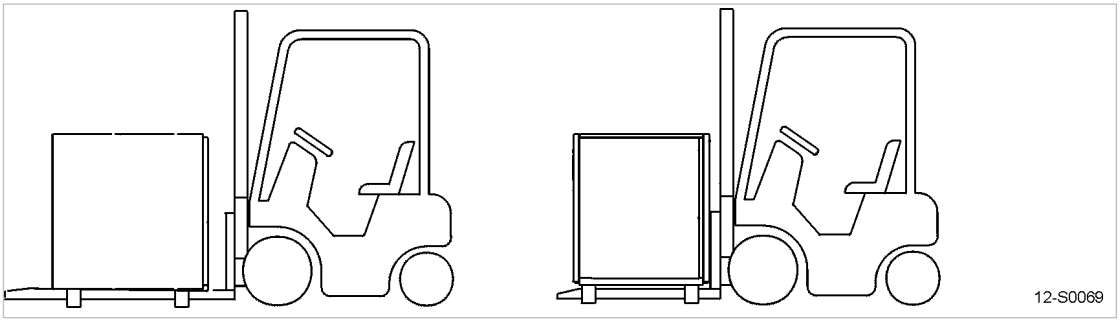


Fig. 42 Transport with a forklift truck

- ➢ Drive the forks completely under the machine or palet and lift carefully.

12.4.3 Transport with a crane

Suitable lifting gear ensures correct transportation.
The lifting slings must be fed under the machine.
The slings may not bear on the side of the machine enclosure.

Examples of unsuitable fixing points:

- Pipe sockets
- Flanges

- Attached components such as cyclone separators, condensate drains, or filters
- Rain protection covers

➢ Please consult with KAESER if you have questions regarding the appropriate lifting gear.

Precondition The lifting gear complies with local safety regulations.
No pressure should bear on the sides of the machine cabinet.

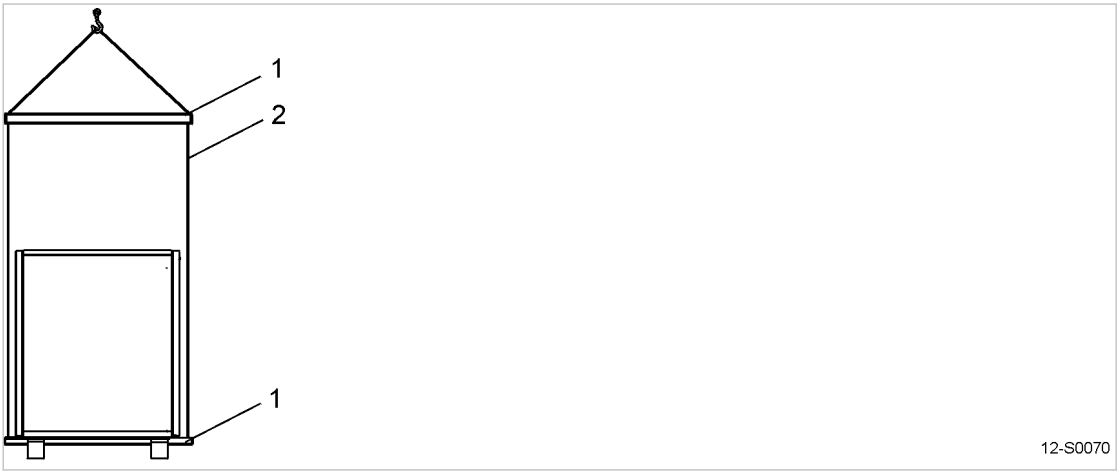


Fig. 43 Transport with a crane
[1] Lifting gear
[2] Slings

1. **NOTICE** *The machine can be damaged by incorrect attachment of the lifting gear!*
   ➢ *Do not attach the lifting gear to any of the machine components.*
2. Use the lifting gear correctly and lift the machine carefully.

12.5 Disposal

When disposing of a machine, drain out all liquids and remove dirty filters.

Precondition The machine is decommissioned.

1. Completely drain the cooling oil from the machine.
2. Remove used filters and the oil separator cartridge.
3. Hand the machine over to an authorized disposal expert.

➢ Parts contaminated with cooling oil must be disposed of in accordance with local environment protection regulations.

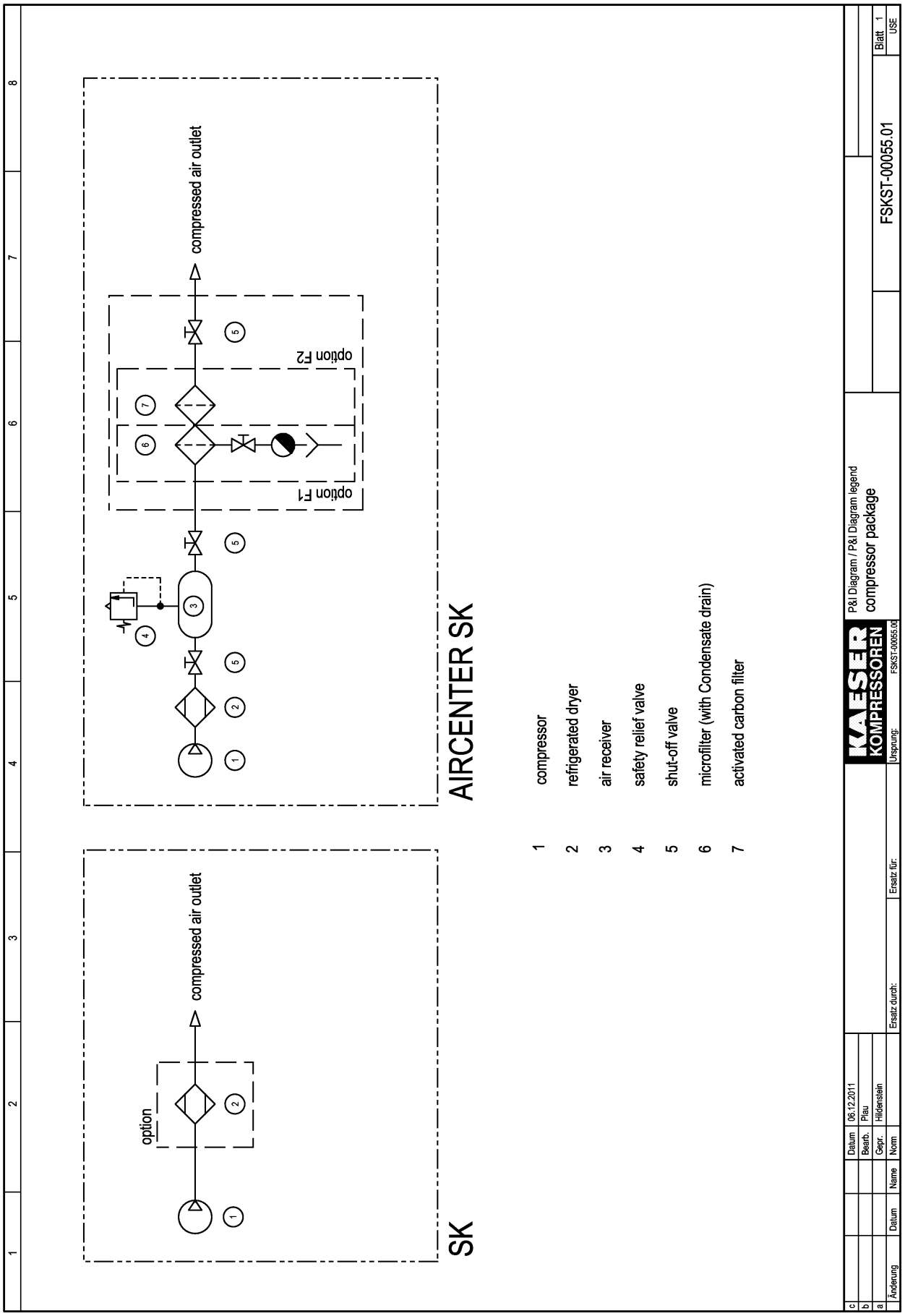
Compressors with refrigeration dryers

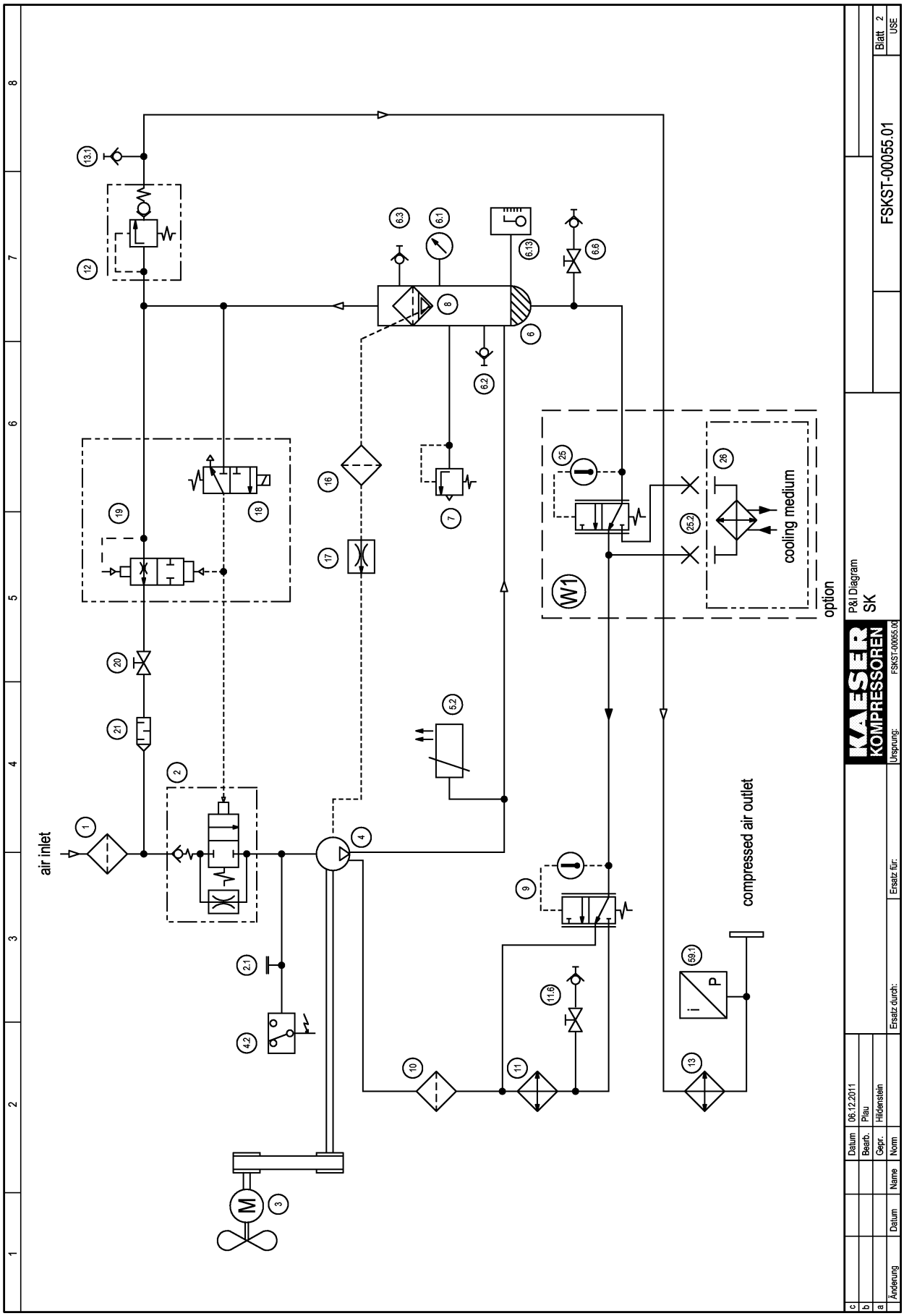
The sealed refrigerant circuit still contains both refrigerant and oil.

➢ Refrigerant and oil must be drained and disposed of by authorized personnel.

13 Annex

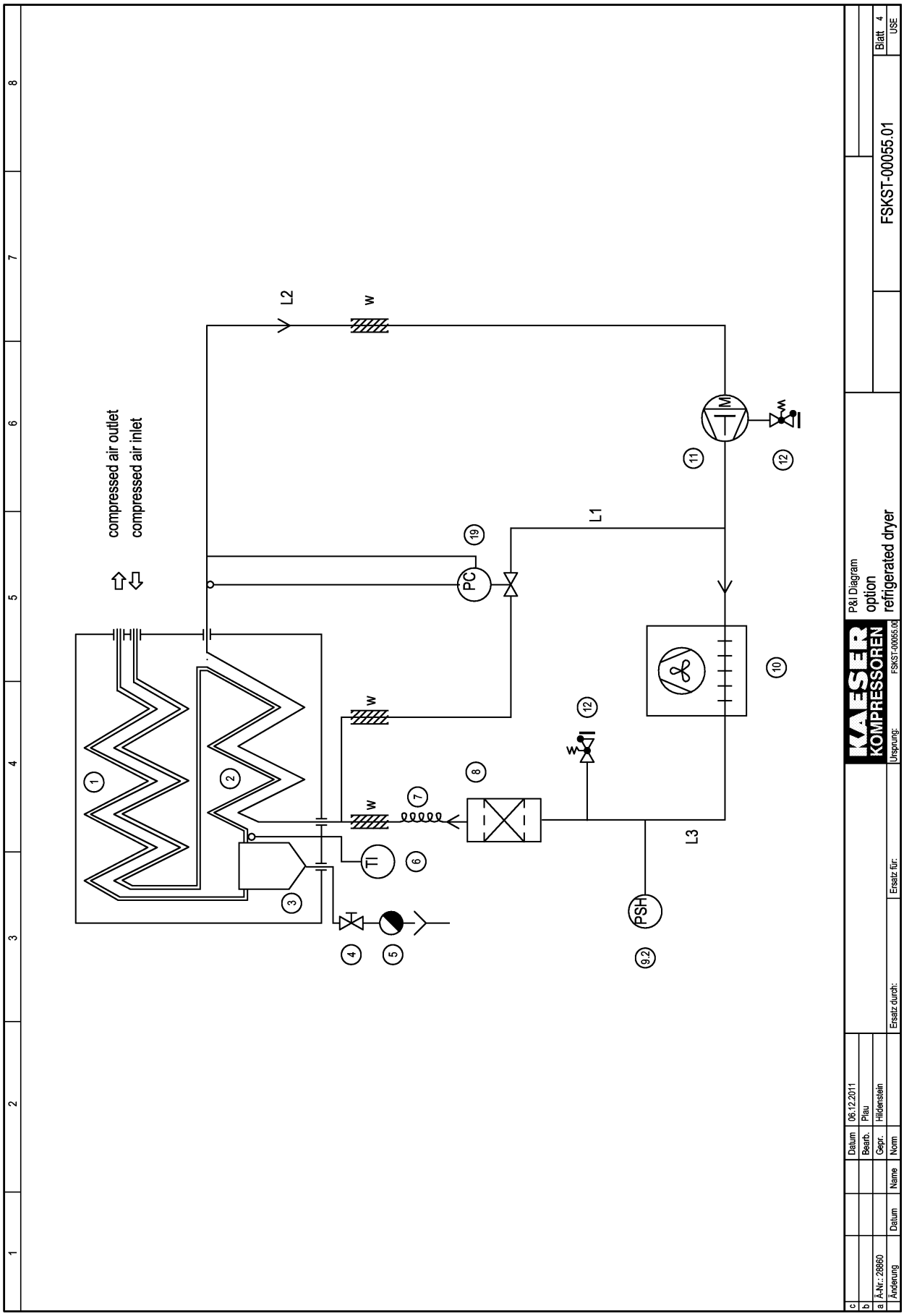
13.1 Pipeline and instrument flow diagram (P+I diagram)


compressed air outlet
option F2
option F1
AIRCENTER SK
compressed air outlet
option
SK
1 compressor
2 refrigerated dryer
3 air receiver
4 safety relief valve
5 shut-off valve
6 microfilter (with Condensate drain)
7 activated carbon filter
P&I Diagram / P&I Diagram legend
compressor package
FSKST-00055.01
Blatt 1
USE


air inlet
compressed air outlet
cooling medium
option
W1
M
P
i
FSKST-00055.01
P&I Diagram
SK
KAESER KOMPRESSOREN
Blatt 2
USE
Ursprung:
FSKST-00055.00
Ersatz für:
Ersatz durch:
Datum
Bearb.
Gepr.
Norm
06.12.2011
Plau
Hildenstein
Name
Datum
Änderung

1	air filter
2	inlet valve
2.1	oil filler port with screw plug
3	drive motor
4	airend
4.2	pressure switch - wrong direction of rotation
5.2	PT100-sensor
6	oil separator tank
6.1	pressure gauge
6.2	hose coupling (oil side)
6.3	hose coupling (air side)
6.6	shut-off valve with hose coupling - oil drain
6.13	oil level indicator
7	safety relief valve
8	oil separator cartridge
9	oil temperature controller
10	oil filter
11	oil cooler
11.6	shut-off valve with hose coupling - oil drain
12	minimum pressure check valve
13	air aftercooler
13.1	hose coupling
16	dirt trap
17	nozzle
18/19	combined control/venting valve
	18 control valve
	19 venting valve
20	shut-off valve - venting line
21	silencer
25	oil temperature thermostat for heat recovery system
25.2	screw plug
26	heat recovery system
59.1	pressure transducer - system pressure
option	
W1	heat recovery system, external

c				Datum	06.12.2011		KAESER KOMPRESSOREN	P&I Diagram legend SK	
b				Bearb.	Plau				
a				Gepr.	Hildenstein				
	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung: FSKST-00055.00	FSKST-00055.01	Blatt 3 USE


compressed air outlet
compressed air inlet
L1
L2
L3
PC
TI
PSH
P&I Diagram
option
refrigerated dryer
FSKST-00055.01
Blatt 4
USE
KAESER KOMPRESSOREN
FSKST-00055.00
Ursprung:
Ersatz für:
Ersatz durch:
Datum
Bearb.
Cepr.
Norm
Name
06.12.2011
Plau
Hildenstein
Änderung
Datum
A-Nr.: 28860

1	2	3	4	5	6	7	8

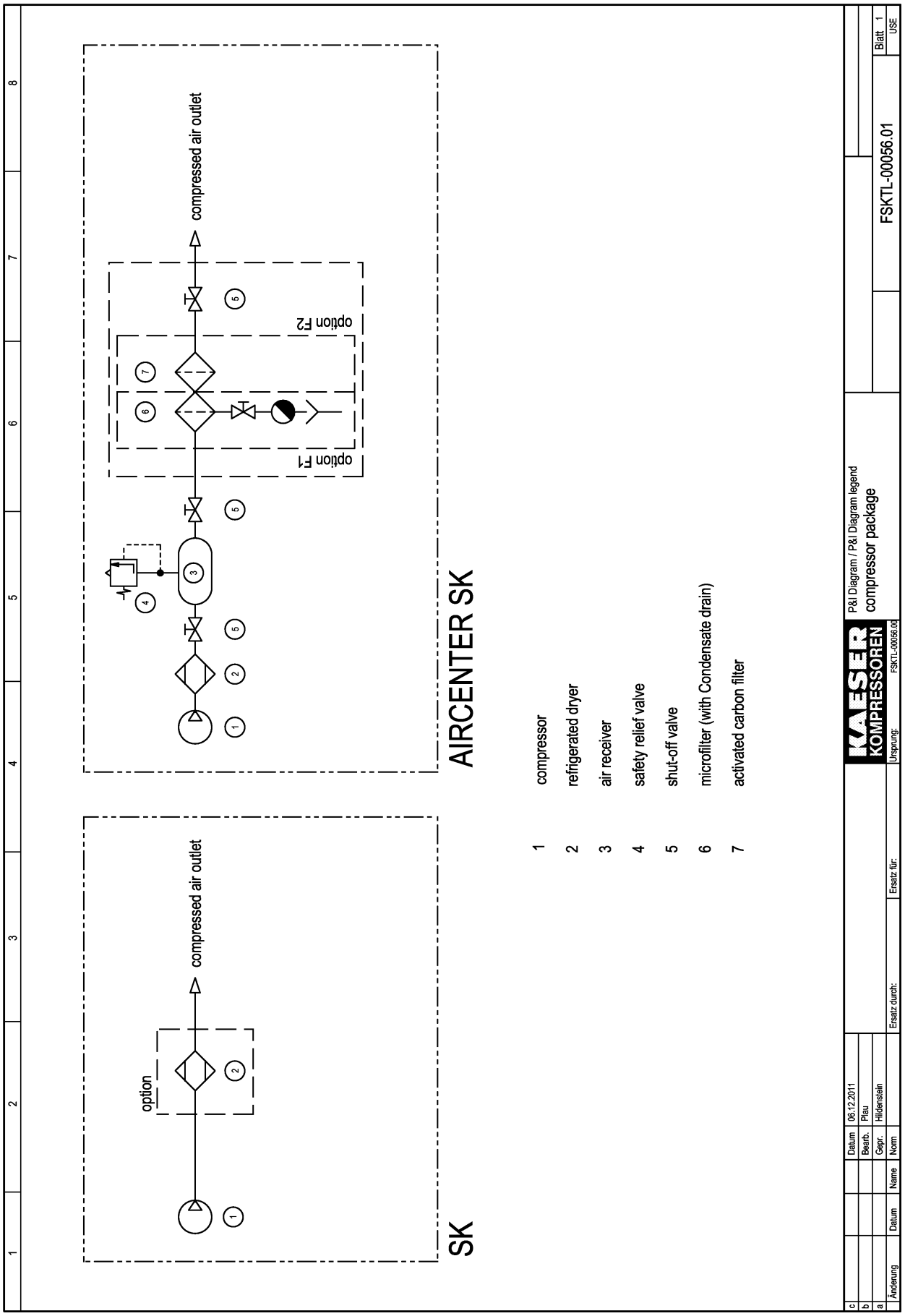
1	air to air heat exchanger	heat insulated	12	service connection (schrader valve)
2	air to refrigerant heat exchanger (vapouriser)		19	hot gas bypass regulator
3	condensate separator			
4	shut-off valve			
5	condensate drain			
6	pressure dew point indicator TI			
7	capillary tube (refrigerant injection)			
8	filter dryer			
9.2	safety pressure controller			
10	refrigerant condenser (air cooled condenser)			
11	refrigerant compressor (hermetic)			

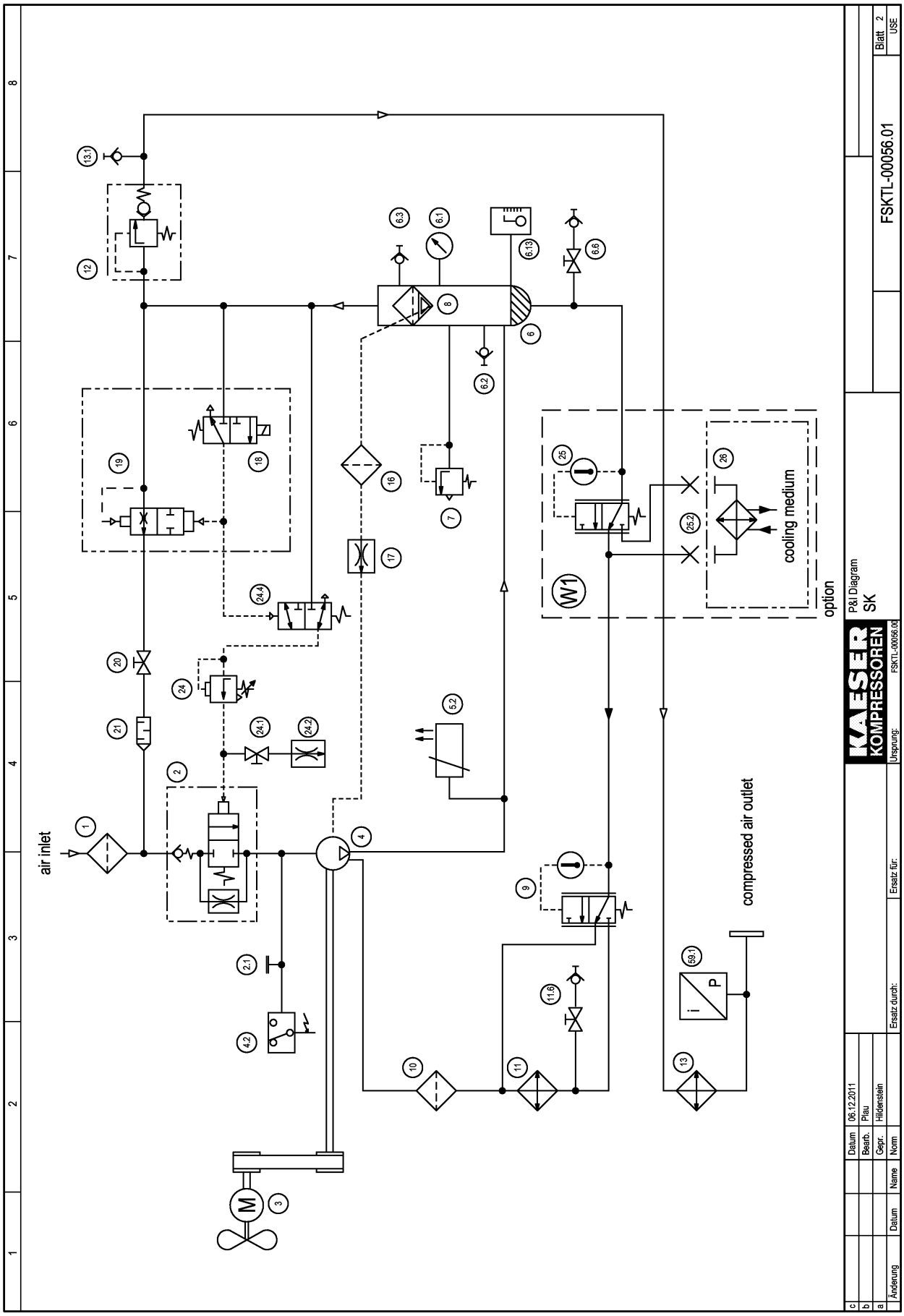
piping:

L1	bypass line
L2	CU-pipe
L3	CU-pipe
w	heat insulated

c				Datum	06.12.2011		KAESER KOMPRESSOREN	P&I Diagram legend option refrigerated dryer	
b				Bearb.	Plau				
a	Ä-Nr.: 28860			Gepr.	Hildenstein				
	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung: FSKST-00055.00	FSKST-00055.01 Blatt 5 USE

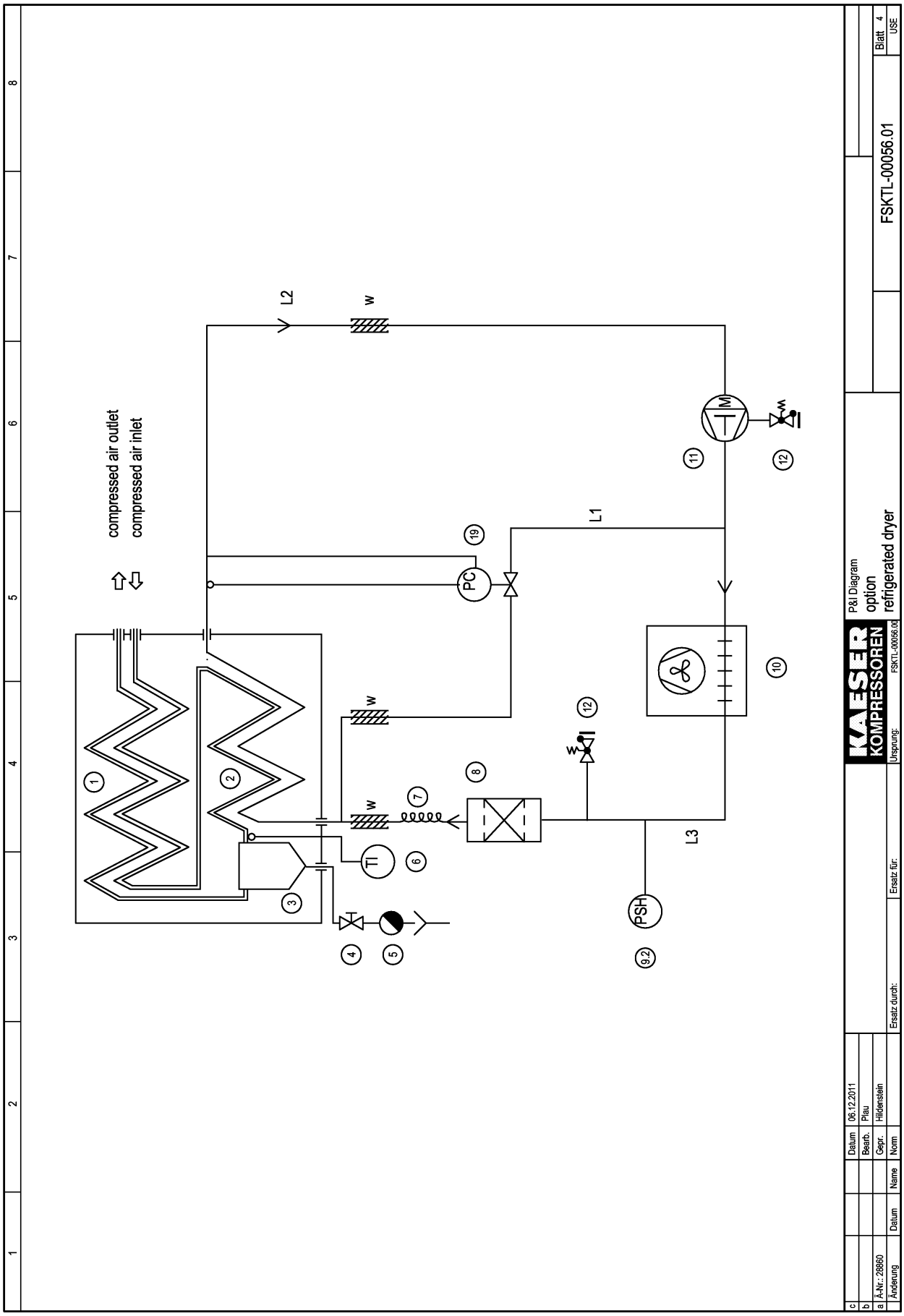
13.2 Option C1 Pipe and Instrument Flow Diagram (P+I diagram): MODULATING control mode


compressed air outlet
option F2
option F1
AIRCENTER SK
compressed air outlet
option
SK
1 compressor
2 refrigerated dryer
3 air receiver
4 safety relief valve
5 shut-off valve
6 microfilter (with Condensate drain)
7 activated carbon filter
P&I Diagram / P&I Diagram legend
compressor package
FSKTL-00056.01
Blatt 1
USE
Datum 06.12.2011
Bearb. Plau
Gepr. Hildenstein
Name Norm
Änderung Datum
Ersatz durch:
Ersatz für:
Ursprung:
FSKTL-00056.01


air inlet
compressed air outlet
cooling medium
option
W1
M
P
i
P&I Diagram
SK
FSKTL-00056.01
Blatt 2
USE
KAESER KOMPRESSOREN
FSKTL-00056.00
Ursprung:
Ersatz für:
Ersatz durch:
Datum 06.12.2011
Bearb. Plau
Gepr. Hildenstein
Norm
Name
Datum
Änderung

1	air filter
2	inlet valve
2.1	oil filler port with screw plug
3	drive motor
4	airend
4.2	pressure switch - wrong direction of rotation
5.2	PT100-sensor
6	oil separator tank
6.1	pressure gauge
6.2	hose coupling (oil side)
6.3	hose coupling (air side)
6.6	shut-off valve with hose coupling - oil drain
6.13	oil level indicator
7	safety relief valve
8	oil separator cartridge
9	oil temperature controller
10	oil filter
11	oil cooler
11.6	shut-off valve with hose coupling - oil drain
12	minimum pressure check valve
13	air aftercooler
13.1	hose coupling
16	dirt trap
17	nozzle
18/19	combined control/venting valve
18	control valve
19	venting valve
20	shut-off valve - venting line
21	silencer
24	proportional controller
24.1	shut-off valve open: machine in modulating control shut-off valve closed: package running in DUAL-/QUADRO or VARIO mode
24.2	nozzle
24.4	3/2-directional control valve
25	oil temperature thermostat for heat recovery system
25.2	screw plug
26	heat recovery system
59.1	pressure transducer - system pressure
option	
W1	heat recovery system, external

c				Datum	06.12.2011		KAESER KOMPRESSOREN	P&I Diagram legend SK	
b				Bearb.	Plau				
a				Gepr.	Hildenstein				
	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung: FSKTL-00056.00	FSKTL-00056.01	Blatt 3 USE


compressed air outlet
compressed air inlet
L1
L2
L3
PC
TI
PSH
M
P&I Diagram
option
refrigerated dryer
FSKTL-00056.01
FSKTL-00056.00
KAESER KOMPRESSOREN
Blatt 4
USE
Datum
Bearb.
Gepr.
Norm
Name
06.12.2011
Plau
Hildenstein
Ersatz durch:
Ersatz für:
Ursprung:
Änderung
A-Nr.: 28860

1	2	3	4	5	6	7	8

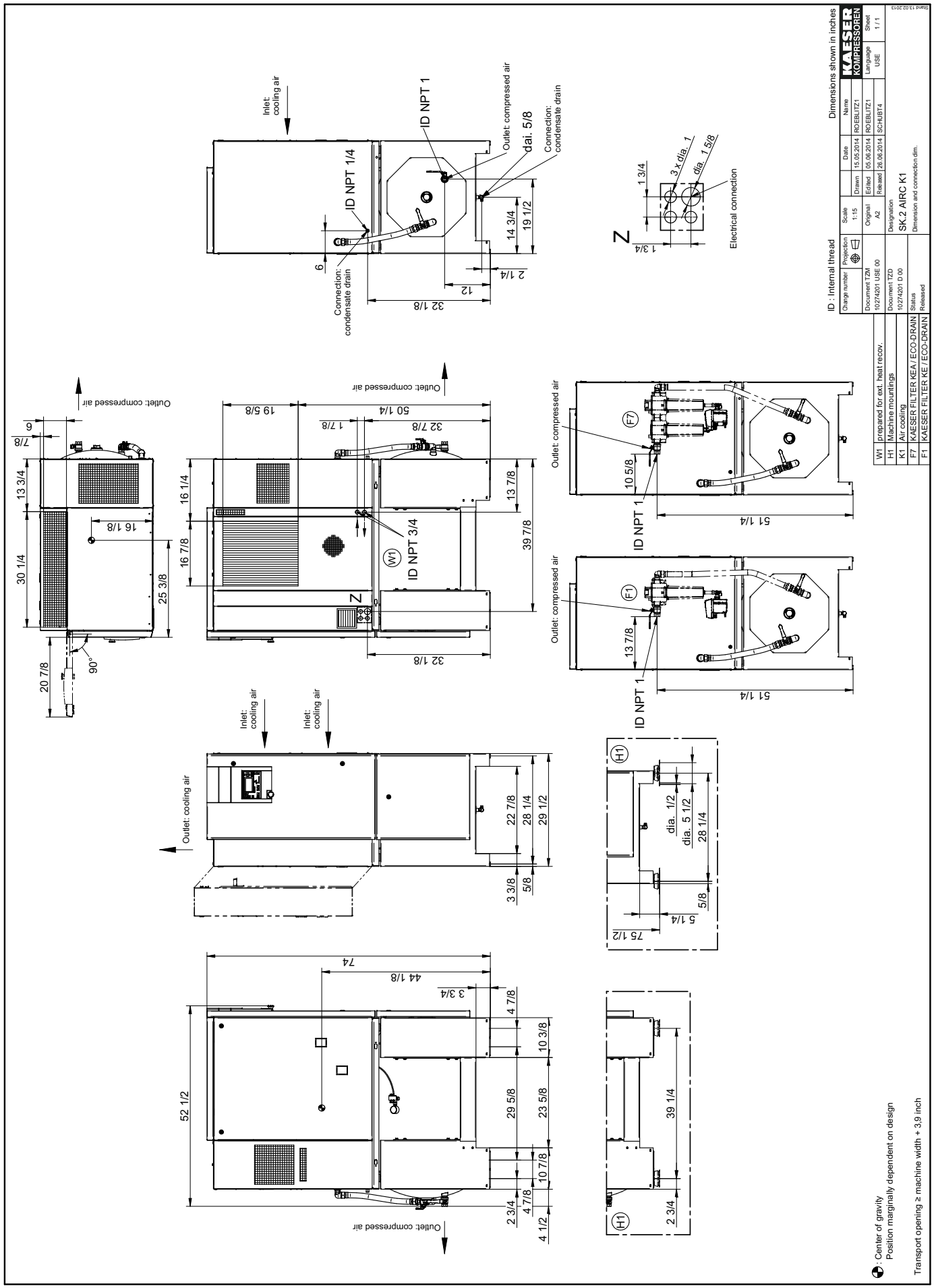
1	air to air heat exchanger	heat insulated	12 service connection (schrader valve)
2	air to refrigerant heat exchanger (vapouriser)		19 hot gas bypass regulator
3	condensate separator		
4	shut-off valve		
5	condensate drain		
6	pressure dew point indicator TI		
7	capillary tube (refrigerant injection)		
8	filter dryer		
9.2	safety pressure controller		
10	refrigerant condenser (air cooled condenser)		
11	refrigerant compressor (hermetic)		

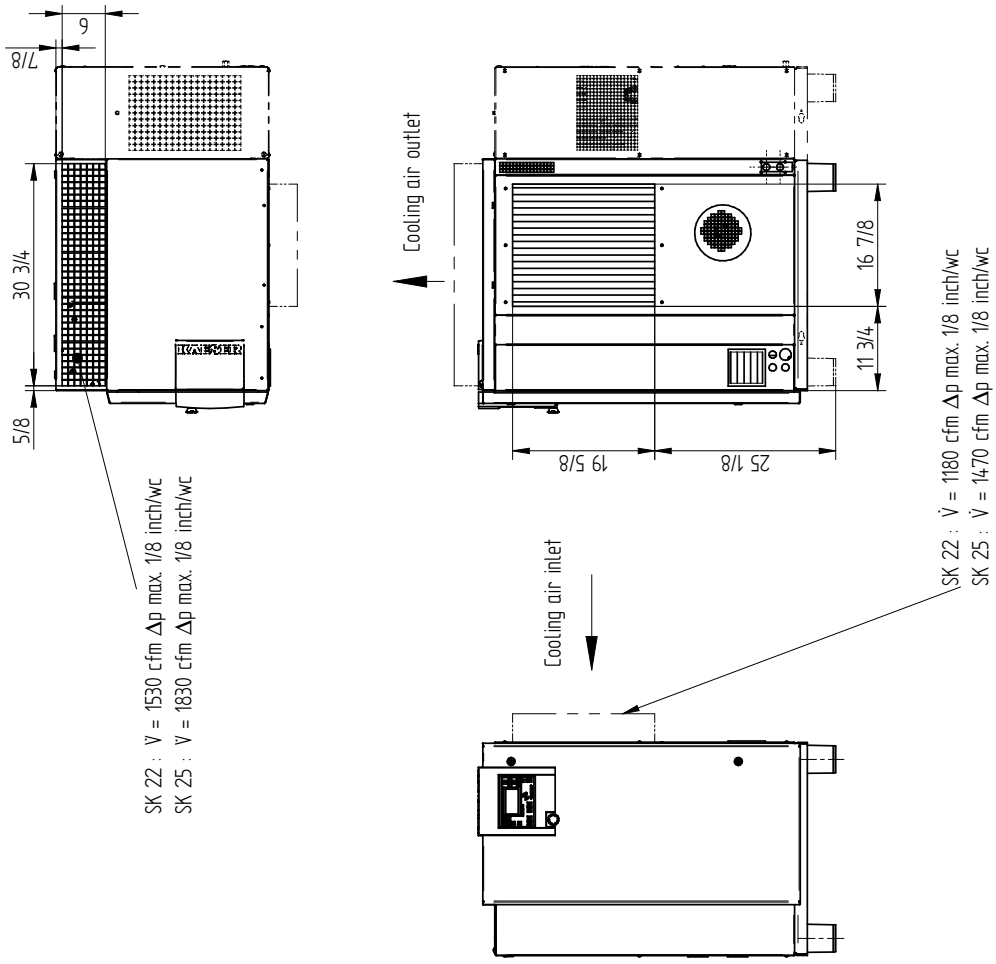
piping:

L1	bypass line
L2	CU-pipe
L3	CU-pipe
w	heat insulated

c				Datum	06.12.2011		KAESER KOMPRESSOREN	P&I Diagram legend option refrigerated dryer	
b				Bearb.	Plau				
a	Ä-Nr.: 28860			Gepr.	Hildenstein				
	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung: FSKTL-00056.00	FSKTL-00056.01 Blatt 5 USE

13.3 Dimensional drawing





Index	Änderungs-Nr.	Maßstab		Datum	Name	KAESER KOMPRESSOREN	
			Gez.	06.10.10	Roeblitz1	Sprache	Blatt
Dokument-Nr.		Original	Bearb.			USE	
10183467 D 00		A3	Freigeg	06.10.10	Schubart, P.		
Techn. Dienst Nr.		Bezeichnung					
T11330.00		SK 22/25 K1 Total permissible pressure loss for installed ducting					

13.4 Electrical Diagram

1	2	3	4	5	6	7	8

ATTENTION !!!

The unit is non-functional when delivered.
Before connecting the electrical supply,
please follow the advice contained
in the 'Installation' chapter and
the wiring diagram of the service manual.

Wiring Diagram

compressor series SK

with SIGMA CONTROL BASIC

208V±10% 3ph 60Hz
230V±10% 3ph 60Hz
460V±10% 3ph 60Hz

Tri-Voltage

Power supply:
WYE system with center point solidly grounded

ATTENTION !!!
The document gives collective information on
power supply voltages and frequencies for all machines.
The voltage and frequency and local conditions under
which any particular machine may be used
are given on the nameplate of the machine
and in the accompanying service manual.

manufacturer: KAESER COMPRESSORS
96450 COBURG
GERMANY

c				Datum	04.07.2012 USE			KAESER KOMPRESSOREN	cover page		=
b				Bearbeiter	Sitter				compressor series SK		+
a				Geprüft	Büchner						
A	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung:		DSK.B-U3003.02	page 1 / 1 Bl.

Lfd. Nr. No.	Benennung Name		Zeichnungsnummer (Kunde) Drawing No. (customer)	Zeichnungsnummer (Hersteller) Drawing No. (manufacturer)	Blatt Page	Anlagenkennzeichen Unit designation
1	cover page			DSK.B-U3003.02	1	
2	list of contents			ZSK.B-U3003.02	1	
3	general instructions			USK.B-U3003.02	1	
4	electrical equipment identification			USK.B-U3003.02	2	
5	electrical component parts list			USK.B-U3003.02	3	
6	wiring diagram	power unit		SSK.B-U3003.02	1	
7	wiring diagram	power unit air dryer		SSK.B-U3003.02	2	
8	wiring diagram	control voltage tapping		SSK.B-U3003.02	3	
9	wiring diagram	supply/Relay-outputs		SSK.B-U3003.02	4	
10	wiring diagram	inputs inside		SSK.B-U3003.02	5	
11	wiring diagram	inputs/outputs external		SSK.B-U3003.02	6	
12	wiring diagram	control voltage supply		SSK.B-U3003.02	7	
13	wiring diagram	supply air dryer		SSK.B-U3003.02	8	
14	terminal connection	terminal strip -X0,-X11		KSK.B-U3003.02	1	
15	terminal connection	option T3/-X31,-3X31		KSK.B-U3003.02	2	
16	lay-out	control panel		ASK.B-U3003.02	1	

c				Datum	04.07.2012		KAESER KOMPRESSOREN	list of contents	=
b				Bearbeiter	Sitter			compressor series SK	+
a				Geprüft	Büchner				
B	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung:	ZSK.B-U3003.02	page 1 1 Bl.

1	2	3	4	5	6	7	8

general instructions

ATTENTION !!!

Install supplies, grounding and shock protection
to local safety regulations.

Do not make or break
live plug-in connectors.

control cabinet wiring for non-designated conductors

primary circuits ungrounded:	black, UL-Style 1015, CSA-TEW
primary circuits grounded:	grey, UL-Style 1015, CSA-TEW
control voltage AC 115V ungrounded:	red, 18AWG UL-Style 1015, CSA-TEW
control voltage AC 115V grounded:	white, 18AWG UL-Style 1015, CSA-TEW
control voltage AC 15V:	brown, 18AWG UL-Style 1015, CSA-TEW
control voltage DC ungrounded:	blue, 18AWG UL-Style 1015, CSA-TEW
control voltage DC grounded:	white/blue, 18AWG UL-Style 1015, CSA-TEW
external voltage:	orange, 16AWG UL-Style 1015, CSA-TEW
measuring circuits:	violet, 18AWG UL-Style 1015, CSA-TEW
ground conductor:	green/yellow, UL-Style 1015, CSA-TEW

option F1 / F7 = KAESER FILTER KE / KEA

option T3 = option refrigeration dryer

c				Datum	04.07.2012		KAESER KOMPRESSOREN	general instructions	=
b				Bearbeiter	Sitter			compressor series SK	+
a				Geprüft	Büchner				
C	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung:	USK.B-U3003.02	page 1 / 3 Bl.

electrical equipment identification

general components

-B25	overload relay compressor motor
-1FU,-2FU	primary control fuse
-3FU	secondary control fuse
-K20	SIGMA CONTROL BASIC
-M1	compressor motor
-Q1	main contactor
-Q2	delta contactor
-Q3	wye contactor
-S1	EMERGENCY STOP pushbutton
-S5	door safety interlock switch
-T11	control transformer

terminal strips/plug-in connections

-X0	terminal strip, power supply
-X11	terminal strip, control
-X31,-3X31	terminal strip refrigeration dryer, option T3

option T3 - refrigeration dryer

-4FU,-5FU	primary control fuse
-6FU	secondary control fuse
-K13	condensate drain, option F1 / F7
-K34	condensate drain
-M30	compressor motor
-M31	vent motor
-Q30	motor starter
-T30	transformer

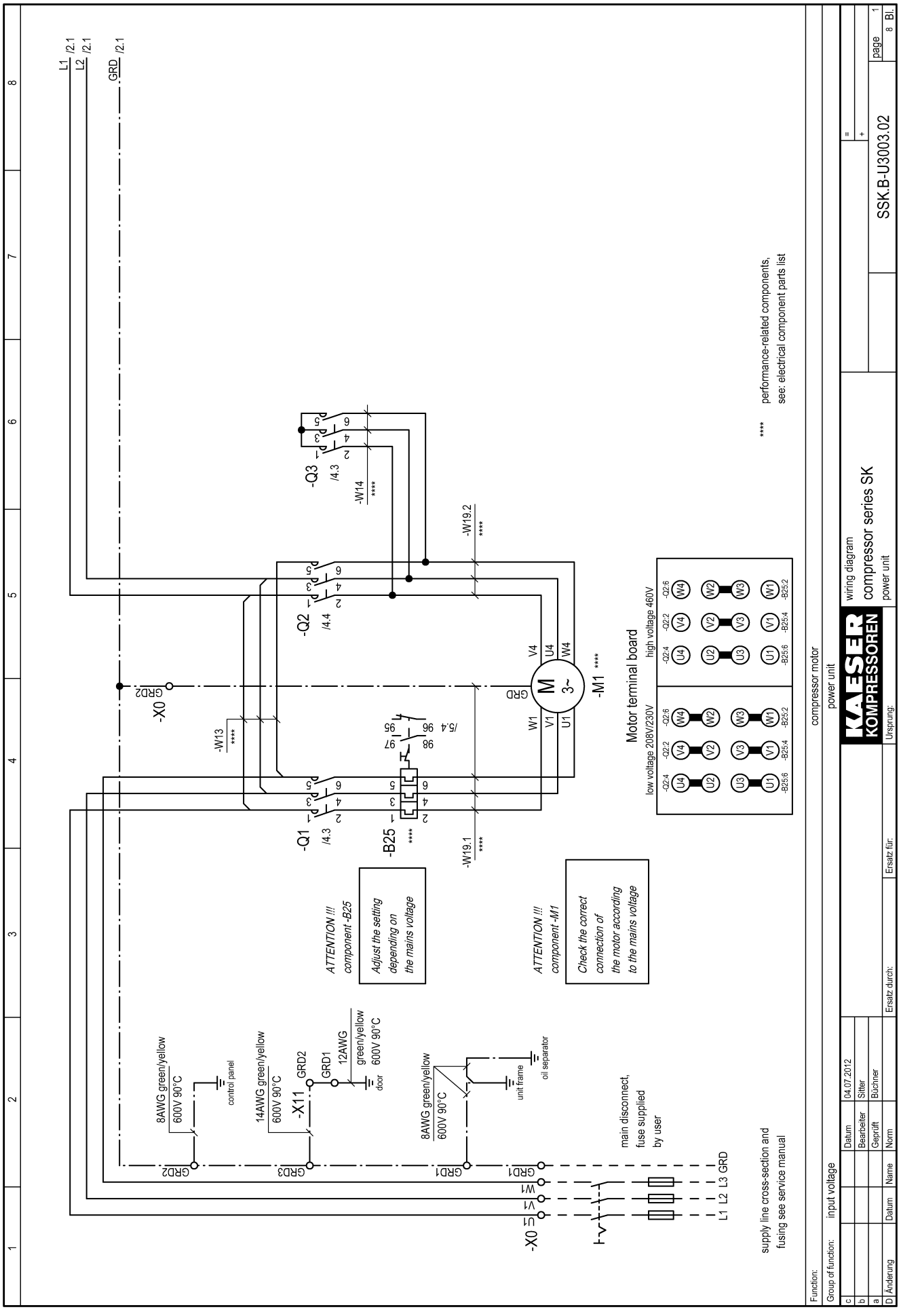
sensors/actuators

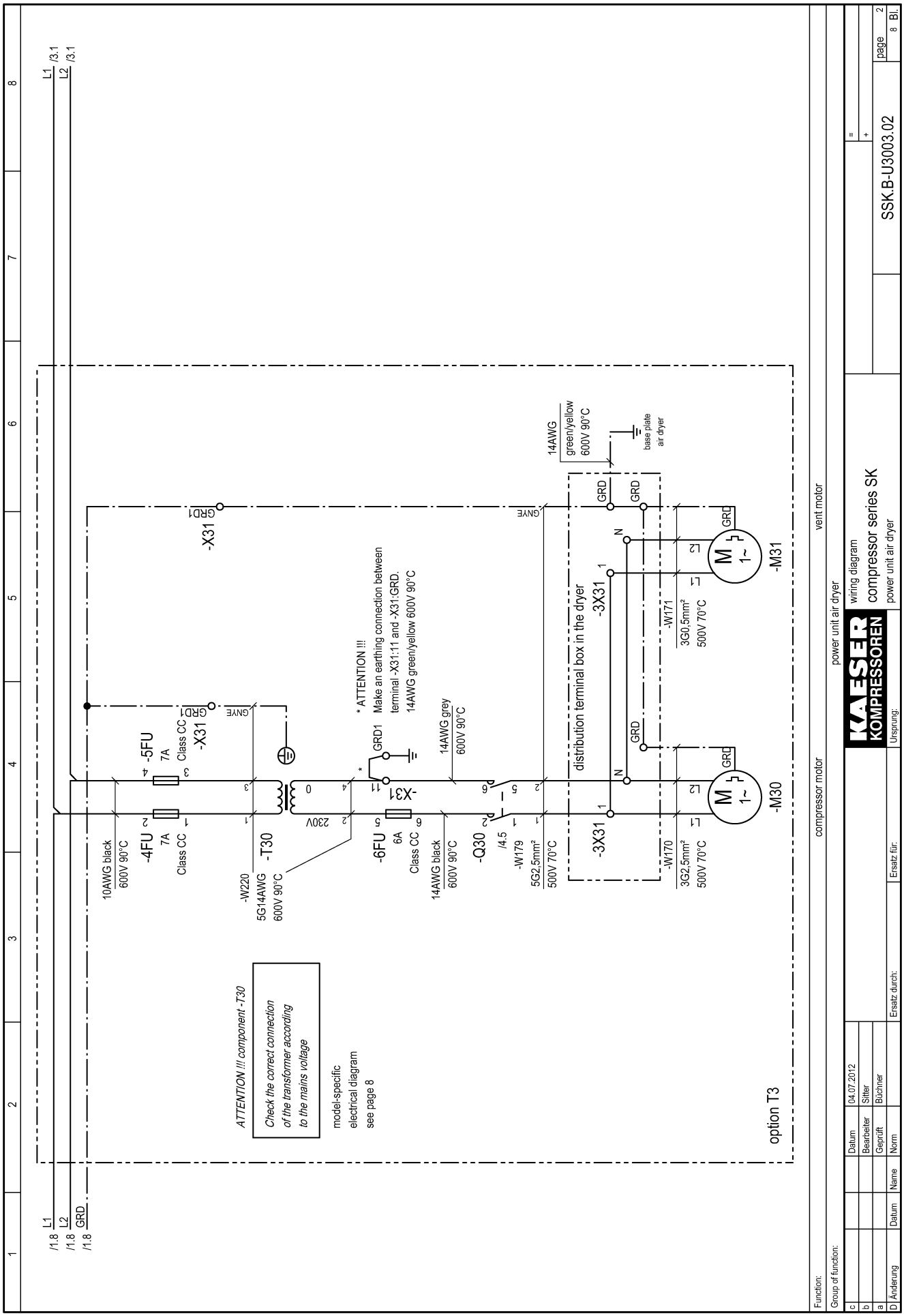
-B1	pressure transducer, air main pressure
-B2	safety air pressure switch-direction of rotation
-B30	safety pressure controller, option T3
-B40	temperature probe, airend discharge temperature
-K1	control valve

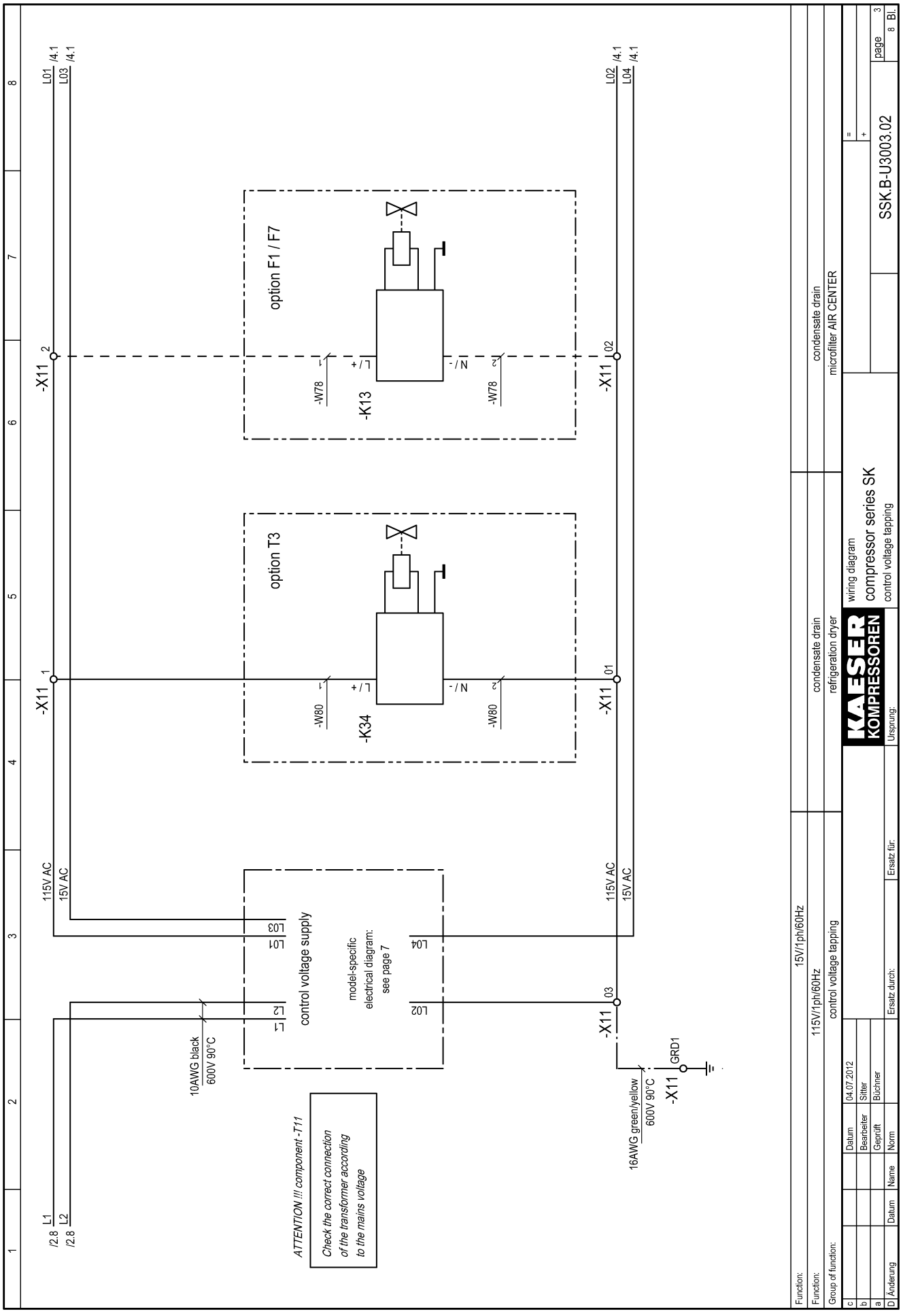
c				Datum	04.07.2012		KAESER KOMPRESSOREN	electrical equipment identification	=
b				Bearbeiter	Sitter			compressor series SK	+
a				Geprüft	Büchner				
C	Änderung	Datum	Name	Norm		Ersatz durch:	Ersatz für:	Ursprung:	USK.B-U3003.02	page 2 / 3 Bl.

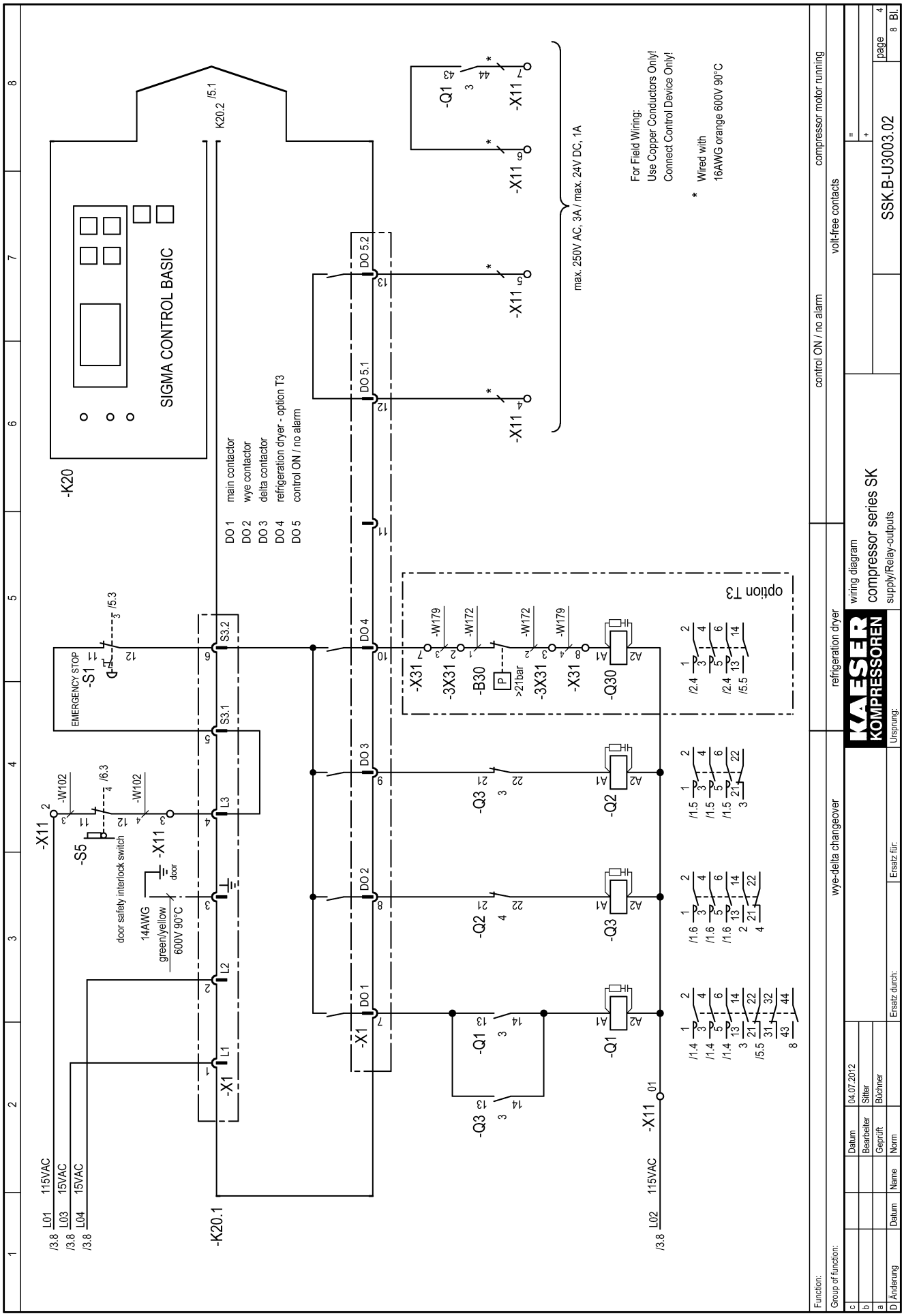
model		electrical component parts list SK 15/SK 15T	SK 20/SK 20T		
machine power supply TRI-VOLTAGE		**208 V ±10 %, 60 Hz** **230 V ±10 %, 60 Hz** **460 V ±10 %, 60 Hz**	**208 V ±10 %, 60 Hz** **230 V ±10 %, 60 Hz** **460 V ±10 %, 60 Hz**		
motors	-M1	15 hp	20 hp		
supply terminals	-X0	7.3140.02090	7.3140.02090		
	Siemens	3RV1935-5A	3RV1935-5A		
terminal strips	-X0	7.6836.00430 Wieland	7.6836.00430 Wieland		
	-X11	7.6836.00410 Wieland	7.6836.00410 Wieland		
option T3	-X11/-X31	7.6836.00420 Wieland	7.6836.00420 Wieland		
contactor	-Q1	7.6867.00010	7.6869.00010		
		3RT1034-1AK60	3RT1036-1AK60		
auxiliary switch		7.3140.02220	7.3140.02220		
		3RH1921-1HA22	3RH1921-1HA22		
interference suppressor		7.3140.02050	7.3140.02050		
	Siemens	3RT1936-1CC00	3RT1936-1CC00		
contactor	-Q2	7.6867.00010	7.6869.00010		
		3RT1034-1AK60	3RT1036-1AK60		
auxiliary switch		7.3140.02030	7.3140.02030		
		3RH1921-1CA01	3RH1921-1CA01		
interference suppressor		7.3140.02050	7.3140.02050		
	Siemens	3RT1936-1CC00	3RT1936-1CC00		
contactor	-Q3	7.6866.00010	7.6866.00010		
		3RT1026-1AK60	3RT1026-1AK60		
auxiliary switch		7.3140.01690	7.3140.01690		
		3RH1921-1CA10	3RH1921-1CA10		
auxiliary switch		7.3140.02030	7.3140.02030		
		3RH1921-1CA01	3RH1921-1CA01		
interference suppressor		7.3140.02040	7.3140.02040		
	Siemens	3RT1926-1CC00	3RT1926-1CC00		
contactor	-Q30	7.6874.00010	7.6874.00010		
option T3		3RT1016-1AK61	3RT1016-1AK61		
interference suppressor		7.3140.02060	7.3140.02060		
	Siemens	3RT1916-1CC00	3RT1916-1CC00		
overload relay	-B25	7.6873.00200	7.6873.00200		
		3RB2036-1UB0	3RB2036-1UB0		
		12,5-50 A	12,5-50 A		
		setting: 28 A (208 V)	setting: 35 A (208 V)		
		setting: 27 A (230 V)	setting: 34 A (230 V)		
	Siemens	setting: 14 A (460 V)	setting: 17 A (460 V)		
fuses	-1FU/-2FU	7.3316.1	7.3316.1		
	Gould	ATQR 1 1/2 (1,5 A, 600 V)	ATQR 1 1/2 (1,5 A, 600 V)		
fuses	-3FU	7.3161.00390	7.3161.00390		
	Gould	ATQR 1 (1 A, 600 V)	ATQR 1 (1 A, 600 V)		
fuses	-4FU/-5FU	7.3306.00010	7.3306.00010		
option T3	Gould	ATDR 7 (7 A, 600 V)	ATDR 7 (7 A, 600 V)		
fuses	-6FU	7.3161.00340	7.3161.00340		
option T3	Gould	ATDR 6 (6 A, 600 V)	ATDR 6 (6 A, 600 V)		
fuse socket	-1FU...-6FU	7.3320.00060	7.3320.00060		
	Wöhner	AMBUS EASYSWITCH	AMBUS EASYSWITCH		
transformer	-T11	7.6844.00010	7.6844.00010		
		B0609053	B0609053		
		160 VA	160 VA		
fuse		7.6849.0	7.6849.0		
	Block	T3,15H / 3,15 A, 250 V	T3,15H / 3,15 A, 250 V		
transformer	-T30	7.2292.10130	7.2292.10130		
option T3	Block	B1008038 (5,3 A)	B1008038 (5,3 A)		
connection	-W13	7.3140.02120	7.3140.02120		
	Siemens	3RV1935-1A	3RV1935-1A		
connection	-W14	10 AWG black	10 AWG black		
	Siemens	600 V, 90°C	600 V, 90°C		
cables	-W19.1/.2	8 AWG black	8 AWG black		
		600 V, 90°C	600 V, 90°C		
compressor control	-K20	7.8700.0	7.8700.0		
	Siemens	SIGMA CONTROL BASIC	SIGMA CONTROL BASIC		
EMERGENCY STOP pushbutton	-S1	7.3217.0 / QRUV	7.3217.0 / QRUV		
auxiliary contact	Schlegel	7.3218.0 / MTHOO	7.3218.0 / MTHOO		
control cabinet	KAESER	7.7681.0	7.7681.0		
control panel	KAESER	212761.0	212761.0		

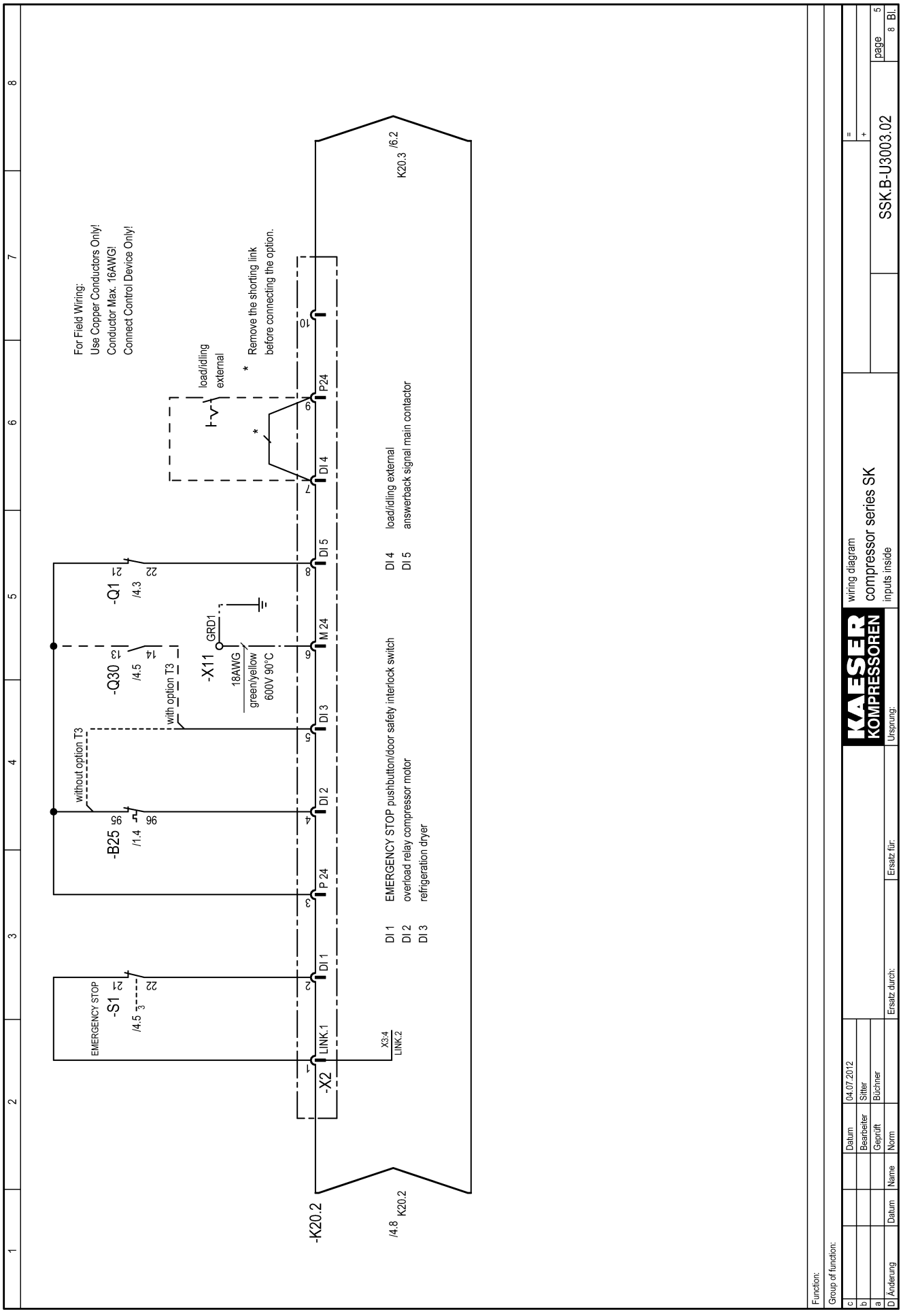
= +
page 3
3 Bl.
USK.B-U3003.02
electrical component parts list
compressor series SK
KAESER KOMPRESSOREN
Ursprung:
Ersatz für:
Ersatz durch:
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Name
Datum
c
b
a
C Änderung

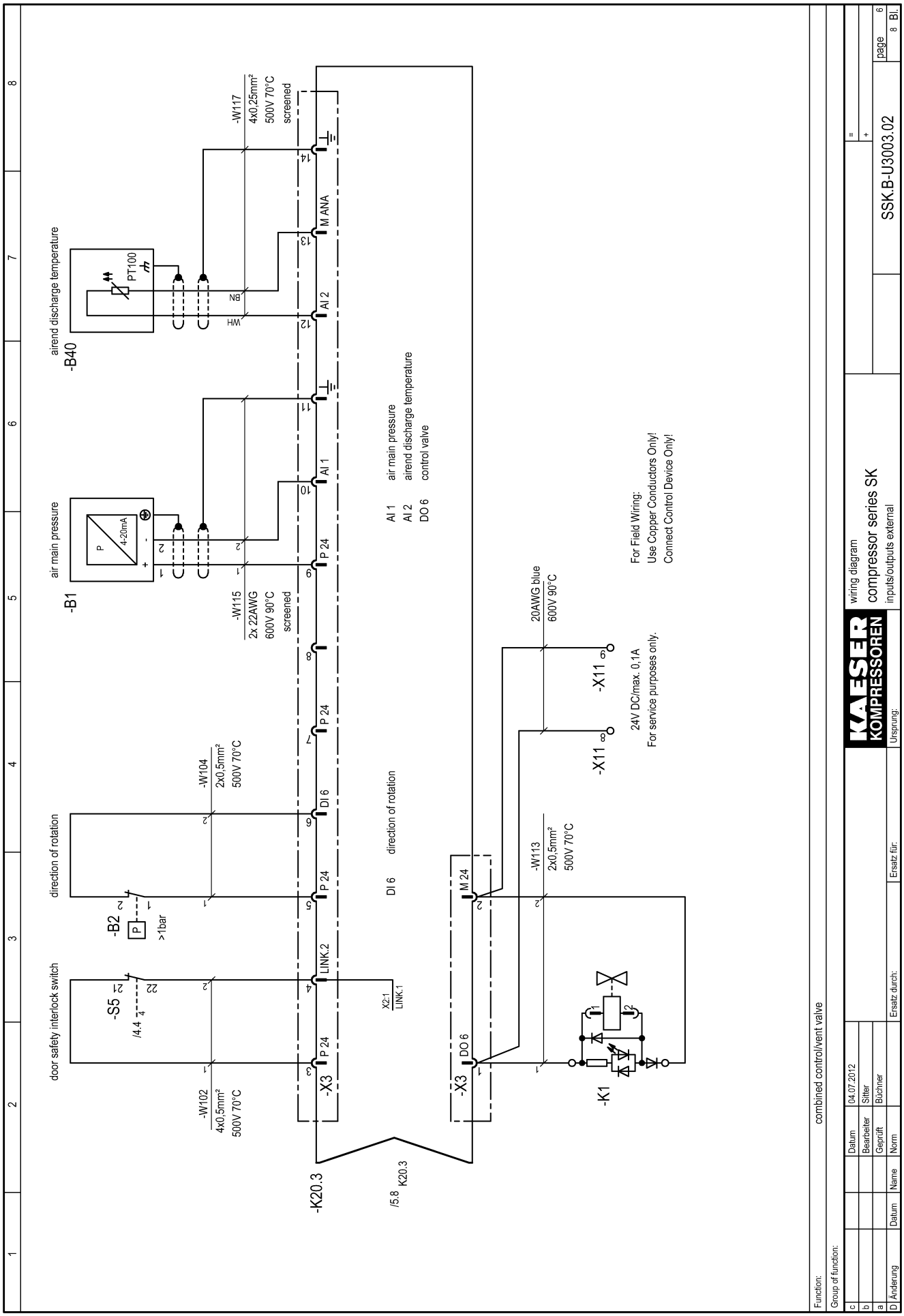

L1 /2.1
L2 /2.1
GRD /2.1
-X0
-Q1 /4.3
-Q2 /4.4
-Q3 /4.3
-B25
-M1 ****
-W13 ****
-W14 ****
-W19.1 ****
-W19.2 ****
Motor terminal board
low voltage 208V/230V
high voltage 460V
ATTENTION !!! component -B25
Adjust the setting depending on the mains voltage
ATTENTION !!! component -M1
Check the correct connection of the motor according to the mains voltage
**** performance-related components, see: electrical component parts list
8AWG green/yellow 600V 90°C
14AWG green/yellow 600V 90°C
12AWG green/yellow 600V 90°C
-X11
GRD1
GRD2
GRD3
control panel
door
unit frame
oil separator
main disconnect, fuse supplied by user
supply line cross-section and fusing see service manual
compressor motor
power unit
Function:
Group of function: input voltage
KAESER KOMPRESSOREN
wiring diagram
compressor series SK
power unit
SSK.B-U3003.02
page 1
8 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Ersatz durch:
Ersatz für:
Ursprung:
Name
Datum
Änderung


L1 /3.1
L2 /3.1
L1 /1.8
L2 /1.8
GRD /1.8
-X31
-5FU 7A Class CC
-4FU 7A Class CC
-T30
-W220 5G14AWG 600V 90°C
10AWG black 600V 90°C
14AWG grey 600V 90°C
14AWG black 600V 90°C
-6FU 6A Class CC
-Q30 /4.5
-W179 5G2,5mm² 500V 70°C
-W170 3G2,5mm² 500V 70°C
-W171 3G0,5mm² 500V 70°C
* ATTENTION !!! Make an earthing connection between terminal -X31:11 and -X31:GRD. 14AWG green/yellow 600V 90°C
14AWG green/yellow 600V 90°C
base plate air dryer
distribution terminal box in the dryer
-3X31
-M30
-M31
option T3
ATTENTION !!! component -T30
Check the correct connection of the transformer according to the mains voltage
model-specific electrical diagram see page 8
compressor motor
vent motor
power unit air dryer
Function:
Group of function:
KAESER KOMPRESSOREN
wiring diagram
compressor series SK
power unit air dryer
SSK.B-U3003.02
page 2
8 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung Datum Name


option F1 / F7
option T3
-K13
-K34
-W78
-W80
-X11
L01 /4.1
L03 /4.1
L02 /4.1
L04 /4.1
115V AC
15V AC
L1
L2
/2.8
/2.8
10AWG black
600V 90°C
control voltage supply
model-specific
electrical diagram:
see page 7
16AWG green/yellow
600V 90°C
GRD1
ATTENTION !!! component -T11
Check the correct connection
of the transformer according
to the mains voltage
15V/1ph/60Hz
115V/1ph/60Hz
control voltage tapping
condensate drain
refrigeration dryer
microfilter AIR CENTER
wiring diagram
compressor series SK
control voltage tapping
SSK.B-U3003.02
page 3
8 Bl.
04.07.2012
Schter
Büchner


SIGMA CONTROL BASIC
-K20
K20.2 /5.1
-K20.1
DO 1 main contactor
DO 2 wye contactor
DO 3 delta contactor
DO 4 refrigeration dryer - option T3
DO 5 control ON / no alarm
EMERGENCY STOP
-S1
-S5
door safety interlock switch
14AWG green/yellow 600V 90°C
door
-W102
-X1
-X11
-X31
-3X31
-B30
>21bar
-W172
-W179
-Q1
-Q2
-Q3
-Q30
option T3
DO 1
DO 2
DO 3
DO 4
DO 5.1
DO 5.2
max. 250V AC, 3A / max. 24V DC, 1A
For Field Wiring:
Use Copper Conductors Only!
Connect Control Device Only!
* Wired with 16AWG orange 600V 90°C
L01 115VAC
L02 115VAC
L03 15VAC
L04 15VAC
control ON / no alarm
compressor motor running
volt-free contacts
refrigeration dryer
wye-delta changeover
wiring diagram
compressor series SK
supply/Relay-outputs
SSK.B-U3003.02
page 4
8 Bl.
Function:
Group of function:
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Name Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung


For Field Wiring:
Use Copper Conductors Only!
Conductor Max. 16AWG!
Connect Control Device Only!
load/idling external
* Remove the shorting link before connecting the option.
-K20.2
/4.8 K20.2
-X2
LINK.1
LINK:2
X3:4
-S1
EMERGENCY STOP
/4.5
-B25
/1.4
without option T3
-Q30
/4.5
with option T3
-X11
GRD1
18AWG
green/yellow
600V 90°C
-Q1
/4.3
K20.3 /6.2
DI 1 EMERGENCY STOP pushbutton/door safety interlock switch
DI 2 overload relay compressor motor
DI 3 refrigeration dryer
DI 4 load/idling external
DI 5 answerback signal main contactor
P24
M 24
DI 1
DI 2
DI 3
DI 4
DI 5
KAESER KOMPRESSOREN
wiring diagram
compressor series SK
inputs inside
SSK.B-U3003.02
page 5
8 Bl.
Function:
Group of function:
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung
Name
Datum


-B40
airend discharge temperature
PT100
-W117
4x0,25mm²
500V 70°C
screened
-B1
air main pressure
4-20mA
-W115
2x 22AWG
600V 90°C
screened
-B2
direction of rotation
>1bar
-W104
2x0,5mm²
500V 70°C
-S5
door safety interlock switch
-W102
4x0,5mm²
500V 70°C
-X3
-K20.3
/5.8 K20.3
X2:1
LINK:1
M ANA
AI 2
AI 1
P 24
DI 6
LINK.2
M 24
DO 6
AI 1 air main pressure
AI 2 airend discharge temperature
DO 6 control valve
DI 6 direction of rotation
-W113
2x0,5mm²
500V 70°C
20AWG blue
600V 90°C
-X11
-K1
24V DC/max. 0,1A
For service purposes only.
For Field Wiring:
Use Copper Conductors Only!
Connect Control Device Only!
Function: combined control/vent valve
Group of function:
KAESER KOMPRESSOREN
wiring diagram
compressor series SK
inputs/outputs external
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page 6
8 Bl.
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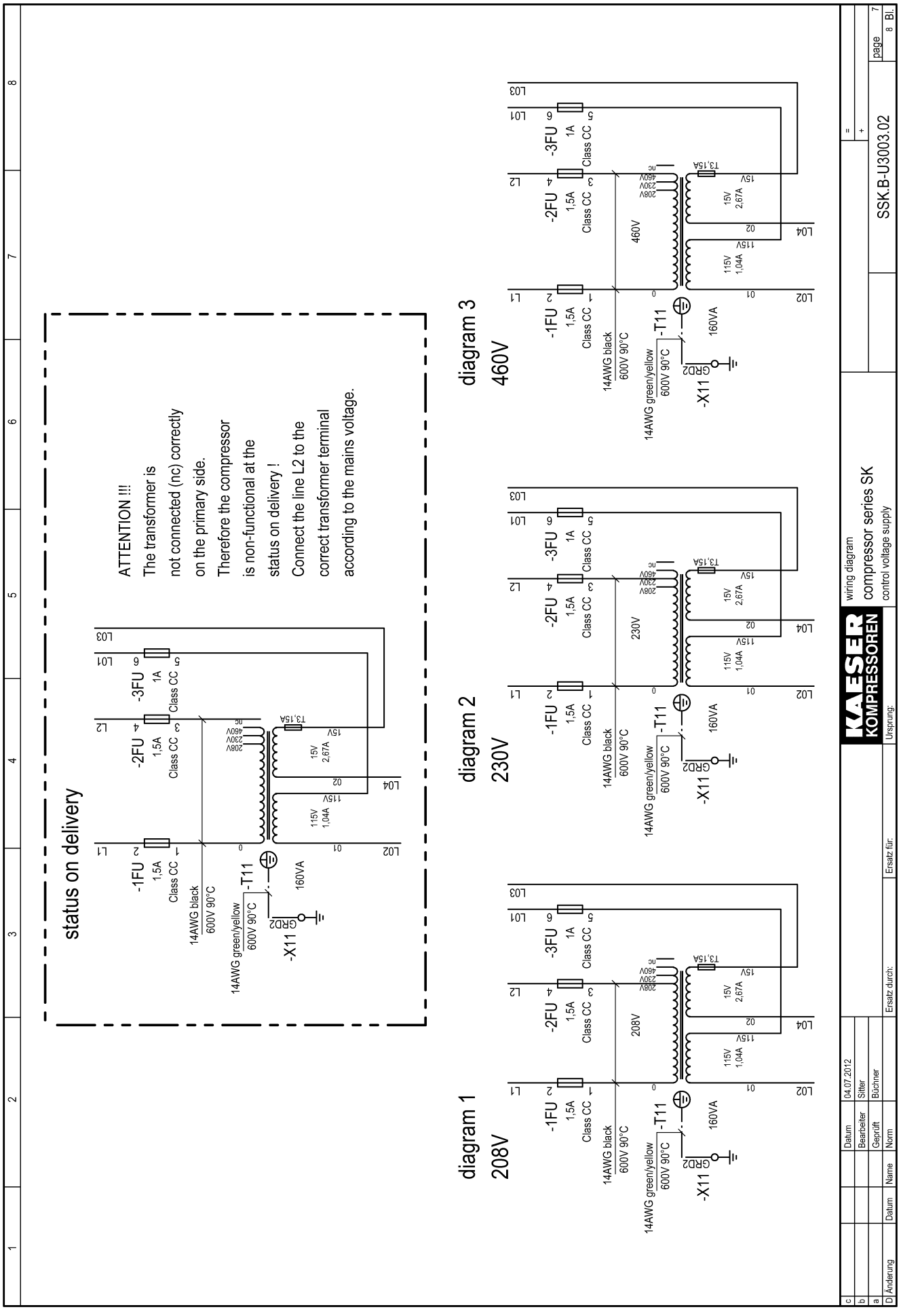
Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung Datum Name


status on delivery
ATTENTION !!!
The transformer is
not connected (nc) correctly
on the primary side.
Therefore the compressor
is non-functional at the
status on delivery !
Connect the line L2 to the
correct transformer terminal
according to the mains voltage.
-1FU 1,5A Class CC
-2FU 1,5A Class CC
-3FU 1A Class CC
-T11 160VA
-X11
14AWG black 600V 90°C
14AWG green/yellow 600V 90°C
L1 L2 L3 L01 L02 L04
208V 230V 460V 115V 15V
T3,15A
15V 2,67A
115V 1,04A
diagram 1 208V
diagram 2 230V
diagram 3 460V
KAESER KOMPRESSOREN
wiring diagram
compressor series SK
control voltage supply
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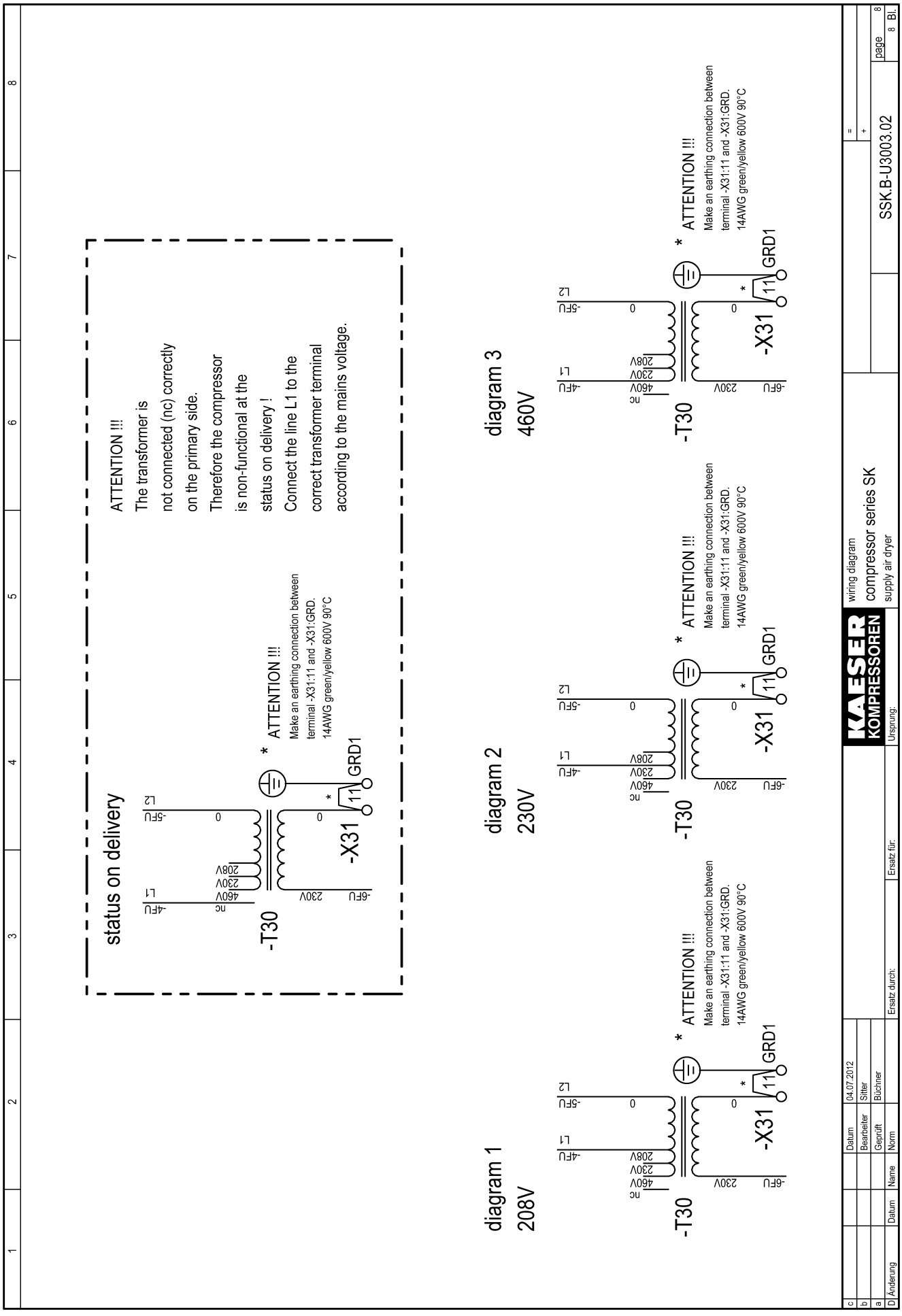
page 7
8 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Name
Datum
Änderung
Ersatz durch:
Ersatz für:
Ursprung:


status on delivery
ATTENTION !!!
The transformer is
not connected (nc) correctly
on the primary side.
Therefore the compressor
is non-functional at the
status on delivery !
Connect the line L1 to the
correct transformer terminal
according to the mains voltage.
-T30
-4FU
-5FU
L1
L2
nc
460V
230V
208V
0
230V
-6FU
-X31
11
GRD1
*
ATTENTION !!!
Make an earthing connection between
terminal -X31:11 and -X31:GRD.
14AWG green/yellow 600V 90°C
diagram 1
208V
diagram 2
230V
diagram 3
460V
KAESER KOMPRESSOREN
wiring diagram
compressor series SK
supply air dryer
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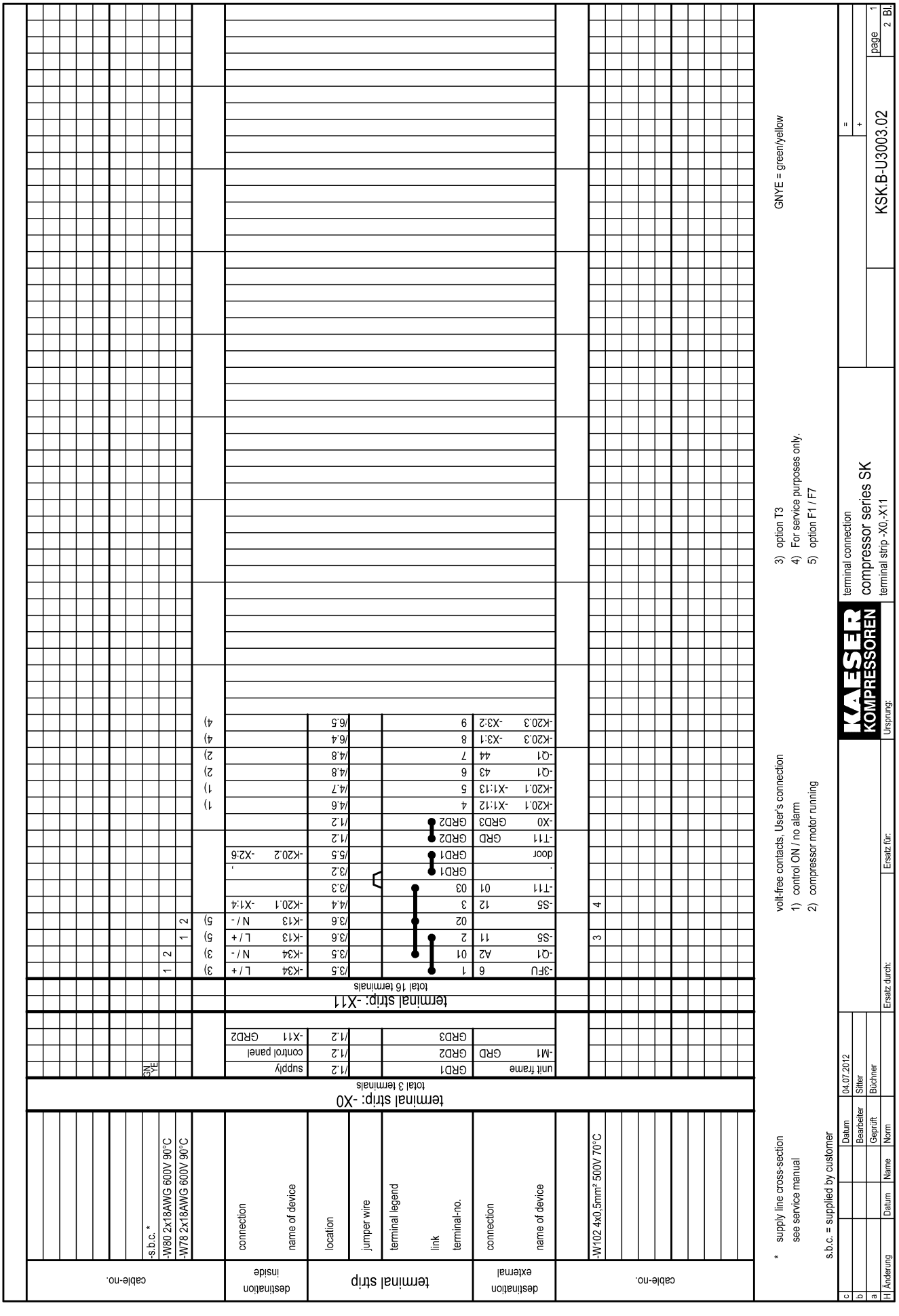
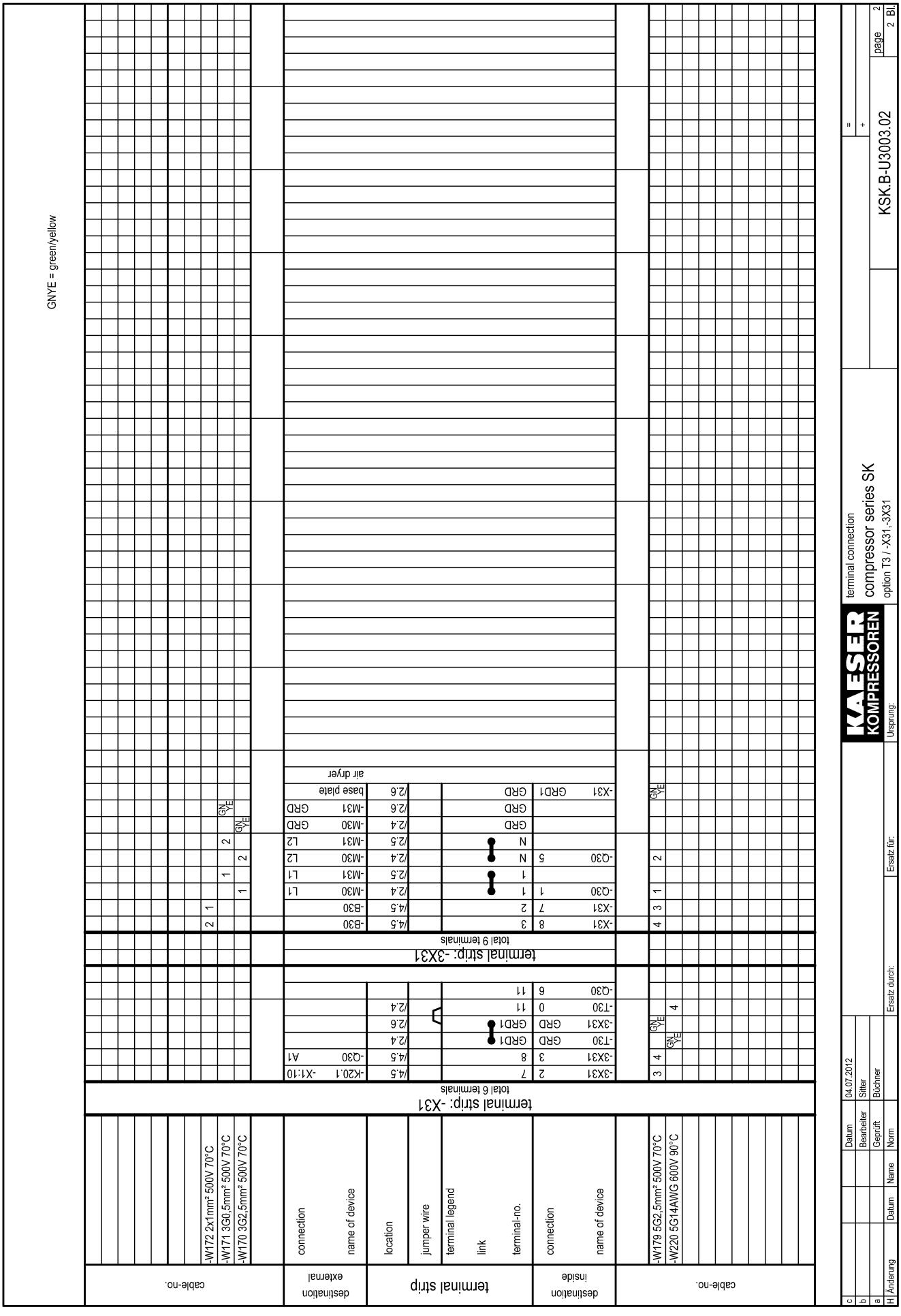
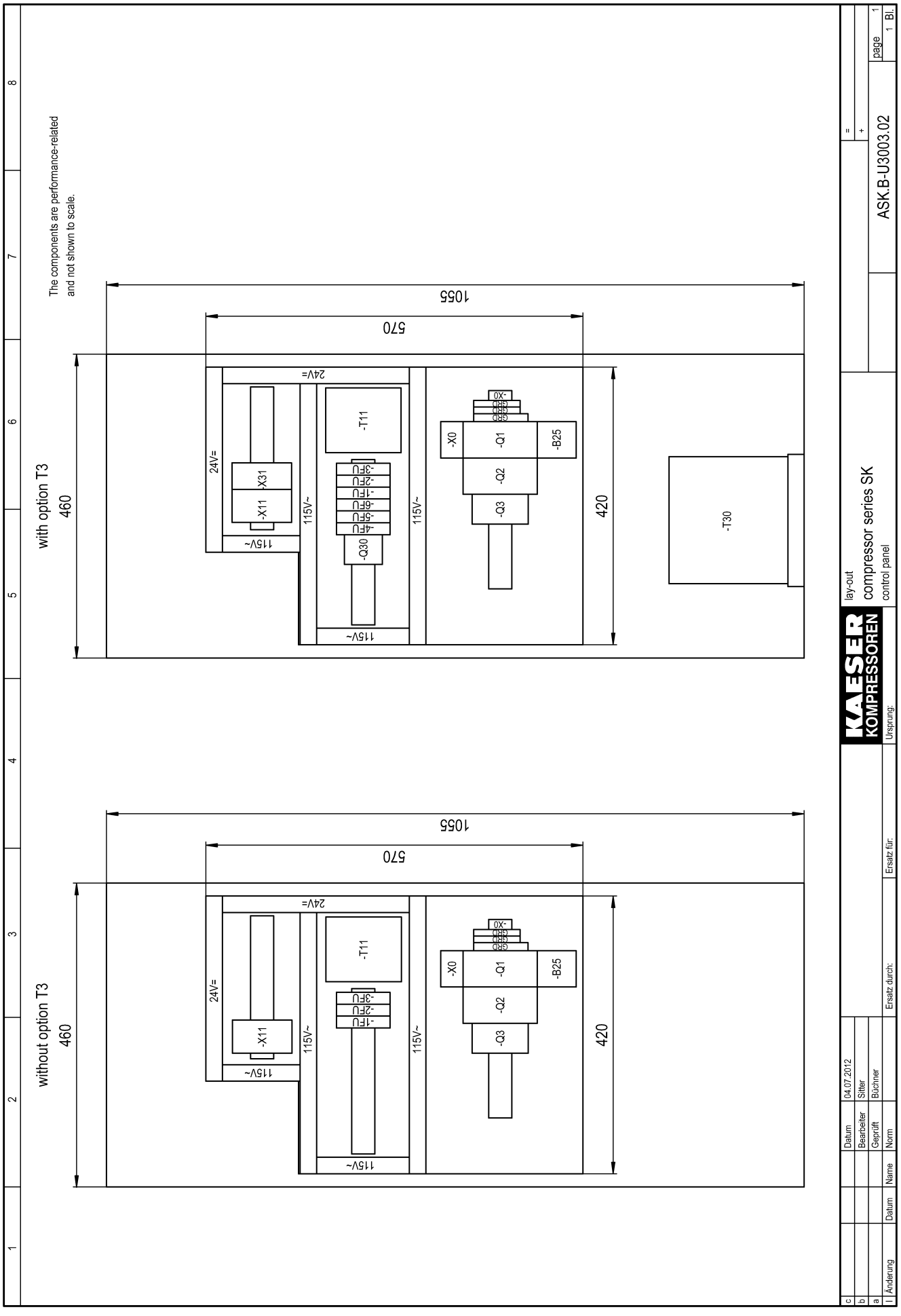
page 8
8 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Name Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung


terminal strip: -X0
total 3 terminals
terminal strip: -X11
total 16 terminals
cable-no.
destination inside
terminal strip
destination external
cable-no.
-s.b.c. *
-W80 2x18AWG 600V 90°C
-W78 2x18AWG 600V 90°C
connection
name of device
location
jumper wire
terminal legend
link
terminal-no.
connection
name of device
-W102 4x0,5mm² 500V 70°C
unit frame
-M1 GRD
GRD1
GRD2
GRD3
supply
control panel
-X11 GRD2
-3FU 6 /3.5 -K34 L / + 3)
-Q1 A2 01 /3.5 -K34 N / - 3)
-S5 11 2 /3.6 -K13 L / + 5) 1
-S5 12 3 /4.4 -K20.1 -X1:4 2
-T11 01 03 /3.3 5)
door GRD1 /3.2 ,
-T11 GRD GRD2 /5.5 -K20.2 -X2:6
-X0 GRD3 GRD2 /1.2
-K20.1 -X1:12 4 /4.6 1)
-K20.1 -X1:13 5 /4.7 1)
-Q1 43 6 /4.8 2)
-Q1 44 7 /4.8 2)
-K20.3 -X3:1 8 /6.4 4)
-K20.3 -X3:2 9 /6.5 4)
-M1 GRD GRD2 /1.2 -X11 GRD2
GRD3 /1.2 -K13 N / - 5) 2
-K20.1 -X1:4
,
-K20.2 -X2:6
-K34 L / + 3)
-K34 N / - 3)
-K13 L / + 5) 1
-K13 N / - 5) 2
-K20.3 -X3:2 9 /6.5 4)
GNYE = green/yellow
* supply line cross-section see service manual
s.b.c. = supplied by customer
volt-free contacts, User's connection
1) control ON / no alarm
2) compressor motor running
3) option T3
4) For service purposes only.
5) option F1 / F7
KAESER KOMPRESSOREN
terminal connection
compressor series SK
terminal strip -X0,-X11
KSK.B-U3003.02
page 1
2 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung Datum Name


GNYE = green/yellow
cable-no.
destination external
terminal strip
destination inside
cable-no.
-W172 2x1mm² 500V 70°C
-W171 3G0,5mm² 500V 70°C
-W170 3G2,5mm² 500V 70°C
connection
name of device
location
jumper wire
terminal legend
link
terminal-no.
connection
name of device
-W179 5G2,5mm² 500V 70°C
-W220 5G14AWG 600V 90°C
terminal strip: -X31
total 6 terminals
terminal strip: -3X31
total 9 terminals
air dryer
base plate
KAESER KOMPRESSOREN
terminal connection
compressor series SK
option T3 / -X31,-3X31
KSK.B-U3003.02
page 2
2 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Norm
Name
Datum
Änderung
Ersatz durch:
Ersatz für:
Ursprung:


The components are performance-related and not shown to scale.
with option T3
without option T3
460
1055
570
420
24V=
115V~
-T11
-X31
-X11
-Q30
-4FU
-5FU
-6FU
-1FU
-2FU
-3FU
-X0
-Q1
-Q2
-Q3
-B25
-T30
KAESER KOMPRESSOREN
lay-out
compressor series SK
control panel
ASK.B-U3003.02
page 1
1 Bl.
Datum 04.07.2012
Bearbeiter Sitter
Geprüft Büchner
Name
Norm
Ersatz durch:
Ersatz für:
Ursprung:
Änderung
Datum

13.5 Service Manual for Compressed Air Filter

Service manual

Compressed air filter

KAESER FILTER KE / KEA; 6 – 26

No.: 901708-TBA 04 USE

Manufacturer:

KAESER KOMPRESSOREN SE

96410 Coburg • PO Box 2143 • GERMANY • Tel. +49-(0)9561-6400 • Fax +49-(0)9561-640130

http://www.kaeser.com

/KKW/AFILT 2.04 en Z1 SBA-FILTER-TBA

20140715 154056

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1 Technical Data

1.1 Options

The table contains a list of possible options.

A combination of KAESER FILTER KE and KAESER FILTER KA is called a filter combination KAESER FILTER KEA .

➢ Enter options here for reference.

Option	Option code	Available?
KAESER FILTER KE Electronic condensate drain	F1	
KAESER FILTER KEA Electronic condensate drain	F7	
KAESER FILTER KE Automatic condensate drain	F11	
KAESER FILTER KEA Automatic condensate drain	F12	
Already available: ✓ not available: —		

Tab. 1 Options

1.2 Model designation of the compressed air filter

Compressed air filter

Product	Model	Degree of filtration
F : Air filter	6 9 16 22 26	KE : Coalescencing filter: Extra KA : Activated carbon filters: Adsorption
Example		
F	22	KE
My compressed air filter		

Tab. 2 Model designation of the compressed air filter

Filter element

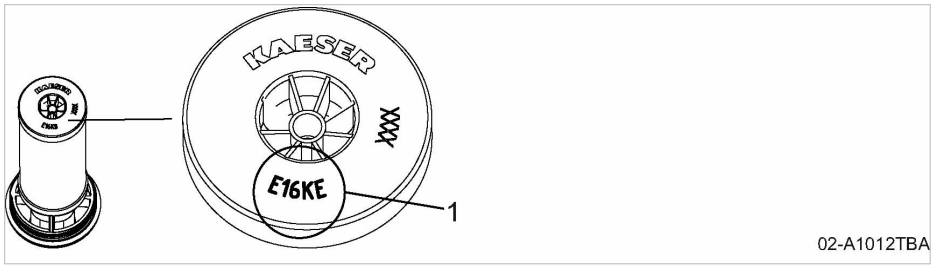


Fig. 1 Model designation of the filter element (example)
[1] Model designation (example)

Product	Model	Degree of filtration
E : Filter element	6 9 16 22 26	KE : Coalescencing filter: Extra KA : Activated carbon filters: Adsorption
Example		
E	16	KE
My filter element		

Tab. 3 Model designation of the filter element

1.3 Operating limits

Application

Degree of filtration	KE	KEA
Short description	Extra	Carbon Combination
Option	F1 / F11	F7 / F12
Suitable fluids	Air Nitrogen	
Fluid properties	Non-corrosive Incombustible Non-toxic Non-explosive Stable	
Application	Used for higher compressed air quality	Simultaneous filtration of aerosols, solid particles, and oil vapors
Fluid quality at the inlet	Free of condensates	Free of condensates

Degree of filtration	KE	KEA
Short description	Extra	Carbon Combination
Option	F1 / F11	F7 / F12
Typical application near the compressor station	Downstream of compressed air dryers	—
Typical application near the consumers	Compressed air filter for increased air quality	Downstream of compressed air filter with degree of filtration KE Compressed air filter for the removal of odors and low concentrations of oil vapor
Air flow direction	From inside to outside	

Tab. 4 Operating limits: Use of KE and KEA

Pressure and temperature

Degree of filtration	KE	KEA
Short description	Extra	Carbon Combination
Option	F1 / F11	F7 / F12
Permissible working pressure [psig] at the inlet	29 – 232	
Permissible fluid temperature [°F] at the inlet	40 – 150	
Permissible ambient temperature [°F]	40 – 120	
Compression stress	Static	

Tab. 5 Operating limits: Pressure and temperature

1.4 Separation efficiency

The separation efficiency is often highly dependent on individual circumstances in the compressed air network (composition of the fluid, pressure and flow situation).

➢ Consult an authorized KAESER service representative for advice on this subject.

Aerosol separation according to ISO 12500-1

Aerosol separation at 10mg/m³ oil aerosol test concentration

Degree of filtration	KE	KEA
Short description	Extra	Carbon Combination
Option	F1 / F11	F7 / F12
Differential pressure[1)] in new state [psi]	<0.73	<0.94
Initial differential pressure at saturation [psi]	<2.90	<3.48

[1)] at max. flow rate (dry)

1 Technical Data

1.4 Separation efficiency

Degree of filtration	KE	KEA
Short description	Extra	Carbon Combination
Option	F1 / F11	F7 / F12
Residual aerosol content [mg/m³]	<0.01	<0.01

[1] at max. flow rate (dry)

Tab. 6 Aerosol separation at 10mg/m³ oil aerosol test concentration

Oil vapor adsorption

Oil (vapor): Hydrocarbon mixture from components with a chain length with more than six C atoms.

Measurement conditions:

- Clean fluid (for example, no oil vapors)
- Cooling oil approved by KAESER
- Max. flow rate
- Working pressure: 100 psig
- Inlet temperature: 68°F
- Relative humidity: 0%
- Oil aerosol test concentration: 10 mg/m³

If the aforementioned measuring condition is met, a residual oil content of <0.003 mg/m³ is to be expected.

2 Safety and Responsibility

2.1 Specified use

The compressed air filter is suited for the following gaseous fluids:

- Air
- Nitrogen

The compressed air filter is designed solely for the cleaning of the aforementioned fluids in an industrial environment. Any other use is considered incorrect. The manufacturer is not liable for any damages that may result from incorrect use. The user alone is liable for any risks incurred.

➢ Comply with the instructions in this operating manual.

➢ Use the compressed air filter only within its performance limits and under the permitted operating conditions.

2.2 Improper use

Improper usage can cause damage to property and/or (severe) injuries.

➢ Only use the filter as intended.

➢ Do not operate the compressed air filter in air networks with temperatures potentially exceeding 122°F. This may be the case downstream of heat-regenerated desiccant dryers.

➢ Do not operate the compressed air filter in areas in which specific requirements with regard to explosion protection are in force.

➢ Do not use the compressed air as breathing air.

➢ Do not modify the compressed air filter and/or its components.

2.3 User's responsibilities

2.3.1 Observe statutory and universally accepted regulations

This is, for example, nationally applied European directives and/or valid national legislation, safety and accident prevention regulations.

➢ Observe relevant statutory and accepted regulations during installation, operation and maintenance of the compressed air filter.

2.3.2 Qualified personnel

These are people who, by virtue of their training, knowledge and experience as well as their knowledge of relevant regulations can assess the work to be done and recognize the possible dangers involved.

➢ Ensure that operating, installation and maintenance personnel are qualified and authorized to carry out their tasks.

2.3.3 Safely dealing with sources of danger

The following describes the various forms of danger that can arise during the operation of the compressed air filter.

Forces of compression

Compressed air/fluid is contained energy. Uncontrolled release of this energy can cause serious injury or death. The following information concerns work on components that could be under pressure.

- ➢ Close shut-off valves or otherwise isolate the compressed air filter from the air distribution network to ensure that no compressed fluid can flow back into the compressed air filter.
- ➢ Depressurize all pressurized components and enclosures.
- ➢ Do not carry out welding, heat treatment or mechanical modifications on pressurized components, as this adversely affects the components' resistance to pressure.
  The safety of the compressed air filter is then no longer ensured.

Compressed air quality

The composition of the fluid must be suitable for the actual application in order to preclude health and life-threatening dangers.

- ➢ Use appropriate systems for air treatment before using the compressed air as breathing air or for the processing of food products.

Temperature

High temperatures are generated during compression. Touching hot components may cause injuries.

- ➢ Allow the surfaces to cool down.
- ➢ Avoid contact with hot surfaces.
- ➢ Wear protective clothing.

Unsuitable spare parts

Unsuitable spare parts compromise the safety of the compressed air filter.

- ➢ Use only spare parts approved by the manufacturer for use in this machine.
- ➢ Use only genuine KAESER replacement parts on pressure bearing parts.

Conversion or modification of the filter

Modifications, additions to, and conversions of the filter or machine can result in unpredictable dangers.

- ➢ Do not convert or modify the compressed air filter!
- ➢ Obtain written approval by the manufacturer prior to any technical modification or expansion of the machine, the controller, or the control programs.

2.3.4 Safe operation of the compressed air filter

The following is information supporting you in the safe handling of the filter during individual product life phases.

Personal protective equipment

When working on the compressed air filter, you may be exposed to dangers that can result in accidents with severe adverse health effects.

- ➢ Wear protective clothing as necessary.

Suitable protective clothing (examples):

- Safety workwear
- Protective gloves
- Safety boots
- Eye protection

Transport

The weight and size of the filter require safety measures during its transport to prevent accidents.

- ➢ Use suitable lifting gear that conforms to local safety regulations.
- ➢ Allow transportation only by personnel trained in the safe movement of loads.
- ➢ Attach lifting gear only to suitable lifting points.
- ➢ Make sure the danger zone is clear of personnel.

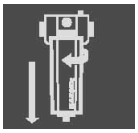
Assembly

- ➢ Use only electrical cables that are suitable and approved for the surroundings and electrical loads applied.
- ➢ Never dismantle compressed air conduits or piping until fully vented.
- ➢ Only use pressure lines that are suitable and approved for the maximum working pressure and the intended medium.
- ➢ Do not allow connection pipes to be placed under mechanical stress.
- ➢ Do not induce any forces into the compressed air filter via the connections, so that the compressive forces must be balanced by bracing.
- ➢ Ensure accessibility to the compressed air filter so that all work can be carried out without danger or hindrance.
- ➢ If installed outdoors, the filter must be protected from frost. .
- ➢ Do not operate in areas in which specific requirements regarding explosion protection are in force.
- ➢ Ensure sufficient and suitable lighting such that the display can be read and work carried out comfortably and safely.
- ➢ Comply with limit values for ambient temperature and humidity.
- ➢ The lower the temperature of the fluid in the filter, the higher its degree of efficiency.
- ➢ The intake air must not contain any damaging contaminants, Damaging contaminants are for instance: explosive or chemically instable gases and vapors, acid or base forming substances such as ammonia, chlorine or hydrogen sulfide.
- ➢ In the event of a surface temperature of the compressed air filter expected to exceed 122°F: Shield the compressed air filter and/or use suitable labelling to warn against hot surfaces.

Commissioning, operation, and maintenance

During commissioning, operation and maintenance you may be exposed to dangers resulting from, e.g., electricity, pressure and temperature. Careless actions can cause accidents with severe adverse effects for your health.

- ➢ Refer to the quick installation guide:

	Symbol	Meaning
1.		➢ Read and understand the operating manual and all safety instructions prior to use.
2.		➢ Only loosen the locking screw manually! ➢ Wait until the compressed air filter is fully depressurized.
3.		➢ Loosen and carefully remove the filter bowl.

Tab. 7 Quick installation guide

- ➢ Allow maintenance work to be carried out only by authorized personnel.
- ➢ Wear close-fitting clothing. Wear protective clothing as necessary.
- ➢ Check that there is no voltage on floating relay contacts.
- ➢ Close shut-off valves or otherwise isolate the machine from the compressed air network to ensure that no compressed air can flow back into the machine.
- ➢ Depressurize all pressurized components and enclosures.
- ➢ Allow the compressed air filter to cool down.
- ➢ Use the compressed air filter only with a suitable condensate drain.
- ➢ Use only spare parts approved by KAESER for use in this compressed air filter.
- ➢ Carry out regular inspections:
  for visible damages,
  of safety installations,
  of any components requiring monitoring.
- ➢ Pay particular attention to cleanliness during all maintenance and repair work. Cover components and openings with clean cloths, paper or tape to keep them clean.

De-commissioning, storage, and disposal

Improper handling of old operating fluids and components represent a danger for the environment.

- ➢ Dispose of the old parts in accordance with local environmental regulations.

2.4 Environment protection

The operation of the compressed air filter may cause dangers for the environment.

- ➢ Do not allow cooling oil to escape to the environment or into the sewage system.
- ➢ Store and dispose of replaced parts in accordance with local environmental protection regulations.
- ➢ Observe national regulations.
  This applies particularly to parts contaminated with cooling fluids or oil.

2.5 Copyright

3 Design and Function

3.1 General design

This section provides information to the design of the compressed air filter, using a filter combination as example.

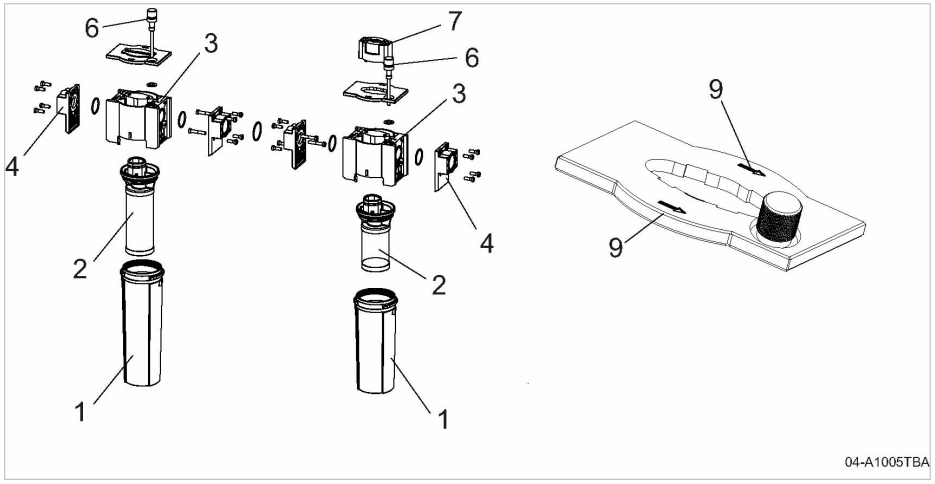


Fig. 2 General design

1	Filter bowl	6	Retaining screw
2	Filter element	7	Pressure differential gauge
3	Filter head	9	Direction of flow
4	Connection flange		

The filter bowl 1 receives the filter element 2.

The connection flanges 4 at the filter head 3 connect the compressed air filter with the air network.

The arrows 9 on the filter head indicate the direction of flow.

The retaining screw 6 secures the filter housing against unintended opening. The compressed air filter is vented as soon as the retaining screw is loosened.

The pressure differential gauge 7 provides information regarding the pressure difference between fluid inlet and fluid outlet.

3.2 Condensate drain

KAESER FILTER features different types of condensate drains to perfectly match your machine. Not all condensate drains described here are available for all machines.

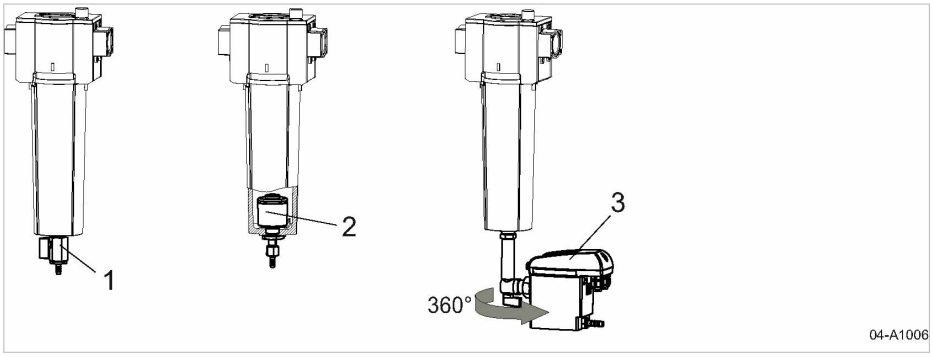


Fig. 3 Condensate drain

1 Manual condensate drain (shut-off valve)
2 Automatic condensate drain (internal float)
3 Electronic condensate drain

Manual condensate drain

A manual condensate drain is provided in the compressed air filter with degree of filtration KA . It is only used for inspection as fluid is not removed from the compressed air flow. In a fault, oil or an oil-water mixture will escape.

Option F11 / F12 Automatic condensate drain

An automatic condensate drain with internal float is available for compressed air filters with degree of filtration KE . It opens automatically as soon as sufficient liquid has accumulated in the filter bowl.

Option F1 / F7 Electronic condensate drain

An electronic condensate drain is available for compressed air filters with degree of filtration KE . The electronic condensate drain opens automatically as soon as sufficient liquid has accumulated in the filter bowl.

In the variant of an electronic condensate drain with alarm contact, a floating contact will transmit a signal in the event of a fault.

The electronic condensate drain works more precisely, more reliably, causes lower pressure losses, and has a longer maintenance interval.

3.3 Pressure differential gauge

The pressure differential gauge does not provide maintenance information. The filter material ages due to the continuous use, regardless of the value of the differential pressure shown.

A significant change in the differential pressure indicates a fault.

➢ Clean the disk of the measured value display only with solvent-free cleaning agents.

The pressure differential gauge indicates the pressure difference currently existing between fluid entry and fluid outlet.

As a rule, the pressure differential of a new filter element will slightly rise within a short time, and then remain at this level for a long time.

KAESER recommends an early replacement of the filter element if the display changes into the red range (350 mbar / 5 psi) prior to the expiry of the regular maintenance interval for the filter element.

Pressure differential gauge (mechanical)

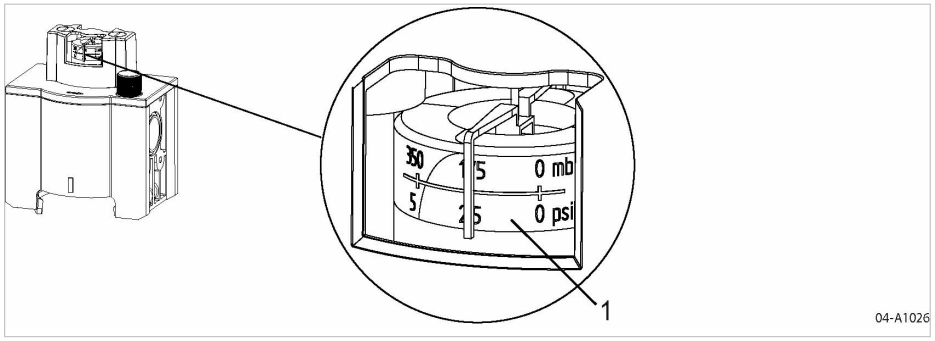


Fig. 4 Pressure differential gauge (mechanical)
[1] Measured value display

4 Installation and commissioning

4.1 Connecting the condensate drain

The condensate must be able to drain freely.

The illustration show a typical installation.
Condensate flows downward in the collecting line. This prevents condensate from the condensate collecting line to flow back to the condensate drain.

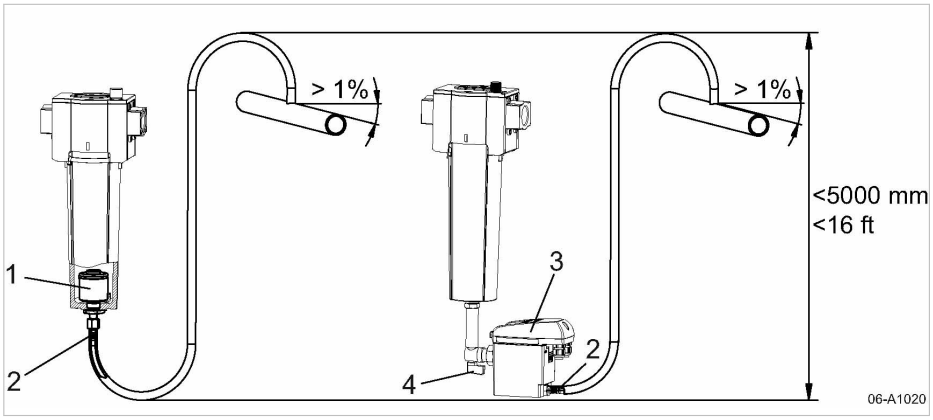


Fig. 5 Connecting the condensate drain

[1] Automatic condensate drain
[2] Hose connector
[3] Electronic condensate drain
[4] Shut-off valve

1. Connect the condensate drain to the hose connection.

➢ Collect condensate in a suitable container and dispose of in accordance with environmental regulations.

4.2 Commissioning the compressed air filter

High flow velocities are generated in all components of an air network when an empty air network is filled. Treatment equipment cannot work under those circumstances. These conditions could damage the material of the filter elements.

➢ Install an air main charging system from KAESER to fill your air network.
You will avoid subsequent damages caused by contaminated compressed air.

➢ Fill the air network slowly, in order not to exceed the permissible volume flow of the compressed air filter.

5 Maintenance

5.1 Regular maintenance tasks

The table below lists maintenance tasks required.

The actually required intervals depend very much on the application conditions of the compressed air filter.

➢ Take these recommendations as a baseline and discuss with KAESER Service the economically appropriate intervals.

➢ Carry out maintenance tasks in a timely manner and according to the operating conditions:

Interval	Maintenance task	see chapter
Weekly	Checking the compressed air filter for condensate. (only degree of filtration KA)	5.4
	Electronic condensate drain: Check function.	See service manual for the machine.
See maintenance sticker Up to 1,000 h	Replacing the filter element: ■ KA	5.2
See maintenance sticker at least annually	Replacing the filter element: ■ KE	5.2
At least annually	Automatic condensate drain; Replace the float.	5.3
At the latest every 2 years	Electronic condensate drain: Exchanging the service module.	See service manual for the machine.
h = operating hours		

Tab. 8 Regular maintenance tasks

5.2 Replacing the filter element

The filter element of the cyclone separator (degree of filtration KC) does not require servicing.

➢ Carefully handle and manually install all components in order to avoid damages. This applies to sealing surfaces in particular.

Material KAESER filter element (including silicone-free sealing grease and O-ring)

5.2.1 Removing the filter element

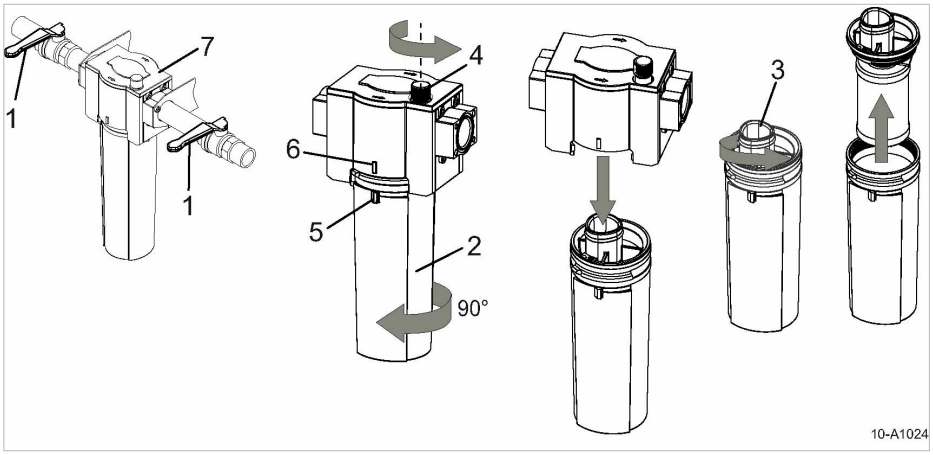


Fig. 6 Removing the filter element

1	Shut-off valve	5	Installation mark at the filter bowl
2	Filter bowl	6	Installation mark at the filter head
3	Filter element	7	Filter head
4	Locking screw (secured against full removal)		

1. Close the shut-off valves 1.
2. Loosen the locking screw 4 only manually until you feel again resistance.
   If the compressed air filter was pressurized, the residual compressed air will escape.

The equipment emits persistent whistling?

The compressed air filter is pressurized!

➢ Disconnect the compressed air filter from the air network, or depressurize the entire air network.

3. Gently jiggle the filter bowl 2 and than turn by 90° until the installation markings at filter bowl 5 and filter head 6 face each other.
4. Remove the filter bowl and the screwed-in filter element vertically downward.
5. Unscrew the filter element 3 (approx. 1 1/2 turns) from the filter bowl.
6. If required: Drain and dispose of the condensate.
7. Check the filter bowl for corrosion.

The filter bowl is clearly corroded?

➢ Determine the cause (e.g., composition of the compressed air, operating conditions)

➢ Replace the compressed air filter completely.

Dispose of the contaminated filter element according to environmental regulations.

5.2.2 Installing the filter element

➢ Do not touch the surface of the filter material.

Precondition The inner surfaces of the filter head and the filter bowl are clean.

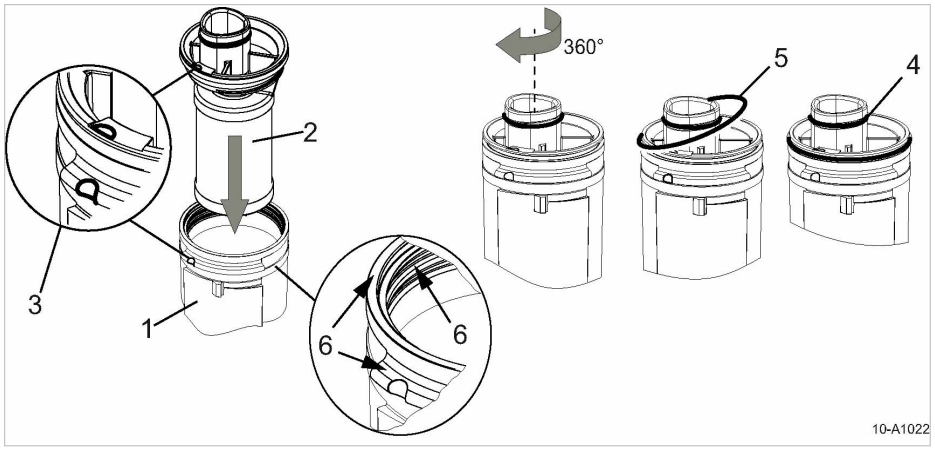


Fig. 7 Installing the filter element

1	Filter bowl	4	O-ring
2	Filter element	5	O-ring
3	Installation marks	6	Surface to be greased

1. Grease the thread, front surface, and bayonet catch of the filter bowl (item 6).
2. Push the filter element 2 into the filter bowl 1 in such a manner that the installation marks 3 are aligned to each other.
3. Use one turn to screw the filter element into the filter bowl.
4. Fully grease the O-ring 5 and insert between filter element and filter bowl.
5. Grease the O-ring 4.

5.2.3 Installing the filter bowl

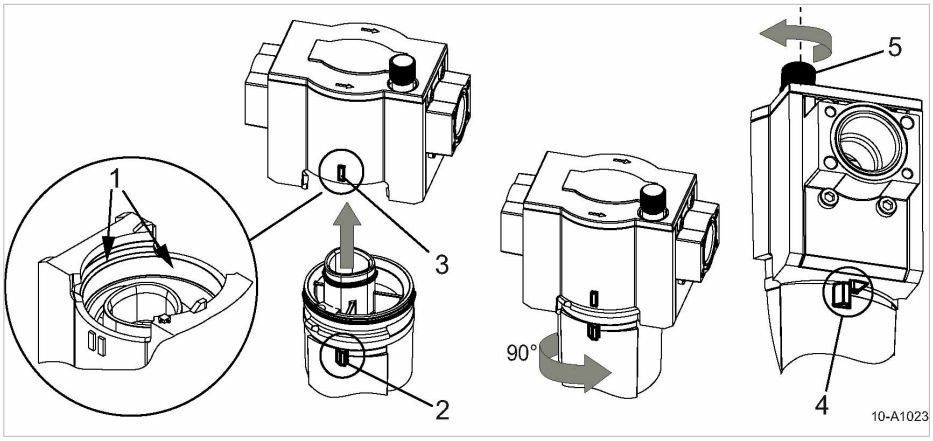


Fig. 8 Installing the filter bowl

1 Surface to be greased
2 Installation mark at the filter bowl
3 Installation mark at the filter head
4 Stop at the filter head
5 Locking screw

1. Grease the interior of the filter bowl (item 1).
2. Align the installation marks (2 and 3) at filter bowl and housing head to each other.
3. Insert the filter bowl into the filter head.
4. Turn the filter bowl 90° to the stop 4.
5. Manually tighten the locking screw 5.

You cannot tighten the locking screw?
The bayonet catch of the filter bowl is not fully closed.
➢ Turn the filter bowl to the stop.

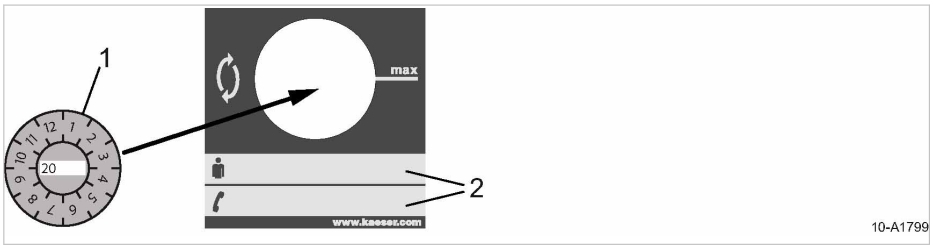


Fig. 9 Amending the maintenance sticker

1 Maintenance sticker
2 Service contact information

6. Inscribe the maintenance sticker with the year for the next maintenance.
7. Attach the maintenance sticker in such a manner that the marking *max* points to the month for the next maintenance.

5.2.4 Pressurizing the compressed air filter

A high flow rate of fluid may damage the filter material.

1. Check whether the locking screw was properly tightened manually.
2. Slowly open the shut-off valve at the **fluid inlet**.
3. Slowly open the shut-off valve at the fluid outlet.

5.3 Option F11 / F12 Automatic condensate drain; Replacing the float

See chapter 5.2 for information on the removal and re-installation of the filter bowl.

Precondition The filter housing is fully vented.

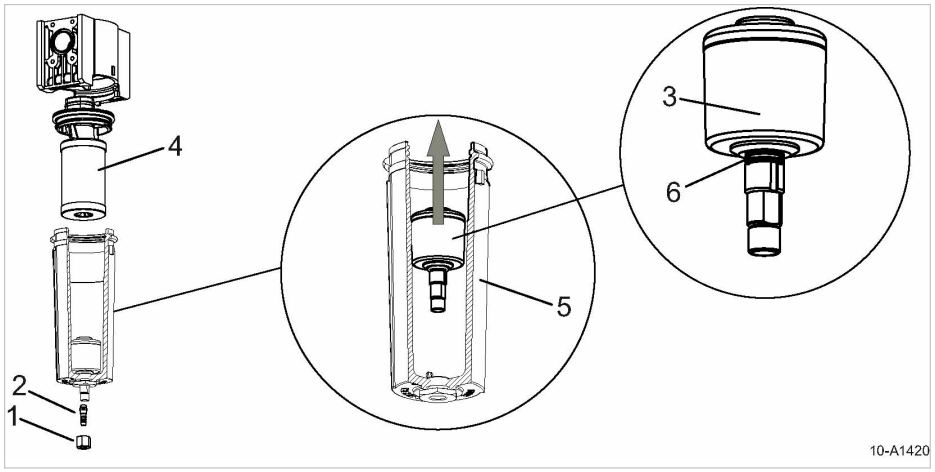


Fig. 10 Replacing the float

1	Union nut	4	Filter element
2	Hose coupling	5	Filter bowl
3	Float	6	O-ring

1. Undo the union nut 1 and remove the hose coupling 2.
2. Remove the filter bowl 5 and the filter element 4.
3. Turn the float 3 clockwise until it is fully removed from the filter bowl.
4. Check whether the O-ring 6 at the bottom of the new float is fully inserted in the groove.
5. Manually screw the float drain into the filter bowl and finally tighten with 3 lbf-ft.
6. Install the filter element and the filter bowl.
7. Install the hose coupling with the union nut.

5.4 Checking the compressed air filter for condensate

This inspection is required only for compressed air filters with degree of filtration KA .

Precondition The filter bowl is pressurized.

Wear safety glasses.

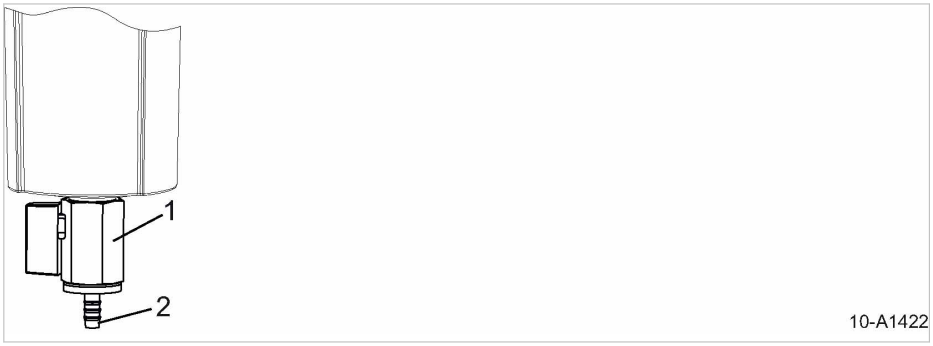


Fig. 11 Checking the compressed air filter for condensate

[1] Shut-off valve
[2] Hose coupling

1. Place a suitable container under the condensate drain.
2. Install a sufficiently long, transparent, and pressure-tight hose at the hose coupling and the collection container.
3. Carefully open the shut-off valve and close immediately when fluid escapes.

Result In case of a fault, oil or an oil-water mixture will escape first. Examine and eliminate the cause of this fault.

6 Spares, Operating Materials, Service

6.1 Note the nameplate

The nameplate contains all information to identify your filter. This information is essential to us in order to provide you with optimal service.

➢ Please give the information from the nameplate with every inquiry and order for replacement parts.

6.2 Ordering replacement parts and operating materials

KAESER replacement parts and operating materials are original KAESER products. They are specifically selected for use in KAESER compressed air filters.

Unsuitable or poor quality consumable parts and operating materials may damage the filter or impair its proper function.

Damage to the filter can also result in personal injury.

⚠ WARNING

There is risk of personal injury or damage to the machine resulting from the use of unsuitable replacement parts or operating materials.

➢ *Use only original KAESER parts and operating materials.*

➢ *Have an authorized KAESER service representative carry out regular maintenance.*

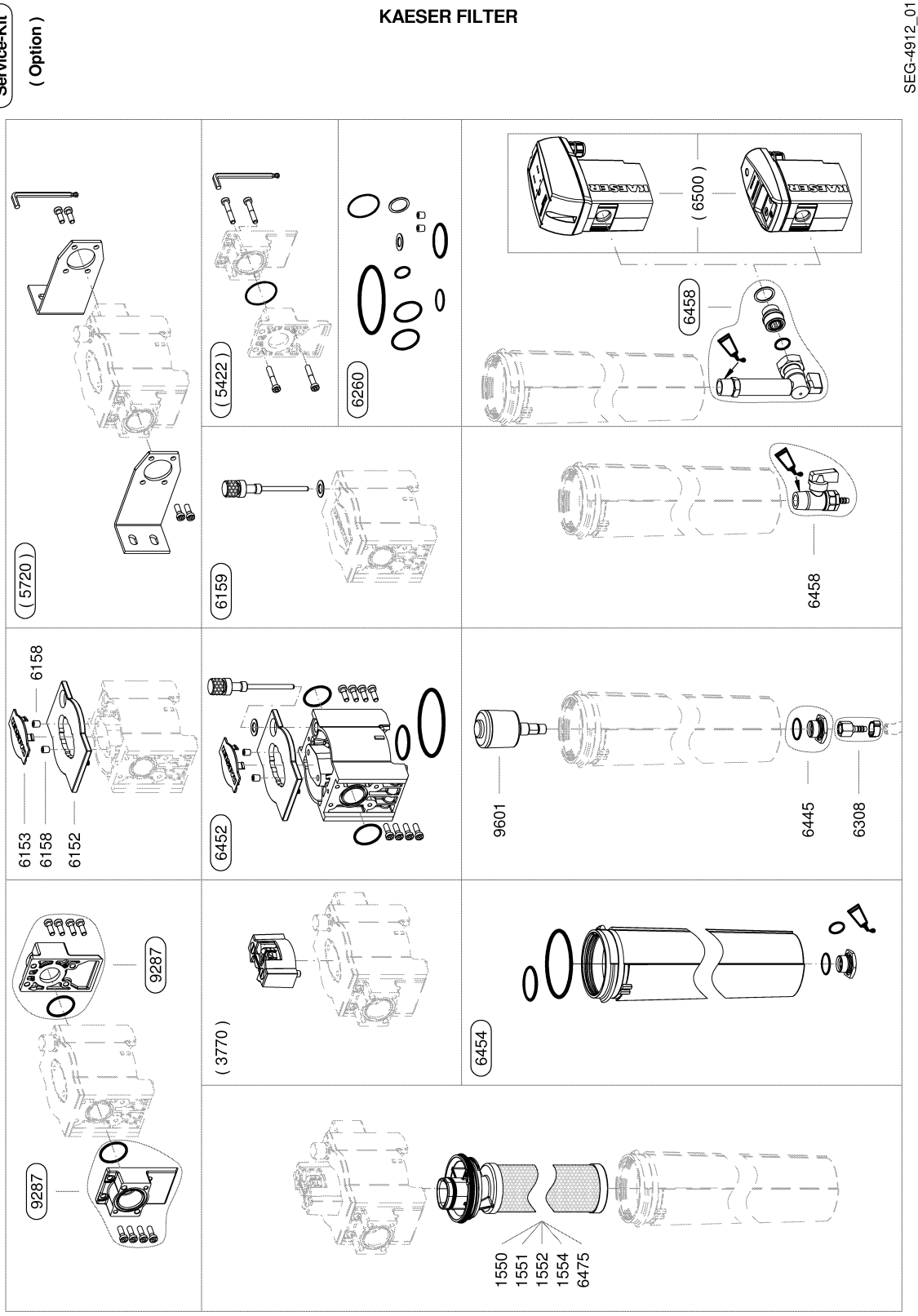
➢ *Do not attempt any tasks other than those described in this manual.*

6 Spares, Operating Materials, Service

6.2 Ordering replacement parts and operating materials

KAESER FILTER

SEG-4912_01



6 Spares, Operating Materials, Service

6.2 Ordering replacement parts and operating materials

Legend		KAESER
	KAESER FILTER	SEL-3642_01 E

Item	Description	Option
1550	Filter element KB	
1551	Filter element KE	
1552	Filter element KA	
1554	Filter element KD	
3770	Pressure diff. indicator	X
5422	Connecting kit	X
5720	Filter support	X
6152	Filter cover	
6153	Filter cover, covering	
6158	Threaded plug	
6159	Locking screw	
6260	Gasket kit	
6308	Hose connection	
6445	Reduction piece	
6452	Upper housing	
6454	Lower housing	
6458	Stop valve	
6475	Centrifugal separator element	
6500	Condensate drain	X
9287	Adaptor	
9601	Maintenance kit, condens.drain	

Please quote the part number and serial number of the machine together with the item number and the description of the part when ordering.

Before and during all work, be sure to read and follow the safety and service instructions in the machine's service manual!

KAESER COMPRESSORS

Built for a lifetime.™

Compressed Air Filters

Superior Filtration for Increased Productivity

Kaeser Gives You the Air Quality You Require

Ambient air contains contaminants that are drawn into the compressor. These contaminants are concentrated during compression and find their way into the compressed air system. A typical compressed air system is contaminated with abrasive solid particles such as dirt, rust and pipe scale, compressor lubricants, condensed water droplets, and oil and hydrocarbon vapors.

Contaminated compressed air systems increase operating costs by robbing the air system of useful power. This results in reduced efficiency, damaged air-operated equipment, higher maintenance and repair costs, reduced production caused by downtime, and increased product rejections.

The properly sized and selected Kaeser filter(s) in conjunction with the appropriate dryer will remove these contaminants. This will allow the compressed air system to deliver the quality of air required for the particular application whether it's plant air, instrument air, or breathing air.

High Performance Filters and Separators

Designed and developed using the latest innovations and manufacturing techniques, Kaeser filter housings are designed with larger flow areas to ensure low pressure drop and to provide easier installation, operation, and maintenance. The result is consistent product quality while minimizing operating costs.

Kaeser Reduces the Cost of Compressed Air

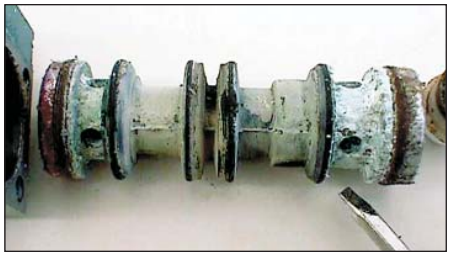
Kaeser filters remove more contaminants with less pressure drop. Compare the operating pressure drop of competitive brand filters and remember, for every extra 2 psi of pressure drop, power requirements increase by 1%.

With a complete selection of application-specific filter types, sizes, technical service, and support, Kaeser offers a customized solution for all of your compressed air quality needs.

What happens when you don't use an air filter?

All ambient air contains harmful particulates and contaminants

Any contaminants that are not filtered from the compressor will eventually wind up in the machinery or end product



Contaminants corrode and damage air-operated equipment

Standard Features and Benefits

1 Delta P Slide Indicator
Ensures economical operation by changing color when filter element requires replacement. Fitted as standard on filters up to 60 scfm (excluding KVF).

2 Color Coded Elements
Allows easy identification. Elements are designed using the latest media innovations and manufacturing technology.

3 Internal Automatic Drain
Reliably discharges collected condensate (excluding KVF and KFS 250 and above).

4 Delta P Gauge
Large, easy-to-read dual gauge faces allow housings to be mounted in any flow direction. Fitted as standard on filters from 100 scfm and up (except KVF).

5 Modular Connections
Space-saving design allows housings to be connected in series without additional piping.

6 Liquid Level Indicator
Visually monitor liquid level and verify drain operation.

Modular Housings for Flows up to 780 scfm

- Manufactured from top quality aluminum and steel
- Powder coat painted (interior and exterior) for added durability and corrosion resistance
- All filter types fit same size housings
- 1/8 turn bayonet head to bowl connections for easy access (20 to 170 scfm)
- Threaded connection for 250 scfm and up
- Optimized air flow through housing minimizes pressure drop
- The tapered housing and non-turbulent lower filter zone prevents condensate from being picked up by the air flow
- Audible warning if disassembly attempted while housing under pressure
- Wall mounting brackets available

Enhanced Performance

- Latest filter media technology results in higher efficiencies and lower Delta P
- Additional filter types for extra critical applications
- 150°F maximum inlet temperature
- 250 psig maximum working pressure (pressure vessels, 225 psig)
- Push-on element for quick, reliable replacement
- Filters maintain rated efficiency down to ten percent of flow capacity
- Filter element seals to filter head
- Stainless steel support sleeves, oil and acid resistant coated collars and end caps

Premium Options

1 Filter Monitor

- Microprocessor control and LCD display
- Indicates optimum element replacement based on:
  - operating time
  - differential pressure
  - filter type
- Filter replacement “warning”
- Continuously measures differential pressure

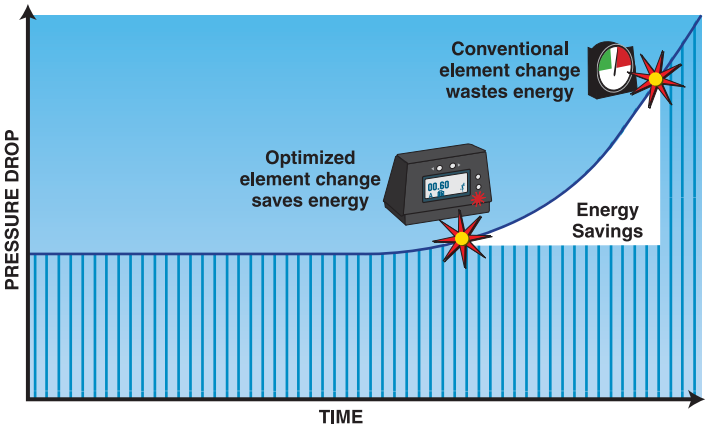
2 Filter Connection Set

Quickly isolates condensate drain for easy maintenance without interrupting air supply.

3 Eco-Drain

- Non-wearing electronic probe does not have moving parts
- Reliably discharges condensate, but not costly compressed air
- Self-checking electronics with automatic alarm test button, and voltage free alarm contact
- LEDs for power supply and alarm

Potential Energy Savings with Filter Monitor

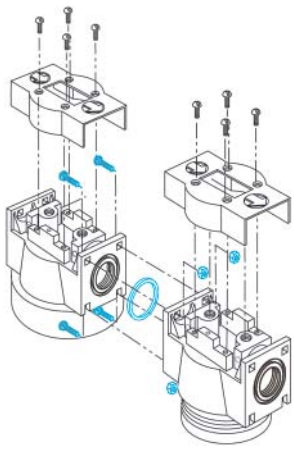


Filter Accessories

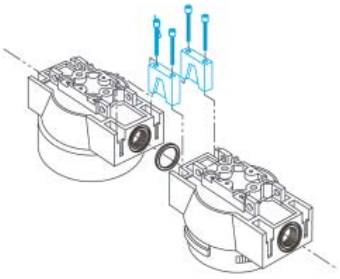
Wall mounting bracket
Available for housings from 20 through 780 scfm

Differential pressure gauge with volt-free contacts for remote alarm indication
Available for housings from 20 through 780 scfm

Manual drain and external drain adapter
Available for housings from 20 through 170 scfm



Manifold connector kit
Available for housings from 250 through 780 scfm (Threaded-type head)



Modular connector kit
Available for housings from 20 through 170 scfm (Bayonet-type head)

Oil Mist Eliminators (OME)

Oil Mist Eliminators (OME) are large oil removal filters with a very low pressure drop. Not only do they remove both oil aerosols and water, but they can handle large slugs of liquid. The cartridge life is normally 8 to 15 years, requiring virtually no maintenance.

Sizes: 125 – 3000 scfm

Other Clean Air Treatment Products

Drain Traps

Kaeser's Automatic Drains like the Automatic Magnetic Drain (AMD) (shown, left) and the award-winning Eco-Drain (shown, right) provide reliability and reduce maintenance. Timed Electric Traps and Automatic Drain Traps complete our compressed air treatment product line.

Condensate Managment

Kaeser's Condensate Filter (KCF) automatically remove oil from compressor condensate. This allows for easy and economical disposal of compressed air condensate in an environmentally responsible way. The low maintenance system requires no electricity for operation.

High Pressure Filters (HP)

High Pressure filters (HP) are available for applications requiring pressures up to 1000 psig. They include seam welded stainless steel cores for greater durability and corrosion resistance.

Membrane Dryers (KMM)

Kaeser Modular Membrane Dryers (KMM) provide a dew point suppression without requiring any external power or regular maintenance. These dryers are well suited for point of use applications and are easy to install with simple piping connections.

Global Standards

ISO 8573.1:2010 was developed by ISO (International Organization for Standardization) as a reference to help facility engineers specify compressed air quality for solid particulates, humidity, and oil.

A typical pharmaceutical plant, for example, might have a compressed air specification of ISO Quality Class 1.2.1. as shown outlined in the specifications below.

SOLID PARTICLES / DUST

Class	Max. particle count per m³ of a particle size with d* (µm)		
	0.1<d≤0.5	0.5<d≤1.0	1.0<d≤5.0
0	Consult Kaeser		
1	≤ 20,000	≤ 400	≤ 10
2	≤ 400,000	≤ 6,000	≤ 100
3	not specified	≤ 90,000	≤ 1,000
4	not specified	not specified	≤ 10,000
5	not specified	not specified	≤ 100,000

Class	Particle concentration* Cp (mg/m³)
6	0 < Cp ≤ 5
7	5 < Cp ≤ 10
X	Cp > 10

HUMIDITY AND LIQUID WATER

Class	Pressure dew point	
0	Consult Kaeser	
1	≤ -70°C	≤ -94°F
2	≤ -40°C	≤ -40°F
3	≤ -20°C	≤ -4°F
4	≤ 3°C	≤ 38°F
5	≤ 7°C	≤ 45°F
6	≤ 10°C	≤ 50°F

Class	Concentration of liquid water* Cw (g/m³)
7	Cw ≤ 0.5
8	0.5 < Cw ≤ 5
9	5 < Cw ≤ 10
X	Cw > 10

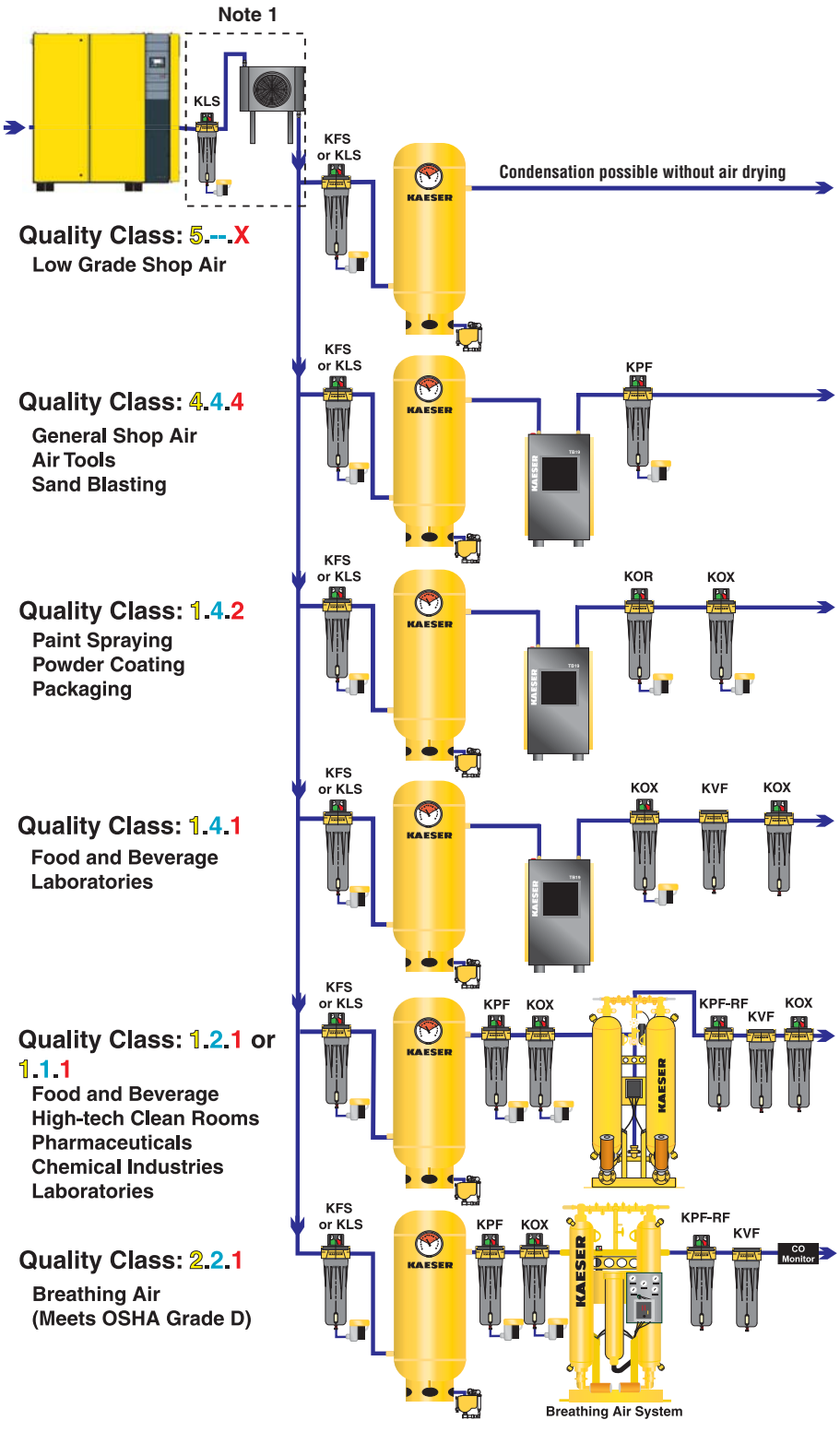
OIL

Class	Total oil concentration* (liquid, aerosol, and vapor)	
	(mg/m³)	(ppm w/w)
0	Consult Kaeser	
1	≤ 0.01	≤ 0.008
2	≤ 0.1	≤ 0.08
3	≤ 1.0	≤ 0.8
4	≤ 5.0	≤ 4
X	> 5.0	> 4

** At reference conditions: 68°F (20°C), 14.5 psia (1 bar), 0% relative humidity*

Example Air Treatment Configurations

with ISO 8573.1: 2010 quality classes shown



Note 1: *All Kaeser Rotary Screw Compressors have built-in aftercoolers. However, for equipment without an aftercooler or where the discharge temperature is 110°F or higher, an aftercooler should be positioned at the location shown.*

The configurations above do not depict every possible dryer-filter combination. Your Kaeser representative will help select the appropriate air treatment products for your application.

Specifications

KLS - Kaeser Liquid Separator

- Liquid Removal: 99+% of water
- Max. Liquid Loading: 30,000 ppm w/w
- Oil Carry-Over: N/A
- Pressure Drop: Wet: 0.8 psi

KFS - Kaeser Filtered Separator

- Liquid Removal: 99+% of water
- Max. Liquid Loading: 25,000 ppm w/w
- Solid Particle Removal: Meets ISO Class 5
- Oil Carry-Over: Meets ISO Class X for aerosols
- Pressure Drop: Dry-1 psi; Wet: 1.5 psi

KPF - Kaeser Particulate Filter

- Liquid Removal: 100% of water
- Max. Liquid Loading: 2,000 ppm w/w
- Solid Particle Removal: Meets ISO Class 4
- Oil Carry-Over: Meets ISO Class 4 for aerosols
- Pressure Drop: Dry: 1 psi; Wet: 2 psi

KOR - Kaeser Oil Removal Filter

- Liquid Removal: 99.99+% of oil
- Max. Liquid Loading: 1,000 ppm w/w
- Solid Particle Removal: Meets ISO Class 2
- Oil Carry-Over: Meets ISO Class 2 for aerosols
- Pressure Drop: Dry: 1 psi; Wet: 3 psi

KOX - Kaeser Oil Removal eXtra Fine Filter

- Liquid Removal: 99.999+% of oil
- Max. Liquid Loading: 100 ppm w/w
- Solid Particle Removal: Meets ISO Class 1
- Oil Carry-Over: Meets ISO Class 2 for aerosols
- Pressure Drop: Dry: 2 psi; Wet: 6 psi

KVF - Kaeser Vapor Filter

- Liquid Removal: 0%
- Max. Liquid Loading: 0 ppm w/w
- Solid Particle Removal: Meets ISO Class 2
- Oil Carry-Over: Meets ISO Class 1 for vapor
- Pressure Drop: Dry: 1 psi; Wet: N/A

Model	Air Flow @ 100 psig (cfm)	Connection Size (in.)	Standard Features of Filters* KLS	KFS	KPF	KOR	KOX	KVF	Max. Working Pressure (psig)	Housing Dimensions W x H (in.)	Weight (lbs.)
Modular Type Housing											
(Filter Type) - 20	20	1/2 NPTF	1	4	4	4	4	9	With Manual Drain: 300	4 1/8 x 9	4
(Filter Type) - 35	35	1/2 NPTF								4 1/8 x 11 1/8	4
(Filter Type) - 60	60	1/2 NPTF								4 1/8 x 13 1/2	5
(Filter Type) - 100	100	1 NPTF		5	5	5	5			5 1/4 x 14 3/8	6
(Filter Type) - 170	170	1 NPTF								5 1/4 x 18 5/8	7
(Filter Type) - 250	250	1 1/2 NPTF		6						6 1/2 x 22 3/4	9
(Filter Type) - 375	375	1 1/2 NPTF							With Auto Drain or LLI: 250	6 1/2 x 27 1/4	10
(Filter Type) - 485.2	485	2 NPTF	2	7	8	8				7 5/8 x 30 5/8	21
(Filter Type) - 485.2.5	485	2 1/2 NPTF								7 5/8 x 30 5/8	21
(Filter Type) - 625	625	2 1/2 NPTF								7 5/8 x 36 3/8	24
(Filter Type) - 780	780	2 1/2 NPTF								7 5/8 x 42 1/2	28
Pressure Vessel											
(Filter Type) - 1000P	1000	3 NPTM	3	3	3	3	3	10	225	16 x 48	90
(Filter Type) - 1250P	1250	3 NPTM								16 x 48	90
(Filter Type) - 1875P	1875	3 NPTM								16 1/4 x 49	118
(Filter Type) - 2500P	2500	4 Flange								20 x 52 1/4	178
(Filter Type) - 3125P	3125	4 Flange								20 x 52 1/4	180
(Filter Type) - 5000P	5000	6 Flange								24 x 54 5/8	271
(Filter Type) - 6875P	6875	6 Flange								28 x 62 9/16	518
(Filter Type) - 8750P	8750	6 Flange								28 x 62 9/16	525
(Filter Type) - 11875P	11,875	8 Flange								33 x 69 1/8	709
(Filter Type) - 16250P	16,250	8 Flange								39 x 68	918
(Filter Type) - 21250P	21,250	10 Flange								45 7/8 x 71	1412

***Standard Features of Filters**

1 - Manual Drain, Liquid Level Indicator (Automatic drain trap is *STRONGLY* recommended)
2 - Manual Drain (Automatic drain trap is *STRONGLY* recommended)
3 - Plugged Drain Port (Automatic drain trap is *STRONGLY* recommended), Delta P Gauge
4 - Internal Automatic Drain, Delta P Slide Indicator, Liquid Level Indicator
5 - Internal Automatic Drain, Delta P Gauge, Liquid Level Indicator
6 - Manual Drain, Delta P Gauge, Liquid Level Indicator (Automatic drain trap is *STRONGLY* recommended)
7 - Manual Drain, Delta P Gauge (Automatic drain trap is *STRONGLY* recommended)
8 - Internal Automatic Drain, Delta P Gauge
9 - Manual Drain (Automatic drain trap not required)
10-Plugged Drain Port (Manual drain recommended, automatic drain trap not required)

Sizing

To find the maximum flow for a filter size at pressures other than 100 psig, multiply the rated flow by the Correction Factor corresponding to the minimum pressure at the inlet of the filter. Do not select filters by pipe size. Use flow rate and operating pressure.

Operating Pressure (psig)	60	80	90	100	110	125	145	150	160	175	190	215	230	250
Capacity Correction Factor	0.65	0.83	0.91	1.00	1.09	1.22	1.39	1.44	1.52	1.65	1.78	2.00	2.13	2.31

Note: Maximum inlet temperature is 150°F.

Specifications are subject to change without notice.

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4011210 Rev B 10/08

KAESER

COMPRESSED AIR FILTERS

Filter Types KLS, KFS, KPF, KPF-RF, KOR, KOX, and KVF
20 - 780 scfm (35 - 1325 m³/hr)

INSTRUCTION MANUAL

General Safety Information

1. Pressurized devices

⚠WARNING

- Do not exceed maximum operating pressure indicated on serial number tag.
- Make certain filter is fully depressurized before servicing.

2. Breathing Air

- Air treated by this equipment may not be suitable for breathing without further purification. Refer to OSHA standard 1910.134 for breathing air requirements.

3. Flammable gases

⚠WARNING

While the materials of construction are compatible with many flammable gases, the following application limitations must be considered:

- Housing materials are slightly porous. The product must be used in a well ventilated area in the absence of sparks or ignition sources. Do not use in Class 1, Division 1, Group D environments.
- The type of area - forced exhaust system used (i.e., high or low level) would be dependent on the gas involved.
- Each application (other than for air or inert gas) must be reviewed to minimize fire or explosion hazard.

Contents

SERVICE DEPARTMENT: (724) 745-3038

Type Identification

Type	Description	Function	Outer foam color
KLS	Mechanical Separator	Impaction type Separator	none
KFS	Separator/filter	Mechanical separator and 3 micron coalescer	none
KPF	General purpose air line filter	1 micron coalescer	none
KPF-RF	Dry Desiccant afterfilter	1 micron afterfilter for desiccant dryers	none
KOR	High efficiency oil removal filter	High efficiency (99.99+%) coalescer	Red
KOX	Maximum efficiency oil removal filter	Maximum efficiency (99.999+%) coalescer	Blue
KVF	Oil vapor removal filter	Activated carbon adsorber	Green

1.0 Installation

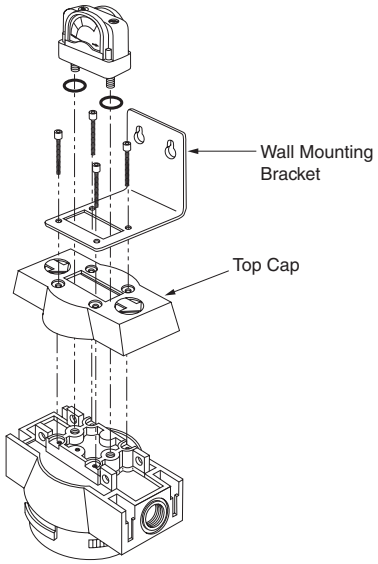
A. Where Used/Air Quality After Filtration

Type	Where used	Solid particle removal (maximum size in microns)	Liquid removal efficiency (at rated conditions)	Maximum inlet liquid loading ppm w/w	Remaining oil content ppm w/w
KLS	Separator - downstream of an aftercooler Point-of-use - where no aftercooler is installed upstream	—	95% of water	30, 000 bulk liquids	—
KFS	Separator - downstream of an aftercooler Point-of-use - where no aftercooler is installed upstream or as prefilter to refrigerated dryer	3	99+% of water aerosols & bulk liquids	25, 000 aerosols & bulk liquids	5 aerosols
KPF	Prefilter - • Prefilter to KOR & KOX - high efficiency coalescing filters Point-of-use - where aftercooler is installed upstream	1	100% of water	2, 000 aerosols	1 aerosols
KPF-RF	Afterfilter - downstream of pressure-swing (heatless) desiccant dryers Downstream of an Activated Carbon or Desiccant Tower	1	No liquid should be present at inlet	No liquid should be present at inlet	—
KOR	Prefilter - ahead of desiccant and membrane dryers Afterfilter • Downstream of refrigerated dryer • Downstream of pressure-swing (heatless) desiccant dryers for finer solid particle removal • Oil removal at point-of-use	0.01	99.99+% of oil	1, 000 aerosols	0.008 aerosols
KOX	Prefilter - ahead of desiccant and membrane dryers (use after KPF to reduce liquid and solids load, prolong element life and ensure filtration efficiency) Afterfilter - downstream of refrigerated dryer	0.01	99.999+% of oil	100 aerosols	0.0008 aerosols
KVF	Afterfilter to KOR & KOX for true oil free applications	0.01	Removes vapors only	No liquid should be present	0.003 vapor

B. Mounting

1. Wall mounting brackets - Mount bracket to filter head:
   (1) remove four (4) screws holding black plastic top cap to filter head
   (2) place bracket on head over plastic cap
   (3) install screws supplied with bracket.

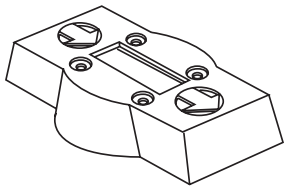
2. Differential Pressure Gauge Mounting to Filter Head
   (1) make certain o-rings are in place on the bottom of the gauge body.
   (2) connect the low pressure transmission bolt (bolt next to the RED band on gauge) to the gauge port at the filter outlet (downstream side of filter).
   (3) connect the high pressure transmission bolt (bolt next to GREEN band on gauge) to the gauge port at the filter inlet (upstream side of the filter).
   (4) use a coin or a flathead screwdriver to tighten/loosen bolts. The tip width of the screwdriver should be at least 3/8" inch (9.5 mm). Torque bolts to 25 +/-5 inch oz. **DO NOT OVER TIGHTEN.**



C. Piping

1. Before installing, blow out pipe line to remove scale and other foreign matter.
2. This unit has DRYSEAL pipe threads; use pipe compound or tape sparingly to male threads only.
3. Mounting (Types KLS, KFS, KPF, KPF-RF, KOR, KOX) - mount so that inlet and outlet connections are horizontal (filter bowl vertical) to ensure proper liquid drainage.
4. Flow Direction - install so that the air flow is in the direction of arrows on the filter head.

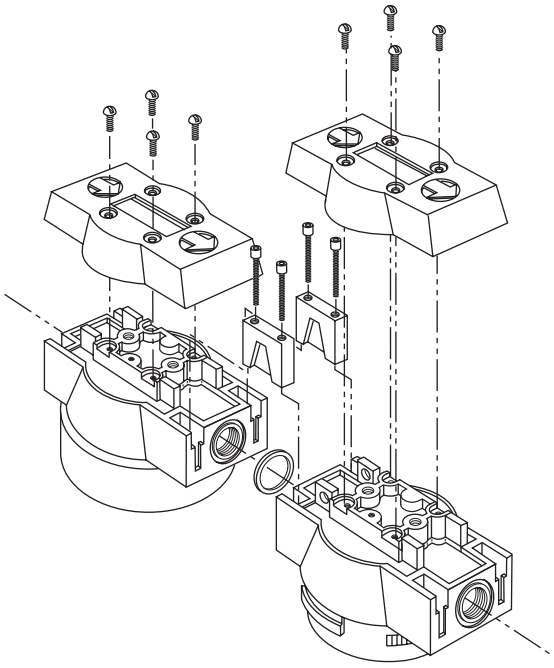
   NOTE: Type KPF-RF flows from outside to inside the element. All other grades flow from inside to outside the element. Observe flow arrows on cap.



5. Direct filter-to-filter (modular) connection - Filter heads may be joined without using a pipe nipple

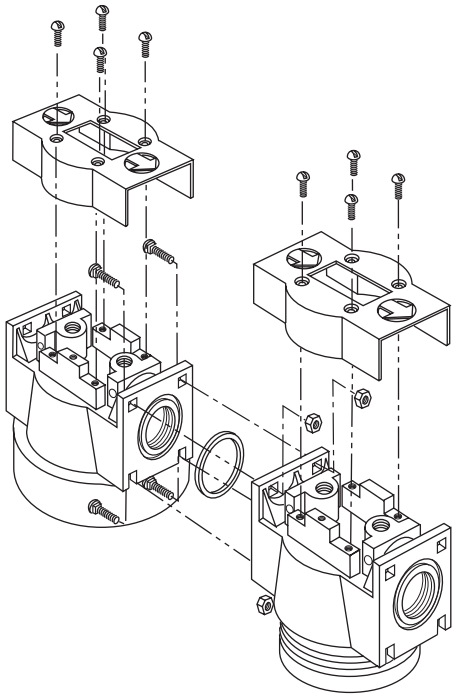
   a. Bayonet type heads - Use two (2) modular connectors, o-ring, and four (4) socket head cap screws (sold as kit)

      Remove black plastic top cap, apply generous amount of lubricant to o-ring, install o-ring in groove, and insert connectors. Screw connectors to head using socket head cap screws.



   b. Threaded heads

      Use four carriage bolts, nuts and o-ring (sold as kit). Remove black plastic top caps, apply generous amount of lubricant to o-ring, install o-ring in groove, and install bolts and nuts.



NOTE: Make certain flow direction through filters is correct (observe pin hole used for aligning top caps). When hole is on side closest to you, inlet is to left. Type KPF-RF - when hole is on the side farther from you, inlet is to left.

NOTE: Lubricate o-ring with generous amount of lubricant before installation.

6. Isolation valves and by-pass piping - For ease of service, isolation and by-pass valves are desirable. In critical applications, two filters installed in parallel may be necessary to avoid interruption of air supply.

D. Drain provisions (Types KFS, KPF, KOR, KOX)

1. Internal Automatic Drains - Drain line
   The bottom of internal automatic drains are provided with 1/8" (inside threads) for connection of a drain line if desired.
2. External Auto Drains - External auto drains may be added as follows:

   Models with flow ratings of 20 through 170 scfm (35-290 m^3/hr) - remove internal drain and install adapter (available from factory). Adapter outlet connection is 1/8" (inside threads).

   ⚠WARNING Discharge is at system pressure; anchor drain line.

   Models with flow ratings 250 through 780 scfm (425-1325 m^3/hr) - remove adapter fitting from bottom of bowl; 1/2" (inside threads) port is available for external drain connection.

2.0 Operation

⚠WARNING Do not operate filter at pressures in excess of Maximum Working Pressure indicated on Serial Number Tag.

NOTE: Maximum Operating Temperature - 150°F (66°C). Liquid filtration above 120°F (49°C) is not recommended since there is typically oil present in a vapor state which passes through the filter and condenses downstream.

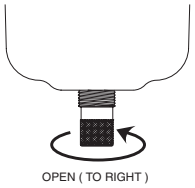
NOTE: KVF Type Filter - If operated above 100°F (38°C) may experience less than 1000 hours of life because of greater oil vapor content.

A. Liquid Draining - Types KLS, KFS, KPF, KOR, and KOX

NOTE: Collected liquids must be removed to ensure proper operation.

NOTE: Depressurize slowly, to avoid filter element damage.

1. Manual Drain - Turn to your right (clockwise) to open and to your left (counterclockwise) to close.
2. Automatic Drain - Liquids will automatically discharge when sufficient accumulation occurs.
   a. Internally Mounted Auto Drains - These drains may be manually drained by turning to your right (clockwise) to open and to your left (counterclockwise) to close.



NOTE: Manually drain internal auto drains daily to verify drain function.

B. Operational Checkpoints

All Types

Check flow, pressure, and temperature to make certain filter is being operated within design conditions.

Types KLS, KFS, KPF, KPF-RF, KOR, and KOX

Check pressure drop across the filter

1. Pressure differential in excess of 6 psi (0.42 kgf/cm^2) - pressure indicator in red area - indicates that the filter sleeve or element should be replaced. Reference page 7 for gauge scale detail.

NOTE: Element should be changed annually or when indicator changes to red, whichever occurs first.

NOTE: Pressure drop should never exceed 50 psi (3.5 kgf/cm^2).

2. Check for sudden reduction in pressure drop. This might indicate:
   a. Possible leak across element o-ring seal
   b. Leak through the element due to physical damage

Types KLS, KFS, KPF, KOR, KOX

1. Check to see that filter is installed level to insure proper drainage.
2. Check that manual drains are drained periodically or that automatic drains are functioning.
3. On models with Liquid Level Sight glass - Check that liquid level is below top of Sight glass.

Type KVF

1. Check for an oily smell by opening the manual valve. If an oily smell exists, the following should be checked:
   a. Filter element adsorption capacity exhausted
   b. Leak across element o-ring seal
   c. Leak through element due to physical damage
   d. Presence of liquids because of lack of or failure of prefilters
   e. Flow, pressure and temperatures outside design conditions
   f. Presence of gaseous impurities which cannot be adsorbed

⚠ CAUTION Methane, carbon monoxide, carbon dioxide and various inorganic gases cannot be removed by an activated carbon filter.

C. Flow Capacity

Maximum air flow for the various filters at 100 psig (7 kgf / cm^2) is indicated in Table 1. To determine maximum air flows at inlet pressures other than 100 psig (7 kgf / cm^2), multiply flow from Table 1 by air flow correction factor from Table 2 that corresponds to the minimum operating pressure at the inlet of the filter.

NOTE: Filters should not be selected by pipe size. Select using flow rate and operating pressure only.

Table 1 - Maximum Flow @100 psig [7 kgf/cm^2]

Types KLS, KFS, KPF, KPF-RF, KOR, KOX, KVF Model Number	scfm	*[m^3/hr]*
20	20	*[35]*
35	35	*[60]*
60	60	*[105]*
100	100	*[170]*
170	170	*[290]*
250	250	*[425]*
375	375	*[640]*
485	485	*[825]*
625	625	*[1060]*
780	780	*[1325]*

Table 2 - Air Flow Correction Factor

Maximum Inlet Pressure	psig	20	30	40	60	80	100	120	150	200	250	300
	kgf/cm^2	1.4	2.1	2.8	4.2	5.6	7.0	8.4	10.6	14.1	17.6	21.1
Correction Factor		0.30	0.39	0.48	0.65	0.82	1.00	1.17	1.43	1.87	2.31	2.74

3.0 Maintenance

A. When to Replace Filter Element

NOTE: Types KPF, KPF-RF, KOR, KOX, and KVF - complete element is replaced; Type KFS - unless separator core is damaged outer sleeve only is replaced.

1. Type 6 (dry desiccant afterfilter)
   Initial drop: 1 psi (0.07 kgf/cm^2). Pressure drop increases as element loads with solid particles. Replace when pressure drop reaches 6 psi (0.42 kgf/cm^2) (indicator in red area) or annually, whichever occurs first. Reference page 7, Figure 3.3 for gauge scale detail.

2. Type KLS (mechanical separator)
   Element should not require replacement unless physically damaged. If sludge accumulates, element can be removed and cleaned with soap and water.

3. Types KFS, KPF, KOR, and KOX
   a. Initial (dry) pressure drop: 1 psi (0.07 kgf/cm^2) to 2 psi (0.14 kgf/cm^2)
   b. Operating pressure drop: As filter becomes liquid loaded (wetted), pressure drop will increase to 2 to 6 psi (0.14 to 0.42 kgf/cm^2). Further pressure drop occurs as element loads with solid particles.
   c. FOR MAXIMUM FILTRATION EFFICIENCY, REPLACE ELEMENT WHEN PRESSURE DROP REACHES 6 PSI (0.42 KGF/CM^2) (INDICATOR IN RED AREA) OR ANNUALLY, WHICHEVER OCCURS FIRST. Reference page 7, for gauge scale detail.

NOTE: Pressure drop may temporarily increase when flow is resumed after flow stoppage. Pressure drop should return to normal within one hour.

NOTE: Types KOR and KOX - During normal operation bottom of foam sleeve will have a band of oil. Spotting above the band indicates that liquids are accumulating faster than they can be drained and that prefiltration is required.

4. Type KVF (activated carbon filters)
   a. Adsorption capacity - 1000 hours at rated capacity. Element life is exhausted when odor can be detected downstream of the filter.

B. Procedure for Element Replacement

⚠WARNING THIS FILTER IS A PRESSURE CONTAINING DEVICE. DEPRESSURIZE BEFORE SERVICING. If filter has not been depressurized before disassembly, an audible alarm will sound when the bowl begins to be removed from the head. If this occurs, stop disassembly, isolate and completely depressurize filter before proceeding.

1. Isolate filter (close inlet and outlet valves if installed) or shut off air supply.

2. Depressurize filter by slowly opening manual drain valve.

3. Remove bowl
   a. For models rated for 20 - 170 scfm (35 - 290m^3/hr) - bayonet mount - push bowl up, turn bowl 1/8th turn to your left, and pull bowl straight down
   b. For models rated 250 - 780 scfm (425 - 1325 m^3/hr) - threaded bowls - unscrew bowl from head using hand, strap wrench or C spanner.

4. Clean filter bowl

5. Replace element
   a. Replacing complete element
      1) Pull off old element and discard.
      2) Make certain o-ring inside top of replacement element is in place and push element onto filter head. For models rated 485 - 780 scfm (825 - 1325 m^3/hr), place element in bowl and secure with centering device.

NOTE: Types KOR, KOX, and KVF - Do not handle elements by outside foam cover. Handle by bottom end cap only.

   b. Type KFS - replacing sleeve only
      1) Pull element straight down to remove.
      2) Remove bolt and bottom cap and remove disposable filter sleeve.
      3) Clean separator core with soap and water if necessary.
      4) Slide new filter sleeve over separator core and replace bottom cap and hand tighten bolt.
      5) Make certain o-ring inside top of element is in place and push element onto filter head.

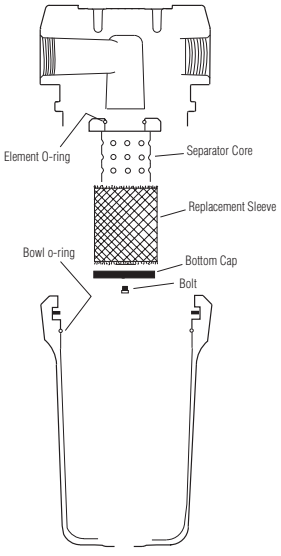
6. After making certain that o-ring inside top of bowl (and on bayonet mount heads, wave spring) are in place, reassemble bowl to head.

NOTE: Make certain o-ring is generously lubricated.

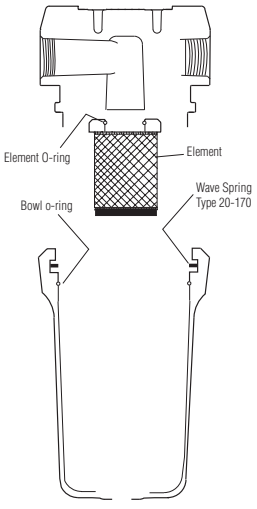
NOTE: Wave spring ends should be pointed down to prevent the wave spring from interfering with reassembly.

NOTE: Threaded bowl to head connection, generously lubricate threads with a high grade/temperature lubricant good for 150°F, 66°C.

NOTE: For Models with flow rating of 20 scfm (35 m^3/hr) manufactured before 12/99 make certain spacer in bowl is in place before reassembling.



Type KFS - Sleeve Replacement



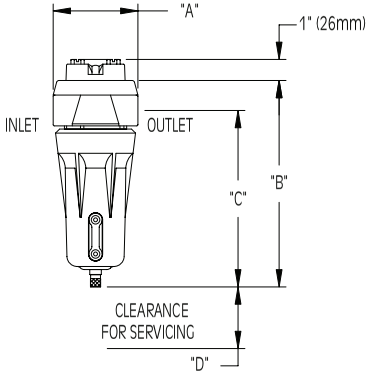
All Types - Element Replacement

C. Auto Drain Mechanism

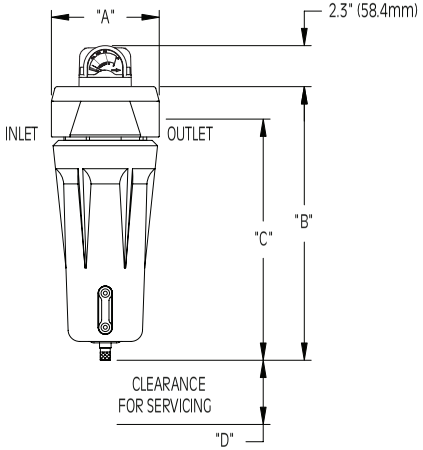
It is recommended that drain mechanism be replaced annually.

Filter Type *KLS, KFS, KPF, KPF-RF, KOR, KOX, AND KVF*	20	35	60	100	170	250	375	485	625	780
Replacement Element *FS, PF, PF-RF, OR, OX, and VF*	20 or 20SS	35 or 35SS	60 or 60SS	100 or 100SS	170 or 170SS	250 or 250SS	375 or 375SS	485 or 485SS	625 or 625SS	780 or 780SS
Nominal Air Flow scfm @100 psig (m^3/hr @ 7.0 bar)	20 (35)	35 (60)	60 (105)	100 (170)	170 (290)	250 (425)	375 (640)	485 (825)	625 (1060)	780 (1325)
In/Out Connection *NPT or BSP*	3/8, 1/2	3/8, 1/2	3/8, 1/2	3/4, 1	3/4, 1	1, 1-1/4, 1-1/2	1, 1-1/4, 1-1/2	2, 2-1/2	2-1/2	2-1/2
"A" in. (mm)	4.13 (105)	4.13 (105)	4.13 (105)	5.25 (133)	5.25 (133)	6.44 (164)	6.44 (164)	7.63 (194)	7.63 (194)	7.63 (194)
"B" in. (mm)	8.15 (207)	10.05 (255)	12.40 (316)	13.32 (338)	17.57 (446)	20.80 (528)	25.29 (642)	29.08 (739)	34.83 (885)	40.96 (1040)
"C" in. (mm)	6.40 (163)	8.59 (224)	10.97 (285)	11.74 (298)	15.99 (406)	18.98 (482)	23.47 (596)	26.83 (681)	32.58 (827)	38.71 (983)
"D" in. (mm)	3.00 (76)	3.00 (76)	3.00 (76)	3.50 (89)	3.50 (89)	4.00 (102)	4.00 (102)	4.00 (102)	4.00 (102)	4.00 (102)
Weight lb. (kg)	4.14 (1.88)	4.5 (2.04)	4.7 (2.13)	6.3 (2.9)	6.9 (3.1)	10.2 (4.63)	11.3 (5.13)	28 (12.70)	33 (14.97)	38 (17.24)
Maximum Working Pressure	Housing - 300 psig, 21.1 kgf/cm^2 Models with Internal Drain or Liquid level indicator - 250 psig, 17.6 kgf/cm^2					Housing - 300 psig, 21.1 kgf/cm^2 Models with Internal Drain or Liquid level indicator - 250 psig, 17.6 kgf/cm^2				
Maximum Operating Temperature	150°F, 66°C					150°F, 66°C				
Head Material	Aluminum					Aluminum				
Bowl Material	Aluminum					Aluminum				
Liquid Level Indicator Material	Isoplast					Isoplast				

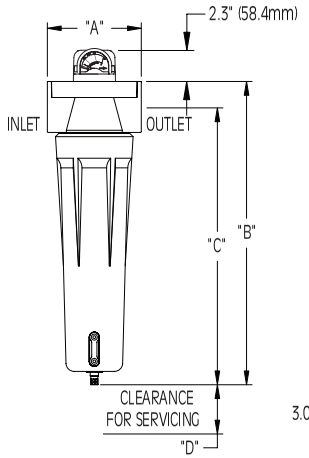
NOTE: Dimensions and Weights are for reference only. Request certified drawings for construction purposes.



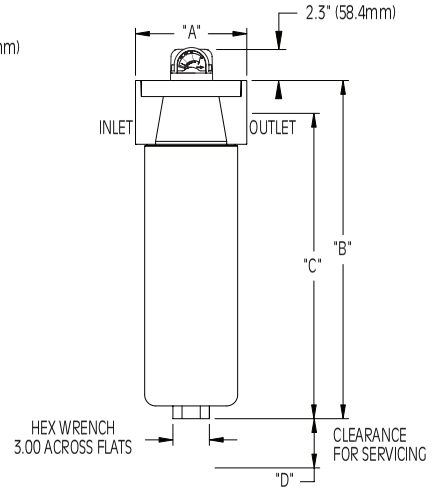
Sizes 20 - 60 scfm
(All Types)



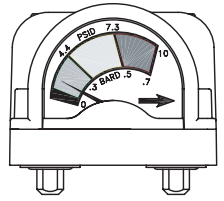
Sizes 100 - 170 scfm
(All Types)



Sizes 250 - 375 scfm
(All Types)



Sizes 485 - 780 scfm
(All Types)



Differential Pressure Gauge

WARRANTY

The manufacturer warrants the product manufactured by it, when properly installed, operated, applied, and maintained in accordance with procedures and recommendations outlined in manufacturer's instruction manuals, to be free from defects in material and workmanship for a period of one (1) year from date shipment to the buyer by the manufacturer or manufacturer's authorized distributor provided such defect is discovered and brought to the manufacturer's attention within the aforesaid warranty period.

The manufacturer will repair or replace any product or part determined to be defective by the manufacturer within the warranty period, provided such defect occurred in normal service and not as a result of misuse, abuse, neglect or accident. Normal maintenance items requiring routine replacement are not warranted. The warranty covers parts and labor for the warranty period. Repair or replacement shall be made at the factory or the installation site, at the sole option of the manufacturer. Any service performed on the product by anyone other than the manufacturer must first be authorized by the manufacturer.

Unauthorized service voids the warranty and any resulting charge or subsequent claim will not be paid.

Products repaired or replaced under warranty shall be warranted for the unexpired portion of the warranty applying to the original product.

The foregoing is the exclusive remedy of any buyer of the manufacturer's product. The maximum damages liability of the manufacturer is the original purchase price of the product or part.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, OR STATUTORY, AND IS EXPRESSED IN LIEU OF THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. THE MANUFACTURER SHALL NOT BE LIABLE FOR LOSS OR DAMAGE BY REASON OF STRICT LIABILITY IN TORT OR ITS NEGLIGENCE IN WHATEVER MANNER INCLUDING DESIGN, MANUFACTURE OR INSPECTION OF THE EQUIPMENT OR ITS FAILURE TO DISCOVER, REPORT, REPAIR, OR MODIFY LATENT DEFECTS INHERENT THEREIN.

THE MANUFACTURER, HIS REPRESENTATIVE OR DISTRIBUTOR SHALL NOT BE LIABLE FOR LOSS OF USE OF THE PRODUCT OR OTHER INCIDENTAL OR CONSEQUENTIAL COSTS, EXPENSES, OR DAMAGES INCURRED BY THE BUYER, WHETHER ARISING FROM BREACH OF WARRANTY, NEGLIGENCE OR STRICT LIABILITY IN TORT.

The manufacturer does not warrant any product, part, material, component, or accessory manufactured by others and sold or supplied in connection with the sale of manufacturer's products.

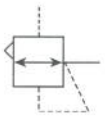
AUTHORIZATION FROM THE SERVICE DEPARTMENT IS NECESSARY BEFORE MATERIAL IS RETURNED TO THE FACTORY OR IN-WARRANTY REPAIRS ARE MADE.

KAESER

www.kaeser.com

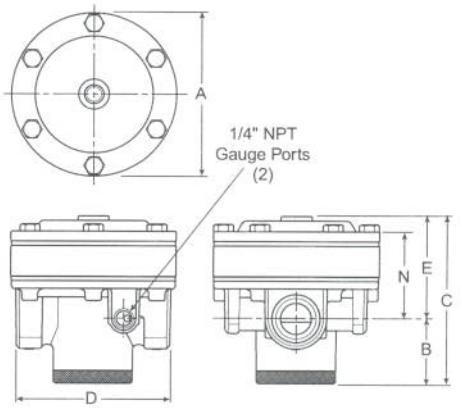
KAESER COMPRESSORS
U.S.A. • P.O. Box 946 • Fredericksburg, VA 22404 • Tel: 540/898-5500 • Fax: 540/898-5520 • Service: (724) 745-3038
Canada • 3760 Rue La Verendrye • Boisbriand (Quebec) J7H 1R5 • Tel: 450/971-1414 • Fax: 450/971-1415 • Service: (724) 745-3038

R119 Pilot Operated Regulators



Features

- Adapted for Control by a Remote or Distant Small Pilot Regulator. Ideal for Maximum Capacity Requirements in Applications where Units are Not Readily Accessible
- High Flow Performance Featuring Rugged Design for the Most Demanding Applications
- Ideal for Those Installations Calling for Constant Pressure with Wide Variation in Flow
- Diaphragm Operated Design with Balanced Poppet and Constant Bleed Pilot for Quick and Accurate Regulation.
- Secondary Aspiration Plus Balanced Poppet Provides Quick Response and Accurate Pressure Regulation
- Reverse Flow Version Available
- High Flow: 3/4", 1" - 300 SCFM§, 1-1/4" & 1-1/2" - 380+ SCFM§



Port Size	NPT Relieving	BSPP Relieving
Without Gauge 0-125 PSIG Reduced Pressure		
3/4"	**R119-06J**	R119G06J
1"	**R119-08J**	R119G08J
1-1/4"	**R119-10J**	R119G10J
1-1/2"	**R119-12J**	R119G12J

Bold Items are Most Popular.
For other models refer to ordering information below.

§ SCFM = Standard cubic feet per minute at 100 PSIG inlet, 75 PSIG no flow secondary setting, and 20 PSIG pressure drop.

R119 Regulator Dimensions					
A	B	C	D	E	N
R119-06J, R119-08J					
4.72 (120)	1.87 (47)	2.94 (75)	4.38 (111)	4.81 (122)	2.47 (63)
R119-10J, R119-12J					
4.94 (125)	1.81 (46)	3.32 (84)	4.94 (125)	5.13 (130)	2.88 (73)

inches
(mm)

⚠ WARNING
Do not connect regulator to bottled gas.
Do not exceed maximum primary pressure rating.
Product rupture can cause serious injury.

Ordering Information

R	119	—	06	J		/**

Port Threads
— NPT
G BSPP

Port Size
06 3/4 Inch
08 1 Inch
10 1-1/4 Inch
12 1-1/2 Inch

Reduced Pressure Range
J Air Pilot Operated

Options
K Non-Relieving
X64* Fluorocarbon O-Rings and Diaphragm
X71 Non-Bleed Pilot (For use with Electronic Controllers)
X7† Brass Bottom Plug

Engineering Change Designator
Will be entered at factory.

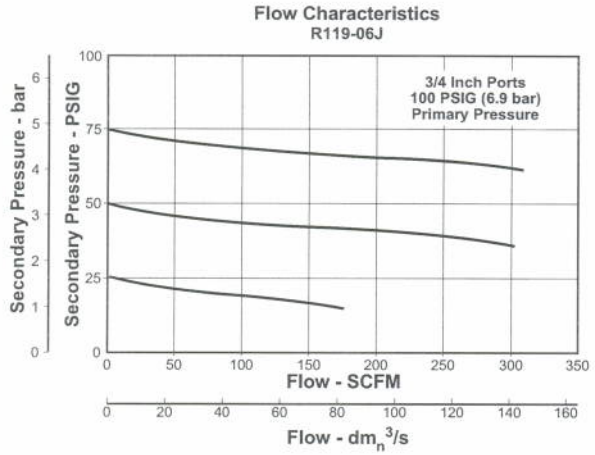
†**NOTE:** Beginning March 2008, Brass Bottom Plug is Optional - Nylon is Standard.

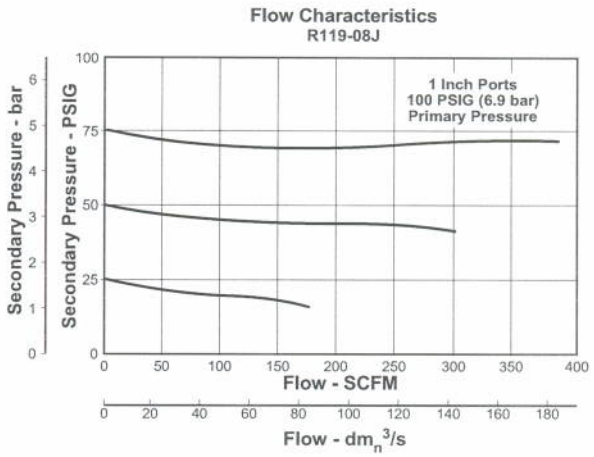
* Brass Bottom Plug Standard with X64 Option.

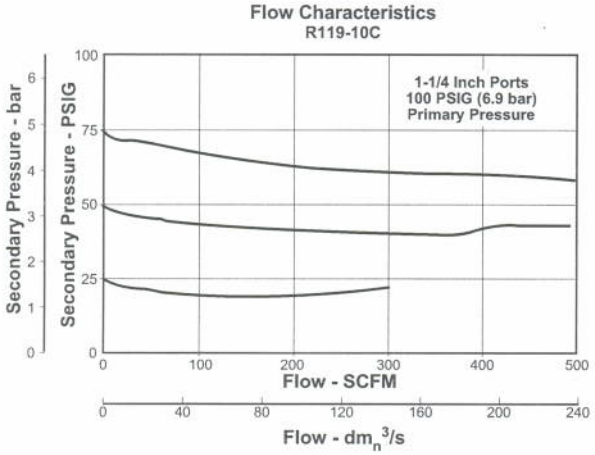
BOLD ITEMS ARE MOST POPULAR.

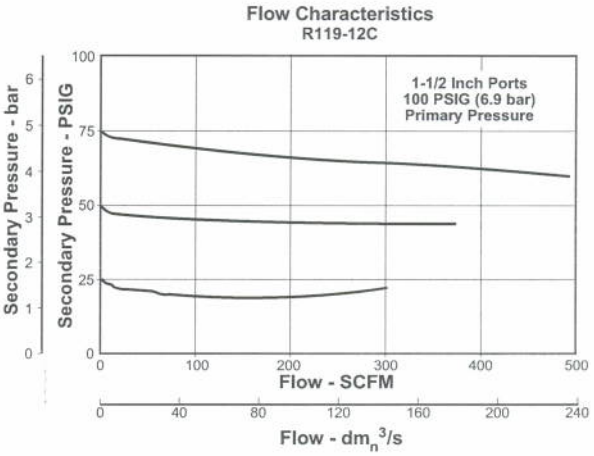
Pneumatic Division
Richland, Michigan
www.wattsfluidair.com

Technical Information









B

R119 Regulator Kits & Accessories

Gauges –

2" Dial Size, 1/4" Back Connection
0 to 60 PSIG (0 to 400 kPa) K4520N14060

2" Dial Size, 1/4" Back Connection
0 to 160 PSIG (0 to 1100 kPa) K4520N14160

2" Dial Size, 1/4" Back Connection
0 to 300 PSIG (0 to 2068 kPa) K4520N14300

Repair Kits –

Non-Relieving Diaphragm,
Valve Assembly (3/4", 1") RK118X20B

Non-Relieving Diaphragm,
Valve Assembly (1-1/4", 1-1/2") RK118X20D

Relieving Diaphragm,
Valve Assembly (3/4", 1") RK119X20B

Relieving Diaphragm,
Valve Assembly (1-1/4", 1-1/2") RK119X20D

For Fluorocarbon Repair Kits, add X64 to Kit Number suffix.

Specifications

Gauge Ports (2) ..... 1/4 Inch

Port Threads ..... 3/4, 1, 1-1/4, 1-1/2 Inch

Reduced Pressure Range –
Adjustable to Within 5 to 7 PSIG of Supply Pressure

Supply Pressure ..... 300 PSIG Maximum (20.4 bar)

Air Consumption –
Constant bleed from air pilot chamber: approx 0.17 SCFM (10 SCFH)

Temperature Rating ..... 40°F to 125°F (4.4°C to 52°C)

Weight –

R119-06J, R119-08J ..... 5.2 lb. (2.36 kg) / Unit
42 lb. (19.05 kg) / 8-Unit Master Pack

R119-10J, R119-12J ..... 5.6 lb. (2.54 kg) / Unit
46 lb. (20.87 kg) / 8-Unit Master Pack

Materials of Construction

Body, Ring, Top Plate ..... Zinc

Bottom Plug ..... Nylon

Innervalve ..... Brass

Seals ..... Buna N

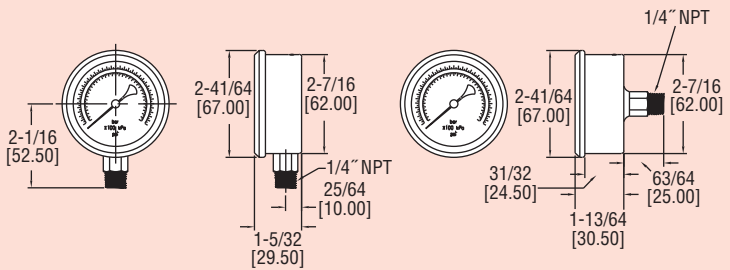
Series SGY

2.5″ Stainless Steel Industrial Pressure Gage

1.5% FS Accuracy, Brass Wetted Parts, Dual PSI/Bar x100 kPa Scales

SGY Bottom

SGY Back with Accessory Pointers



The Series SGY Gages have dual psi and bar (x100 kPa) scales with ±1.5% full-scale accuracy. The Series SGY gages are designed with 304 SS housings and brass wetted parts for excellent chemical compatibility. These gages cover a wide variety of ranges from full vacuum to 1,000 psi and are available in both bottom or back connections. Series SGY gages employ an easy-open breather plug on top, which allows liquid filled units to breathe, relieving any built up internal pressures. Plug easily pops open and does not need to be entirely removed or cut like a typical gages' rubber plug grommet.

APPLICATIONS

- Vacuums in pneumatic conveying lines
- Positive pressure in compressed air headers

Model	Range	Model	Range
SGY-D10122N	30″ Hg to 0	SGY-D10722N	0 to 200 psi
SGY-D10322N	0 to 30 psi	SGY-D11022N	0 to 300 psi
SGY-D10422N	0 to 60 psi	SGY-D11122N	0 to 500 psi
SGY-D10522N	0 to 100 psi	SGY-D11222N	0 to 1000 psi
SGY-D10622N	0 to 160 psi		

Note: To order with glycerin fill add - GF to the end of the model
For back connect, change ending from 22N to 42N

SPECIFICATIONS

Service: Compatible gases and liquids.
Wetted Materials: Brass connection, bronze tube.
Housing: 304 SS.
Lens: Polycarbonate.
Accuracy: ±1.5% FS.
Pressure Limit: FS range.
Temperature Limits: -4 to 140°F (-20 to 60°C).
Size: 2.5″ (63 mm).
Process Connections: 1/4″ male NPT.
Weight: 4.9 oz (139 g) bottom, 5.8 oz (164 g) back. Add 2.8 oz (78 g) for fill.

ACCESSORIES

A-445D, U-Bracket Mounting Kit for 2.5″ Gage
A-499R, Red Sliding Color Pointer
A-499Y, Yellow Sliding Color Pointer
A-499G, Green Sliding Color Pointer

OPTION

For NIST traceable calibration certificate, use order code NISTCAL-PG1.

KAESER COMPRESSORS

Built for a lifetime.™

Electronic Demand Condensate Drain Traps

Eco-Drain Series

Series Features:

- Capacitance sensor activates the solenoid only when liquid is present
- Only clean compressed air is used to control the valve
- Large discharge prevents emulsification
- Automatically attempts to clear discharge line blockages
- LED indicators for power on, valve operation, and blockage alarm (except Eco-Drain 30 model)
- Function test button
- 6 foot power cord with 3-prong plug
- Dry contacts for central alarm signaling are standard on most models
- 30, 31, and 32 models have quick change maintenance modules

Remove Condensate

Condensate is a natural by-product of compressed air. Mostly water, it also contains oils, dirt, and other material. If left in your air system, it will contaminate products and cause equipment malfunction. Kaeser Eco-Drains automatically remove condensate from aftercoolers, filters, dryers, tanks, and air lines. Unlike manual valves and timed solenoids, Eco-Drains ensure that condensate does not build up in your system. They sense when liquid is present and automatically discharge it, but they only open when condensate is present, saving costly compressed air.

Accurate Electronic Control

A capacitance sensor monitors condensate levels in the drain and activates the Eco-Drain's solenoid, eliminating compressed air losses. Eco-Drains feature LEDs that indicate power, valve and alarm status, as well as a test button to manually check drain operation. Dry contacts enable remote monitoring and alarm functions.

Reliable Components

Eco-Drains' rugged cast aluminum housing and superior diaphragm valve technology ensure many years of reliable service. Other drain types put valves in direct contact with contaminated condensate, which clogs control lines and disrupts solenoid movement. In Eco-Drains, a patented pilot air control design separates the working components from the condensate chamber, providing worry free operation and high reliability.

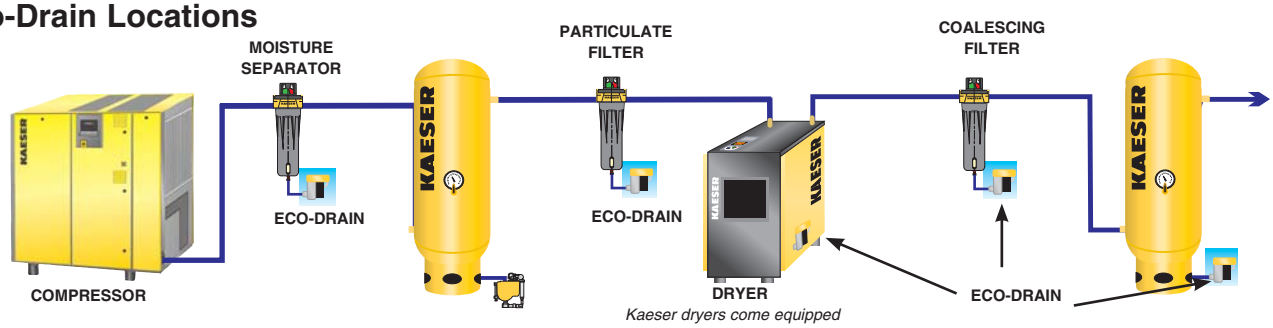
Technical Specifications

Model	Maximum Capacity (cfm)			Pressure min/max (psig)	Temp. min/max (°F)	Inlet Connection Size NPT (in.)	Condensate Discharge Size (in.)	Weight (lb.)
	Compressor	Dryer	Filter*					
Eco-Drain 30	100	200	1000	12/230	34/140	1/2	3/8	1.8
Eco-Drain 31	225	450	2250					2.2
Eco-Drain 32	500	1000	5000					3.6
Eco-Drain 13	1200	2400	12,000				1/2	4.4
Eco-Drain 14	3500	7000	35,000			3/4		6.4

Electrical supply: 115V / 1 Ph / 60 Hz * downstream of the dryer

Specifications are subject to change without notice.

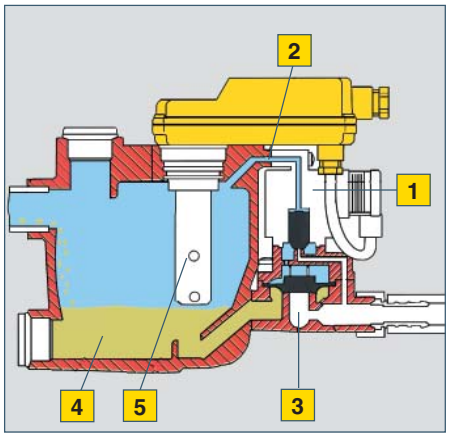
Eco-Drain Locations



Kaeser dryers come equipped with an Eco-Drain drain trap

Operation

A solenoid valve (1) allows clean compressed air (2) to pass and force the diaphragm valve (3) to the closed position. When the collection chamber (4) fills with condensate to a maximum level, the capacitance sensor (5) signals to energize the solenoid valve, which allows the air above the diaphragm to vent. Condensate is released from the collection chamber and the diaphragm valve closes before air is lost.



Easy Maintenance

Maintenance for Eco-Drains is quick and simple. Just replace the snap-in service module and discard the old one. Maintenance for Eco-Drains 13 and 14 consists of replacing wear items. All replaceable items are contained in a simple kit for each drain model.

Eco-Drain 30, 31, and 32

KAESER COMPRESSORS

Built for a lifetime.™

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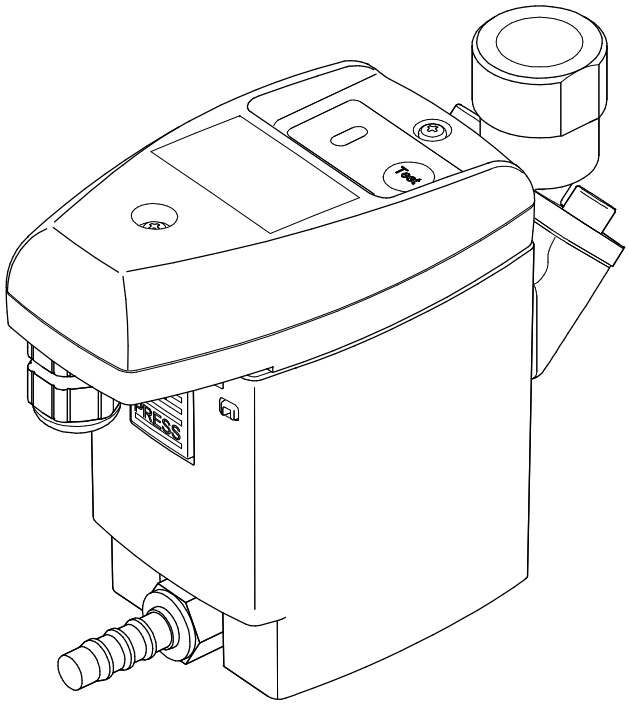
EN-US - english US

Instructions for installation and operation

Condensate drain

ECO-DRAIN 30



01-2287

Dear customer,

Thank you for deciding in favor of the ECO-DRAIN 30 condensate drain. Please read the installation and operating instructions carefully before mounting and starting up the ECO-DRAIN 30, and follow our directions. Perfect functioning of the ECO-DRAIN 30, and thus reliable condensate discharge, can only be guaranteed when the provisions and notes stipulated here are strictly adhered to.

1 Pictograms and symbols

Observe the installation and operating instructions

Observe the installation and operating instructions
(on the type plate)

General danger symbol (danger, warning, caution)

General danger symbol (danger, warning, caution) for supply voltage and supply voltage-carrying plants components

2 Safety instructions

Please check whether or not these instructions correspond to the device type.

Adhere to all advice given in these operating instructions. They include essential information which must be observed during the installation, operation and maintenance. Therefore it is imperative for the service technician and the responsible operator / technical staff to read these operating instructions prior to installation, start-up and maintenance.

The operating instructions must be accessible at any time at the place of application of the ECO-DRAIN 30 .

In addition to these operating instructions, local or national regulations must be complied with, if necessary.

Make sure that the ECO-DRAIN 30 is operated only within the permissible limit values indicated on the type plate. Any deviation involves a risk for persons and materials, and may result in malfunction and service failures.

If you have any queries regarding these installation- and operating instructions, please contact KAESER.

Danger!

Compressed air!

Risk of serious injury or death through contact with quickly or suddenly escaping compressed air or through bursting plant components or plant components which are not secured.

Measures:

- Do not exceed the maximum operating pressure (see type plate).
- **Only carry out service measures when the system is pressure less.**
- Use pressure-resistant installation material only.
- The feed pipe must be tubed firmly. Discharge pipe: short, fixed pressure hose onto pressure-resistant pipe.
- Make sure that persons or objects cannot be hit by condensate or escaping compressed air.

Danger!

Supply voltage!

There is the risk of an electric shock involving injury or death when coming into contact with non-insulated components carrying supply voltage.

Measures:

- During electric installations, all regulations in force need to be adhered to (e.g. VDE 0100 / IEC 60364).
- **Service measures must only be undertaken when the system is deactivated.**
- **The removed control unit has no IP degree of protection.**
- All types of electrical works must be carried out by authorized and qualified personnel only.

Further safety instructions:

- For installation and operation, the national regulations and safety codes in force must also be adhered to.
- Do not use the ECO-DRAIN 30 in hazardous areas.
- Regarding the inlet screw joints, excessive tightening forces must be avoided. This applies in particular to conical screw joints.
- The ECO-DRAIN 30 will only function when voltage is applied.
- Do not use the test button for permanent drainage.
- Use genuine spare parts only. This is imperative to ensure perfect functioning.

Additional advice:

- The removed control unit has **no IP degree of protection**.
- During installation, use spanner flat at the feed pipe (wrench size SW27) as a back rest.
- The service unit must not be dismantled.

Caution!

Malfunction during operation!

Through incorrect installation and poor maintenance, malfunction may occur at the ECO-DRAIN.

Condensate which is not discharged may cause damage to plants and in production processes.

Measures:

- Condensate drainage which is reliable in performance directly optimizes the compressed-air quality.
- To prevent damage and breakdowns, it is imperative to observe the following:
  - Exact compliance with the specifications of use and with the performance parameters of the ECO-DRAIN, in connection with the case of application (see "Proper use" section)
  - Exact compliance with the installation- and operation instructions in this manual
  - Regular maintenance and control of the ECO-DRAIN in accordance with the instructions in this operating manual

3 Proper use

- The ECO-DRAIN 30 is an electronically level-controlled condensate drain for compressed-air plants.
- The device is employed within the permissible performance parameters (see "Technical data").
- The ECO-DRAIN 30 is able to drain condensate under operating pressure from the plant components virtually without compressed-air loss.
- For its function, the ECO-DRAIN 30 requires an supply voltage and an operating pressure (see "Technical data").
- As far as the employment in plants with increased demands on compressed air is concerned (food industry, medical technology, laboratory equipment, special processes etc.), the operator must decide on measures for the monitoring of the compressed-air quality. These have an effect on the safety of the subsequent processes and may prevent damage to persons and plants.
- It is the task of the operator to ensure that the indicated conditions are met during the entire operating time.

4 Exclusion from the scope of application

- The ECO-DRAIN 30 as a condensate drain **alone cannot** guarantee a defined compressed-air quality, for this purpose, other additional technical devices are required.
- ECO-DRAIN 30 is **not** suitable for use in plants carrying vacuum or atmospheric ambient pressure or in ex-areas.
- The ECO-DRAIN 30 must not be exposed to permanent direct solar or thermal radiation.
- The ECO-DRAIN 30 must not be installed and operated in areas with an aggressive atmosphere.
- The ECO-DRAIN 30 is not heatable and, therefore, not suitable for the use in areas where frost is likely to occur.
- The ECO-DRAIN 30 is not suitable for CO_2 plants.

5 Technical data

min./max. operating pressure (see type plate)	0,8...16 bar (12...230 psi) or 1,2...16 bar (17...230 psi)
min./max. temperature (see type plate)	+1...+60 °C (+34...+140 °F) or +1...+70 °C (+34...+158 °F)
Condensate inflow	NPT ½ (½") internal max. screw-in depth 13,5 mm (½")
Condensate outflow	G ¼ (¼") Ø 8 ... 10 mm hose connector
Condensate	oil-contaminated + oil-free
Housing	aluminium + plastic, glass fibre-reinforced
Weight (empty)	0,8 kg (1.8 lbs)

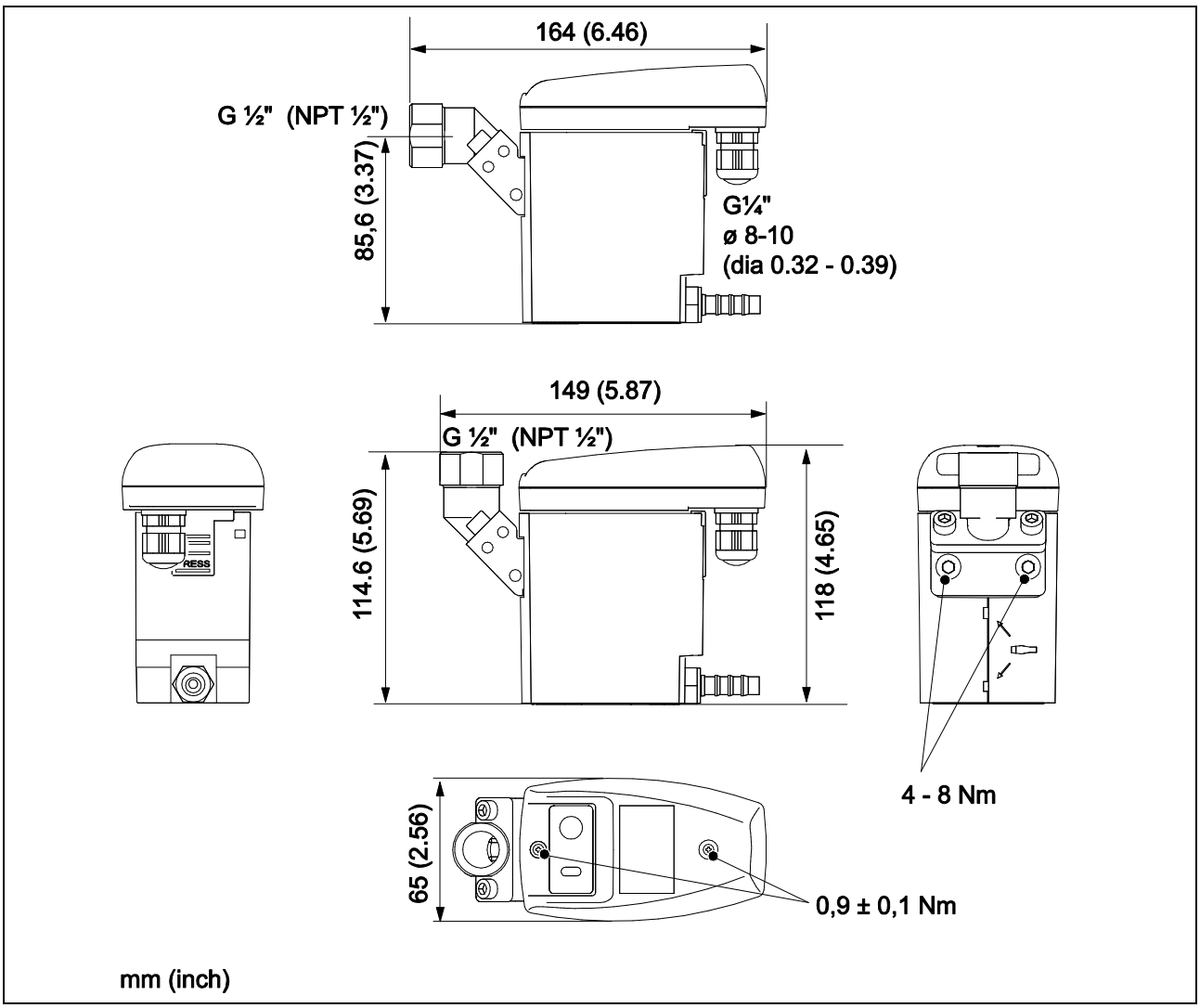
Peak compressor performance	100 scfm
Peak refrig. dryer performance (only with pre-separation)	200 scfm
Peak filter performance (behind dryer)	1000 scfm

Technical data

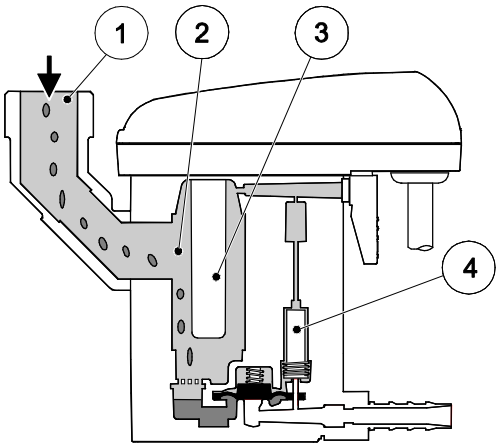
Supply voltage (see type plate)	95…240 VAC ±10% (50…60 Hz) /100…125 VDC ±10% or 24…48 VAC ±10% (50…60 Hz) / 18…72 VDC ±10%
Power consumption	P = 0,6 ... 3 VA (W)
Recommended cable-jacket diameter	Ø 5,0…10 mm (0,20“…0,39“)
Recommended wire cross-section Spring-loaded terminal	0,75...1,5 mm² (AWG 16...20)
Recommended wire cross-section Screw terminal	0,75...2,5 mm² (AWG 14...20)
Recommended stripping of cable jacket	~ 50 mm (~ 1.97")
Recommended length of the wire end tube Spring-loaded terminal	~ 8 mm (~ 0.31 inch)
Recommended length of the wire end tube Screw terminal	~ 6 mm (~ 0.24 inch)
Protection class	IP 67
Overvoltage category (IEC 61010-1)	II

VAC = V alternating current
VDC = V direct current

6 Dimension drawing

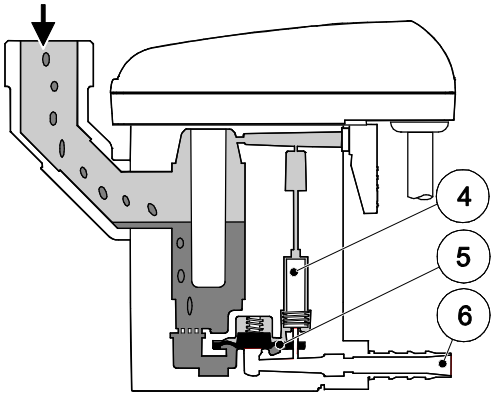


7 Function



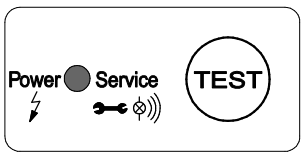
Via the inlet line (1) the condensate flows into the ECO-DRAIN 30 and accumulates in the housing (2).

A capacitive functioning sensor (3) continuously registers the filling level and relays a signal to the electronic control as soon as the container is filled.



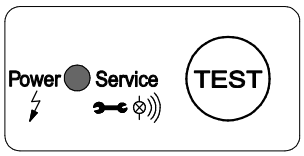
The pilot valve (4) is activated and the membrane (5) opens the outlet line to discharge the condensate (6).

When the ECO-DRAIN 30 is empty, the outlet line is reclosed tightly in time before unnecessary compressed-air losses occur.

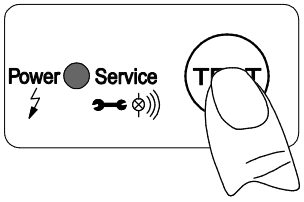


When applying supply voltage, the ECO-DRAIN 30 carries out a **self-test**.

The LED is lit orange for 1 second; subsequently, the device changes over to the "**ready-to-operate**" state and the LED is lit green.



Ready to operate, voltage is applied.



Test of the valve function (manual drainage):

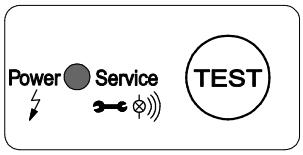
Press and hold the push-button for approx. 2 s.

Do not use for permanent drainage.

The ECO-DRAIN 30 releases a maintenance message for a service that is to be carried out.

Depending on the operating mode, a visual maintenance message (service) is activated which signalizes the replacement of the service unit.

The maintenance message is indicated by the flashing supply voltage-LED "Power".

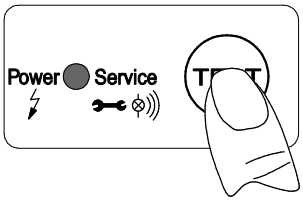


The maintenance message is released after 2 x 8.760 h or
one million switching cycles.

The maintenance signal is released when one of these two values is reached.

In the event of a power outage or when the energy supply is deactivated, the status of the timer will be maintained.

The activities to be carried out regarding maintenance are described in the chapter entitled "Check and maintenance".



Prior to the replacement of the service unit, a reset needs to be carried out. The control unit is released by actuating the arresting hook. When removed, the TEST button must be pressed and held for at least five seconds.

8 Installation

Danger!

Compressed air!

Risk of serious injury or death through contact with quickly or suddenly escaping compressed air or through bursting plant components or plant components which are not secured.

Measures:

- Do not exceed the maximum operating pressure (see type plate).
- **Only carry out service measures when the system is pressure less.**
- Use pressure-resistant installation material only.
- The feed pipe must be tubed firmly. Discharge pipe: short, fixed pressure hose onto pressure-resistant pipe.
- Make sure that persons or objects cannot be hit by condensate or escaping compressed air.

Caution!

Malfunction during operation!

Through incorrect installation and poor maintenance, malfunction may occur at the ECO-DRAIN.

Condensate which is not discharged may cause damage to plants and in production processes.

Measures:

- Condensate drainage which is reliable in performance directly optimizes the compressed-air quality.
- To prevent damage and breakdowns, it is imperative to observe the following:
  - Exact compliance with the specifications of use and with the performance parameters of the ECO-DRAIN, in connection with the case of application (see "Proper use" section)
  - Exact compliance with the installation- and operation instructions in this manual
  - Regular maintenance and control of the ECO-DRAIN in accordance with the instructions in this operating manual

Note

It is imperative to observe all hazard statements and warnings listed here.

Please also observe all regulations and notes regarding industrial safety and fire prevention at the place of installation.

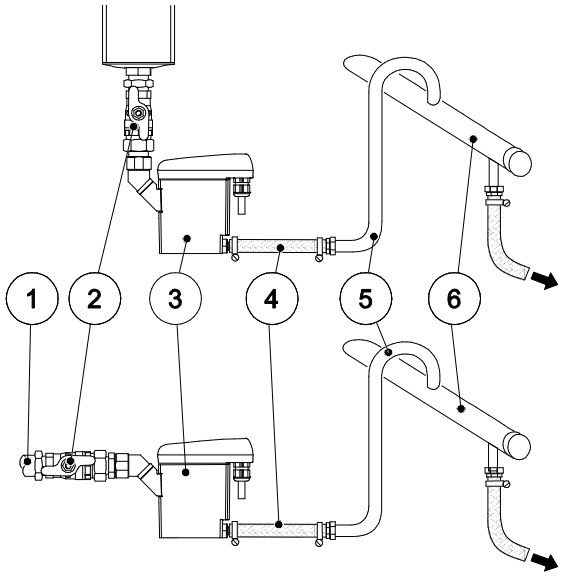
As a matter of principle, only use suitable and appropriate tools and materials in a proper condition.

Do not use aggressive cleaners and improper devices such as high-pressure cleaners.

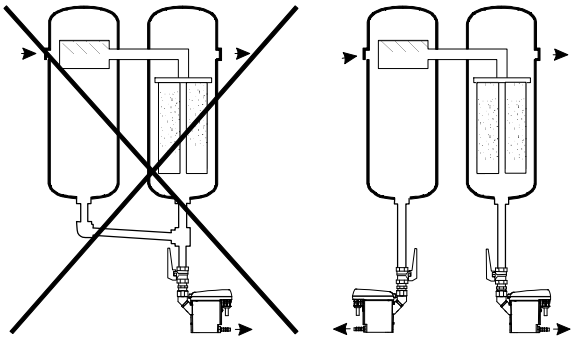
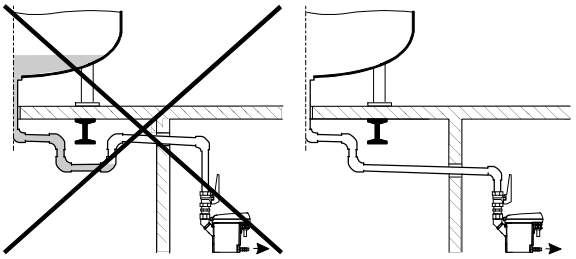
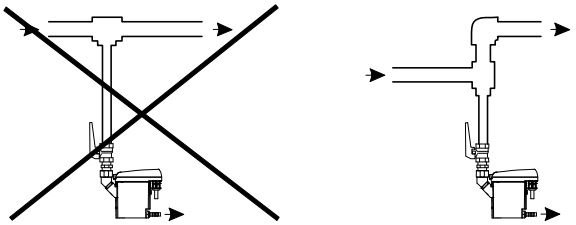
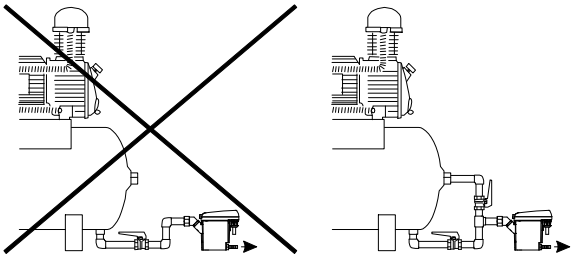
Please note that condensates may contain aggressive or harmful components. Therefore, skin contact should be avoided.

Condensate is subject to mandatory waste disposal. As such, it must be collected in suitable containers, and disposed of or processed properly.

Installation instructions:



- Only the displayed installation position of the ECO-DRAIN (3) is permissible. Never install in a horizontal or any other tilted position.
- Feed pipe (1) and ball valve (2) at least G½.
- No filter or screen in the inlet line.
- Slope in the inlet line >1%.
- Use ball valves (2) only.
- Operating pressure: min. 0,8/1,2 bar (12/17 psig), max. 16 bar (230 psig). See type plate.
- Short pressure hose (4) fixed on a pressure-resistant pipe.
- The required minimum pressure increases by 0,1 bar (1,4 psi) per metre gradient in the discharge pipe (5).
- Discharge pipe (5) rising by max. 5 m (16,4ft).
- Install manifold (6) ½" with a slope of 1%.
- Introduce the discharge pipe (5) from the top into the manifold (6).
- Prior to the start-up, always carry out a leak test and verify the correct engagement of the control unit.

wrong / correct	
	**Pressure differences!** Each condensate accumulation point must be drained separately.
	**Continuous slope!** Avoid a water pocket when installing the feed pipe
	**Deflector area!** If drainage is to be carried out directly from the pipe, deflection of the air flow will be useful.
	**Ventilation!** If the slope in the inlet line is not sufficient or if any other inflow problems occur, a venting line needs to be installed.

9 Electrical installation

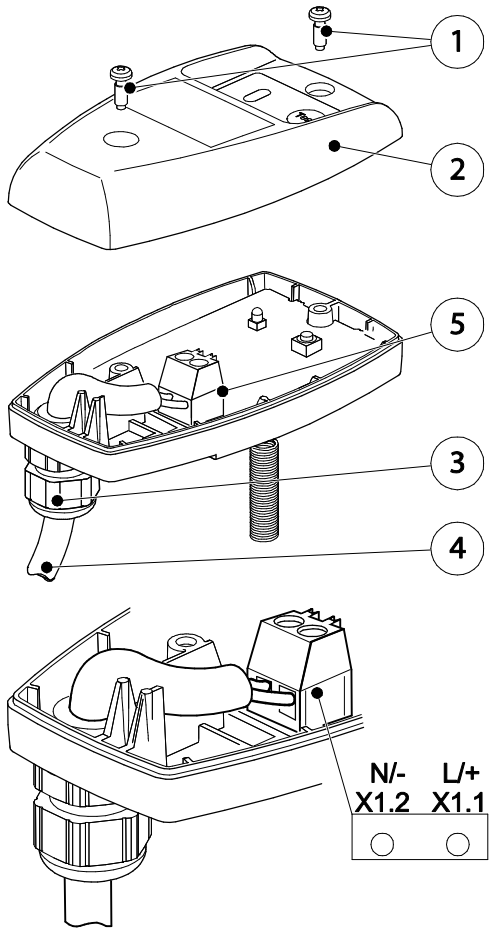
Danger!

Supply voltage!

There is the risk of an electric shock involving injury or death when coming into contact with non-insulated components carrying supply voltage.

Measures:

- During electric installations, all regulations in force need to be adhered to (e.g. VDE 0100 / IEC 60364).
- **Service measures must only be undertaken when the system is deactivated.**
- **The removed control unit has no IP degree of protection.**
- All types of electrical works must be carried out by authorized and qualified personnel only.



Note:

1. Read the permissible supply voltage on the type plate and make sure this voltage is observed.
2. For the supply voltage, a reliably accessible separator must be provided close-by (e.g. power plug or switch), which separates all current-carrying conductors.
3. At a low-voltage supply (< 50 VAC / < 75 VDC), only use a protective extra-low-voltage.
4. Carry out installation in accordance with VDE 0100 / IEC 60364.
5. Observe the terminal assignment.
6. Do not install when the device is energized.
7. Unscrew the screws (1) and remove the upper part of the cover (2).
8. Unscrew the threaded cable connection (3), remove the plug (if there is one), and lead the cable (4) for the power supply through.
9. Connect the cable (4) with terminals X1 (1.1, 1.2) (5).
10. Install the cables as shown (see also terminal assignment in the following text).
11. Tighten the threaded cable connection (3) with a slightly sealing effect.
12. Put on the upper part of the cover (2) and tighten the screws (1) fingertight.

Electrical installation

Terminal assignment supply voltage (operating voltage)

X 1	
L/+	N/-
phase	neutral
1.1	1.2

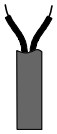
Power supply
- X 1.1 L/+
- X 1.2 N/-

L = Outer conductor
N = Neutral conductor

Terminal assignment low voltage (operating voltage)

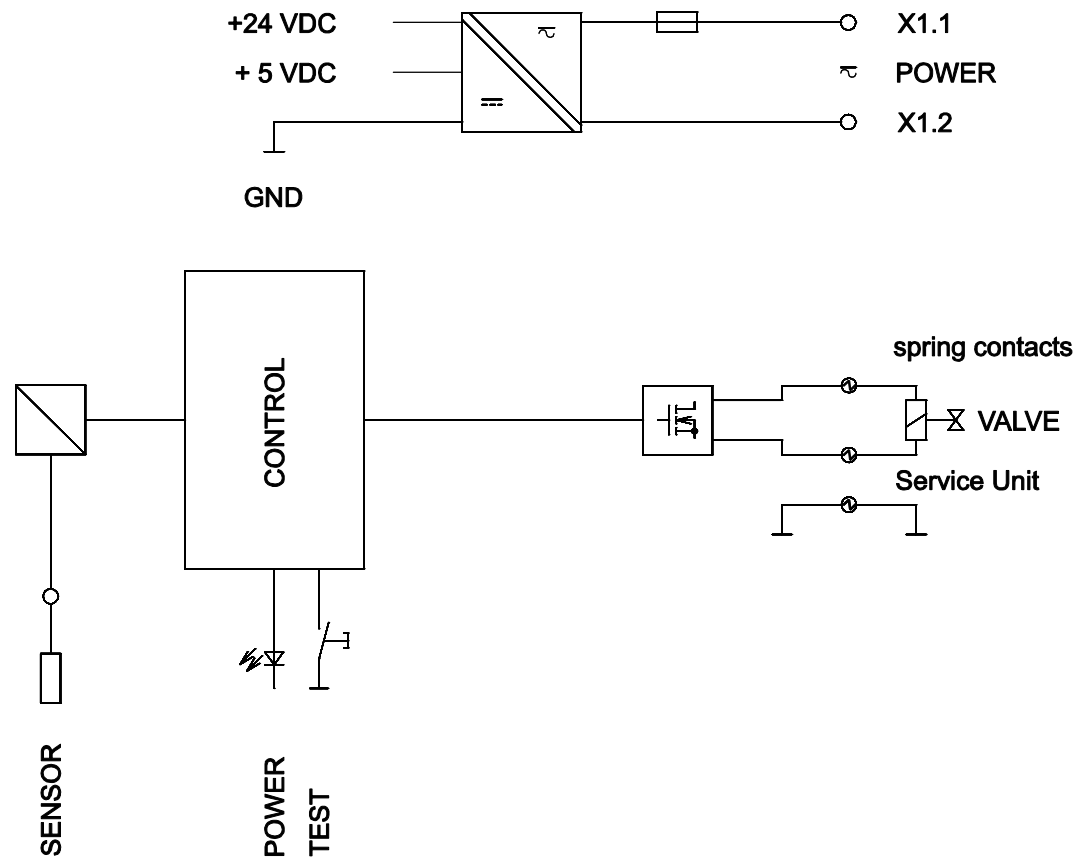
X 1	
L/+	N/-
power	power
1.1	1.2

Power supply
- X 1.1 L/+
- X 1.2 N/-



Note:

At a low voltage supply (< 50 VAC / < 75 VDC), only use a protective extra-low-voltage.
Tighten the threaded cable connection with a slightly sealing effect.



Electric diagram

10 Control and maintenance

Danger!

Compressed air!

Risk of serious injury or death through contact with quickly or suddenly escaping compressed air or through bursting plant components or plant components which are not secured.

Measures:

- Do not exceed the maximum operating pressure (see type plate).
- **Only carry out service measures when the system is pressure less.**
- Use pressure-resistant installation material only.
- The feed pipe must be tubed firmly. Discharge pipe: short, fixed pressure hose onto pressure-resistant pipe.
- Make sure that persons or objects cannot be hit by condensate or escaping compressed air.

Danger!

Supply voltage!

There is the risk of an electric shock involving injury or death when coming into contact with non-insulated components carrying supply voltage.

Measures:

- During electric installations, all regulations in force need to be adhered to (e.g. VDE 0100 / IEC 60364).
- **Service measures must only be undertaken when the system is deactivated.**
- **The removed control unit has no IP degree of protection.**
- All types of electrical works must be carried out by authorized and qualified personnel only.

Caution!

Malfunction during operation!

Through incorrect installation and poor maintenance, malfunction may occur at the ECO-DRAIN.

Condensate which is not discharged may cause damage to plants and in production processes.

Measures:

- Condensate drainage which is reliable in performance directly optimizes the compressed-air quality.
- To prevent damage and breakdowns, it is imperative to observe the following:
  - Exact compliance with the specifications of use and with the performance parameters of the ECO-DRAIN, in connection with the case of application (see "Proper use" section)
  - Exact compliance with the installation- and operation instructions in this manual
  - Regular maintenance and control of the ECO-DRAIN in accordance with the instructions in this operating manual

Note

It is imperative to observe all hazard statements and warnings listed here.

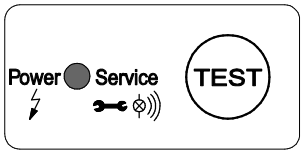
Please also observe all regulations and notes regarding industrial safety and fire prevention at the place of installation.

As a matter of principle, only use suitable and appropriate tools and materials in a proper condition.

Do not use aggressive cleaners and improper devices such as high-pressure cleaners.

Please note that condensates may contain aggressive or harmful components. Therefore, skin contact should be avoided.

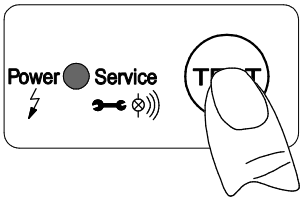
Condensate is subject to mandatory waste disposal. As such, it must be collected in suitable containers, and disposed of or processed properly.



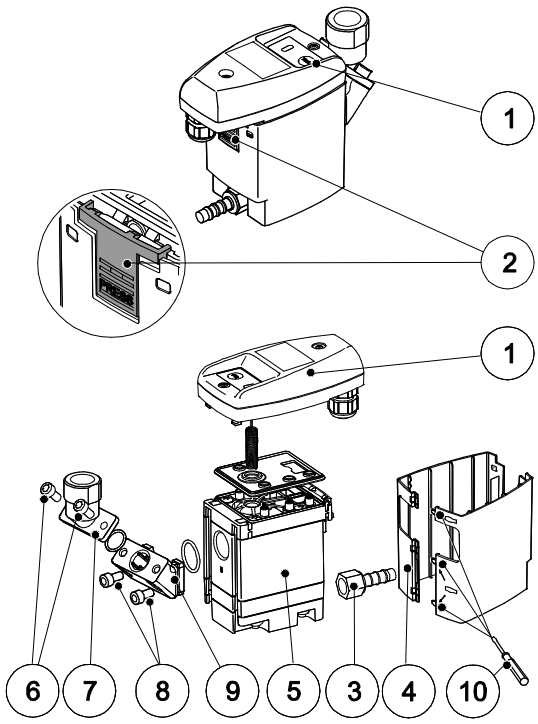
Maintenance recommendation:

After 2 x 8,760 operating hours or one million switching cycles, a maintenance message is released.

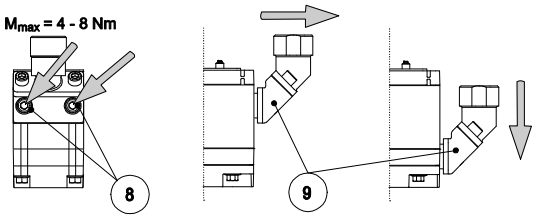
The green power LED flashes. Afterwards, or at the latest after two years (2 x 8,760 operating hours), the service unit (5) needs to be replaced.



1. Prior to the replacement of the service unit, a reset needs to be carried out. The control unit is released by actuating the arresting hook. When removed, the TEST button below the LED must be pressed and held for at least five seconds.

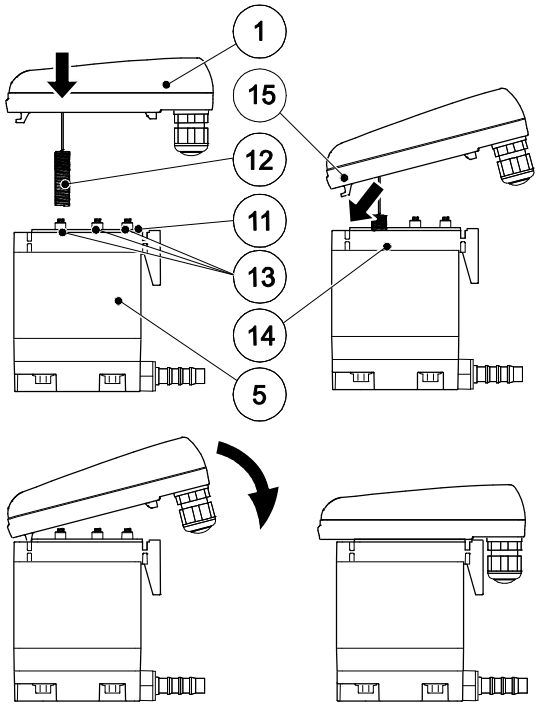


2. Remove the control unit (1) by pressing the arresting hook (2).
3. Unfasten the ECO-DRAIN 30 from the outlet (3).
4. Remove the design shell (4) (if there is one) using a screwdriver (10).
5. Detach the service unit (5) from the tubing at the inlet by removing the union nut.
6. **or** remove the screws (6) from the angle nozzle (7).



7. **or** remove the screws (8) at the intermediate adapter (9) and remove the latter from the service unit by pulling it downwards.
8. Check whether or not the new service unit (5) goes with the control unit (1)
   (model designation and color
   of the arresting hook (2)).

9. Installation of the new service unit (5) in reverse order.



Installation of the control unit on the service unit:

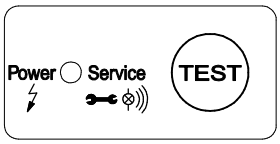
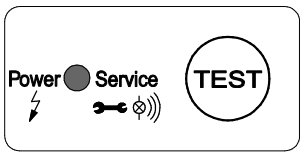
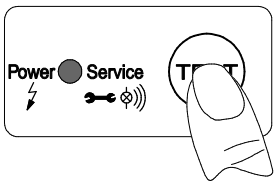
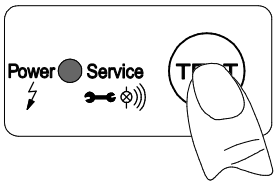
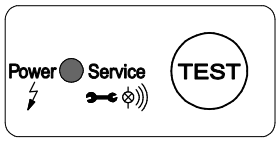
1. Check whether or not the service unit (5) goes with the control unit (1) (model designation and color of the arresting hook).
2. Check whether or not the sealing mat (11) and the contact springs (13) are clean, dry, and free from impurities.
3. Introduce the sensor (12) into the sensor tube plate (14).
4. Hang the hook (15) of the control unit (1) in the sensor tube plate (14).
5. Press the control unit (1) against the service unit (5) and snap into place.

Start-up subsequent to maintenance measures:

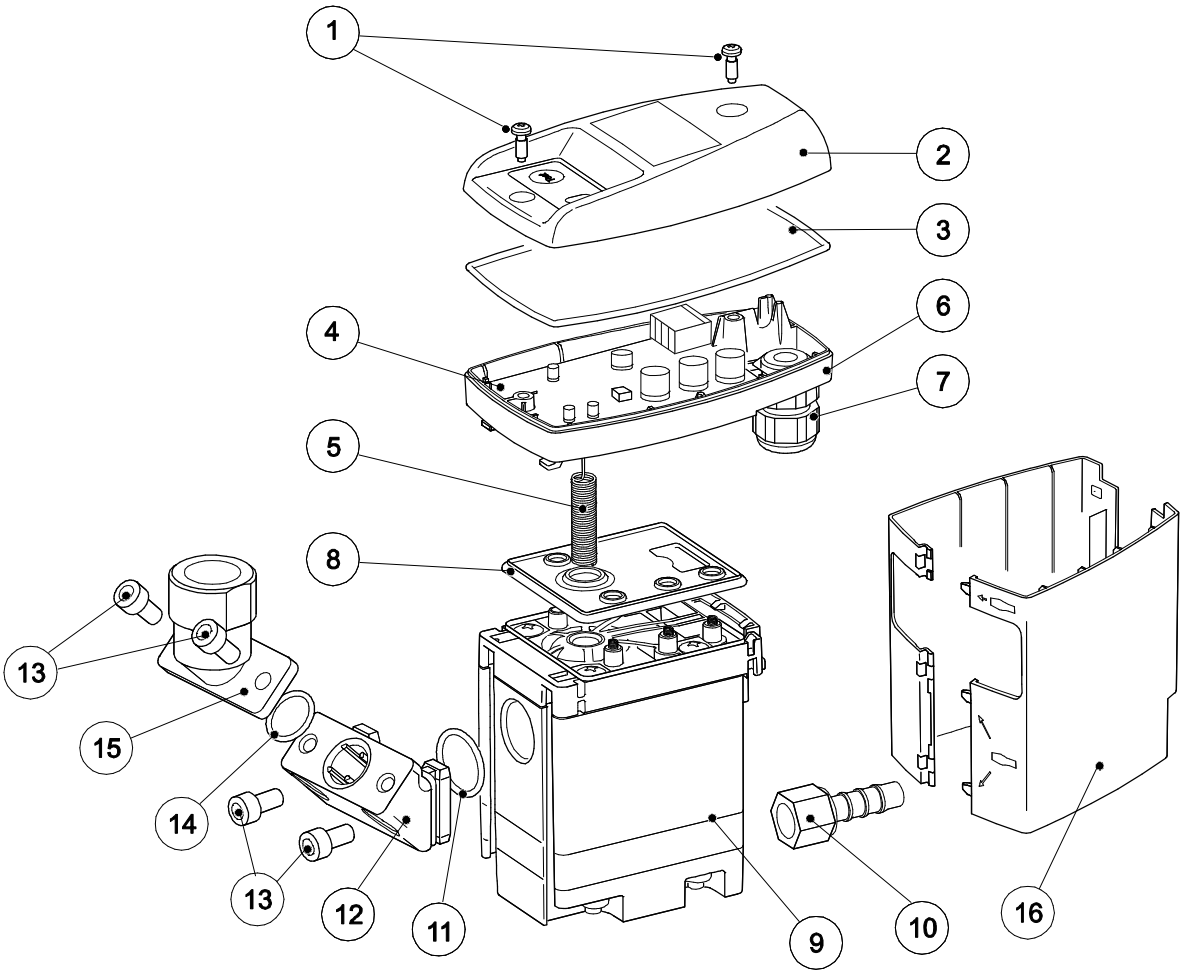
Always carry out prior to the start-up:

- Leak test of the screwed connector
- Check of the electrical connections
- Check of the correct engagement of the control unit

11 Troubleshooting and fault elimination

Symptoms	Possible reasons	Measures
 **LED does not light up**	Supply voltage incorrect Circuit board defective	Check voltage on the type plate Check the connections and the supply voltage Check the circuit boards for possible damage
 **LED lights continuously orange**	Failure during the start of the programme Circuit board defective	Separate the device from the supply voltage and reactivate after > 5 s Check the circuit boards for possible damage
 **Test button pressed, but no condensate discharge**	Feed pipe and/or discharge pipe blocked or obstructed Wear and tear Circuit board defective Service unit defective Minimum pressure not reached Maximum pressure exceeded	Check feed and discharge pipe Check whether or not the valve opens audibly (press the test button several times for > 2 seconds) Check the circuit board for possible damage Check the operating pressure
 **Condensate discharge only when the test button is pressed**	Feed pipe without sufficient slope Cross section not large enough Condensate accumulation too high (surge) Service unit extremely dirty	Install feed pipe with a slope Replace the service unit
 **Device blows off continuously**	Service unit defective or dirty	Replace the service unit

12 Elements and components



1 Screw 3.5 x 10
2 Upper part of the cover
3 Cord packing 2 x 307
4 Circuit board
5 Sensor
6 Lower part of the cover
7 Cable bushing
8 Sealing mat
9 Service unit
10 Hose connector G¼
11 O-ring 20 x 2
12 Intermediate adapter
13 Screw M6 x 12
14 O-ring 14 x 1.78
15 Angle adapter G½
16 Design shell

13 Recommended spare parts

Available sets of spare parts	Contents	Order number
Service-Unit AN8247400340 for ANECODRAIN30 Service-Unit AN8247400340* for ANECODRAIN30230	8, 9, 11**	AN8247400340 AN8247400340*
Gasket kit	3, 8, 11**, 14**	AN8247400350
Design shell*	16**	AN8247400400
Connection adapter G** Connection adapter NPT**	11**, 12**, 13**, 14**, 15**	AN4010155 AN4012610

** Not for ECO-DRAIN 30 built-in

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www.kaeser.com

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ASHCROFT®
Trust the shield.™

B-Series Switches – Pressure, Differential Pressure & Hydraulic

FEATURES

B-Series switches have proven reliable in such harsh environments as:

- ***Offshore oil rigs***
- ***Chemical and petrochemical plants***
- ***Pulp and paper mills***
- ***Steel mills***
- ***Power plants***
- ***Water and sewage-treatment plants***
- ***Other corrosive environments***

Ashcroft Inc. supplies highly reliable Ashcroft® switches and controls for industrial and process applications. We begin with rock-solid designs, matching the most appropriate technology with the safety and reliability requirements of the applications. The materials of construction are specified to Ashcroft's exacting standards, and product is built to last in the toughest applications. Our modern, responsive manufacturing facility is supported by an extensive network of stocking distributors and factory sales offices located in virtually every part of the world. Special application assistance is always just a telephone call away.

The Ashcroft B-Series switch line is designed to satisfy most switch requirements. Materials of construction have been selected for long life. A wide variety of precision switch elements are available to meet every application requirement, including hermetically sealed contacts for added reliability and safety. The actuators we use have been proven in more than 20 years of service in the world's plants and mills. Special designs are available for fire safety, NACE, limit control and other more stringent requirements. Simplicity and ease of use are stressed to improve reliability of the installation.

Applications include: pumps, compressors, washers, filters, degreasers, evapora-tors, recovery systems, food processing, ground support equipment, reverse osmosis systems, heat exchangers, hydraulic systems, lubrication systems, marine equipment, textile machinery, heating and air conditioning equipment.

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ASHCROFT®
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B-Series Switches – Pressure, Differential Pressure & Hydraulic

Pressure & Differential Pressure Switches

B-Series pressure, differential pressure and vacuum switches use two different actuators depending on setpoint requirements. For setpoints between 2 and 3000 psi, the simple, rugged diaphragm-sealed piston actuator is used. This design features high reliability and choice of actuator seal materials for virtually every application. An optional welded design is also available for setpoints up to 1000 psi for maximum reliability. This design is available in 316 SS or Monel. Differential pressure models use a unique, dual diaphragm-sealed piston design that features very high static operating pressures and small size.

For setpoints between 4.5 and 150 inches of H_2O, a large diaphragm is used for increased sensitivity in both pressure and differential pressure designs with good choice of materials of construction.

All standard models feature ±1 percent of range setpoint repeatability and a minimum of 400 percent of range proof pressures.

These standard designs perform well in applications where shock and vibration could be a problem and may be used in conjunction with Ashcroft diaphragm seals in extreme services such as slurries or abrasive process fluids.

PRESSURE/VACUUM SWITCHES

Nominal Range[1]			Overpressure Ratings		Approximate Deadband[2] Switch Element				
			Proof psi	Burst psi	20, 26, 27	21, 24, 31	50	22	32, 42
Vacuum									
–30″ Hg	–760mm Hg	-100 kPa	250	400	0.3-0.7	1.5-3.0	0.5-2.2	0.4-1.5	2.1-4.2
Compound									
–15″ H_2O/ 15″ H_2O	–375mm H_2O/ 375mm H_2O	–3.7 kPa/ 3.7 kPa	20	35	0.15-.75/ 0.15-.75	1.5-2.5/ 1.5-2.5	0.45-2.0/ 0.45-2.0	0.5-1.2/ 0.5-1.2	2.1-3.5/ 2.1-3.5
–30″ H_2O/ 30″ H_2O	–760mm H_2O/ 760mm H_2O	–7.5 kPa/ 7.5 kPa	20	35	0.30-.60/ 0.30-.60	1.5-2.5/ 1.5-2.5	0.45-2.0/ 0.45-2.0	0.5-1.5/ 0.5-1.5	2.1-3.5/ 2.1-3.5
–30″ Hg/ 15 psi	–760mm Hg/ 1.0 kg/cm²	–100 kPa/ 100 kPa	250	400	0.5-1.0/ 0.3-0.7	2.0-3.0/ 0.5-1.5	0.75-2.5/ 0 .5-1.0	0.7-1.8/ 0.7-1.4	2.8-4.2/ 0.7-2.1
–30″ Hg/ 30 psi	–760mm Hg/ 2.0 kg/cm²	–100 kPa/ 200 kPa	250	400	1.0-1.5/ 0.3-0.8	3.0-6.0/ 1.0-2.0	1.2-4.5/ 0.7-1.5	1.4-2.4 0.4-1.3	4.2-8.4/ 1.4-2.8
–30″ Hg/ 60 psi	–760mm Hg/ 4.0 kg/cm²	–100 kPa/ 400 kPa	250	400	2.0-3.0/ 0.7-1.5	5.0-9.0/ 3.0-5.0	2.5-7.0/ 1.1-4.0	2.8-4.5 1.0-2.3	7.0-12.0/ 4.2-7.0
Pressure									
10″ H_2O	250mm H_2O	2.5 kPa	20	35	0.2-0.5	1.0-2.0	0.35-1.5	0.4-1.0	1.4-2.8
30″ H_2O	750mm H_2O	7.5 kPa	20	35	0.3-0.6	1.5-2.5	0.45-2.0	0.5-2.0	2.1-3.5
60″ H_2O	1500mm H_2O	15 kPa	20	35	0.5-1.3	1.5-3.5	0.9-2.5	0.7-3.0	2.1-5.0
100″ H_2O	2500mm H_2O	25 kPa	20	35	0.6-1.6	2.5-5.5	1.1-4.0	1.0-4.0	3.5-7.7
150″ H_2O	3750mm H_2O	37 kPa	20	35	1.0-2.5	4.5-8.5	1.7-6.5	2.0-6.0	6.0-12.0
15 psi	1.0 kg/cm²	100 kPa	500	1500	0.1-0.35	0.5-1.5	0.2-1.0	0.4-1.0	0.7-2.1
30 psi	2.0 kg/cm²	200 kPa	500	1500	0.1-0.50	0.5-1.5	0.3-1.0	0.4-1.0	0.7-2.1
60 psi	4.0 kg/cm²	400 kPa	500	1500	0.3-1.0	1.0-3.5	0.7-2.5	0.6-2.0	1.4-5.0
100 psi	7.0 kg/cm²	700 kPa	1000	3000	0.5-1.7	1.5-5.0	1.1-3.5	1.0-4.5	2.1-7.0
200 psi	14 kg/cm²	1400 kPa	1000	3000	1-3	5-13	2-9	3.0-7.5	7.0-18.2
400 psi	28 kg/cm²	2800 kPa	2400	3000	4-7.5	5-24	5.5-15	4.0-11.0	7.0-33.6
600 psi	42 kg/cm²	4200 kPa	2400	3000	4-11	9-30	7-20	5.0-23.0	12.6-42
1000 psi	70 kg/cm²	7000 kPa	12000	18000	7-30	30-110	18-70	15-80	42-154
3000 psi	210 kg/cm²	2100 kPa	12000	18000	15-60	80-235	37-160	30.0-230	112-329

DIFFERENTIAL PRESSURE SWITCHES

Nominal Range[1]			Pressure Ratings		Approximate Deadband[2] Switch Element				
			Static Working Pressure	Proof psi	20, 26, 27	21, 24, 31	50	22	32, 42
30″ H_2O	750mm H_2O	7.5 kPa	5.4	21.6	0.3-0.6	1.5-2.5	0.45-2.0	0.5-2.0	2.1-3.5
60″ H_2O	1500mm H_2O	15 kPa	5.4	21.6	0.5-1.3	1.5-3.5	0.9-2.5	0.7-3.0	2.1-5.0
100″ H_2O	2500mm H_2O	25 kPa	5.4	21.6	0.6-1.6	2.5-5.5	1.1-4.0	1.0-4.0	3.5-7.7
150″ H_2O	3750mm H_2O	37 kPa	5.4	21.6	1.0-2.5	4.5-8.5	1.8-6.5	2.0-6.0	6.3-12.0
15 psid	1.0 kg/cm²	100 kPa	500	2000	0.5-1.0	2.0-5.0	0.7-3.5	0.7-1.4	2.8-7.0
30 psid	2.0 kg/cm²	200 kPa	500	2000	1.0-2.0	2.0-5.0	1.5-3.5	1.4-2.8	2.8-7.0
60 psid	4.0 kg/cm²	400 kPa	500	2000	2.0-4.0	3.0-6.0	3.0-4.5	2.8-5.6	4.2-8.5
100 psid	7.0 kg/cm²	700 kPa	1000	4000	4.0-10.0	11.0-20.0	7.0-15.0	6.0-14.0	16.0-28.0
200 psid	14.0 kg/cm²	1400 kPa	1000	4000	5.0-15.0	12.0-40.0	10.0-26.0	7.0-21.0	17.0-56.0
400 psid	28.0 kg/cm²	2800 kPa	1000	8000	10.0-20.0	20.0-60.0	15.0-40.0	14.0-28.0	28.0-84.0
600 psid	42 0 kg/cm²	4200 kPa	1000	8000	20.0-40.0	80.0-150.0	30.0-115.0	30.0-56.0	112.0-210.0

Values shown are for zero static working pressure.

NOTES:

1 Switches may generally be set between 15% and 100% of nominal range on increasing pressure. Consult factory for applications where setpoints must be lower.

2 All deadbands are given in English units as shown in the nominal range column. Deadbands shown are for switches with Buna N diaphragm. Approximate deadbands for optional diaphragms:

Viton:	Multiply Buna N value by 1.4
Teflon:	Multiply Buna N value by 1.2
Stainless Steel:	Multiply Buna N value by 1.7
Monel:	Multiply Buna N value by 1.7
Dual Switch Element:	Multiply single switch element value by 1.6 for approximate deadband.

ASHCROFT®
Trust the shield.™

B-Series Switches – Pressure, Differential Pressure & Hydraulic

B-SERIES PRESSURE AND DIFFERENTIAL PRESSURE SWITCH MODEL NUMBER:

To specify the exact switch desired, select entries from appropriate tables as shown in example below.

1		2		3	4			5
B	4	2	0	B	X	P	K	600 PSI

1 – ENCLOSURE	
B4	Pressure switch, Type 400, watertight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
B7	Pressure switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.
D4	Differential pressure switch, Type 400, water-tight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.
D7	Differential pressure switch, Type 700, explosion-proof enclosure meets Div. 1 & 2, NEMA 7, 9 and IP66 requirements.

3 – ACTUATOR SEAL					
		Range			
Code and Material	**Process Temperature Limits °F[9]**	**Vac. ˝ H_2O**	**0-600 psi**	**1000 psi**	**3000 psi**
B – Buna-N	0 to 150	•	•	•	•
V – Viton	20 to 300	•	•	•	
T – Teflon	0 to 150	•	•	•	•
S – 316L[8]	0 to 300		•	•	
P – Monel[8]	0 to 300		•	•	

4 – OPTIONS	5 – RANGE
Use table from page 7	Select from table on page 3

NOTES:

1 Standard switch.
2 Not available with psid ranges.
3 Dual switches are 2 SPDT snap-action switches, not independently adjustable.
4 Wires cannot be terminated inside B400 switch enclosure.
5 Not available with type 700 enclosure.
6 Estimated dc. rating, 2.5A, 28 Vdc (not UL listed).
7 Estimated dc rating, 0.4A, 120 Vdc (not UL listed).
8 Available on pressure only.
9 Ambient operating temperature limits –20 to 150°F, all styles, setpoint shift of ±1% of range per 50°F temperature change is normal. Switches are calibrated at 70°F reference.

2 – SWITCH ELEMENT SELECTION		
Order Code	**Switch Elements UL/CSA Listed SPDT**	
20[7]	Narrow deadband ac	15A, 125/250 Vac
21	Ammonia service	5A, 125/250 Vac
22[6]	Hermetically sealed switch, narrow deadband	5A, 125/250 Vac
23	Heavy duty ac	22A, 125/250 Vac
24[1]	General purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc; 6A, 30 Vdc
25[2]	Heavy duty dc	10A, 125 Vac or dc, ⅛ HP, 125 Vac or dc
26[7]	Sealed environment proof	15A, 125/250 Vac
27	High temperature 300°F	15A, 125/250 Vac
28[5]	Manual reset trip on increasing	15A, 125/250 Vac
29[5]	Manual reset trip on decreasing	15A, 125/250 Vac
31	Low level (gold) contacts	1A, 125 Vac
32	Hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
42	Hermetically sealed switch, gold contacts	1A, 125 Vac
50	Variable deadband	15A, 125/250 Vac
UL/CSA Listed Dual (2 SPDT)		
61[7]	Dual narrow deadband	15A, 125/250 Vac
62[7]	Dual sealed environment proof	15A, 125/250 Vac
63	Dual high temp. 300°F	15A, 125/250 Vac
64	Dual general purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc
65	Dual ammonia service	5A, 125/250 Vac
67[4,6]	Dual hermetically sealed switch, narrow deadband	5A, 125/250 Vac
68[4]	Dual hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
70	Dual low level gold contacts	1A, 125 Vac
71[4]	Dual hermetically sealed switch, gold contacts	1A, 125 Vac

B-Series Switches – Pressure, Differential Pressure & Hydraulic

B-SERIES HYDRAULIC PRESSURE SWITCH MODEL NUMBER:

To specify the exact switch desired, select entries from appropriate tables as shown in example below.

1		2		3	4			5
H	4	2	4	V	X	F	S	3000 PSI

1 – ENCLOSURE	
H4	Hydraulic pressure switch, Type 400, watertight enclosure meets NEMA 3, 4, 4X, 13 and IP66 requirements.

2 – SWITCH ELEMENT SELECTION		
Order Code	**Switch Elements UL/CSA Listed SPDT**	
20[3]	Narrow deadband ac	15A, 125/250 Vac
21	Ammonia service	5A, 125/250 Vac
22	Hermetically sealed switch, narrow deadband	5A, 125/250 Vac
23	Heavy duty ac	22A, 125/250 Vac
24[1]	General purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc; 6A, 30 Vdc
25	Heavy duty dc	10A, 125 Vac or dc, ⅛ HP, 125 Vac or dc
26[3]	Sealed environment proof	15A, 125/250 Vac
27	High temperature 300°F	15A, 125/250 Vac
28	Manual reset trip on increasing	15A, 125/250 Vac
29	Manual reset trip on decreasing	15A, 125/250 Vac
32	Hermetically sealed switch, general purpose	11A, 125/250 Vac 5A, 30 Vdc
42	Hermetically sealed switch, gold contacts	1A, 125 Vac
UL/CSA Listed Dual (2 SPDT)		
61[3]	Dual narrow deadband	15A, 125/250 Vac
62[3]	Dual sealed environment proof	15A, 125/250 Vac
63	Dual high temp. 300°F	15A, 125/250 Vac
64	Dual general purpose	15A, 125/250/480 Vac ½A, 125 Vdc ¼A, 250 Vdc
65	Dual ammonia service	5A, 125/250 Vac
70	Dual low level, gold contacts	1A, 125 Vac

3 – ACTUATOR SEAL		
Code and Material	**Process Temperature Limits °F**[4]	
V – Viton	20 to 300	Viton O-Ring, Stainless Steel Pressure Connection

4 – OPTIONS
Use table from page 7

5 – STANDARD PRESSURE RANGE		
Range psi	**Adjustable Setpoint Limits psi**	**Proof Pressure psi**
1000	150-1000	12,000
2000	300-2000	12,000
3000	450-3000	12,000
5000	750-5000	10,000
7500	1125-7500	100,000

NOTES:

1 Standard switch.
2 Dual switches are 2 SPDT snap-action switches, not independently adjustable.
3 Estimated dc rating, 0.4A, 120 Vdc (not UL listed).
4 Ambient operating temperature limits –20 to 150°F, all styles, setpoint shift of ±1% of range per 50°F temperature change is normal. Switches are calibrated at 70° F reference.

B-Series Switches – Pressure, Differential Pressure & Hydraulic

OPTIONAL FEATURES AND ACCESSORIES

B-SERIES SWITCH OPTIONS							
		Appicable Switch Series					
		Pressure		Differential Pressure		H	
Code	Description	(psi)	(in. H_2O)	(psi)	(in. H_2O)		Notes
XBP	Wall Mounting Bracket in. H_2O		•		•		
XBX	½″ Male NPT Bushing					•	
XCH	Chained Cover	•	•	•	•	•	
XC8	CSA Approval	•	•	•	•		10
XCN	ATEX Directive 94/9/EC	•	•	•	•		15
XD2	Dual Seal Rating (700 Series only)	•			•		
XFM	FM Approval – Single Element	•	•	•	•		14
	FM Approval – Dual Element	•	•	•	•		14
XFP	Fungus Proofing	•	•	•	•	•	
XFS	Factory Adjusted Setpoint	•	•	•	•	•	2
XG3	Belleville Actuator	•					13,14
XG5	UL Limit Control to 150″ H_2O				•		1, 14
XG6	UL Limit Control to 600 psi	•					1, 14
XG7	Secondary Chamber with Vent	•					11
XG8	Steam Limit Control to 300 psi	•					7
XG9	Fire Safe Welded Actuator	•					7
XHS	High Static Differential Pressure			•			12
XHX	High Pressure, 40 psi, (static) d/p only 160 psi (proof) d/p only 100 psi (proof) pressure only (″ H_2O)		•		•		
XJK	Left Conduit Connection	•	•	•	•	•	8
XJL	¾″ to ½″ Reducing Bushing	•	•	•	•	•	
XJM	Metric Electrical Conduit Connection M20 x 1.5	•	•	•	•	•	
XK3	Terminal Block (700 Series only)	•	•	•	•		6
XLE	6 foot Leads on the Micro Switch	•	•	•	•	•	
XNH	Tagging Stainless Steel	•	•	•	•	•	
XNN	Paper Tag	•	•	•	•	•	
XPK	Pilot Light(s) Top Mounted	•	•	•	•	•	4
XPM	¾″ Sealed Conduit Connection with 16″ Lead Wires	•	•	•	•	•	
XTA	316 Stainless Steel Pressure Connection for in. H_2O Range		•		•		
XTM	2″ Pipe Mounting Bracket	•	•	•	•		
XUD	316 Stainless Steel Pressure Conn.			•			
XUX	IECEx Rating (700 Series only)	•	•	•	•	•	
X06	Pressure Connection: ½ NPT Male, ¼ NPT Female 316 Stainless Steel (Combination)	•	•	•	•		5
X07	½ NPTF Press. Conn., 316 SS	•	•	•	•		9
X6B	Cleaned for Oxygen Service	•	•	•			3
	Diaphragm Seal	•	•	•	•		

NOTES:

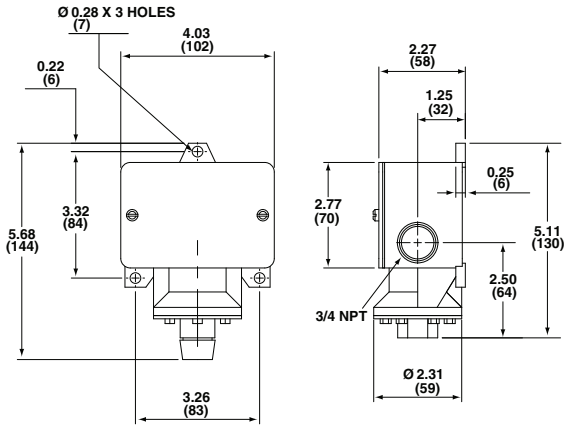
1 Buna N and Viton diaphragm.
2 Advise static or working pressure for differential pressure switches.
3 Buna N cannot be cleaned for oxygen service.
4 N/A on 700 Series.
5 Standard with 1000 and 3000 psi ranges. Bottom connection only on DP in H_2O ranges.
6 Terminal Blocks standard with 700 dual switches.
7 Stainless steel diaphragm only.
8 Standard on 700 Series. N/A with DPDT element on 400 Series.
9 N/A with Monel diaphragm.
10 Standard on 400 Series.
11 SS diaphragm required. Teflon diaphragm is the backup. NEMA 7 only.
12 Buna N and Viton diaphragm – 15#D & 30#D only.
13 24, 32, 64 or 68 element only.
14 N/A on all combinations.
15 700 Series only.

Ex II 2GD
Ex d IIC T6 Gb
Ex t IIIC T85° C Db IP 6X
(Ta = –20°C to +60°C)

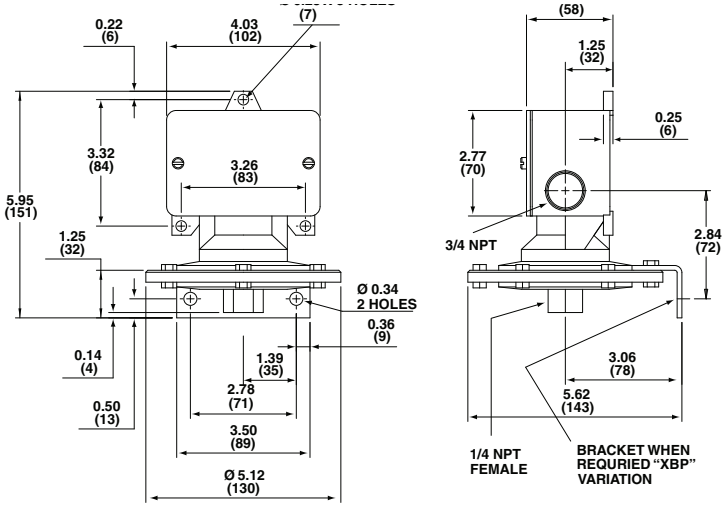
B-Series Switches – Pressure, Differential Pressure & Hydraulic

Dimensions – 400 Series

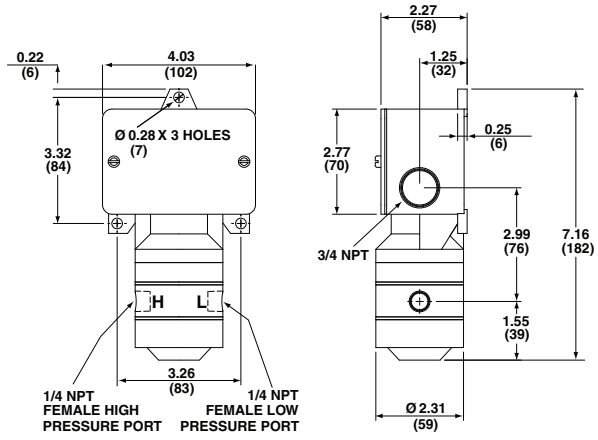
Pressure switch – psi ranges



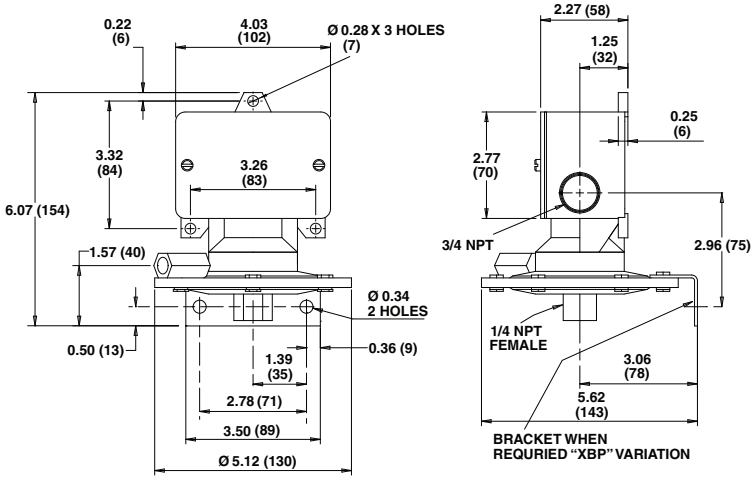
Pressure switch – inches of water ranges



Differential pressure switch – psi differential ranges



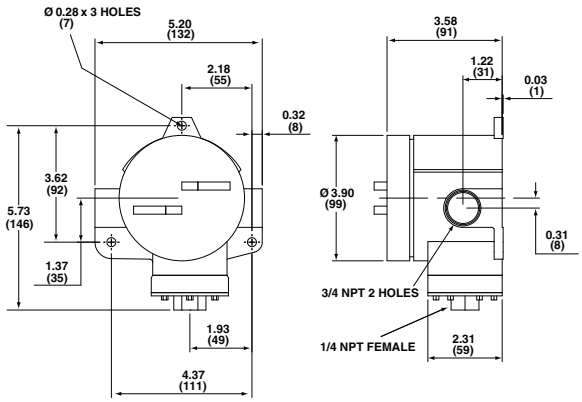
Differential pressure switch – inches of water ranges



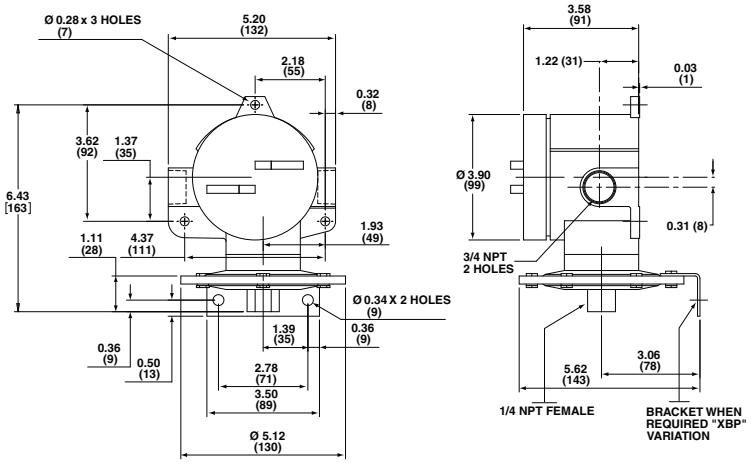
B-Series Switches – Pressure, Differential Pressure & Hydraulic

Dimensions – 700 Series

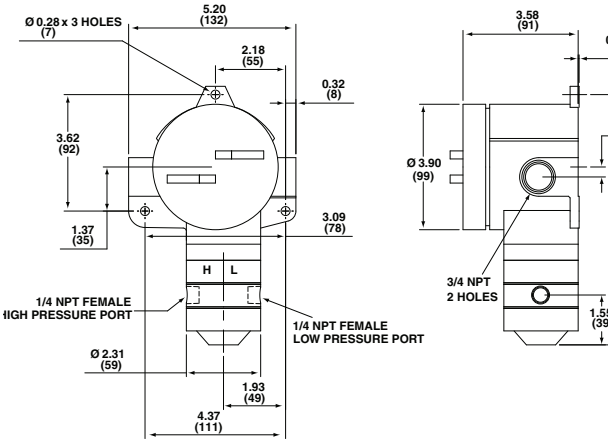
Pressure switch – psi ranges



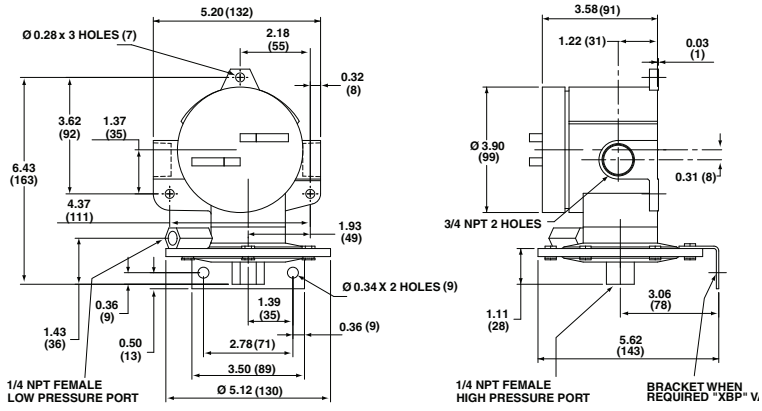
Pressure switch – inches of water ranges



Differential pressure switch – psi differential ranges

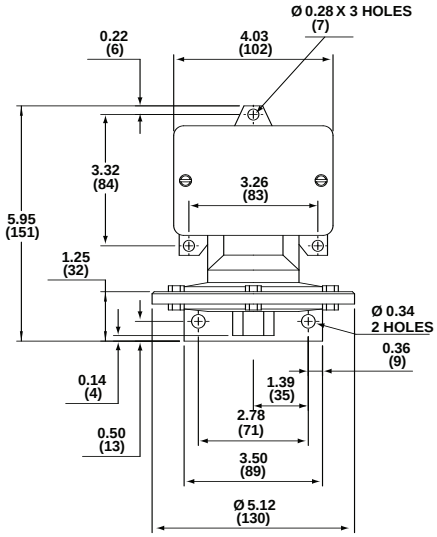


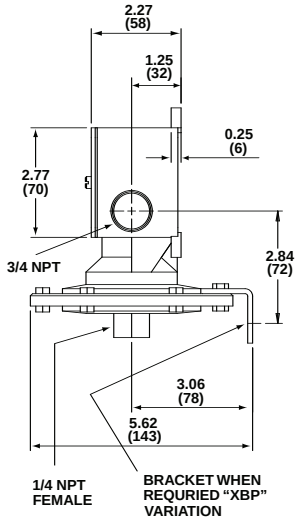
Differential pressure switch – inches of water ranges



Installation and Maintenance Instructions for B400 & B700 ASHCROFT® Snap Action Switches for Pressure Control

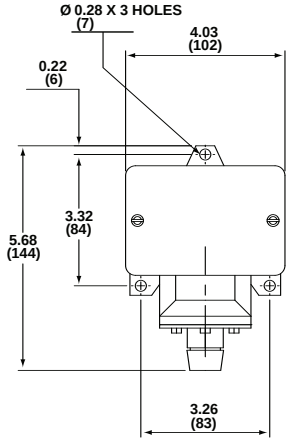
B400

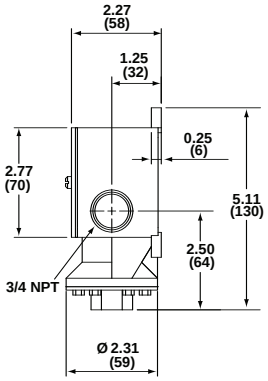




STANDARD RANGES
10, 30, 60, 100, 150 ˝H_2O
15˝H_2O vac.-15˝H_2O

2.7 lb
(1.2 kg)

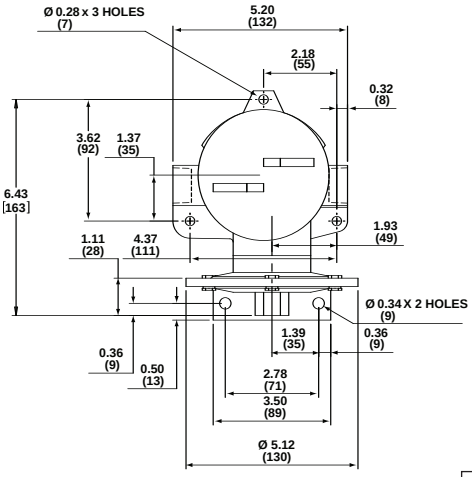


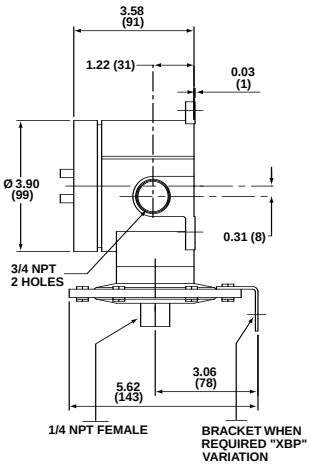


STANDARD RANGES
15, 30, 60, 100, 200, 400, 600 psi
1000, 3000 psi
30˝Hg vac.-0

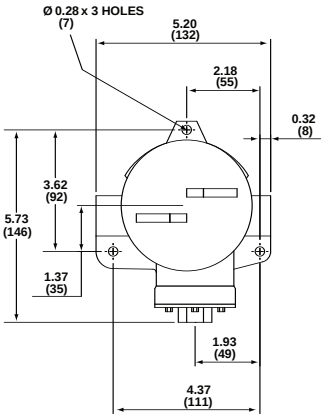
1.8 lb
(.81 kg)

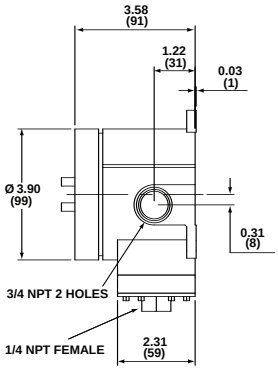
B700





3.6 lb
(1.6 kg)





2.7 lb
(1.2 kg)

INTRODUCTION

The Ashcroft pressure switch is a precision built agency approved control device which features a mechanical snap action switch. Controllers are available for operation on pressure or vacuum with fixed or variable differential. Also manual reset types for operation on increasing or decreasing pressure. The manual reset types remain tripped until reset by pressing a button on top of the enclosure. Standard electrical switch is SPDT, available with various electrical characteristics. Two SPDT switch elements mounted together are available except on variable Deadband and manual reset types. Various wetted material constructions for compatibility with a range of pressure media may be obtained.

The Ashcroft snap action pressure switch is furnished in the standard NEMA 4 and explosion-proof NEMA 7 & 9 enclosure styles. Both enclosures are epoxy coated aluminum castings.

Installation and Maintenance Instructions for B400 & B700 ASHCROFT® Snap Action Switches for Pressure Control

ASHCROFT®

INSTALLATION

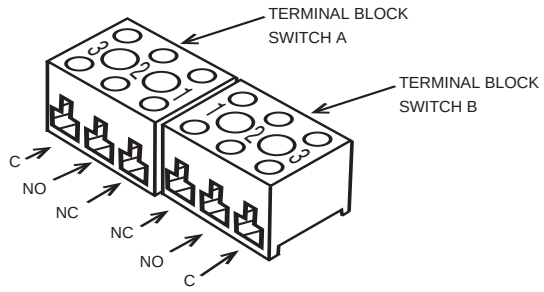
These controls are precision instruments and should never be left with internal components exposed. During installation insure that covers are in place and conduit openings are closed except when actually working on the control.

MOUNTING B400 AND B700 SERIES

Three holes external to the enclosure for surface mounting. Location of these holes is shown on the general dimension drawing. They may also be mounted directly on pressure line using the pressure connection. *When tightening control to pressure line, always use the wrench flats or hex on the lower housing.*

ELECTRICAL CONNECTIONS

Remove cover.
B400 Series – two screws hold cover to enclosure
B700 Series – cover unscrews



CONDUIT CONNECTIONS

Note – It is recommended that Teflon tape or other sealant be used on conduit, bushing or plug threads to ensure integrity of the enclosure.

B400 Series standard – one ¾″ NPT conduit hole right side.
B700 Series standard – two ¾″ NPT conduit holes with one permanent plug. NEMA 7 & 9 enclosures require proper conduit seals and breathers as per the National Electrical Code.

B400 & B700 Series – XJL variation – two ¾″ NPT conduit holes with two ¾″ to ½″ NPT reducing bushings.
B400 Series – XJK variation – two ¾″ NPT conduit holes.

B400 SERIES

SPDT – Wire directly to the switch according to circuit requirements. On controls with pilot lights wire lights according to circuit diagram on inside of cover. See special wiring instruction tag for single switches with two pilot lights and dual switches with one or more lights.

2 SPDT – Dual switching elements consist of two SPDT switches mounted together in a bracket. Switches are calibrated to have simultaneous operation within 1% of range either on increasing or decreasing pressure but not in both directions. Wire directly to the front and rear switch according to circuit requirements. Leads are provided on rear switch color coded as follows:

Common – White
Normally Closed – Red
Normally Open – Blue

See SPDT instructions for pilot light hook-up.

When hermetically sealed switch elements(s) are supplied, the lead color coding is as follows:

Common – White
Normally Closed – Red
Normally Open – Blue

B700 SERIES

SPDT – Wire directly to the switch according to circuit requirements.
2 SPDT – Wire to front switch terminal block (left) and rear switch terminal block (right) as marked. Strip insulation 5⁄16″, insert in proper terminal connector and tighten clamping screw to secure.

ADJUSTMENT OF SETPOINT

B400 & B700 Series – A single setpoint adjustment nut (⅞″) is located centrally at the bottom on the inside of the enclosure.

For accurate setpoint calibration, mount the switch on a calibration stand, a pump or catalog No.1305 deadweight gauge tester. A suitable reference standard such as an Ashcroft Duragauge or Test Gauge is necessary to observe convenient changes in pressure.

As received, the pressure switch will normally be set to approximately 90% of the indicated range. Pressurize the system to required setpoint and turn the adjustment nut until switch changes mode. Direction of turning is indicated on a label affixed to the inside of the control enclosure. When setpoint has been achieved raise and lower pressure to insure that setpoint is correct.

After installation of the control replace cover to insure electrical safety and to protect internal parts from the environment.

B450 and B750 VARIABLE DEADBAND SWITCHES

Deadband is varied by rotating the wheel on the precision switch. When viewed from the front of the enclosure, rotation to the left increases deadband – rotation to the right decreases deadband. Letters on the wheel may be used as a reference. Deadbands obtainable will vary from 0.5% to 9% of pressure range depending on range segment and type of diaphragm.

ADJUSTMENT OF SETPOINT

As received, the pressure switch will normally be set to approximately 90% of range. Rotate the wheel on the MICRO SWITCH all the way to the right; this will provide smallest deadband. Pressurize the system to the required setpoint and turn the adjustment nut until the switch changes mode. Lower the pressure to reset the switch. Rotate the wheel on the MICRO SWITCH until the desired deadband is obtained. The upper setpoint will be changing upward with this adjustment. Lower the pressure to reset the switch. Then increase the pressure to the desired setpoint and turn the adjusting nut until the switch changes mode. Lower the pressure and check resetpoint and deadband.

Note – As indicated above, adjustment of setpoint is made by use of ⅞″ nut. Precision switch element mounting screws and bracket adjusting screw are factory sealed and should not be tampered with.

Note – Since vacuum models are already above setpoint at atmosphere, the Normally Open (NO) circuit will be closed as received.

Features

- Lightweight, low-cost valves for air service
- Ideal for low pressure applications
- Provides high flow, Cv up to 138 (Kv 118)
- Air and vacuum service

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals, Diaphragms, Disc	NBR
Disc-Holder	PA (10.1 and 11.6 watt Normally Open only)
Core Guide	CA
Core Tube	305 Stainless Steel
Rider Rings	PTFE
Core and Plugnut	430F Stainless Steel
Springs*	302 Stainless Steel
Shading Coil	Copper
* For 8040H006, 8040H007, 8040H008, spring material is 17-7 PH	

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part No.			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
B	14.9	-	-	-	-	62691	-	-
F	-	15.4	27	160	99257	-	99257	-
F	-	28.2	50	385	206409	-	206409	-

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz), 6, 12, 24, 120, 240 volts DC. Must be specified when ordering. Other voltages available when required. (Note: 24 volt AC, 60 Hz not available with 28.2 watt coil)

Solenoid Enclosures

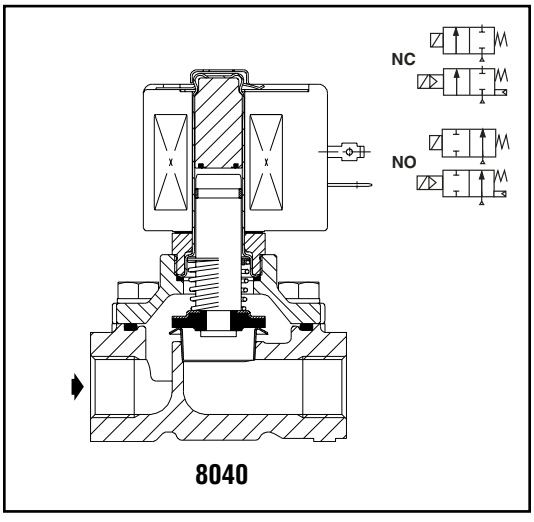
Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; RedHat - Explosionproof and Raintight, Types 3, 7, and 9. (Except EF8215A40 and EF8215A90, which are suitable for Types 3 and 7 (C and D) only and have a T2B temperature rating code.)
To order, add prefix "EF" to catalog number.

See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

Series	AC	DC	
	RedHat II/RedHat	RedHat II	RedHat
8040	-40˚F to 125˚F (-40˚C to 52˚C)	-	-
8215	32˚F to 125˚F (0˚C to 52˚C)	32˚F to 104˚F (0˚C to 40˚C)	32˚F to 77˚F (0˚C to 25˚C) (104˚F/40˚C occasionally)
Refer to Engineering Section for details.			



8040

Approvals:

CSA certified to:

8040 Series:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.
3) Automatic Gas Safety Shutoff Valves C/I (3.9), File 112872.

8215 Series Normally Closed:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.

8215 Series Normally Open:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 10381.

UL listed, as indicated. FM approved (Normally Closed only, except Catalog Numbers 8215A090 and 8215A040). RedHat II meets applicable CE directives.

Refer to Engineering Section for details.

2/2 SERIES 8040 8215

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Gas Capacity Btu/hr ⑥	Operating Pressure Differential (psi)			Max. Fluid Temp. ˚F		Aluminum Body	Const. Ref.		UL ⑤ Listing	Watt Rating/ Class of Coil Insulation ②	
				Min.	Max. AC Air-Fuel Gas	Max. DC Air-Fuel Gas	AC	DC	Catalog Number	AC	DC		AC	DC
NORMALLY CLOSED (Closed when de-energized)														
1/8	5/16	1.0	53,700	0	15	-	125	-	8040H006	11		❍	6.1/F	-
1/4	5/16	1.1	59,000	0	15	-	125	-	8040H007	11		❍	6.1/F	-
3/8	5/16	1.2	64,400	0	15	-	125	-	8040H008	11		❍	6.1/F	-
3/8	3/4	3.4	183,000	0	50	25	125	104	8215G010	2		❍	10.1/F	11.6/F
3/8	3/4	3.5	-	5	125	125	125	104	8215G001 ①	1		❍	6.1/F	11.6/F
1/2	3/4	5.4	291,000	0	2	-	125	-	8040G022	13A		❍	10.1/F	-
1/2	3/4	4.4	238,500	0	50	25	125	104	8215G020	2		❍	10.1/F	11.6/F
1/2	3/4	4.8	-	5	125	125	125	104	8215G002 ①	1		❍	6.1/F	11.6/F
3/4	3/4	9.5	512,000	0	2	-	125	-	8040G023	13B		❍	10.1/F	-
3/4	3/4	5.1	247,500	0	50	25	125	104	8215G030	4		❍	10.1/F	11.6/F
3/4	3/4	5.1	-	5	125	125	125	104	8215G003 ①	3		❍	6.1/F	11.6/F
1	1 5/8	21	1,119,000	0	25	25	125	77	8215B050 ③	6	16	❍	15.4/F	14.9/B
1 1/4	1 5/8	32	1,730,000	0	25	25	125	77	8215B060 ③	6	16	❍	15.4/F	14.9/B
1 1/2	1 5/8	35	1,900,000	0	25	25	125	77	8215B070 ③	6	16	❍	15.4/F	14.9/B
2	2 3/32	60	3,251,000	0	25	15	125	77	8215B080 ③	7	17	❍	15.4/F	14.9/B
2 1/2	3	117	5,821,000	0	5	-	125	-	8215A090 ⑦	8		❍	28.2/F	-
3	3	138	7,430,000	0	5	-	125	-	8215A040 ⑦	8		❍	28.2/F	-
NORMALLY OPEN (Open when de-energized)														
3/8	3/4	3.2	172,500	0	125	125	125	104	8215G013	9		●	10.1/F	11.6/F
1/2	3/4	4	206,250	0	125	125	125	104	8215G023	9		●	10.1/F	11.6/F
3/4	3/4	4.6	247,500	0	125	125	125	104	8215G033	10		●	10.1/F	11.6/F
1	1 5/8	22	1,191,750	0	25	15	125	77	8215C053	12	18	●	15.4/F	14.9/B
1 1/4	1 5/8	33	1,793,250	0	25	15	125	77	8215C063	12	18	●	15.4/F	14.9/B
1 1/2	1 5/8	37	1,988,250	0	25	15	125	77	8215C073	13	19	●	15.4/F	14.9/B
2	2 3/32	58	3,100,000	0	25	15	125	77	8215C083	14	20	●	15.4/F	14.9/B
2 1/2	3	117	6,290,000	0	5	-	125	-	8215B093 ④⑦	15		●	28.2/F	-

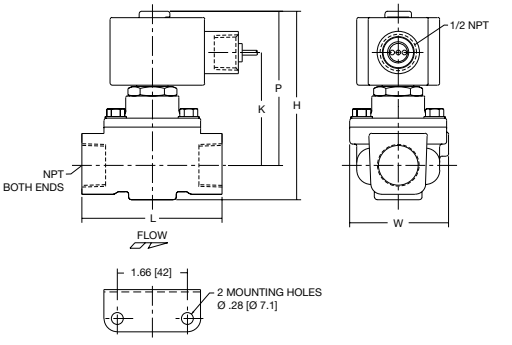
① Do not use for Fuel Gas.
② On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
③ FM Approved Process Control Valves. *See Engineering Section (Approvals) for details.*
④ Type I enclosure only.
⑤ ❍ = Safety Shutoff Valve; ● = General Purpose Valve. *Refer to Engineering Section (Approvals) for details.*
⑥ 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.
⑦ Not available with 24 volt, 60 Hz coil.

Dimensions: inches (mm)

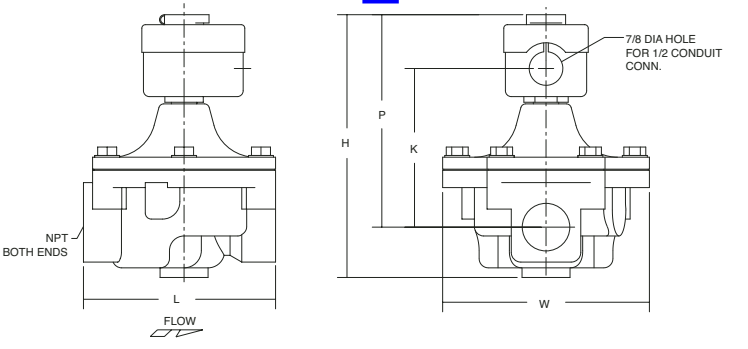
Const. Ref.		H	K	L	P	W
1	ins.	3.42	2.00	2.75	2.87	2.46
	mm	87	51	70	73	63
2	ins	4.02	2.49	2.75	3.46	2.46
	mm	102	63	70	88	63
3	ins.	3.87	2.19	3.31	3.05	2.33
	mm	98	56	84	77	59
4	ins.	4.46	2.68	3.31	3.64	2.33
	mm	113	68	84	92	59
6 ①	ins.	6.84	4.25	5.00	5.59	5.38
	mm	174	108	127	142	137
7 ①	ins.	7.47	4.53	6.09	5.94	6.31
	mm	190	115	155	151	160
8 ①	ins.	10.25	5.75	7.75	7.31	7.94
	mm	260	146	198	201	202
9	ins.	4.42	2.72	2.75	3.86	2.36
	mm	112	69	70	98	60
10	ins.	4.86	2.72	3.31	4.04	2.36
	mm	123	69	84	103	60
11	ins.	2.74	1.44	2.00	2.30	1.69
	mm	69	36	51	58	43
12	ins.	6.84	2.22	5.00	3.63	5.38
	mm	174	56	127	92	137
13	ins.	6.84	2.16	5.00	3.56	5.38
	mm	174	55	127	90	137
13A	ins.	4.05	2.46	2.75	3.44	2.42
	mm	103	63	70	87	62
13B	ins.	4.49	2.65	3.31	3.63	2.39
	mm	114	67	84	92	61
14 ②	ins.	7.44	2.41	6.09	3.81	6.31
	mm	189	61	155	97	160
15 ②	ins.	10.25	3.07	7.80	5.22	7.94
	mm	260	78	198	133	202
16	ins.	7.59	4.03	5.00	6.34	5.38
	mm	193	102	127	161	137
17	ins.	8.19	4.38	6.09	6.69	6.31
	mm	208	111	155	170	160
18	ins.	6.16	2.09	5.00	4.41	5.38
	mm	156	53	127	112	137
19	ins.	7.59	2.03	5.00	4.34	5.38
	mm	193	52	127	110	137
20	ins.	8.19	2.28	6.09	4.59	6.31
	mm	2.08	58	155	117	160

IMPORTANT: Valves may be mounted in any position except all DC constructions and those marked ①, which must be mounted with the solenoid vertical and upright. Constructions marked ② must be mounted with the solenoid vertical and upright or horizontal only.

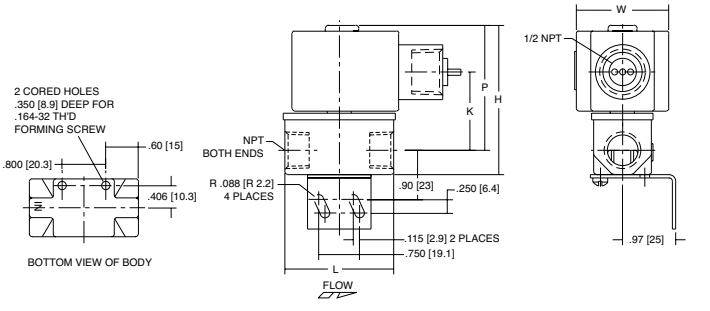
Const. Ref. 1-4, 9, 10, 13A, 13B



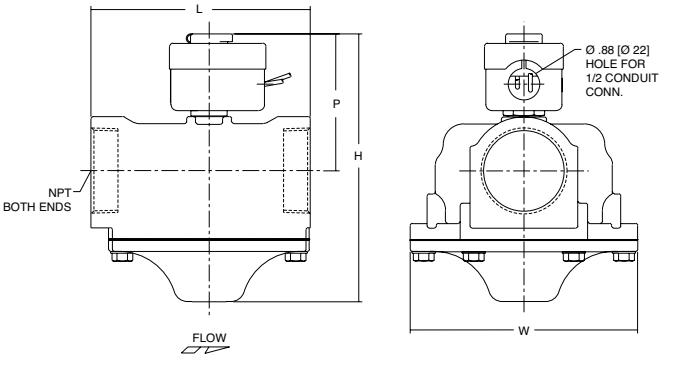
Const. Ref. 6, 7, 8, 16, 17



Const. Ref. 11

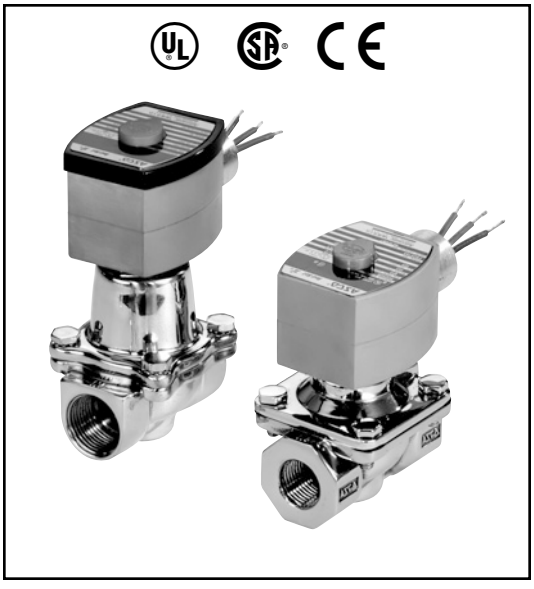


Const. Ref. 12-15, 18-20



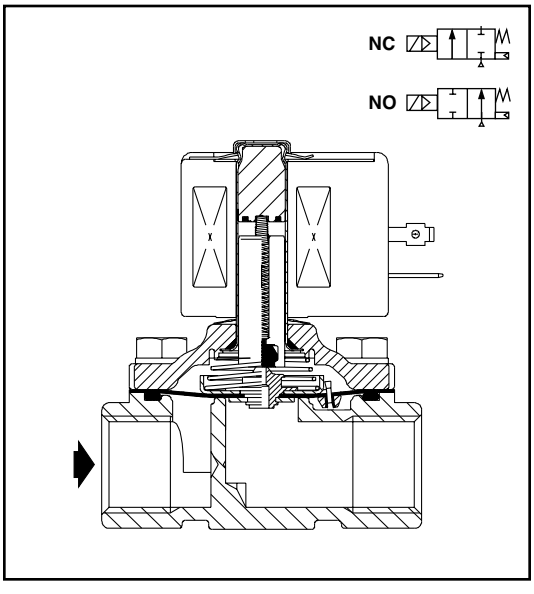
Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage
- High Flow Valves for liquid, corrosive, and air/inert gas service
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps



Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver



Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
		AC			General Purpose		Explosionproof	
	DC Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910	-	238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering.
Other voltages available when required.

Solenoid Enclosures

Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.

(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B057, 8210B058, and 8210B059, which are not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

RedHat II/
RedHat AC: 32˚F to 125˚F (0˚C to 52˚C)

RedHat II DC: 32˚F to 104˚F (0˚C to 40˚C)
RedHat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)

8210G227 AC: 32˚F to 130˚F (0˚C to 54˚C)
DC: 32˚F to 90˚F (0˚C to 32˚C)

Refer to Engineering Section for details.

Approvals

UL listed as indicated. CSA certified.
RedHat II meets applicable CE directives.
Refer to Engineering Section for details.

2/2 SERIES 8210

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. ˚F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Const. Ref. ④	UL ⑤ Listing	Catalog Number	Const. Ref. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G073 ③	1P	●	8210G036 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G093	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G001	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G006	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G015 ③	2P	●	8210G037 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G094	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G087	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G002	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G007	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	130	90	8210G227	5D	❍ †	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G088	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G009	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G095	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G003	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B026 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G026 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B054 ‡	31D	-	8210D089	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G054	41D	●	8210G089	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G004	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G027 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G078 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B055 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G055	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G008	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B056 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G056	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G022	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G033	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G011 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G034	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G030	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G012 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G035	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G038	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C013	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G013	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B057 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D014	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G014	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B058 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D018	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G018	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B059 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D032	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G032	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210 103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210 104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

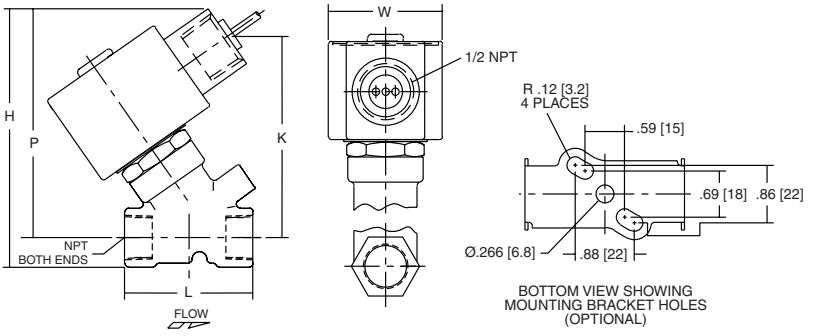
① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes Ultem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.
⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless steel disc-holder.
‡ Must have solenoid mounted vertical and upright.
† UL listed for fire protection systems per UL429A.

Dimensions: inches (mm)

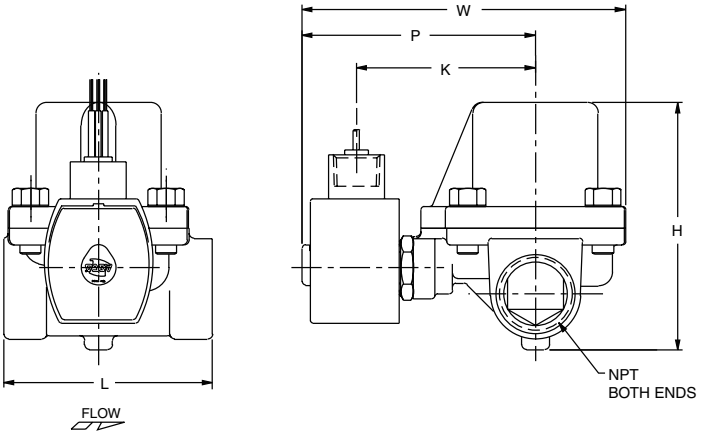
Const. Ref.		H	K	L	P	W
1*	ins.	3.85	3.00	1.91	3.41	1.69
	mm	98	76	49	87	43
2*	ins.	4.17	3.25	2.28	3.63	1.69
	mm	106	83	58	92	43
5	ins.	3.84	2.31	2.75	3.28	2.28
	mm	98	59	70	83	58
6*	ins.	3.38	1.94	2.75	2.80	2.28
	mm	86	49	70	71	58
7	ins.	4.19	2.50	2.81	3.47	2.39
	mm	106	64	71	88	61
8	ins.	4.13	2.47	2.81	3.44	2.29
	mm	105	63	71	87	58
9*	ins.	3.66	2.10	2.81	2.96	2.28
	mm	93	53	71	75	58
10*	ins.	5.25	X	2.81	4.59	2.31
	mm	133	X	71	117	59
11*	ins.	4.16	2.66	3.84	3.52	2.75
	mm	106	68	98	89	70
12	ins.	5.64	3.15	3.75	4.01	3.36
	mm	143	80	95	102	85
13	ins.	4.44	3.22	3.75	4.19	5.81
	mm	113	82	95	106	147
15*	ins.	5.34	X	3.75	4.47	3.84
	mm	136	X	95	114	98
16	ins.	5.64	3.15	3.66	4.01	3.56
	mm	143	80	93	102	90
18	ins.	6.11	3.30	4.38	4.16	3.92
	mm	155	84	111	106	100
20*	ins.	7.33	3.71	5.06	4.57	4.87
	mm	186	94	129	116	124
21*	ins.	7.33	3.71	5.50	4.57	4.87
	mm	186	94	140	116	124
23	ins.	4.35	2.65	2.75	3.79	2.28
	mm	110	67	70	96	58
24	ins.	5.06	X	3.78	4.44	2.75
	mm	129	X	96	113	70
25	ins.	4.64	2.81	2.81	3.94	2.28
	mm	118	71	71	100	58
26	ins.	6.53	X	3.75	4.91	3.19
	mm	166	X	95	125	81
27	ins.	8.22	X	5.50	5.47	4.87
	mm	209	X	140	139	124
28	ins.	6.53	X	3.66	4.91	3.19
	mm	166	X	93	125	81
29	ins.	7.03	X	4.38	5.06	4.40
	mm	179	X	111	129	112

* DC dimensions slightly larger.
IMPORTANT: Valves may be mounted in any position, except as noted in specifications table.

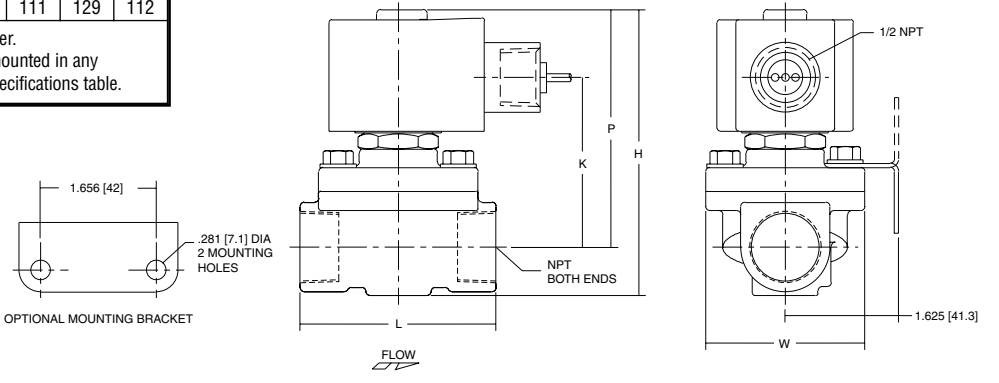
Const. Ref. 1, 2



Const. Ref. 13



Const. Ref. 5-9, 11, 20, 21, 23, 25, 37,38



SECTION 18 - 1600 SERIES PROCESS EQUIPMENT - ENCLOSURE SUMP

LEVEL SENSOR (SVE ENCLOSURE) - DWYER MODEL F7-SB

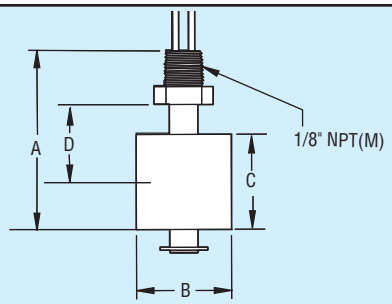
LEVEL SENSOR (GWT ENCLOSURE) - DWYER MODEL F7-SB

Series F6 & F7

Level Switches - Vertical

Low Cost, Reliable and Compact, Hermetically Sealed Contacts

UL LISTED



Series F6 & F7 compact level switches combine low cost and reliability with fast, simple installation. Hermetically sealed reed switches are actuated by magnets permanently bonded inside the float and can be easily adapted to open or close a circuit on rising or falling levels. Vertical mount models are shipped with normally open switch contacts which close as the float rises toward the mounting threads. Reverse switch action by removing the float, rotating it end-for-end and replacing it on the stem. Vertical models mount internally, oriented within 30° of vertical, or select optional fittings for external mounting. Switch ratings are suitable for many solid state control systems and monitors or alarms. Simple relay interfaces can be used for higher current applications.

Dimensions in Inches [mm]

Model	(A) Stem Length	(B) Float Diameter	(C) Float Height	(D) Actuation from Hex①
F7-SB	2.75 (70)	1.38 (35)	1.13 (29)	1.2 (31)
F7-SS2	2.06 (52)	1.0 (25)	1.0 (25)	0.73 (19)
F6-SS	2.17 (55)	1.11 (28)	1.11 (28)	–
F7-MPP	1.63 (41)	0.63 (16)	0.63 (16)	0.47 (12)
F7-PP	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)
F7-BT	2.18 (55)	1.18 (30)	1.0 (25)	0.69 (18)
F7-K	2.13 (54)	1.0 (25)	1.0 (25)	0.65 (17)
F7-C11	2.06 (52)	1.0 (25)	1.0 (25)	0.56 (14)
F7-C21	2.06 (24)	1.0 (25)	1.0 (25)	0.56 (14)
F7-BB	3.19 (81)	1.88 (48)	1.81 (46)	1.19 (30)
F7-PS	3.38 (86)	1.88 (48)	1.88 (48)	1.25 (32)
F7-PVC	3.44 (87)	1.5 (38)	1.81 (46)	0.75 (19)
F7-T1	3.47 (88)	2.13 (54)	1.94 (49)	0.92 (22)
F7-ST713	3.38 (86)	2.06 (52	2.06 (52)	1.09 (28)
F7-ST714	3.38 (86)	2.06 (52)	2.06 (52)	1.09 (28)

Model	Applications	Material Float/Stem	Temp. Limits	Press. Limits	Min. S.G.	Electrical Rating	Wire Leads	Mtg NPT(M)	Weight oz (g)
F7-SB	General purpose	Buna-N & Epoxy/ 316 SS	220°F (105°C)	150 psig 10 bar	0.60	25 VA: 1A @ 220 VAC	22 AWG 18″ (45 cm)	1/8″	2 (58)
F7-SS2	High temp/pressure, corrosives	316 SS (CYC)/ 316 SS	300°F (149°C)	450 psig 31 bar	0.75	25 VA: 1A @ 200 VAC	22 AWG 18″ (45 cm)	1/8″	1.2 (34)
F6-SS	Corrosives	316 SS/ 316 SS	257°F (125°C)	218 psig 15 bar	0.65	20 VA: 0.08A @ 240 VAC	22 AWG 11.8″ (30 cm)	1/8″	1.59 (45)
F7-MPP**	Broad chemical compatibility	Polypropylene/ Polypropylene	180°F (82°C)	100 psig 6.89 bar	0.90	10 VA: 0.1A @ 100 VAC	22 AWG 24″ (61 cm)	1/8″	0.8 (23)
F-MPP-NO**	Broad chemical compatibility	Polypropylene/ Polypropylene	176°F (80°C)	100 psig 6.89 bar	0.90	50 VA: 0.2A @ 240 VAC	22 AWG 24″ (61 cm)	1/8″	0.8 (23)
F7-PP	Broad chemical compatibility	Polypropylene & Epoxy/Polypropylene	220°F (105°C)	100 psig 6.89 bar	0.60	30 VA: 0.14A @ 220 VAC	22 AWG 24″ (61 cm)	1/8″	0.8 (23)
F7-BT	Oils & Fuels	Buna-N & Epoxy/ PBT*	220°F (105°C)	150 psig 10 bar	0.45	30 VA: 0.14A @ 220 VAC	22 AWG 24″ (61 cm)	1/8″	0.7 (20)
F7-K	Food/beverage, corrosives	PVDF/ PVDF	180°F (82°C)	100 psig 6.89 bar	1.00	50 VA: 0.25A @ 150 VAC	22 AWG 24″ (61 cm)	1/8″	1.5 (43)
F7-C11	General purpose	Buna-N/ Brass	180°F (82°C)	150 psig 10 bar	0.45	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/8″	1.5 (43)
F7-C21	Oils & water, general purpose	Buna-N/ 316 SS	180°F (82°C)	150 psig 10 bar	0.45	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/8″	1.5 (43)
F7-BB	High viscosity liquids	Buna-N/ Brass	180°F (82°C)	150 psig 10 bar	0.55	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/4″	5 (140)
F7-PS	Water-based liquids, complies with FDA	Polysulfone/ Polysulfone†	225°F (107°C)	50 psig 3 bar	0.55	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/4″	4 (110)
F7-PVC	Chemical & plating	CPVC/ CPVC	180°F (82°C)	15 psig 1 bar	0.85	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/4″	5 (140)
F7-T1	Viscous, sticky or corrosive liquids	PTFE/ TFE	300°F (149°C)	30 psig 2 bar	0.80	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/4″	6 (170)
F7-ST713	Oils, water & chemicals	316 SS/ 316 SS	300°F (149°C)	750 psig 52 bar	0.80	20 VA: 0.08A @ 240 VAC	22 AWG 24″ (61 cm)	1/4″	6 (170)

① Distance between hex and liquid (S.G. = 1.0) level at actuation point will vary with specific gravity changes.
*PBT - Polybutylene Terephthalate.
† Incudes 316 SS clip.
‡ Spherical floats.
**F7-MPP is normally closed
F7-MPP-NO is normally open

UL Listed

OPTIONAL FITTINGS — For external mounting of vertical models
A-347, 1/8″ x 1-1/4″ NPT carbon steel adapter
A-347-SS, 1/8″ x 1-1/4″ NPT 316 SS adapter
A-348, 1/8″ x 1-1/2″ NPT carbon steel adapter
A-348-SS, 1/8″ x 1-1/2″ NPT 316 SS adapter

Level

SECTION 19 - POWER DISTRIBUTION EQUIPMENT

DISTRIBUTION PANEL 480Y/277V, 3 PHASE, 4 WIRE, 200 AMP MAIN - SQUARE D MODEL NF430L2C

TRANSFORMER, 480-208Y/120V, 45kVA - SQUARE D MODEL EE45T3H

DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 125 AMP MAIN - SQUARE D MODEL QO330MQ125

DISTRIBUTION PANEL: 208Y/120V, 3 PHASE, 4 WIRE, 60 AMP MAIN - SQUARE D MODEL QO320L125GRB

JUNCTION BOX - HAMMOND MODEL EN4SD16126GY

JUNCTION BOX - HAMMOND MODEL EN4SD24206GY

POWER MONITOR TRANSMITTER - LEVITON MODEL 3500 / 3KUMT-02M

E-STOPS (3) - SQUARE D MODEL ZB5AS844

NF/NFOM Panelboards
Information Manual
Class 1670

Instruction Bulletin

80043-741-02

Retain in the directory card pocket for future use.

SQUARE D

by Schneider Electric

HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, can result in property damage.

Provides additional information to clarify or simplify a procedure.

PLEASE NOTE Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

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Introduction

This bulletin contains instructions for installing Square D® brand NF and NFOM circuit breaker panelboards. These panelboards are Underwriters Laboratories (cULus) listed and accept ECB, EDB, EGB, and EJB branch circuit breakers.

For technical support on the installation of this panelboard, contact the Square D/Schneider Electric Customer Information Center at 1-888-SquareD (1-888-778-2733).

See the labels on the equipment for rating and safety information. Additional equipment labels are provided with this document.

Safety Precautions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Read and understand this entire instruction bulletin and the included NEMA PB 1.1 standards publication before installing, operating, or maintaining this equipment.
- Local codes vary, but are adopted and enforced to promote safe electrical installations. A permit may be needed to do electrical work, and some codes may require an inspection of the electrical work.
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside the equipment.
- Always use a properly-rated voltage sensing device to confirm all power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

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Installation

This section provides instructions for the following NF/NFOM panelboard procedures:

Interior Mounting for Square D Brand Enclosures

A separate standards publication, titled "General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less" (NEMA PB1.1), has been provided with this equipment. Familiarize yourself with the content of this document before proceeding with any of the following procedures.

If you did not receive a copy of this document, or if you have any questions regarding this equipment, contact your local distributor or Schneider Electric representative.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

- Ensure all connections are properly tightened.
- Refer to the torque information label provided on the panelboard before tightening the connections.

Failure to follow these instructions can result in equipment damage.

To properly mount and install the NF/NFOM panelboard interior, please refer to the NEMA PB 1.1 standards publication, and follow the instructions below for either "Surface Mounting (Enclosure Mounted on Wall)" or "Flush Mounting (Enclosure Recessed in Wall)."

Surface Mounting (Enclosure Mounted on Wall)

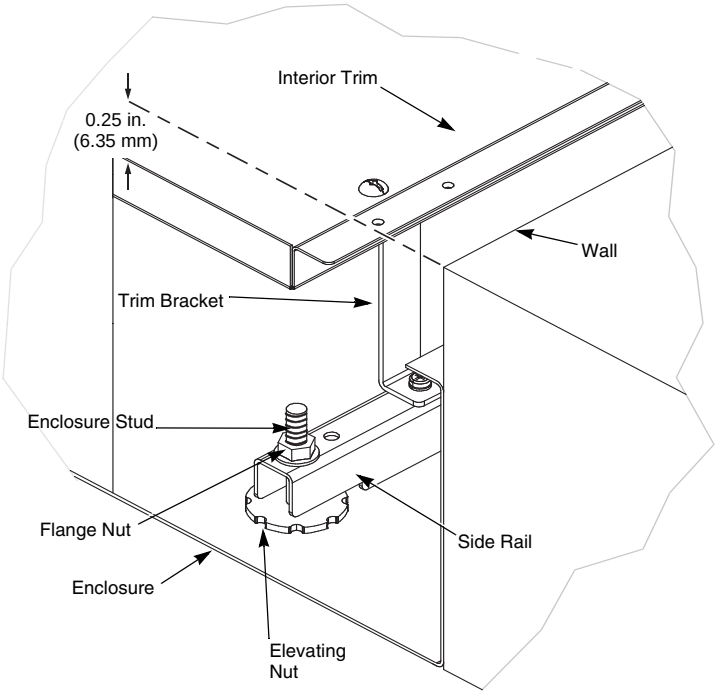
1. Mount the enclosure as instructed in the NEMA PB 1.1 standards publication.
2. Remove the interior trim from the trim brackets.
3. Install the interior as described below:
   a. Thread the provided elevating nuts on the enclosure studs.
   b. Set the interior on the enclosure studs. (See Figure 1 on page 10).
   c. Tighten the flange nuts against the interior side rails until the rails are against the back of the enclosure.
   d. Remount the interior trim after wiring.
4. If used as service entrance equipment, neutral bonding is required. See the “Neutral Bonding Strap Installation” instructions on page 11.
5. Apply equipment labels (located in the bag assembly) as directed by the instructions on the back of the equipment label sheet.

Flush Mounting (Enclosure Recessed in Wall)

1. Mount the enclosure as instructed in the NEMA PB 1.1 standards publication.
2. Remove the interior trim from the trim brackets.
3. Install the interior as described below:
   a. Thread the provided elevating nuts on the enclosure studs.
   b. Set the interior on the enclosure studs (see Figure 1 on page 10). Place the flange nuts onto the enclosure studs, but do not tighten.
   c. Adjust the elevating nuts so that the lip of the interior trim is approximately 0.25 inches (6.35 mm) from wall line.
   d. Tighten the flange nuts against the side rails.
   e. Remount the interior trim after wiring.
4. If used as service entrance equipment, neutral bonding is required. See the “Neutral Bonding Strap Installation” instructions on page 11.
5. Apply equipment labels (located in the bag assembly) as directed by the instructions on the back of the equipment label sheet.

ENGLISH

Figure 1: Interior Mounting of Square D Brand Enclosures



Neutral Bonding Strap Installation

The neutral bonding strap should be used only when the panelboard is **installed** as service equipment.

To properly bond the neutral to the panelboard, follow the instructions for either “125 A or 250 A Maximum NF Panelboards”, “400 A or 600 A Maximum NF Panelboards”, or “800 A Maximum NF Panelboards” below, and on pages 12–14.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off all power supplying this equipment before working on or inside the equipment.
- The main bonding strap should be used only when the panelboard is installed as service equipment.
- Do not mix the mounting screws with the interior trim screws.

Failure to follow these instructions will result in death or serious injury.

NOTE: The bonding strap parts are found in the bag assembly provided with the interior.

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125 A or 250 A Maximum NF Panelboards

To install a neutral bonding strap on a 125 A or 250 A maximum NF panelboard, refer to Figure 2 and follow the instructions below.

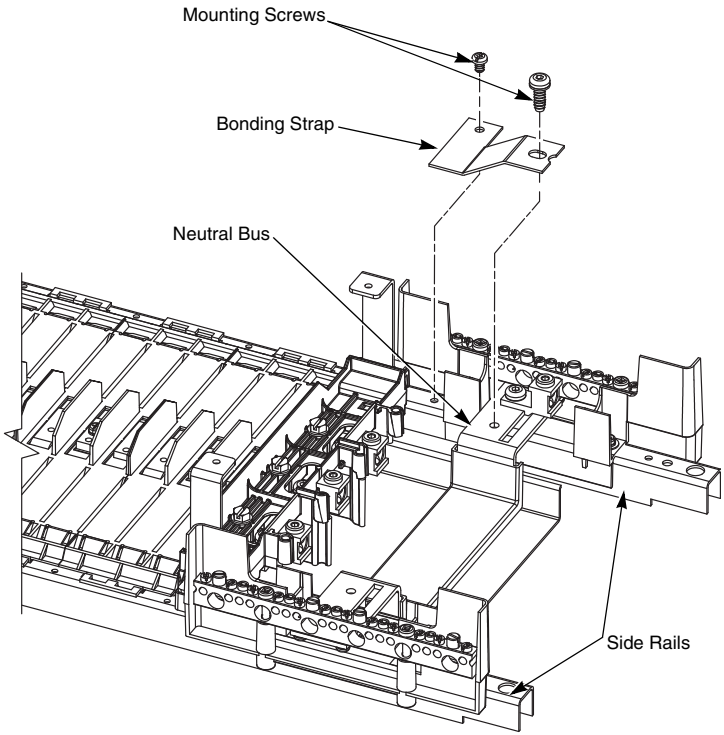
1. Align the bonding strap on the side rail, as pictured.

   NOTE: For some applications, it may be necessary to remove the lug (not pictured) before installing the bonding strap.

2. Insert the two mounting screws, as pictured. Tighten the 10-32 screw to 10–12 lb-in (1.1–1.4 N•m) and the 1/4-20 screw to 25–30 lb-in (2.8–3.4 N•m).

   NOTE: If the lug was removed in Step 1, reinstall it on top of the bonding strap. Use the 1/4-20 x 3/4 in. mounting screw. Lug mounting screws are provided in the bonding strap bag assembly.

Figure 2: Bonding Strap Installation — 125 A or 250 A Maximum NF Panelboards



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400 A or 600 A Maximum NF Panelboards

To install a neutral bonding strap on a 400 A or 600 A maximum NF panelboard, refer to Figure 3 and follow the instructions below.

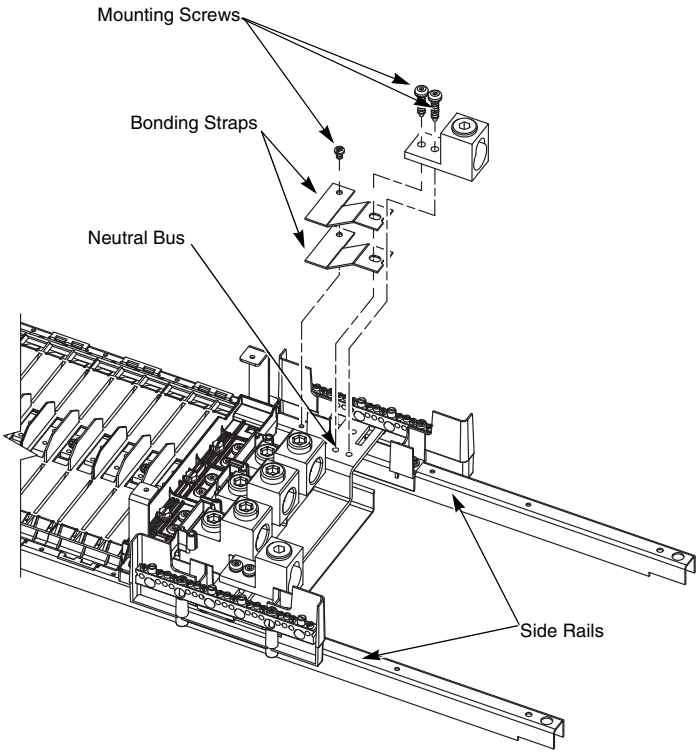
1. Align the two bonding straps on the side rail, as pictured.

   NOTE: For some applications, it may be necessary to remove the lug before installing the bonding strap.

2. Insert the three mounting screws, as pictured. Tighten the 10-32 screw to 10–12 lb-in (1.1–1.4 N•m) and the two 1/4-20 screws to 60–65 lb-in (6.8–7.3 N•m).

   NOTE: If the lug was removed in Step 1 above, reinstall it on top of the bonding strap. Use the 1/4-20 x 1 1/8 in. mounting screws. Lug mounting screws are provided in the bonding strap bag assembly.

Figure 3: Bonding Strap Installation — 400 A or 600 A Maximum NF Panelboards



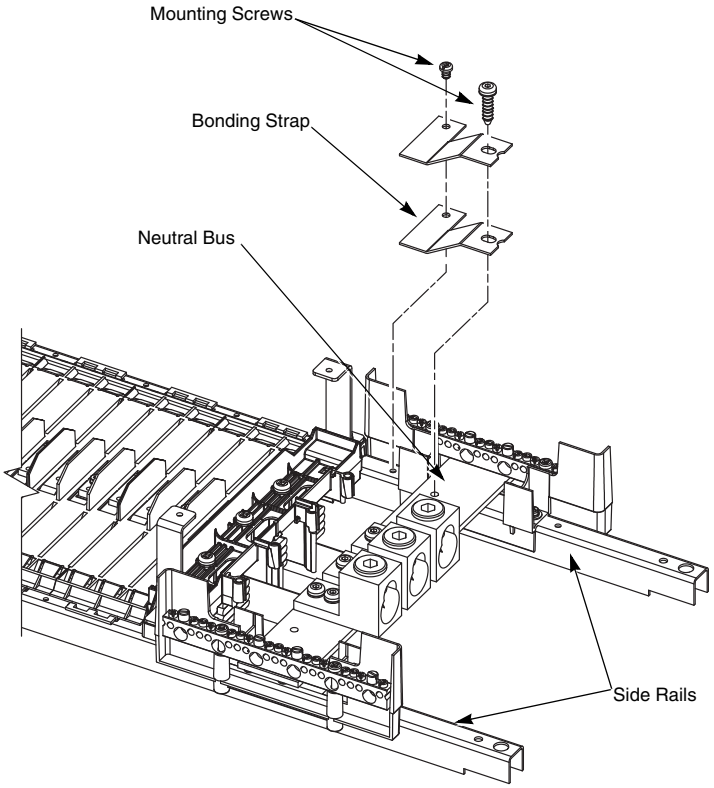
ENGLISH

800 A Maximum NF Panelboards

To install a neutral bonding strap on an 800 A maximum NF panelboard, refer to Figure 4 and follow the instructions below.

1. Align the two bonding straps on the side rail, as pictured.
2. Insert the two mounting screws, as pictured. Tighten the 10-32 screw to 10–12 lb-in (1.1–1.4 N•m) and the 1/4-20 screw to 60–65 lb-in (6.8–7.3 N•m).

Figure 4: Bonding Strap Installation — 800 A Maximum NF Panelboards



ECB, EDB, EGB, and EJB Circuit Breaker Installation and Removal

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly-rated voltage sensing device to confirm that all power is off.
- All unused spaces must be filled with blank fillers.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

ECB, EDB, EGB, and EJB Circuit Breaker Installation

Refer to Figure 5 on page 16 for the following instructions:

1. Turn off all power to the panelboard.
2. Turn the breaker off.
3. Remove the interior trim.
4. With the bolt-on connector end of the circuit breaker slightly elevated, insert the mounting foot into the slot in the phase cover.
5. Rotate the breaker down and back until the captive screw(s) align with the tapped holes in the breaker connectors.
6. Engage the screws into the branch connector hole and tighten it to 20–30 lb-in (2.3–3.4 N•m).
7. Install the load wire.
8. Reinstall the interior trim.

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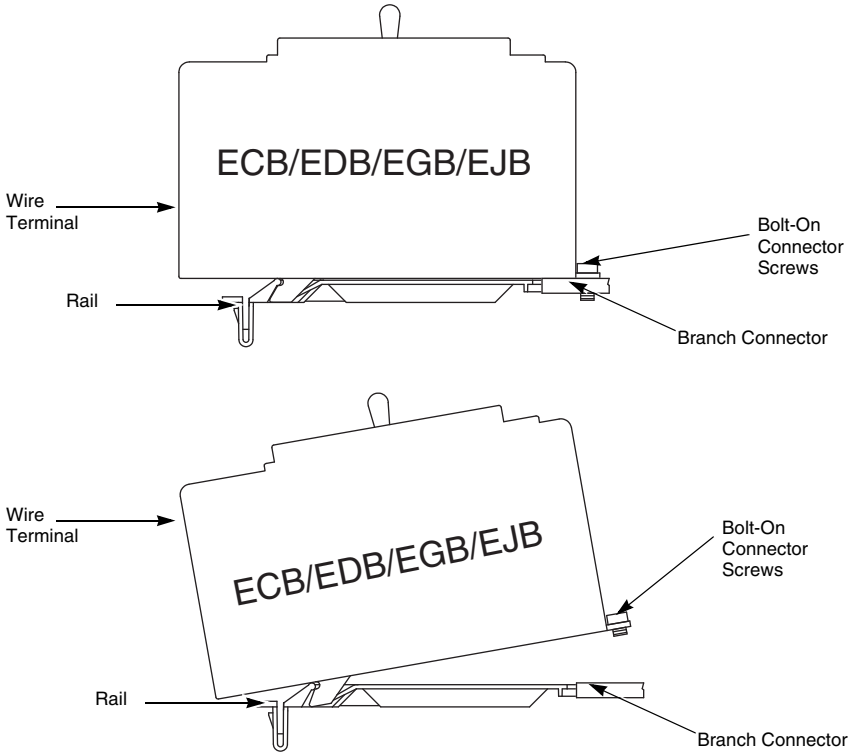
ECB, EDB, EGB, and EJB Circuit Breaker Removal

Refer to Figure 5 on page 16 for the following instructions:

1. Turn off all power to the panelboard.
2. Remove the interior trim.
3. Turn the breaker off.
4. Remove the load wire.
5. Loosen the screw(s) in the breaker connector and lift the breaker off of the panelboard.
6. Reinstall the interior trim.

Figure 5: ECB, EDB, EGB, and EJB Circuit Breaker Installation and Removal



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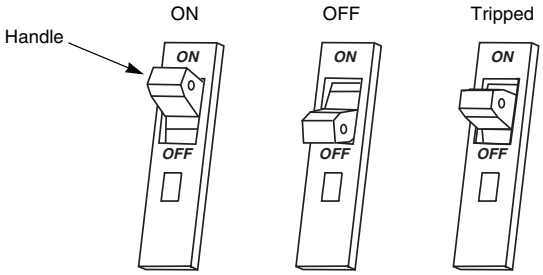
Circuit Breaker Reset Instructions

If the circuit breaker is tripped, the handle will be at the mid-position between ON and OFF. To reset the circuit breaker, push the handle to the OFF position, then to the ON position.

Figure 6: Circuit Breaker Handle Positions



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Interior Trim Preparation

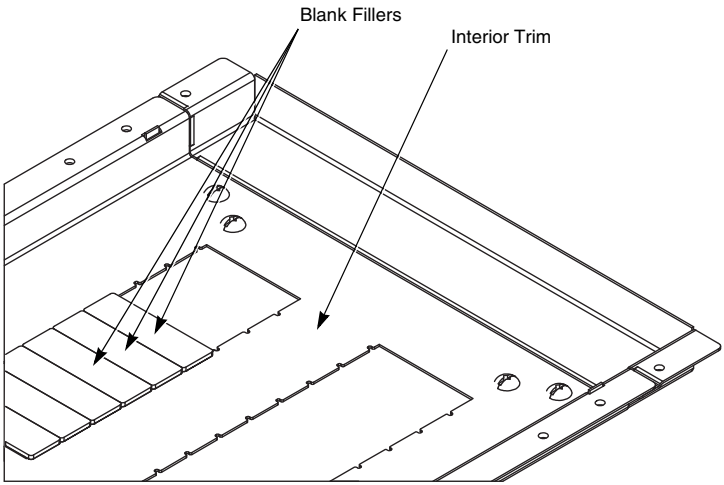
⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Before energizing the panelboard, all unused spaces must be filled with blank fillers.
- Replace all devices, doors, and covers before energizing this equipment.

Failure to follow this instruction will result in death or serious injury.

Figure 7: Interior Trim Diagram



NOTE: The back of the interior trim lists the catalog number for its corresponding compatible blank fillers.

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Appendix 1: Specifications

Typical Wiring

NOTE: Do not use on 600 V or 480 V, 3-phase 3-wire delta systems.

Table 1: Panelboard Typical Wiring[1]

	1-Phase Panelboards		3-Phase Panelboards	
Voltage AC	**Phase**	**Wires**	**Phase**	**Wires**
600Y/347	1	3	3	4
480Y/277	1	3	3	4
208Y/120	1	3	3	4
120/240	1	3	—	—
240[2]	1	2	3	3
240	3	3	—	—
240/120[3]	—	—	3	4 Delta

1 Additional information is provided on the panelboard. See the main circuit breaker rating, if used.

2 For this system, the neutral is not used.

3 When wiring for a delta system, phases “A” and “C” must be 120 V to neutral, phase “B” 208 V to neutral.

Integral Main or Sub-Feed
(FI, KI, H, J, LA, LC, LH, EDB, EGB, EJB)

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Figure 8: NF/NFOM 125–250 A Main Lugs or Main Breaker Diagram

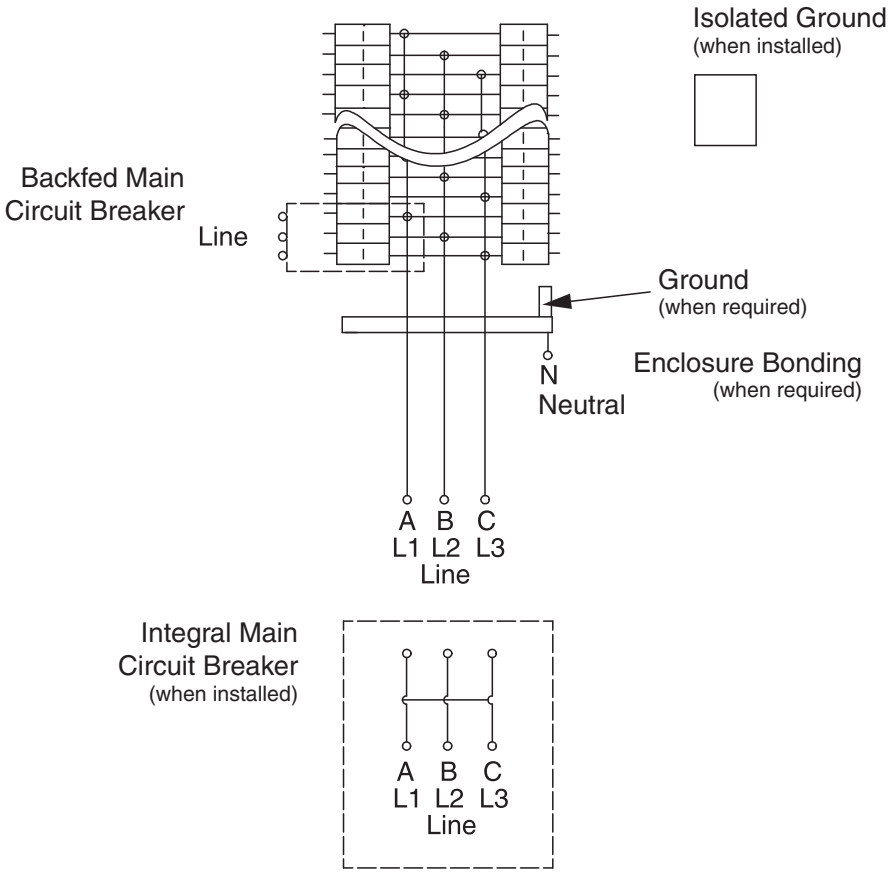

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Figure 9: NF 400–800 A Main Lugs or Main Circuit Breaker with or without Feed-Through Lugs Diagram

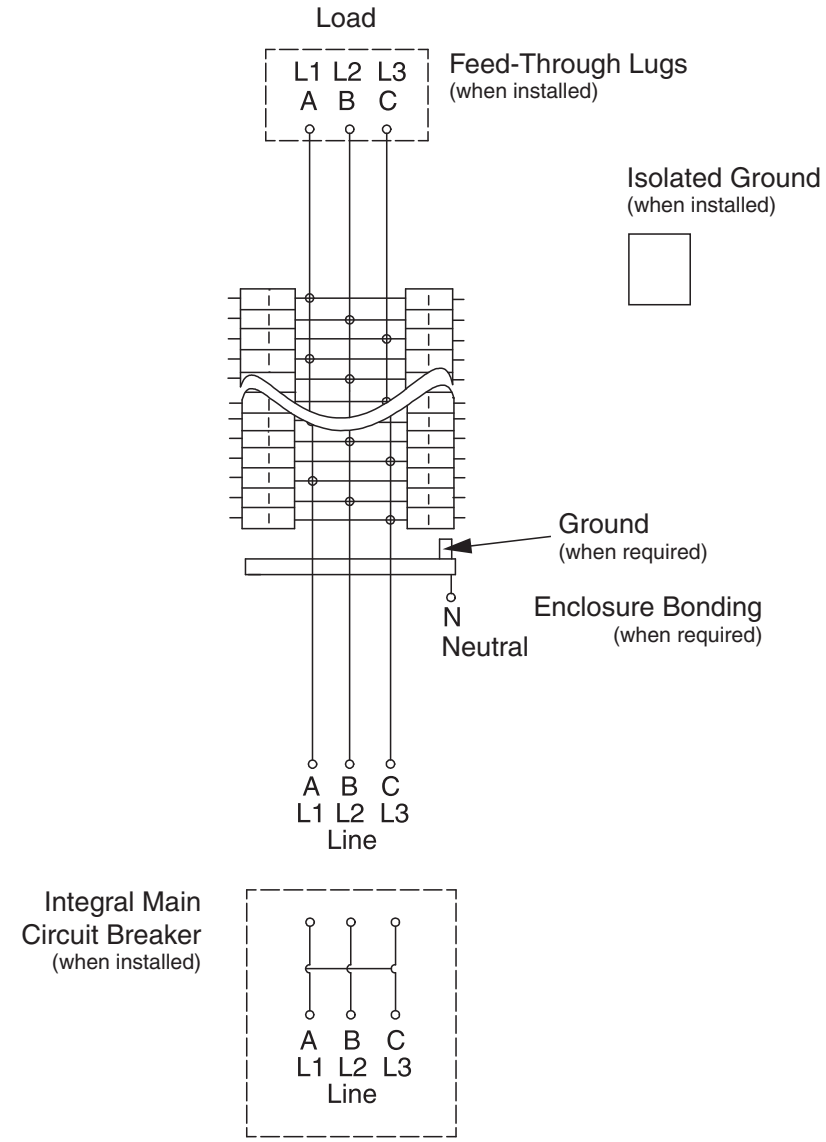

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Figure 10: NF 400–800 A Main Circuit Breaker with Feed-Through Lugs or Sub-Feed Circuit Breakers Diagram

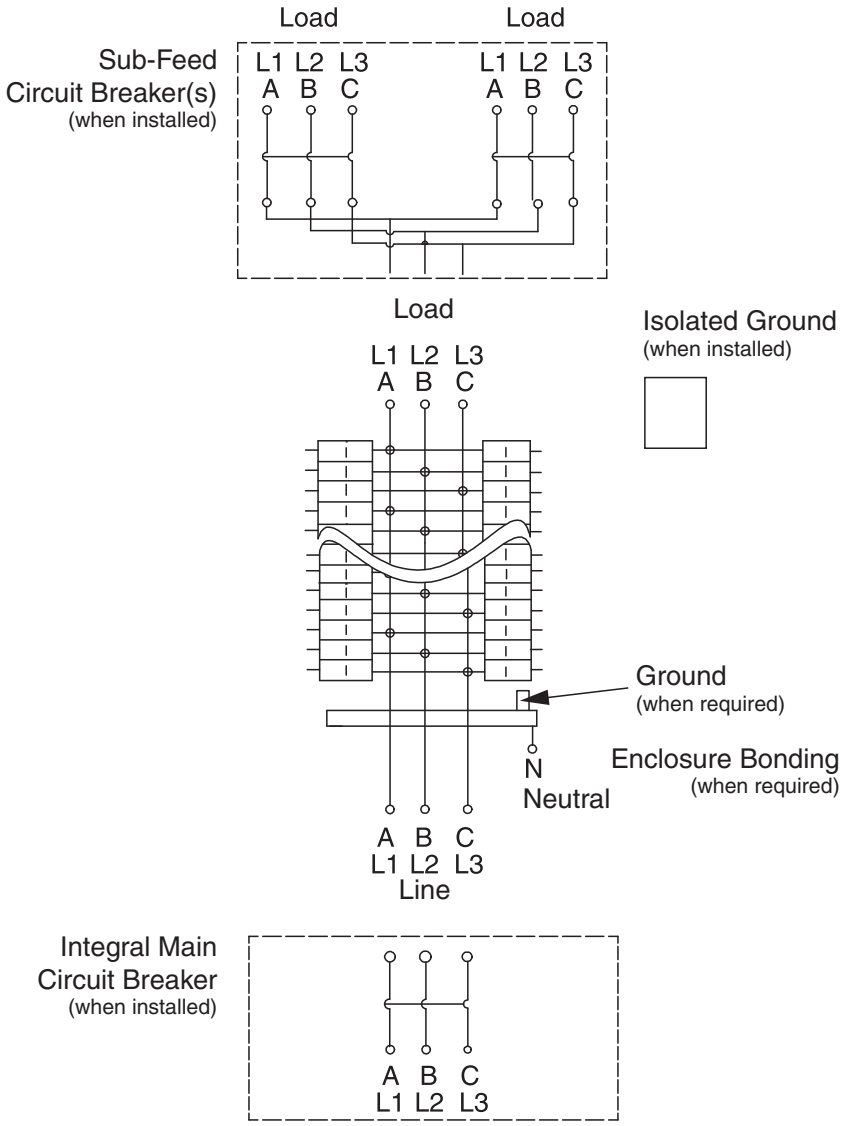

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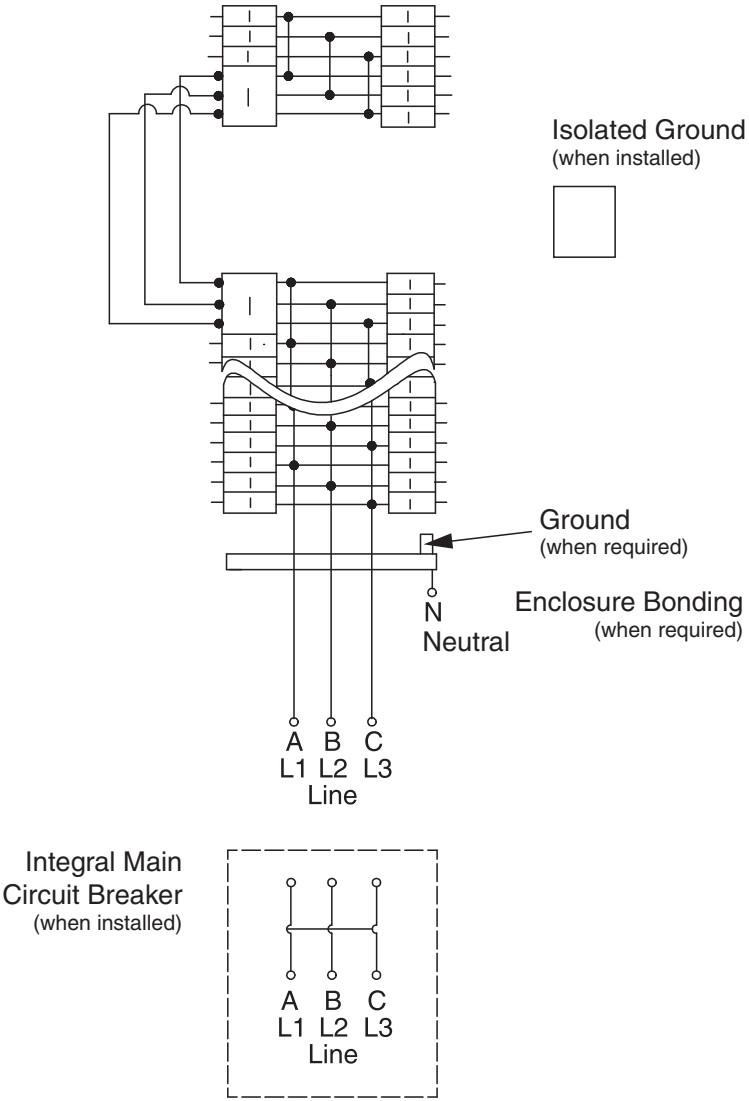
Figure 11: Typical NF Panelboard with Split Bus Diagram



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Panelboard Ratings

Refer to NEC section 110-22 and CEC rule 14-014 for more information. The series rated system label is located in the bag assembly.

NOTE: 125 A ED/EG/EJ breakers are 480Y/277 Vac maximum only.

Table 2: Series Connected Breaker Ratings (RMS Symmetrical)

Max. System Voltage AC[1]	Max. Short Circuit Current Rating	Square D Brand Integral or Remote Main Circuit Breakers and Remote Main Fuses	Square D Brand Branch Circuit Breaker Catalog Designation and Allowable Ampere Ranges
120 120/240 240	65,000	EG, FH, FG, KH, LH, MH, MX, HG, JG, DG	EDB, EDB–EPD
		EG	ECB–G3
	100,000	EJ, FC, FJ, KC, LC, LX, HJ, JJ	EDB, EDB–EPD, EGB
		DJ	EDB, EGB
		EJ, FC, KC, HJ, JJ	ECB–G3
	125,000	HL, JL	EDB, EDB–EPD, EGB, ECB–G3
	200,000	FI, KI, LI, LXI	EDB, EDB–EPD, EGB, EJB
		FI, KI	ECB–G3
		Class J or T (600 V) 200 A Max Fuses	ECB–G3
277 480Y/277	35,000	EG. FG, KH, LH, HG, JG, DG	EDB, EDB–EPD
		EG, HG, JG	ECB–G3
	65,000	EJ, FC, FJ, KC, LC, LX, HJ, JJ, DJ	EDB, EDB–EPD, EGB
		EJ, FC, KC, HJ, JJ	ECB–G3
	100,000	HL, JL	EDB, EDB–EPD, EGB, EJB
		DL	EDB, EGB, EJB
		400 A Max Fuses	EDB, EDB–EPD, EGB, EJB
	200,000	FI, KI, LI, LXI	EDB, EDB–EPD, EGB, EJB
		FI, KI	ECB–G3
		200 A Max Fuses	EDB, EDB–EPD, EGB, EJB, ECB–G3
600Y/347	18,000	HG, JG, MG	EDB
	25,000	EJ, FI, KH, KI, LC, LE, LX, LI, LXI, HJ, JJ	EDB, EGB
		LH	(15–70 A) EDB, EGB
	35,000	LC, LE, LX	EDB, EGB, EJB
	50,000	HL, JL	EDB, EGB, EJB
	65,000	FI, KI	EDB, EGB, EJB
		LI, LXI	EJB
	200,000	Class J or T (600 V) 200 A Max Fuses	EDB, EGB, EJB

[1] Short circuit tests are conducted at 100–105% of the maximum rated voltage of the panelboard.

Short Circuit Current Rating for Main Lug Interiors with Sub-Feed or Feed-Through Lugs

Main lug interiors equipped with sub-feed or feed-through lugs, where the device feeding the interior is unknown or not a Square D device, are rated to 25,000 RMS symmetrical amperes at 600Y/347 Vac maximum for three cycles. Use of one of the Square D circuit breakers of the correct ampere rating, listed as main circuit breakers on page 19, ahead of these lugs will result in a rating equal to that of the circuit breaker.

CAUTION

HAZARD OF EQUIPMENT DAMAGE

Use only one wire per phase for incoming circuit breaker connections when the integral LH main circuit breaker is upstream of the feed-through lugs.

Failure to follow these instructions can result in equipment damage.

CE Marking

Interiors with the “CE” mark meet the IEC 60439-1 standard.

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Appendix 2: Accessory Kits

An assortment of field-installable accessory kits are available for NF panelboards:

Equipment Ground Bar Kits

Equipment ground bar kits, suitable for copper or aluminum wire, meet the grounding needs of NF panelboards.

Table 3: Equipment Ground Bar Kits Specifications

Panelboard		Use Ground Bar Kit Catalog Number	
Branch Circuit	**Mains Rating**	**Aluminum[1]**	**Copper[2]**
1–42	800 A Maximum	(1) PK27GTA	(1) PK27GTACU
54–84		(2) PK27GTA	(2) PK27GTACU

1 Aluminum bars suitable for 60° C or 75° C Copper or Aluminum conductors.

2 Copper bars suitable for 60° C or 75° C Copper conductors.

Ground bar mounting locations are identified by the ground symbol ⏚ stamped into the backwall of the enclosure.

Sub-Feed Lug Kits 125–400 A Panelboards

Sub-Feed main lugs are available for 125, 250, or 400 A applications.

Table 4: Sub-Feed Lugs kits for 125–400 A Panelboard Applications

Main Amps	Kit Catalog Number	Maximum Circuits
125	NF125SFL	18, 30
250	NF250SFL	30, 42, 54, 66, 84
400	NF400SFL	30, 42, 54, 66, 84

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Main Lug Kits

Table 5: Mechanical Lug Kits — Aluminum

Panelboard Amps	Kit Catalog Number	Wire Range
125	Standard	#6–350 kcmil 13.3–177.3 mm^2
250	Standard	
400	Standard	(1) 1/0–750 kcmil (2) 1/0–350 kcmil (1) 53.48–380 mm^2 (2) 53.48–177.3 mm^2
600	Standard	(2) 1/0–750 kcmil (2) 53.48–380 mm^2
800	Standard	(3) 1/0–750 kcmil (3) 53.48–380 mm^2

Table 6: Mechanical Lug Kits — Copper

Panelboard Amps	Kit Catalog Number	Wire Range
125	NFCUM1	#6–350 kcmil 13.3–177.3 mm^2
250	NFCUM2	
400	NFCUM4	(1) 1/0–750 kcmil (2) 1/0–350 kcmil (1) 53.48–380 mm^2 (2) 53.48–177.3 mm^2
600	NFCUM6	(2) 1/0–750 kcmil (2) 53.48–380 mm^2

Table 7: Versa-Crimp® Compression Lug Kits — Aluminum

Panelboard Amps	Kit Catalog Number	Wire Range	Crimp Tool
125	NFALV1	#4–300 kcmil 21.15–152 mm^2	VC6
250	NFALV2	250–350 kcmil 126.7–177.3 mm^2	
400	NFALV4	(2) 2/0–500 kcmil (2) 67.43–253.4 mm^2	
600	NFALV6		

Table 8: Versa-Crimp® Compression Lug Kits — Copper

Panelboard Amps	Kit Catalog Number	Wire Range	Crimp Tool
125	NFCUV1	#6–1/0 kcmil 13.30–53.48 mm^2	VC6-3
250	NFCUV2	(1) 2/0–300 kcmil (1) 67.43–152 mm^2	VC6-FT, VC7, VC7-FT, VC8
400	NFCUV4	(1) 400–750 kcmil (1) 202.7–380 mm^2	
600	NFCUV6	(2) 250–500 kcmil (2) 126.7–253.4 mm^2	VC6 Series

Product Data Sheet

EE45T3H

Transformer Dry Type 45kVA 480D208Y120

SQUARE D by Schneider Electric

List Price $6,234.00 USD

Availability **Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Full Capacity Taps	(6) 2.5% 2+4-
Temperature Rise	150 Degrees C
Weathershield	WS363 (purchase seperately)
Winding Material	Aluminum
Width	20.00 Inches
Enclosure Code	18D
Depth	20.00 Inches
Enclosure Material	Painted Steel
Height	30.00 Inches
Enclosure Rating	NEMA 2
Enclosure Type	Drip Proof (Indoor)
Insulation Temperature	220 Degrees C
Mounting Brackets	Wall: WMB363364 - Ceiling: CMB363
Mounting Type	Floor - Ceiling or Wall with mounting brackets
Phase	3-Phase
Primary	480VAC Delta
Rating	45kVA
Secondary	208Y/120VAC

Shipping and Ordering

Category	16285 -
Discount Schedule	PE2E
GTIN	00785901671770
Package Quantity	1
Weight	376 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	MX

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

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Schneider Electric

Instruction Bulletin

Replaces 43006-850-01, 12/1992

ENGLISH

Dry-Type Transformers 600 Volts and Below

General Installation, Operation, and Maintenance

Class 7410

Retain for future use.

SAFETY PRECAUTIONS

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.

Failure to follow these instructions will result in death or serious injury.

RECEIVING, HANDLING, AND STORING

RECEIVING

Inspect new transformers when received for damage during shipment. Upon receipt, check the packing list against the equipment received to ensure the order and shipment are complete. Claims for shortages or errors must be made in writing to Schneider Electric within 60 days after delivery. Failure to give such notice will constitute unqualified acceptance and a waiver of all such claims by the purchaser.

Immediately inspect the equipment for any damage which may have occurred in transit. If damage is found or suspected, file a claim with the carrier immediately and notify Schneider Electric. Delivery of equipment to a carrier at any of the Schneider Electric/Square D® plants or other shipping points constitutes delivery to the purchaser regardless of freight payment and title. All risk of loss or damage passes to the purchaser at that time.

For details concerning claims for equipment shortages and other errors, refer to “Terms and Conditions of Sale”.

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HANDLING

Keep all transformers in the upright position in which they were shipped. Use lifting cables or chains with spreader bars to avoid damage to the finish or parts. Whenever there are no external lifting provisions, remove the top cover. Secure cables or chains to the top core-clamping channels or angles where holes are provided for this purpose.

Lifting with hand trucks or fork lifts is permissible if the blades or forks are long enough to pass completely under the enclosure. Since most dry-type transformers have a high center of gravity and are top heavy, extreme caution should be exercised when lifting or moving units in this manner.

Rolling may be used to move a dry-type transformer if the shipping skids remain attached to the base.

For superficial or minor case part damage, spare parts may be available. Contact your local Schneider Electric/Square D distributor.

STORING

Store dry-type transformers, preferably in a warm, dry location with a uniform temperature. Cover ventilation openings to keep out dust. If it is necessary to leave a transformer outdoors, protect it completely to prevent moisture and foreign material from entering the equipment. Install space heaters or small electric heaters to prevent or greatly reduce condensation and moisture. If condensation is evident, it may be necessary to dry out the unit.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off power supplying this equipment before working on it.
- Discharge all static charges held by coils.

Failure to follow these instructions will result in death or serious injury.

INSTALLATION

Keep these factors in mind when placing dry-type transformers:

- accessibility
- ventilation
- atmospheric conditions

STORED TRANSFORMERS OR TRANSFORMERS ALREADY PLACED IN SERVICE

If a transformer has been moved or stored, remove access panels or plates to inspect the equipment.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

Do not remove access panels or plates while the transformer is energized.

Failure to follow this instruction will result in death or serious injury.

Internally inspect the equipment for:

- damage or displacement of parts.
- loose or broken connections.
- cracked insulators.
- dirt or foreign material.
- presence of water or moisture.

Refer to “Maintenance” on page 5 for additional inspection guidelines.

LOCATION/PLACEMENT OF VENTILATED AND NON-VENTILATED TRANSFORMERS

Ventilated dry-type transformers normally are designed for installation in dry locations. They will, however, operate successfully while energized where the humidity is high. Under this condition, though, it may be necessary to take precautions to keep them dry if they are shut down for prolonged periods. Refer to “Operation” on page 5 for more detailed information.

Avoid placement of the transformer where dripping water exists. If this is not possible, provide suitable protection to prevent water from entering the transformer enclosure. Also, take precautions to guard against accidental entrance of water, such as from an open window, by a break in a water or stream line, or from use of water near the transformers.

Ventilated general purpose dry-type transformers are supplied in enclosures rated NEMA 2 for indoor installation. Weather shield kits are available to convert these enclosures for Underwriters Laboratories® (UL®) outdoor NEMA 3R use. Obtain the appropriate weather shield kit number from the transformer front panel label or from a Schneider Electric/Square D distributor or representative.

NOTE: Non-ventilated, resin-filled transformers are rated indoor/outdoor and do not require weather shield kits for outdoor use.

Adequate ventilation is essential to properly cool ventilated transformers. Clean, dry air is desirable. Filtered air may reduce maintenance if the location of the transformer presents a particular problem. Refer to National Electrical Code® (NEC®) Article 450. Forced air cooling should provide a minimum of 100 CFM per KW of losses (based on 40° C maximum ambient).

Place and install dry-type transformers in areas free from unusual dust-producing mediums or chemical fumes.

Non-ventilated transformers can be mounted directly on a wall. Consider accessibility for maintenance when placing the transformer. If the transformer will be placed near combustible materials, the minimum separations established by the NEC should be maintained.

The transformer enclosure is designed to prevent the entrance of most small animals and foreign objects.

GROUNDING

Permanently and adequately ground the enclosure and core assembly of these transformers in accordance with NEC requirements. Windings may be grounded with consideration given to local conditions in accordance with the NEC.

SEISMIC QUALIFICATIONS

Seismic qualification of nonstructural components by Schneider Electric is just one link in the total chain of responsibility required to maximize the probability that the equipment will be intact and functional after a seismic event. The equipment manufacturer determines that the equipment will be functional following a seismic event via shake-table testing programs. The seismic qualification testing results validate that Schneider Electric equipment will perform the intended function after the earthquake. However, the foundation and the anchorage system must also meet the applicable building codes and standards for the entire installation to maintain post earthquake functionality. Equipment inadequately mounted or mounted to weak or flexible foundations will not meet the requirements.

The equipment specifier/installer determines that the equipment is rigidly supported and will not leave its foundation during a seismic event. During an earthquake, the equipment must be able to transfer the loads that are created through the mounting pad and anchorage to the load-bearing path of the building structural system. If the equipment is not attached to the building structure in accordance with the minimum standards recommended

herein, the complete equipment installation might become too flexible and may overturn or shear the attachment devices and slide off its foundation.

The structural civil engineer or design engineer of record is responsible for detailing the equipment connection and anchorage requirements (including the lateral restraint system if appropriate) for the given installation. The installer and manufacturers of the anchorage and lateral restraint system are responsible for ensuring that the mounting requirements are met. Schneider Electric/Square D is not responsible for the specification and performance of these anchorage systems.

Drawings are available that include specific mounting information for seismic qualifications. Contact your local Schneider Electric/Square D representative or call 1-888-Square D (1-888-778-2733) to obtain these drawings.

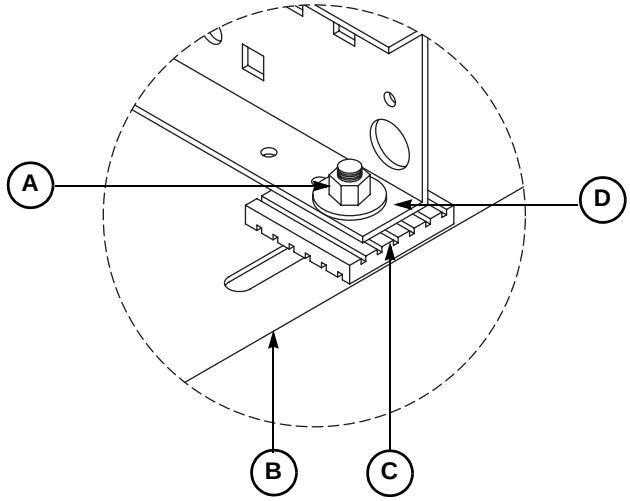
SOUND CONTROL

All transformers emit sound. This is caused by the alternating voltage applied to the transformer. The resulting magnetic field causes the core steel to expand and contract, resulting in audible sound. The transformer has been designed to minimize the level of sound produced.

During manufacture, sound isolation pads are secured between the transformer mounting bracket and the enclosure using bolts and nuts (Figure 1). The mounting hardware is tightened prior to shipment to prevent damage. To reduce audible sound levels further, back off the nut 1/4-inches (5 mm) to float the transformer on the isolation pads, isolating the transformer from the enclosure.

Figure 1: Isolation Pads for “Quiet Operation”

A. Back off the nut approximately 1/4 in. (5 mm) after installation
B. Base assembly
C. Isolation pad
D. Core clamp



Additionally, the area where the transformer is located can affect the sound level:

- Try to avoid installing the transformer in a corner, narrow hall, or in an area with smooth surfaces. Doing so can result in the sound being reflected and amplified.
- Securely fasten all the enclosure panels. Panel looseness can result in rattling, thereby increasing the sound produced.
- Use flexible conduit, if possible.
- Ensure that the type of structure on which the transformer is mounted is strong enough to support the weight of the transformer(s).

Once installed, the sound level may exceed the NEMA tested level due to some of the points previously illustrated. The NEMA maximum allowable average of the readings in decibels is listed in Table 1:

Table 1: Sound Levels

Transformer kVA Rating	NEMA Sound Levels
0–9	40 dB
10–50	45 dB
51–150	50 dB
151–300	55 dB
301–500	60 dB
501–700	62 dB
701–1000	64 dB

OPERATION

EFFECTS OF HUMIDITY

Humidity conditions are unimportant as long as the transformer is energized. However, follow the precautionary steps listed below if the transformer is de-energized, is allowed to cool to ambient temperature, and will exceed a shutdown of 12 hours (especially in high humidity conditions).

1. Place small strip heaters in the bottom of the unit shortly after shutdown to maintain the temperature of the unit a few degrees above that of the outside air.
2. Inspect the unit for evidence of moisture before returning it to service.
3. Check the insulation resistance. If evidence of moisture exists, or if the insulation resistance is less than 1 megohm, dry out the transformer by placing it in an oven or by blowing heated air over it.

ENCLOSURE TEMPERATURE

The temperature rise on the enclosure exterior for ventilated transformers should not exceed 50° C (122° F), except as indicated in UL 1561.

MAINTENANCE

Transformers require periodic maintenance and inspections to ensure the most satisfactory service from the equipment and successful operation of it. Inspect the equipment at regular intervals, and perform corrective measures when necessary.

PERIODIC MAINTENANCE AND INSPECTION

The frequency at which transformers should be inspected depends on operating conditions. For clean, dry locations, annual inspections may be sufficient. However, for other locations, such as where the air is contaminated with dust or chemical fumes, an inspection at three- or six-month intervals may be required. Usually after the first few inspection periods, a definite schedule can be set up based on the transformer's existing conditions.

ENGLISH

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off power supplying this equipment before working on it.
- Discharge all static charges held by coils.

Failure to follow these instructions will result in death or serious injury.

1. De-energize the transformer, and remove the access covers. Inspect for:
   - — dirt on insulating surfaces and at areas which tend to restrict air flow.
   - — loose connections.
   - — the condition of tap changers or terminal boards.
   - — the general condition of the transformer.
2. Observe for signs of overheating and for voltage creepage over insulating surfaces, evident by tracing or carbonization.
3. Check for evidence of rusting, corrosion and deterioration of the paint. Corrective measures should be taken where necessary.

CLEANING

Remove excess dirt accumulations from the transformer windings and insulators to permit free circulation of air and to guard against the possibility of insulation breakdowns. Additionally, carefully and thoroughly clean the top and bottom ends of winding assemblies and ventilation ducts.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Turn off power supplying this equipment before working on it.
- Discharge all static charges held by coils.

Failure to follow these instructions will result in death or serious injury.

1. De-energize the transformer, and clean the windings with a vacuum cleaner, a blower, or with compressed air. Use clean, dry compressed air; apply it at relatively low pressure (not over 25 psi).

   NOTE: A vacuum cleaner is preferred as the first step in cleaning, followed by the use of compressed air.
2. Brush and wipe lead supports, tap changers and terminal boards, bushings, and other major insulating surfaces with a dry cloth.
3. Do not use liquid cleaners because some of them have a solvent or deteriorating effect on most insulating materials.

CONNECTIONS AND CONTACT SURFACES

A clean contact surface area is necessary. Therefore, terminals must be clean. If transformers are installed outdoors or in a harsh environment, seal the connections with approved electrical joint compound. Apply the compound to exposed connections and the surface area before a bolted connection is made.

REPLACEMENT PARTS AND ACCESSORIES

Table 2 lists available transformer lug kits. For additional information regarding terminal connectors, refer to the label on the transformer, on the reverse side of the front panel.

Table 2: VERSAtile™ Compression Lugs and Mechanical Set-Screw Types—UL Listed Lugs AL9CU (90° C Rated)

Transformer kVA Sizes	Kit Catalog Number	Terminal Lugs		Aluminum or Copper Conductor Range (AWG or kcmil)	Hardware Included	
		Qty.	Catalog Number		Qty.	Type
VERSAtile Compression Equipment Lugs						
15–37 1/2 1Ø	VCELSK1	8	VCEL02114S1	#8–1/0	8	1/4 in. x 1 in. cap screws
15–45 3Ø		5	VCEL030516H1	#4–300 kcmil	1	1/4 in. x 2 in. cap screws
50–75 1Ø	VCELSK2	13	VCEL030516H1	#4–300 kcmil	8	1/4 in. x 1 in. cap screws
75–112 1/2 3Ø					8	1/4 in. x 2 in. cap screws
100–167 1Ø 150–300 3Ø	VCELSK3	3	VCEL030516H1	#4–300 kcmil	3	1/4 in. x 3/4 in. cap screws
		26	VCEL07512H1	#500–750 kcmil Al 500 kcmil Cu	16	3/8 in. x 2 in. cap screws
500 3Ø	VCELSK4	34	VCEL07512H1	#500–750 kcmil Al 500 kcmil Cu	21	3/8 in. x 2 in. cap screws
Mechanical Set– Screw Type Lugs						
15–37 1/2 1Ø	DASK1	8	DA2	#14–#2	9	1/4 in. x 3/4 in. cap screws
15–45 3Ø		5	DA250	#6–250 kcmil		
50–75 1Ø	DASK2	13	DA250	#6–250 kcmil	8	1/4 in. x 1 in. cap screws
75–112 1/2 3Ø					8	1/4 in. x 1 3/4 in. cap screws
100–167 1Ø	DASK3	3	DA250	#6–250 kcmil	3	1/4 in. x 1 in. cap screws
150–300 3Ø		26	DA600	#2–600 kcmil	16	3/8 in. x 2 in. cap screws
500 3Ø	DASK4	34	DA600	2–600 kcmil	21	3/8 in. x 2 in. cap screws

NOTE: Refer to UL 486A for torque values to be used with lug connection hardware.

To order replacement enclosure parts and other accessories, refer to the transformer section in the Schneider Electric *Digest,* and call 1-888-Square D (1-888-778-2733).

ENGLISH

Schneider Electric USA
6 Commercial Road
Huntington, IN 46750 USA
1-888-SquareD (1-888-778-2733)
www.us.SquareD.com

Product Data Sheet

QO330MQ125

LOAD CENTER QO MB 125A 3PH 30 CIRCUIT

List Price	$1,839.00 USD
Availability	**Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Ampere Rating	125A
Approvals	UL Listed - CE Marked
Enclosure Type	Indoor
Cover Type	Order separately
Application	Designed to meet residential, commercial and industrial requirements to protect electrical systems, equipment and people.
Box Number	12
Bus Material	Tin Plated Copper
Short Circuit Current Rating	25kA
Maximum Tandem Circuit Breakers	0
Phase	3-Phase
Main Type	Convertible Mains - Breaker
Spaces	30
Enclosure Rating	NEMA 1
Maximum Single Pole Circuits	30
Grounding Bar	Order Separately
Voltage Rating	208Y/120 Vac - 240/120 Vac Delta - 240 Vac Delta
Wire Size	#4 to 300 AWG/kcmil(Al/Cu)
Wiring Configuration	4-Wire

Notes:

Certified to IEC 60439-1 for use on 415Y/240VAC 3-Phase 4W. 3kA SCCR when QODX branch circuit breakers are used and 10kA SCCR when QOVS branch circuit breakers are used.

Shipping and Ordering

Category	00011 - Load Centers, 3 phase, Indoor
Discount Schedule	DE3
GTIN	00785901290520
Package Quantity	1
Weight	25.75 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	US

As standards, specifications, and designs change from time to time, please ask for confirmation of the information given in this document.

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Instruction Bulletin

Replaces 40271-891-02 dated 03/2002

ENGLISH

QO® Outdoor Load Centers

Class 1130

Retain for future use.

INTRODUCTION

This bulletin contains instructions for the installation and operation of QO® outdoor load centers for Canada manufactured by Schneider Electric.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

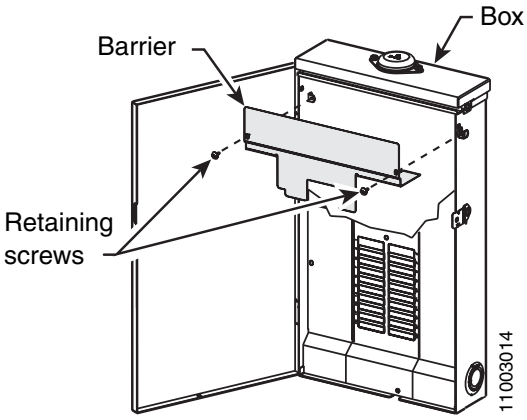
- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E.
- This equipment must only be installed and serviced by qualified electrical personnel.
- Turn off all power supplying this equipment before working on or inside equipment.
- Always use a properly rated voltage sensing device to confirm power is off.
- Replace all devices, doors and covers before turning on power to this equipment.
- Do not allow petroleum-based paints, solvents, or sprays to contact the nonmetallic parts of this product.
- Before starting a wiring installation or addition, consult a local building or electrical inspector for current National Electrical Code requirements. Local codes vary, but are adopted and enforced to promote safe electrical installations. A permit may be needed to do electrical work, and some codes may require an inspection of the electrical work.
- This equipment may not be suitable for use in corrosive environments present in agricultural buildings. See NEC 547 or CEC 2–400.

Failure to follow these instructions will result in death or serious injury.

PREPARATION

1. Determine the wiring or conduit requirements for the main and branch circuits, as required by local electrical codes.
2. Select the proper cable clamp, or use other approved methods for securing the cable or conduit to the enclosure.
3. Remove the line termination area barrier. See Figure 1.
   a. Remove the retaining screws.
   b. Remove the barrier. (Barrier must be replaced before energizing the load center.)

Figure 1: Removing the Barrier



NOTE: Load centers used in Canada as service entrance panels must have a barrier between the line termination and load termination area. All Schneider Electric main circuit breaker load centers include a factory installed barrier.

ENGLISH

4. Remove the appropriate knockouts for installation of cable clamps or conduit. See Figure 2.

Figure 2: Removing the Knockouts

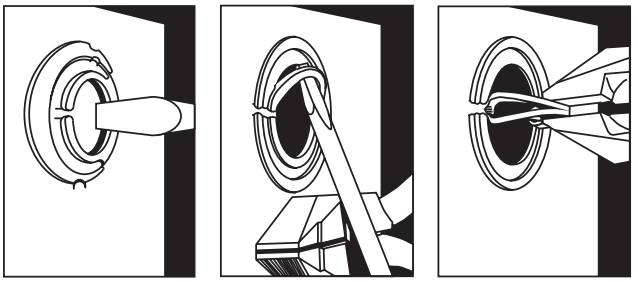


Table 1: Bolt-On Conduit Hubs for Outdoor Load Centers (order separately)

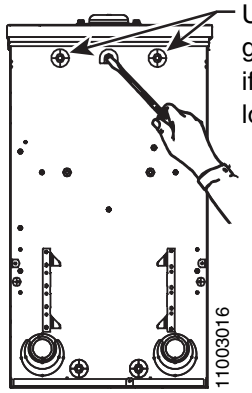
Conduit	Hub No.
3/4 in.	B-075
1 in.	B-100
1-1/4 in.	B-125
1-1/2 in.	B-150
2 in.	B-200
2-1/2 in.	B-250

BOX MOUNTING

Surface Mounting

Fasten the box to the wall with screws or nails, using the pre-punched mounting holes. See Figure 3.

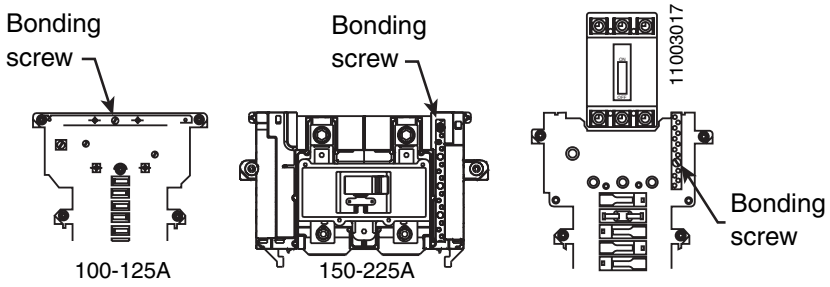
Figure 3: Surface Mounting



MAIN CIRCUIT BREAKER OR MAIN LUG WIRING

1. Pull the conductors into the box. Use approved wire clamps, conduit bushings, or other approved methods to secure the conductor to the box and to prevent damage to the conductor insulation.
2. Connect the main and neutral conductors.
   a. Install the main and neutral conductors according to the load center wiring diagram.
   b. Connect the service ground, equipment grounding conductor, or both as required by local electrical code.
   c. Torque each terminal to the value specified on the load center wiring diagram attached to the box.
3. If the main breaker load center is not used as a service entrance panel, remove the brass neutral bonding screw as shown in Figure 4.
4. Reinstall the line termination area barrier (for load centers used as service entrance panels). Secure barrier with retaining screws and torque screws to 35 lb-in (4 N•m).

Figure 4: Removing the Neutral Bonding Screw



Single-phase Load Centers **Three-phase Load Centers**

ENGLISH

BRANCH CIRCUIT BREAKERS

⚠ WARNING

HAZARD OF PERSONAL INJURY OR EQUIPMENT DAMAGE

Use only Square D® circuit breakers and accessories.

Failure to follow this instruction can result in injury or equipment damage.

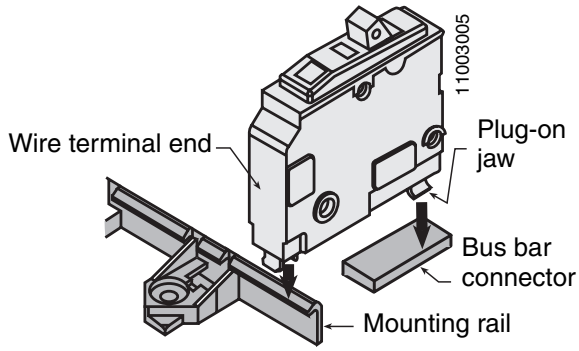
Installation

1. Determine the wiring or conduit requirements for the branch circuit breaker.
2. Turn OFF (O) the circuit breaker.
3. Install the wire terminal end of the circuit breaker to the mounting rail and push inward until the plug-on jaw fully engages the bus bar connector. Check the terminal end of the circuit breaker for engagement to the mounting rail.
4. Remove the insulation from the conductor as required. Install the conductor into the load terminal of the circuit breaker.
5. Torque each circuit breaker terminal to the value specified on the circuit breaker.
6. Torque each neutral and ground terminal to the value specified on the load center box label attached to the inside of the box.

Removal

1. Turn OFF(O) the circuit breaker. Remove the conductors.
2. Lift the plug-on end of the circuit breaker until the circuit breaker jaw disconnects from the bus bar. Continue to lift up until the terminal end disengages from the mounting rail. See Figure 5.

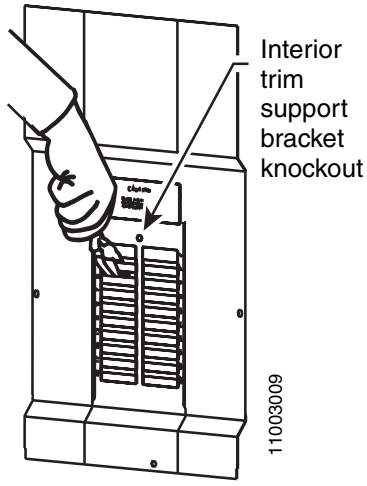
Figure 5: QO Branch Circuit Breaker



INSTALLING THE TRIM

1. Remove the cover twistouts. See Figure 6.
   a. Remove only enough twistouts to match the number of circuit breakers being installed.
   b. Twist out with pliers at the center of the twistout.
   c. Close all unused open spaces in the cover using filler plates, as listed on the cover directory label.
2. Attach the French translation label, supplied with the load center, to the inside of the door. See Figure 7.

Figure 6: Twistout Removal

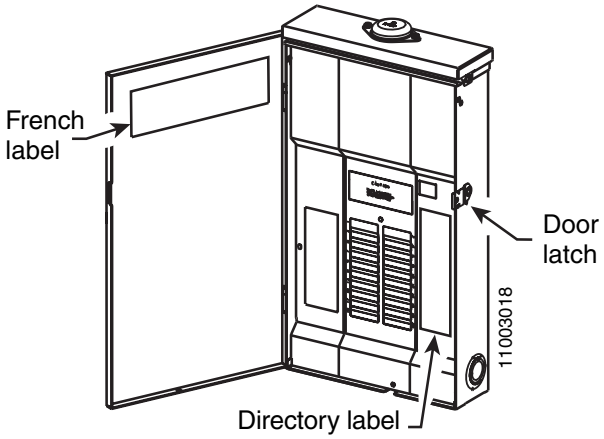


3. Identify the circuit breakers on the directory label.
4. Install the trim using the three screws provided. For QO load centers, 150–225 A, single-phase, main lug devices rated for 22,000 RMS symmetrical amperes short circuit systems, use four screws by removing the interior trim support bracket knockout.

ENERGIZING THE LOAD CENTER

1. Before energizing the load center, turn OFF (O) the main and all branch circuit breakers.
2. After power is turned ON to the load center, first turn ON the main circuit breaker (if installed) and then turn ON the branch circuit breakers.
3. Rotate the door latch counterclockwise to allow engagement through the door slot.
4. Close the door until secured by the latch.

Figure 7: Label Locations on Load Center Cover



Schneider Electric USA
1601 Mercer Road
Lexington, KY 40511 USA
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Product Data Sheet

QO320L125GRB

LOAD CENTER QO MLO 240V 125A 3PH 20SP

SQUARE D by Schneider Electric

List Price	$629.00 USD
Availability	**Stock Item: This item is normally stocked in our distribution facility.**

Technical Characteristics

Ampere Rating	125A
Approvals	UL Listed
Enclosure Type	Outdoor/Rainproof
Application	Designed to meet residential, commercial and industrial requirements to protect electrical systems, equipment and people.
Cover Type	Surface
Box Number	4R
Bus Material	Tin Plated Copper
Short Circuit Current Rating	65kA
Maximum Tandem Circuit Breakers	0
Phase	3-Phase
Main Type	Fixed Mains - Lugs
Spaces	20
Enclosure Rating	NEMA 3R
Maximum Single Pole Circuits	20
Grounding Bar	Included
Voltage Rating	208Y/120 Vac - 240/120 Vac Delta - 240 Vac Delta
Wire Size	#6 to 2/0 AWG(Al/Cu)
Wiring Configuration	4-Wire

Notes:
Side hinge door device allow 1.25 inches on the left side for door to open.

Shipping and Ordering

Category	00017 - Load Centers, 3 phase, Outdoor
Discount Schedule	DE3
GTIN	00785901295426
Package Quantity	1
Weight	25.04 lbs.
Availability Code	Stock Item: This item is normally stocked in our distribution facility.
Returnability	Y
Country of Origin	US

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Schneider Electric

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Panel Sold Separately

Single Door with latching handle

Single Door with quarter turns

Single Door with 3-point latching handle and quarter turns

Application

- Designed to enclose electrical and/or electronic equipment and protect against harsh, industrial environments for wallmount applications.
- Impressive styling features like hidden hinges, attractive latching systems make the Eclipse a suitable addition to any high-tech equipment installation.
- A wide range of sizes and practical accessories make this product line a complete package.
- For high temperature applications, a gasket retainer may be required, please refer to factory.

Standards

- UL 508 Type 3R, 4, and 12
- CSA Type 3R, 4, and 12
- **Complies with**
  - NEMA Type 3R, 4, and 12
  - IEC 60529, IP66

Construction

- Formed 14 or 16 gauge steel.
- Smooth, continuously welded seams ground smooth.
- Door stiffeners are provided where required for increased strength and rigidity - designed to also permit additional mounting options.
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Doors may be easily removed for modifications and are interchangeable.
- Oil resistant gaskets are permanently secured.
- Collar studs provided for mounting inner panel.
- Includes hardware kit with panel mounting nuts and sealing washers for wall mounting holes.
- Bonding stud provided on door and grounding stud installed in enclosure
- Hinges are constructed from 304 stainless steel.
- Hinge pins are stainless steel.
- Quarter turn latch and 3 point handle (key lockable) are zinc diecast with black epoxy finish.

Finish

- Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with choice of ANSI 61 smooth Gray (GY) or RAL7035 textured light gray (LG).
- RAL7032 textured beige (CG) versions with gland plates are available as non-stock items.

Accessories

- Air conditioners...see page 387-405
- Blowers...see page 406
- Breather kits...see page 423
- DIN rails...see page 29
- DIN rail mounting kit...see page 29
- Door stop kit...see page 447
- Filter fans...see page 408-413
- Gland Plates...see page 441
- Heaters...see page 418-420
- Handles...see page 30
- Inner panel...see page 28
- Quarter turn inserts and keys...see page 30
- Literature pocket...see page 451
- Mounting foot kit...see page 30
- Swing frame...see page 29
- Swing panel...see page 28
- Replacement hinge pins...see page 28
- Replacement quarter turn assemblies...see page 30
- Thermostats...see page 421
- Touch up paint...see page 450
- UL/CSA approved hardware kit...see page 430
- Padlock Adapter (EPA)...see page 431

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

Quality Enclosures. Service Excellence.

Canada: 519.822.2960 or 905.456.3770 USA: 716.630.7030

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Part No. (ANSI 61 Gray)	Part No. (RAL7035 Light Gray)	Overall Dimensions A	B	C	Door/ Body Gauge	Latches Qty	Type	Opt. Panel Part No.	Panel Size D	E	# Hinges	F	Ship Wt. Lbs.
EN4SD12126GY	EN4SD12126LG	12	12	6	16	1	Qtr Turn	EP1212	10.2	10.2	2	6	12
EN4SD12246GY	EN4SD12246LG	12	24	6	16	1	Qtr Turn	EP1224	10.2	22.2	2	18	24
EN4SD16126GY	EN4SD16126LG	16	12	6	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16166GY	EN4SD16166LG	16	16	6	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	19
EN4SD16206GY	EN4SD16206LG	16	20	6	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	22
EN4SD20126GY	EN4SD20126LG	20	12	6	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	20
EN4SD20166GY	EN4SD20166LG	20	16	6	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	22
EN4SD20206GY	EN4SD20206LG	20	20	6	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	26
EN4SD20246GY	EN4SD20246LG	20	24	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	14	32
EN4SD24126GY	EN4SD24126LG	24	12	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	24
EN4SD24166GY	EN4SD24166LG	24	16	6	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24206GY	EN4SD24206LG	24	20	6	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	30
EN4SD24246GY	EN4SD24246LG	24	24	6	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	37
EN4SD30166GY	EN4SD30166LG	30	16	6	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	35
EN4SD30206GY	EN4SD30206LG	30	20	6	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	38
EN4SD30246GY	EN4SD30246LG	30	24	6	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	40
EN4SD36246GY	EN4SD36246LG	36	24	6	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	52
EN4SD36306GY	EN4SD36306LG	36	30	6	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	60
EN4SD12248GY	EN4SD12248LG	12	24	8	16	1	Qtr Turn	EP1224	10.2	22.2	2	6	25
EN4SD16128GY	EN4SD16128LG	16	12	8	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16168GY	EN4SD16168LG	16	16	8	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	21
EN4SD16208GY	EN4SD16208LG	16	20	8	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	25
EN4SD20128GY	EN4SD20128LG	20	12	8	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	22
EN4SD20168GY	EN4SD20168LG	20	16	8	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	25
EN4SD20208GY	EN4SD20208LG	20	20	8	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	28
EN4SD20248GY	EN4SD20248LG	20	24	8	16	1	Qtr Turn	EP2024	18.2	22.2	2	14	32
EN4SD24128GY	EN4SD24128LG	24	12	8	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	25
EN4SD24168GY	EN4SD24168LG	24	16	8	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24208GY	EN4SD24208LG	24	20	8	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	32
EN4SD24248GY	EN4SD24248LG	24	24	8	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	40
EN4SD24308GY	EN4SD24308LG	24	30	8	14	2	Qtr Turn	EP2430	22.2	28.2	2	18	48
EN4SD30128GY	EN4SD30128LG	30	12	8	14	2	Qtr Turn	EP3012	28.2	10.2	3	12	34
EN4SD30168GY	EN4SD30168LG	30	16	8	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	40
EN4SD30208GY	EN4SD30208LG	30	20	8	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	42
EN4SD30248GY	EN4SD30248LG	30	24	8	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	46
EN4SD30308GY	EN4SD30308LG	30	30	8	14	2	Qtr Turn	EP3030	28.2	28.2	3	12	67
EN4SD30368GY	EN4SD30368LG	30	36	8	14	2	Qtr Turn	EP3036	28.2	34.2	3	12	77
EN4SD36248GY	EN4SD36248LG	36	24	8	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	55
EN4SD36308GY	EN4SD36308LG	36	30	8	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	77
EN4SD36368GY	EN4SD36368LG	36	36	8	14	2	Qtr Turn	EP3636	34.2	34.2	3	15	94
EN4SD42248GY	EN4SD42248LG	42	24	8	14	1	3-point	EP4224	40.2	22.2	4	12	80
EN4SD42308GY	EN4SD42308LG	42	30	8	14	1	3-point	EP4230	40.2	28.2	4	12	95
EN4SD42368GY	EN4SD42368LG	42	36	8	14	1	3-point	EP4236	40.2	34.2	4	12	105
EN4SD48248GY	EN4SD48248LG	48	24	8	14	1	3-point	EP4824	46.2	22.2	4	14	110
EN4SD48308GY	EN4SD48308LG	48	30	8	14	1	3-point	EP4830	46.2	28.2	4	14	115
EN4SD48368GY	EN4SD48368LG	48	36	8	14	1	3-point	EP4836	46.2	34.2	4	14	120
EN4SD60368GY	EN4SD60368LG	60	36	8	14	1	3-point	EP6036	58.2	34.2	4	18	150
EN4SD161210GY	EN4SD161210LG	16	12	10	16	1	Qtr. Turn	EP1612	14.2	10.2	2	10	18
EN4SD161610GY	EN4SD161610LG	16	16	10	16	1	Qtr. Turn	EP1616	14.2	14.2	2	10	23
EN4SD162010GY	EN4SD162010LG	16	20	10	16	1	Qtr. Turn	EP1620	14.2	18.2	2	10	28
EN4SD201610GY	EN4SD201610LG	20	16	10	16	1	Qtr. Turn	EP2016	18.2	14.2	2	14	28
EN4SD202010GY	EN4SD202010LG	20	20	10	16	1	Qtr. Turn	EP2020	18.2	18.2	2	14	31
EN4SD202410GY	EN4SD202410LG	20	24	10	16	1	Qtr. Turn	EP2024	18.2	22.2	2	14	36
EN4SD241210GY	EN4SD241210LG	24	12	10	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	26
EN4SD241610GY	EN4SD241610LG	24	16	10	16	1	Qtr. Turn	EP2416	22.2	14.2	2	18	30

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

Quality Enclosures. Service Excellence.

Canada: 519.822.2960 or 905.456.3770 USA: 716.630.7030

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Panel Sold Separately

Single Door with latching handle

Single Door with quarter turns

Single Door with 3-point latching handle and quarter turns

Application

- Designed to enclose electrical and/or electronic equipment and protect against harsh, industrial environments for wallmount applications.
- Impressive styling features like hidden hinges, attractive latching systems make the Eclipse a suitable addition to any high-tech equipment installation.
- A wide range of sizes and practical accessories make this product line a complete package.
- For high temperature applications, a gasket retainer may be required, please refer to factory.

Standards

- UL 508 Type 3R, 4, and 12
- CSA Type 3R, 4, and 12
- **Complies with**
  - NEMA Type 3R, 4, and 12
  - IEC 60529, IP66

Construction

- Formed 14 or 16 gauge steel.
- Smooth, continuously welded seams ground smooth.
- Door stiffeners are provided where required for increased strength and rigidity - designed to also permit additional mounting options.
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Doors may be easily removed for modifications and are interchangeable.
- Oil resistant gaskets are permanently secured.
- Collar studs provided for mounting inner panel.
- Includes hardware kit with panel mounting nuts and sealing washers for wall mounting holes.
- Bonding stud provided on door and grounding stud installed in enclosure
- Hinges are constructed from 304 stainless steel.
- Hinge pins are stainless steel.
- Quarter turn latch and 3 point handle (key lockable) are zinc diecast with black epoxy finish.

Finish

- Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with choice of ANSI 61 smooth Gray (GY) or RAL7035 textured light gray (LG).
- RAL7032 textured beige (CG) versions with gland plates are available as non-stock items.

Accessories

- Air conditioners...see page 387-405
- Blowers...see page 406
- Breather kits...see page 423
- DIN rails...see page 29
- DIN rail mounting kit...see page 29
- Door stop kit...see page 447
- Filter fans...see page 408-413
- Gland Plates...see page 441
- Heaters...see page 418-420
- Handles...see page 30
- Inner panel...see page 28
- Quarter turn inserts and keys...see page 30
- Literature pocket...see page 451
- Mounting foot kit...see page 30
- Swing frame...see page 29
- Swing panel...see page 28
- Replacement hinge pins...see page 28
- Replacement quarter turn assemblies...see page 30
- Thermostats...see page 421
- Touch up paint...see page 450
- UL/CSA approved hardware kit...see page 430
- Padlock Adapter (EPA)...see page 431

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

Quality Enclosures. Service Excellence.

Canada: 519.822.2960 or 905.456.3770 USA: 716.630.7030

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Part No. (ANSI 61 Gray)	Part No. (RAL7035 Light Gray)	Overall Dimensions			Door/ Body Gauge	Latches		Opt. Panel Part No.	Panel Size		# Hinges	F	Ship Wt. Lbs.
		A	B	C		Qty	Type		D	E			
EN4SD12126GY	EN4SD12126LG	12	12	6	16	1	Qtr Turn	EP1212	10.2	10.2	2	6	12
EN4SD12246GY	EN4SD12246LG	12	24	6	16	1	Qtr Turn	EP1224	10.2	22.2	2	18	24
EN4SD16126GY	EN4SD16126LG	16	12	6	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16166GY	EN4SD16166LG	16	16	6	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	19
EN4SD16206GY	EN4SD16206LG	16	20	6	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	22
EN4SD20126GY	EN4SD20126LG	20	12	6	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	20
EN4SD20166GY	EN4SD20166LG	20	16	6	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	22
EN4SD20206GY	EN4SD20206LG	20	20	6	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	26
EN4SD20246GY	EN4SD20246LG	20	24	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	14	32
EN4SD24126GY	EN4SD24126LG	24	12	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	24
EN4SD24166GY	EN4SD24166LG	24	16	6	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24206GY	EN4SD24206LG	24	20	6	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	30
EN4SD24246GY	EN4SD24246LG	24	24	6	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	37
EN4SD30166GY	EN4SD30166LG	30	16	6	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	35
EN4SD30206GY	EN4SD30206LG	30	20	6	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	38
EN4SD30246GY	EN4SD30246LG	30	24	6	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	40
EN4SD36246GY	EN4SD36246LG	36	24	6	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	52
EN4SD36306GY	EN4SD36306LG	36	30	6	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	60
EN4SD12248GY	EN4SD12248LG	12	24	8	16	1	Qtr Turn	EP1224	10.2	22.2	2	6	25
EN4SD16128GY	EN4SD16128LG	16	12	8	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16168GY	EN4SD16168LG	16	16	8	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	21
EN4SD16208GY	EN4SD16208LG	16	20	8	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	25
EN4SD20128GY	EN4SD20128LG	20	12	8	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	22
EN4SD20168GY	EN4SD20168LG	20	16	8	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	25
EN4SD20208GY	EN4SD20208LG	20	20	8	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	28
EN4SD20248GY	EN4SD20248LG	20	24	8	16	1	Qtr Turn	EP2024	18.2	22.2	2	14	32
EN4SD24128GY	EN4SD24128LG	24	12	8	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	25
EN4SD24168GY	EN4SD24168LG	24	16	8	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24208GY	EN4SD24208LG	24	20	8	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	32
EN4SD24248GY	EN4SD24248LG	24	24	8	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	40
EN4SD24308GY	EN4SD24308LG	24	30	8	14	2	Qtr Turn	EP2430	22.2	28.2	2	18	48
EN4SD30128GY	EN4SD30128LG	30	12	8	14	2	Qtr Turn	EP3012	28.2	10.2	3	12	34
EN4SD30168GY	EN4SD30168LG	30	16	8	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	40
EN4SD30208GY	EN4SD30208LG	30	20	8	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	42
EN4SD30248GY	EN4SD30248LG	30	24	8	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	46
EN4SD30308GY	EN4SD30308LG	30	30	8	14	2	Qtr Turn	EP3030	28.2	28.2	3	12	67
EN4SD30368GY	EN4SD30368LG	30	36	8	14	2	Qtr Turn	EP3036	28.2	34.2	3	12	77
EN4SD36248GY	EN4SD36248LG	36	24	8	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	55
EN4SD36308GY	EN4SD36308LG	36	30	8	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	77
EN4SD36368GY	EN4SD36368LG	36	36	8	14	2	Qtr Turn	EP3636	34.2	34.2	3	15	94
EN4SD42248GY	EN4SD42248LG	42	24	8	14	1	3-point	EP4224	40.2	22.2	4	12	80
EN4SD42308GY	EN4SD42308LG	42	30	8	14	1	3-point	EP4230	40.2	28.2	4	12	95
EN4SD42368GY	EN4SD42368LG	42	36	8	14	1	3-point	EP4236	40.2	34.2	4	12	105
EN4SD48248GY	EN4SD48248LG	48	24	8	14	1	3-point	EP4824	46.2	22.2	4	14	110
EN4SD48308GY	EN4SD48308LG	48	30	8	14	1	3-point	EP4830	46.2	28.2	4	14	115
EN4SD48368GY	EN4SD48368LG	48	36	8	14	1	3-point	EP4836	46.2	34.2	4	14	120
EN4SD60368GY	EN4SD60368LG	60	36	8	14	1	3-point	EP6036	58.2	34.2	4	18	150
EN4SD161210GY	EN4SD161210LG	16	12	10	16	1	Qtr. Turn	EP1612	14.2	10.2	2	10	18
EN4SD161610GY	EN4SD161610LG	16	16	10	16	1	Qtr. Turn	EP1616	14.2	14.2	2	10	23
EN4SD162010GY	EN4SD162010LG	16	20	10	16	1	Qtr. Turn	EP1620	14.2	18.2	2	10	28
EN4SD201610GY	EN4SD201610LG	20	16	10	16	1	Qtr. Turn	EP2016	18.2	14.2	2	14	28
EN4SD202010GY	EN4SD202010LG	20	20	10	16	1	Qtr. Turn	EP2020	18.2	18.2	2	14	31
EN4SD202410GY	EN4SD202410LG	20	24	10	16	1	Qtr. Turn	EP2024	18.2	22.2	2	14	36
EN4SD241210GY	EN4SD241210LG	24	12	10	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	26
EN4SD241610GY	EN4SD241610LG	24	16	10	16	1	Qtr. Turn	EP2416	22.2	14.2	2	18	30

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

LEVITON

Series 3500 Meter Kits with Ethernet Communications

Indoor

Outdoor

DEFINITION

The Leviton Series 3500 Meter is a revenue-grade kWh electrical meter featuring Time of Use (TOU) meter readings, per-phase meter data, and a user-friendly LCD display. The Series 3500 Meter is designed for use on both 3-phase, 3-wire (Delta) and 3-phase, 4-wire (WYE) circuits, and features multi-function universal voltage.

The Leviton Series 3500 Meter is a highly accurate, 0.5% accuracy class kWh/demand meter. Offering a full range of electrical parameter measurement—kVA and kVAR, PF, per phase voltage, etc., this meter is ideally suited to commercial and industrial applications where advanced communications protocols are demanded. As an Ethernet-enabled product, the Series 3500 meter can be configured for Modbus TCP/IP for easy integration into existing Modbus networks. The meter can also be configured for BACNet IP to meet the requirements of today's Direct Digital Control based Building Automation Systems. In addition to the advanced protocols, the Series 3500 Meter comes standard with an Isolated Pulse output as an additional communication capability.

A highly accurate, multi-function smart meter, the Leviton Series 3500 Meter offers seamless integration into the advanced building control and management systems in today's market.

APPLICATIONS

Use Series 3500 Meters in commercial, institutional, industrial and government applications for:

- Load profiling and benchmarking
- AMR/BAS/BMS/EMS integration
- Usage aggregation
- Tenant cost allocation
- Measurement and verification
- Energy conservation and cost reduction
- Green building initiatives and Government mandates

Series 3500 Multi-Function Ethernet Meter Kits

Leviton Mfg. Co., Inc. Lighting & Energy Solutions
20497 SW Teton Avenue, Tualatin, OR 97062 1-800-736-6682 Tech Line: 1-800-959-6004 Fax: 503-404-5594 www.leviton.com/les

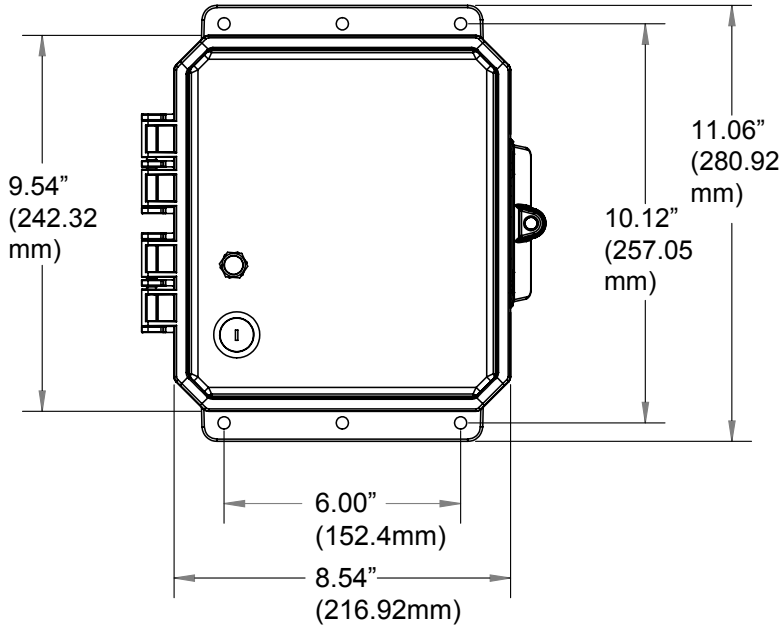
PRODUCT DATA

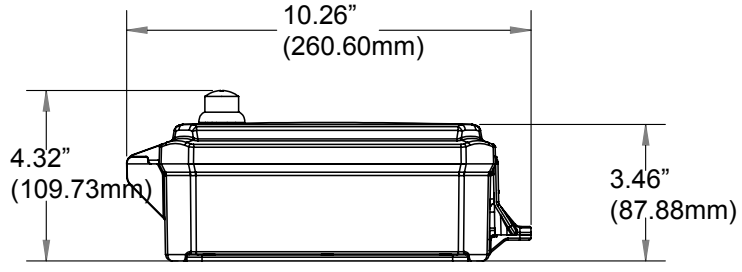
FEATURES
- Revenue grade accuracy: 0.5% accuracy class
- Large LCD display with scroll feature
- Indoor JIC steel and outdoor (NEMA 4X) enclosure options
- Up to three sets of CTs paralleled with no multipliers
- Use with split core or solid core CTs
- Installation diagnostics
- Low voltage detection
- Real time clock with battery back up for TOU reading
- UL and cUL listed energy usage monitor per CCN FTRZ

COMMUNICATIONS
- Modbus TCP/IP or BACnet IP
- Isolated pulse output

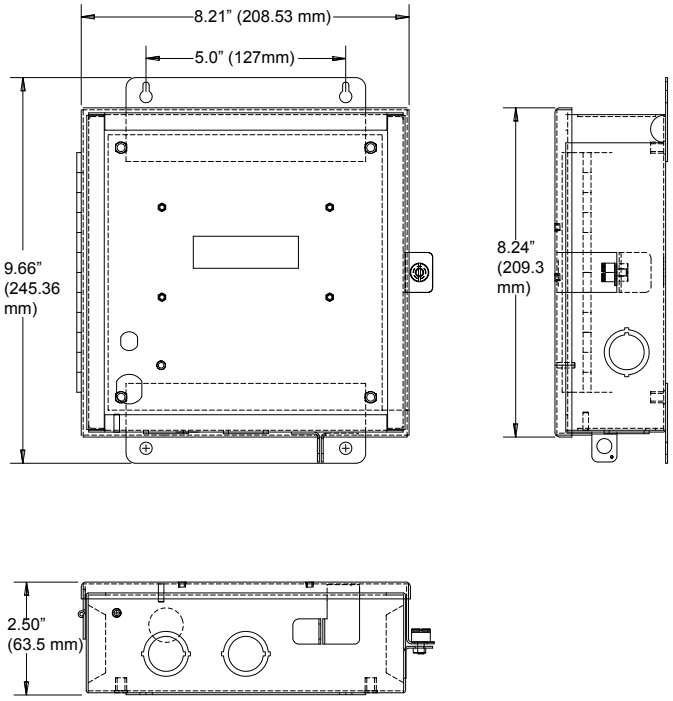
MEASURED PARAMETERS
- Total Meter
  - kWh/kW
  - kVAh
  - kVA and kVAR
  - Power Factor
  - Line Frequency
  - Voltage L-L
- Per Phase
  - Voltage L-N
  - Current
  - Watts
  - VA, VAR
  - Power Factor

DIMENSIONS
SERIES 3500 OUTDOOR ENCLOSURE





DIMENSIONS
SERIES 3500 INDOOR ENCLOSURE



SPECIFICATIONS

ELECTRICAL		
	NO NEUTRAL	**NEUTRAL**
Input Configurations	2PH 2W 208VAC 2PH 2W 480VAC 3PH 3W 240VAC 3PH 3W 480VAC	2PH 3W 120/208VAC 3PH 4W 120/208VAC 3PH 4W 240VAC Grounded Delta 3Ph 4W 277/480VAC 3PH 4W 480VAC Grounded Delta
Supply Voltage Range (Line 1 to Line 2)	177-552VAC	
Maximum Input Power	10.2 VA Max	
Maximum Rated Current	Primary: Max Rated Current +10% Secondary: 0.11A	
Line Frequency	60Hz	
Power Factor Range	0.5 to 1.0 leading or lagging	
Accuracy*	kWh: Meter shall meet or exceed ANSI C12.1 and C12.20(0.5) All other parameters: +/- 1% of reading or registration	
Meter Operating Temperature Range	-22° to 140°F (-30°C to 60°C)	
Display Operating Temperature Range	-4°F to 122°F (-20°C to 50°C)	
TERMINAL BLOCKS		
Voltage Inputs	14AWG, 12 in-lb of torque maximum	
Current Transformer Inputs, Pulse & RS485 Outputs	14-18AWG, 4.4 in-lb of torque maximum	

Leviton Mfg. Co., Inc. Lighting & Energy Solutions
20497 SW Teton Avenue, Portland, OR 97062 1-800-736-6682 Tech Line: 1-800-959-6004 Fax: 503-404-5594 www.leviton.com/les

LEVITON®

Series 3500 Multi-Function Ethernet Meter Kits

ORDERING KEY - KITS (CURRENT TRANSFORMERS INCLUDED)

3 □ U M T - □ □ M

KIT TYPE

K = Indoor
O = Outdoor
NEMA 4X

AMPERAGE RATING & CT TYPE

01 = 100A Split Core
02 = 200A Split Core
04 = 400A Split Core
08 = 800A Split Core
16 = 1600A Split Core
30 = 3000A Split Core
50 = 5000A Split Core
1S = 100A SOLID Core
2S = 200A SOLID Core
4S = 400A SOLID Core

ORDERING KEY - INDIVIDUAL METERS (CURRENT TRANSFORMERS SOLD SEPARATELY)

3 □ U M T - □ □ M

KIT TYPE

N = Indoor
R = Outdoor
NEMA 4X

AMPERAGE RATING

01 = 100A
02 = 200A
04 = 400A
08 = 800A
16 = 1600A
30 = 3000A
50 = 5000A

LEVITON SPECIFICATION SUBMITTAL	
JOB NAME:	CATALOG NUMBERS:
JOB NUMBER:	

Leviton Manufacturing Co., Inc. Lighting & Energy Solutions
20497 SW Teton Avenue, Tualatin, OR 97062 • Tel: 1-800-736-6682 • Fax: 503-404-5594 • Tech Line (6:00AM-4:00PM P.S.T. Mon-Fri): 1-800-959-6004

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Visit our Website at: www.leviton.com/les

Series 3300 Multi-Function Meter with RS485 Communications

Series 3500 Multi-Function Meter with Ethernet Communications

Installation and User's Manual

Revision C
0XA6609-890000

Table of Contents

Definitions

5-point rolling average: The valuations method used for most 'instantaneous' readings, including volts, amps, VA, and demand. It consists of the average of the 5 most recent sample data, with samples occurring approximately every second.

Accuracy: The extent to which a given measurement agrees with the defined value.

Demand: The average power or related quantity over a specified period of time.

Demand-Maximum: The highest demand measured over a selected period of time.

Percentage Error: The difference between percentage registration and 100%.

Percentage Registration: The ratio of the actual registration to the true value, expressed as a percent.

Power-Active: The time average of the instantaneous power over one period of a wave, measured in Watts (W).

Power-Apparent: The product of rms current and voltage, measured in Volt-Amperes (VA).

Registration: The amount of electric energy, or other quantity, recorded by the meter.

1. Product Description

1.1 General Description

Series 3300/3500 Meters are revenue grade kWh electrical meters featuring Time of Use (TOU) meter readings, per-phase meter data, compatibility with either 3-phase Delta or Wye configurations, and a user friendly LCD display.

1.2 Meter Features

- Revenue-grade accuracy energy data with solid-core CTs or easy to install split-core CTs
- Wide operating temperature range
- Built in LCD display
- Battery backed-up real time clock (RTC) for TOU meter readings
- Low voltage detection
- CT reverse (energy direction) indicator arrow
- Voltage, current, and power consumption per phase
- Power Factor
- Communication Options:
    - RS485 Options (Series 3300)
        - Modbus RTU
        - BACnet MS/TP
    - Ethernet Options (Series 3500)
        - Modbus TCP/IP
        - BACnet
    - Isolated Pulse Outputs (10Wh and 1kWh), all models
- 10-year warranty

2. Technical Specifications

2.1 Part Number Keys

Series 3300/3500 Kits (CTs Included)

3 K U M R – 0 1 M

Series
3 = 3300/3500

Kit Type
K = Indoor Steel
O = Outdoor Plastic NEMA 4X

Voltage Rating
U = Universal (208-480VAC)

Communication Protocol
MR = Modbus RTU (3300)
BM = BACnet MS/TP (3300)
MT = Modbus TCP or BACnet IP (3500)

Meter Type
M = Multifunction

Amperage Rating & CT Type
01 = 100A Split Core
02 = 200A Split Core
04 = 400A Split Core
08 = 800A Split Core
16 = 1600A Split Core
30 = 3000A Split Core
50 = 5000A Split Core
1S = 100A Solid Core
2S = 200A Solid Core
4S = 400A Solid Core

Series 3300/3500 Meters (CTs ordered separately)

3 N U M R – 0 1 M

Series
3 = 3300/3500

Enclosure Type
N = Indoor Steel
R = Outdoor Plastic NEMA 4X

Voltage Rating
U = Universal (208-480VAC)

Communication Protocol
MR = Modbus RTU (3300)
BM = BACnet MS/TP (3300)
MT = Modbus TCP or BACnet IP (3500)

Meter Type
M = Multifunction

Amperage Rating
01 = 100A
02 = 200A
04 = 400A
08 = 800A
16 = 1600A
30 = 3000A
50 = 5000A

2.2 Serial Number Description

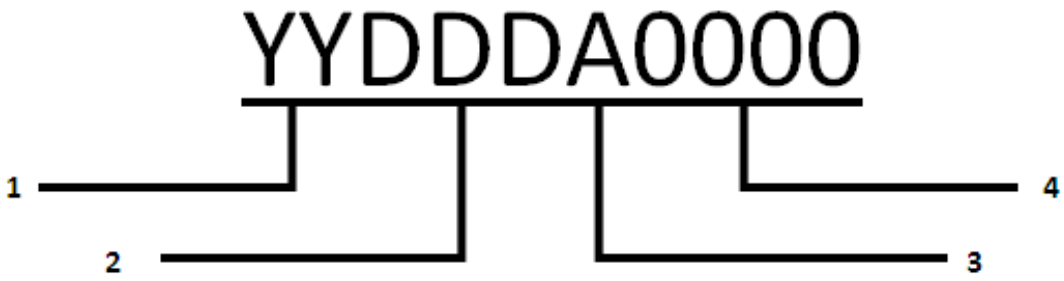


Figure 1: Series 3300/3500 Serial Number Format

1. YY: Last two digits of the manufacturing year
2. DDD: Day of manufacture, 1-366
3. A: First digit of meter serial number, alphabetic A-Z
4. 0000: Last four digits of meter serial number, numeric 0-9

For storage purposes, the last five digits of the serial number are converted to a hexadecimal number. For instance, meter C3591 is stored as 0x005C27.

2.3 Electrical Specifications

Input Configurations	No-Neutral Configurations* 3PH 3W 240VAC 3PH 3W 480VAC Neutral Configurations* 2PH 3W 120/208VAC 3PH 4W 120/208VAC 3PH 4W 240VAC Grounded Delta 3PH 4W 277/480VAC 3PH 4W 480VAC Grounded Delta * For all 2PH Configurations hot legs must be landed on L1 and L2.
Supply Voltage Range (Line 1 to Line 2)	177-552 VAC
Maximum Input Power	10.2 VA Max.
Maximum Rated Current	Primary: Max Rated Current + 10% Secondary: 0.11 A

Line Frequency	60 Hz
Power Factor Range	0.5 to 1.0 leading or lagging
Accuracy[1]	kWh: Compliant with ANSI C12.1
Meter Operating Temperature	-30 to +60 degrees C
Display Operating Temperature	-20 to +50 degrees C
Terminal Blocks	
Voltage Inputs	14 AWG, 12 in-lb of torque maximum
Current Transformers Inputs, Pulse and RS485 outputs	14-18 AWG, 4.4 in-lb of torque maximum

Table 1: Series 3300/3500 electrical specifications

[1]Accuracy based on Leviton solid-core current transformers with 100 mA max output. Meter input burden resistance at 1.62 Ohms.

[2]Pollution Degree 2: Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.

2.4 I/O Connections and User Display

Figure 2: Series 3300 Connections and Display

Voltage Inputs	**Description**
L1	Voltage Input, Line 1

L2	Voltage Input, Line 2
L3	Voltage Input, Line 3 (if provided)
N	Neutral input (if provided)
CT Inputs	
CT1 : X1	Current Transformer input, CT1. Colored wire of CT1
CT1 : X2	Current Transformer input, CT1. White wire of CT1
CT2 : X1	Current Transformer input, CT2. Colored wire of CT2
CT2 : X2	Current Transformer input, CT2. White wire of CT2
CT3 : X1	Current Transformer input, CT3. Colored wire of CT3
CT3 : X2	Current Transformer input, CT3. White wire of CT3
Isolated Pulse Outputs	
10 (+) Terminal 1	Real Energy (kWh) consumption (energy delivered) pulse output, collector connection of an NPN opto-isolated transistor. 10 Watthour (Wh) pulse rate (5 watthours on, 5 watthours off). V_{CE} = 70VDC; I_{CE} 50mA max
COM (-) Terminal 2	Common connection (emitters) for 10 Wh and 1 kWh Isolated Pulse Outputs.
1k (+) Terminal 3	Real Energy (kWh) consumption (energy delivered) pulse output, plus (+) connection (collector of an NPN opto-isolated transistor). 10 Watthour (Wh) pulse rate (500 watthours on, 500 watthours off). VB_{CE} = ?; I_{CE} Max = ?

RS485 Connections	For Modbus RTU and BACnet MS/TP. See Section 6 of this manual.
RJ-45	For Modbus TCP and BACnet IP. See Section 7 of this manual.

Table 2: Series 3300 I/O connections

3. Installation Instructions

The following section contains installation and wiring instructions for Series 3300 and Series 3500 meters in an outdoor or outdoor enclosure. If technical assistance is required at any point during the installation, contact information can be found at the end of this manual. Leviton is not responsible for damage to the meter caused by incorrect wiring.

3.1. Explanation of Warning Symbols

	Indicates the need to consult the operation manual due to the presence of a potential risk.
	Indicates the presence of electric shock hazards. Prior to proceeding, de-energize the circuit and consult the operation manual.
	Indicates that the equipment is protected throughout by double insulation.

Table 3: Warning symbols

3.2 Safety Precautions

WARNING

- **Installation of electric meters requires working with possibly hazardous voltages. These instructions are meant to be a supplement to aid trained, qualified professionals.**
- **Turn off all power supplying the equipment before performing any wiring operations. Use a properly rated voltage sensing device to confirm power is off.**
- **Bonding is not automatic for metal conduit connections; separate bonding is to be provided (see note 1).**
- **Installations should be done in accordance with local codes and current National Electric Code requirements.**
- **Equipment used in a manner not specified by this document impairs the protection provided by the equipment.**

Failure to follow these warnings could result in serious injury or death.

[1] Bonding kit must be UL recognized. Leviton recommends Rockwell Automation 855BM-ABK

3.3 Preparation

1. Verify the model number and electrical specifications of the device being installed to confirm they are appropriate for the intended electrical service (see Section 2).

2. Consult local codes for any possible permits or inspections required before beginning electrical work.

3. Outdoor applications: Ensure the conduit for the installation is flexible and non-metallic. Conduit and conduit fittings must be rated UL Type 4X. Failure to use the appropriate conduit impairs the degree of equipment protection.

4. Make sure all tools to be used during installation have proper insulation ratings.

5. Look inside the meter enclosure and electrical panel for possible exposed wire, broken wire, damaged components or loose connections.

3.4 List of Materials

- Series 3300/3500 Meter and associated mounting materials.
- Line 1, Line 2, Line 3 and Neutral hook-up wires as needed for the electrical service. 14 AWG wires recommended and 600VAC minimum rating required. Check local electrical code for compliance with regulations.
- List torque setting information.
- Current Transformers (CTs): This product is designed for use with Leviton CTs; see Section 3.7 for details.
- Conduit and fittings (see note 5 in Section 3.3).

3.5 Mounting the Enclosure

3.5.1 Mounting Location

- Series 3300/3500 meters require a switch or circuit breaker as part of the building installation.
- The switch or circuit breaker must be marked as the disconnecting device for the meter.
- It is recommended that the enclosure be mounted near the disconnecting device in an area with adequate ventilation.
- The enclosure should not be positioned in a manner that makes it difficult to operate the disconnecting device.
- Ensure that the lengths of the CT and voltage leads and conduit are capable of reaching the enclosure from the breaker panel. See Section 10.2 for more information.
- If a suitable mounting location near the panel cannot be found, additional in-line fuses or circuit breaker may be required in accordance with NEC regulations.

3.5.2 Making Conduit Holes

Steel (Indoor) Enclosure

The Series 3300/3500 steel enclosure comes with several 1 1/16" knockouts (3/4"conduit). Remove as needed to connect conduit fittings. Reference voltage and CT connections should enter in lower half of enclosure.

Outdoor Plastic Enclosure

The bottom, top, and non-hinge side of the plastic enclosure can be used as the conduit location in outdoor single meter enclosures. Reference voltage and CT wires should enter

in lower half of enclosure. If used, communication wires should enter in top-left of enclosure. Conduit openings should be as far away from inner components as possible for the installation. Opening sizes must be appropriate to fittings, and large enough to fit all voltage and CT wiring. Keep drill bit away from components inside the enclosure. Remove shavings from enclosure after drilling conduit holes.

3.5.3 Mounting Procedure and Conduit Installation

1. Fasten the enclosure to the selected surface using the mounting holes and appropriate screws. There are mounting holes on both top and bottom of each enclosure. See Figures 3 and 4 for mounting dimensions.
2. Upon mounting verify that the enclosure is not loose and that all connections are secure.
3. Attach the conduit between enclosure and distribution panel, routing wires as necessary for later use. For outdoor enclosures **UL Type 4X conduit and fittings must be used in order to maintain the outdoor rating of the enclosure.**
4. Ensure conduit fittings are aligned properly and tightened securely to prevent moisture from entering the enclosure (outdoor applications).

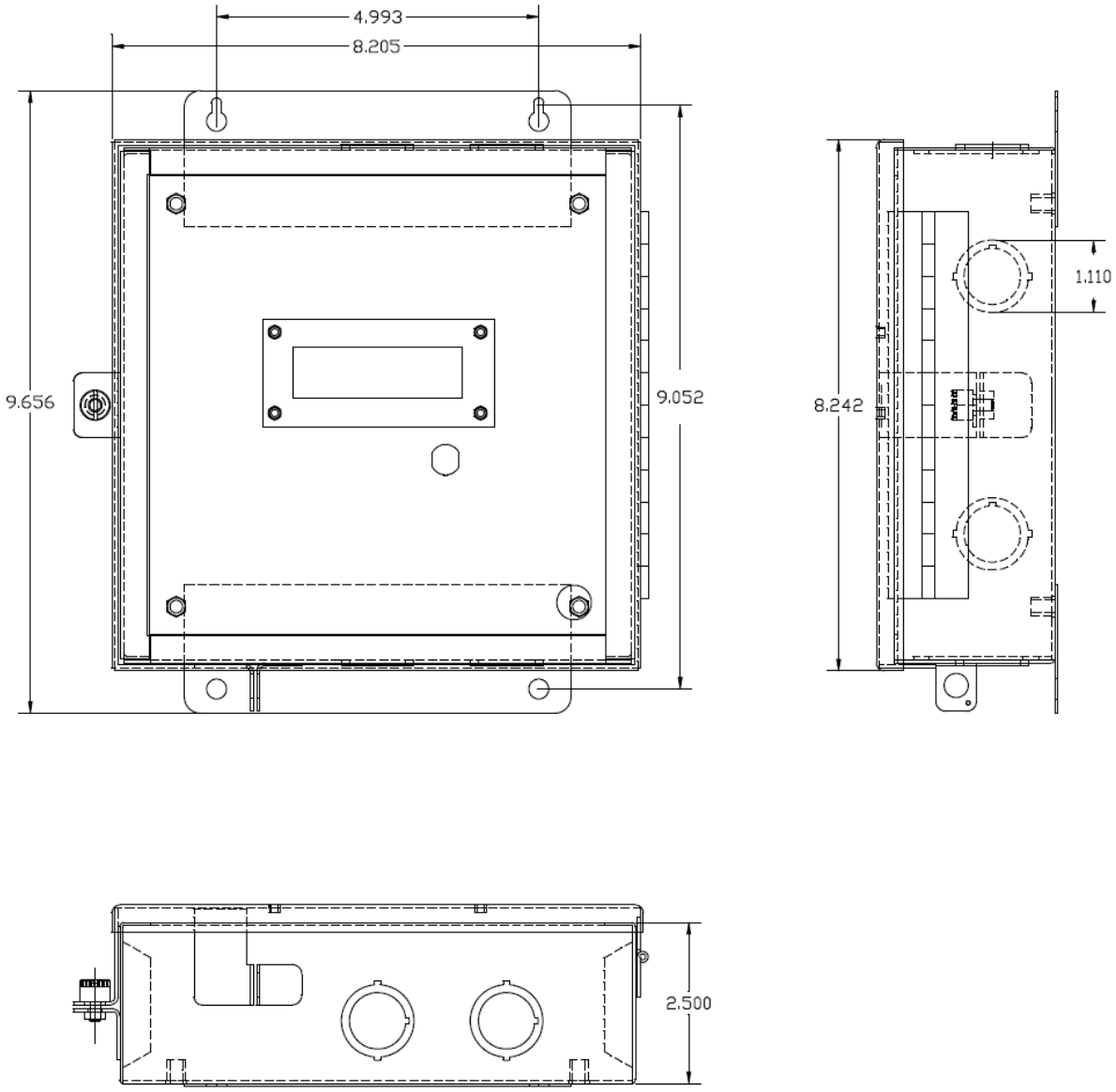


Figure 3: Series 3300/3500 Indoor Steel Enclosure Dimensions, in Inches

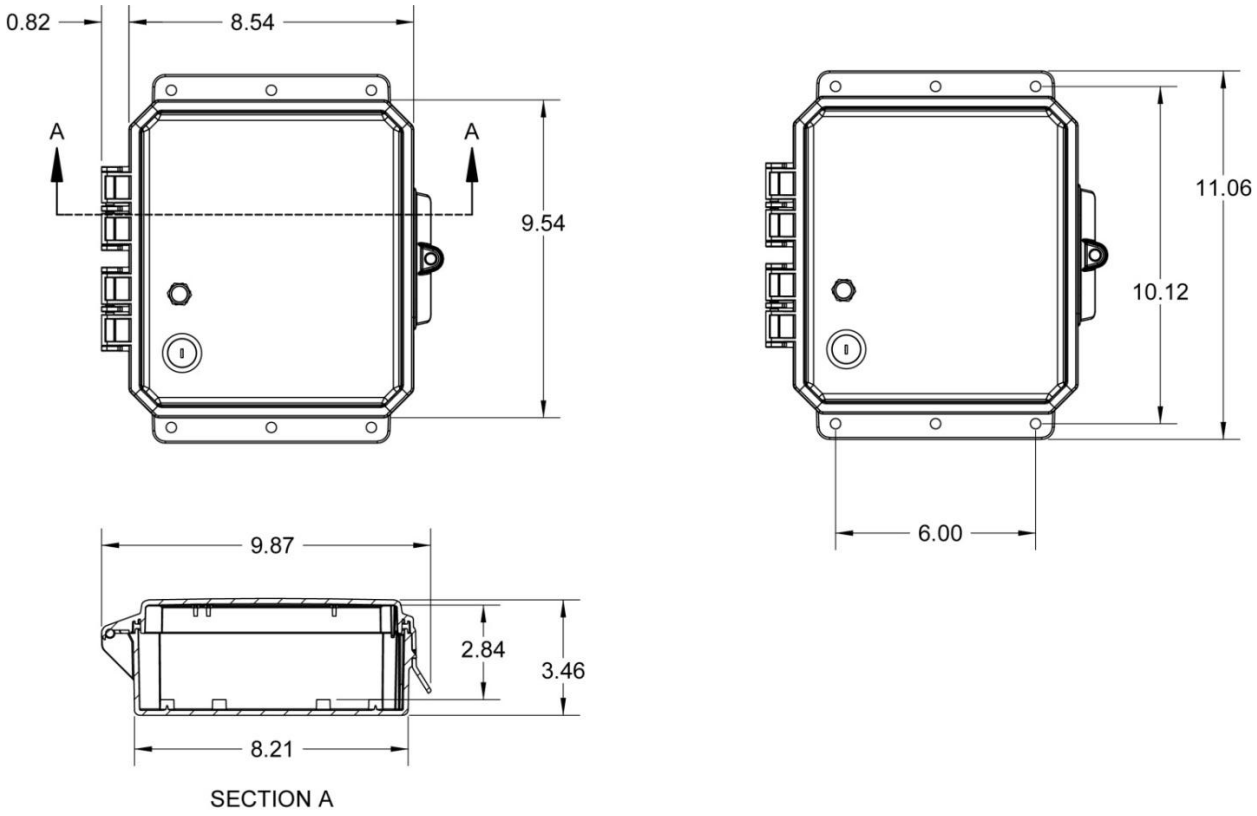


Figure 4: Series 3300/3500 Outdoor (plastic) Enclosure Dimensions, in Inches

3.6 Installation of Voltage Lines

Check to ensure service is disconnected before any connections are made. Verify if additional in line fuses are required based on National and Local electrical codes.

1. The Series 3300/3500 meter is compatible with both 3-phase 3-wire (no-neutral) and 3-phase 4-wire systems. The meter derives power from the Line 1 and Line 2 voltage connections, which must be between 177 and 552V for the meter to work properly. Field wired voltage connections are made to the Series 3300/3500 voltage terminal block. The rated torque for these terminal blocks is 12 in-lb., and can be used with 14 AWG solid or stranded copper wires.
2. Connect 600 V min. insulated wiring for Line voltages and Neutral to the appropriate locations in the breaker panel, in accordance with all national and local electrical codes; see Hookup Diagrams in Figures 8 – 11 below for correct wiring information.
3. Route wires through the conduit if not already done.
4. Trim the wire to the appropriate length to avoid coils of excess wiring.
5. Connect additional in line fuses if required.
6. For connections to the Series 3300/3500 pulse outputs: Route wiring through the top of the enclosure. Strip wiring to approximately .300 inches and connect to the appropriate

terminals. Wires should be tightened so that they are held snuggly in place, but do not to over-tighten, as this may compress and weaken the conductor.

3.7 Variations and Installation of Current Transformers

To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before installing or servicing current transformers.

In accordance with NEC, CTs may not be installed in any panel board where they exceed 75% of the wiring space of any cross-sectional area.

General Requirements:

- Splices on the CT leads must be within the meter enclosure, not inside the conduit. Leviton provided CT leads are 48 inches minimum. Wire insulation should be stripped so that the bare conductor length that connects to the meter terminal block does not exceed 0.300 inches.
- CTs should be securely fastened such that they will not slide down to live terminals.
- Wires should be tightened so that they are held snuggly in place, but do not to over-tighten, as this may compress and weaken the conductor. Maximum rated torque for CT terminal blocks is 4.4 in-lb.
- Current and voltage inputs must be installed 'in phase' (e.g. CT1 on Line 1, CT2 on Line 2, CT3 on Line 3) and oriented correctly as shown in Hookup Diagrams in Figures 8 through 11.

CT Terminal Block in Place CT Terminal Block Removed

Figure 5: CT Terminal Block

CT Variations

- Leviton solid core CTs (Figure 6, left photo): In accordance with CT label, the LINE side of CT must face incoming Line. White lead connects to the appropriate X2 terminal. Black or colored lead connects to the appropriate X1 terminal.

Figure 6: Leviton solid core and Split Core CTs

- Leviton split core CTs (Figure 6, right photo): The side with the white dot, white label, or H1, must face the incoming LINE. White wire connects to X2 terminal, black wire connects to X1 terminal.
- The hash marks on the two pieces of a split core CT must align as shown in figure 7.

Figure 7: Hash Marks on Split Core CT

CT Installation Procedures

1. Route CT secondary wires through conduit if not already done.
2. Trim the wire to the appropriate length to avoid coils of excess wiring.
3. Strip wiring to approximately .300 inches.
4. Connect the CT leads to the appropriate terminals; see Hookup Diagrams in figures 8 through 11 below for correct CT orientations and connections. The CT terminal block is removable to make wire connections easier; see Figure 5. After securing CT wires to the appropriate terminals slide terminal block up into header until fully seated.
6. For Split Core CTs: Remove two thumb nuts (Figure 6) and remove section from CT. With power to the conductors turned off, place the 3-sided section of the CT around the appropriate conductor while ensuring that white label, white dot or H1 faces Line (source). Reassemble the CT while ensuring that the white hash marks align (figure 5) and reinstall thumb nuts. Repeat for remaining conductors for two or three phase applications, as shown in Figures 8 through 11.
7. For Solid Core CTs: With power turned off, disconnect each monitored conductor one at a time and slide on appropriate CT, ensuring the CT is correctly oriented as shown in Figures 8 through 11. Reconnect the conductors.

Hookup Diagrams, Figures 8 through 11

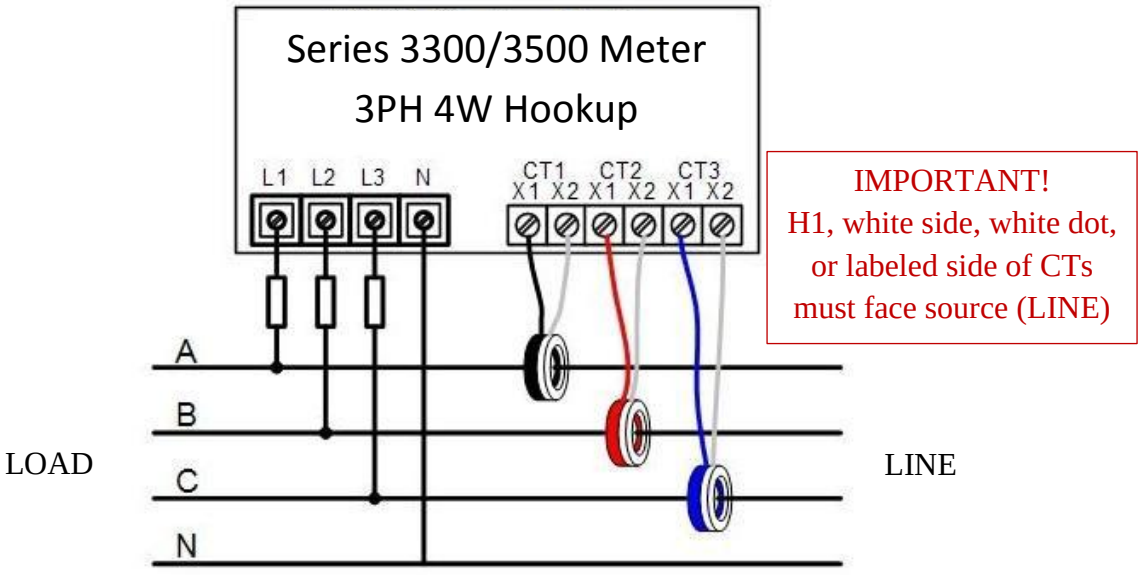


Figure 8: 3-phase 4-wire Wye hookup diagram

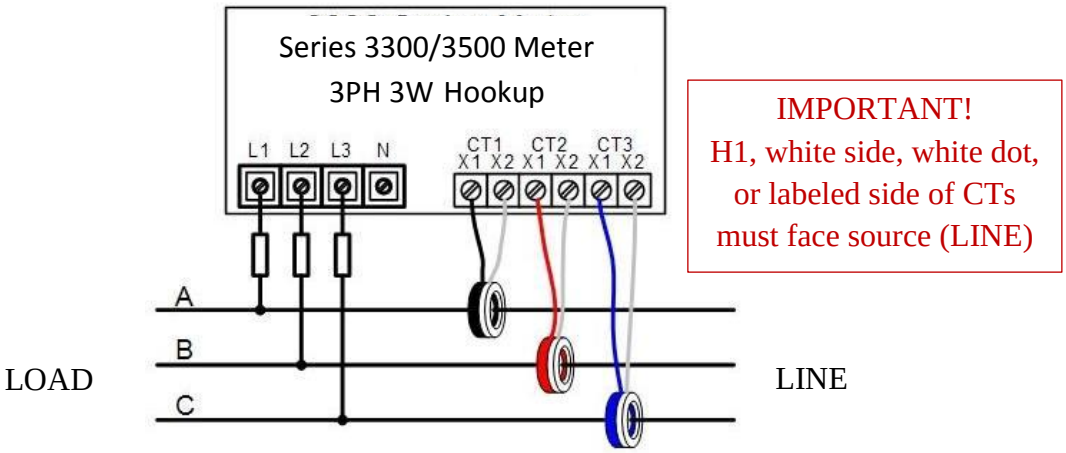


Figure 9: 3-phase, 3-wire (no-Neutral) hookup diagram

3.8 Securing the Enclosure

The outdoor enclosure ships with a padlock and key for securing the door after installation is complete. The indoor enclosure has a captive screw for securing the enclosure door.

3.9 Turning Power On and Checking for Correct Functionality

1. After installation is completed and enclosure has been secured the meter may be energized at the disconnect switch, upon which the meter will go through a power up sequence as described in Section 4.3. **It is strongly advised that users of this product read Section 4 below for a complete description of meter functionality and displayed values.**

2. Several diagnostic tools built into the Series 3300/3500 meter that should be utilized to ensure the meter and CTs are installed correctly and functioning properly:

    a. Energy Flow arrow – Indicates direction of 'energy flow' on amperage and kW screens.
    b. For mono-directional metering applications the Energy Flow arrow should always point to the right. If an Amperage or kW screen shows the arrow pointing to the left a current transformer may be installed backwards or on the wrong phase, or CT connections at the meter may be reversed or connected to the wrong CT input terminals, or voltage wires at the meter could be cross-phased. Section 4 further describes how the Amperage screens operate to indicate a reverse energy

condition. Refer to Hookup Diagrams in Figures 8 through 11 for correct wiring and CT orientations.

c. Power Factor Screens – Except in rare circumstances where predominantly inductive loads are metered, Power Factor values should have an absolute value greater than 0.6. A lower value indicates CTs installed on the wrong phase, backwards, or incorrectly connected at the meter, or voltage connections at the meter could be cross-phased. If PF is lower than 0.6 recheck CT placements and orientations and CT and voltage connections at the meter against the appropriate Hookup Diagram shown in Figures 8 through 11.

3. Bi-directional metering is typically used in grid-tied applications in which solar PV or energy from a source other than the utility grid is fed into the metered service. CTs are located between the grid and the electrical service so that if the locally generated energy exceeds the service loads, the grid will receive energy instead of delivering it. The Series 3300/3500 meter indicates energy direction with the Energy Flow arrow and blinking Amperage and phase indicator icons on the Amperage and kW screens.

4. General Metering Features and Functionality

4.1 Display

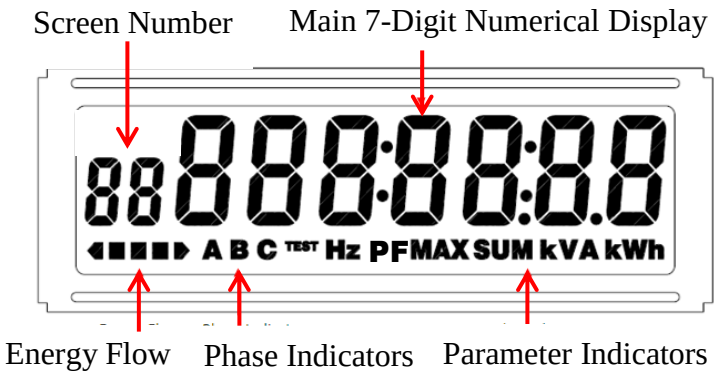


Figure 12: Custom LCD sections

Main Numerical Display and Scroll Button

The main numerical display section indicates the numerical value of the current item. After startup sequence (see section 4.3) the display will revert to Real Energy (kWh) delivered (consumed). The Scroll button on the enclosure door permits the user to scroll through nineteen screens of information (00-18) as shown in Table 4. Depress and hold scroll button for a few seconds to enter auto-scroll mode in which each screen appears for 4 seconds in the order shown in Table 4. To return to manual mode press and release the scroll button briefly (less than one second).

Phase Indicators and Parameter Indicators

The Phase and Parameter Indicator sections have two purposes. The Phase Indicators show the phase currently being displayed on per-phase values. Parameter Indicators are associated with values on the main numerical display.

- Low Voltage

  Low voltage (below minimum rated voltage with respect to neutral) on a phase is shown by a blinking of the 'V' Parameter Indicator in conjunction with corresponding Phase Indicator. For example, if low voltage is detected on phase A the 'V' Parameter Indicator and the 'A' phase indicator will blink simultaneously.

- Energy Flow Indicator

  On all Amps and kW screens the Energy Flow arrow will illuminate indicating energy direction. Arrow pointing to the right indicates energy delivered (from grid for grid-tied meters in renewable energy applications); arrow pointing to the left indicates energy received (to the grid). In addition to the arrow, the Amps parameter indicator ("A") and the corresponding phase indicator (A, B, or C) flash when Energy Flow arrow points left. **When meter is installed in a mono-directional metering application, the Amps and kW arrows should always point to the right when load current is present**.

4.2 Display Sequence and Screen Numbers

See Appendix B for examples of each display.

Table 4: Screen Numbers and Sequence Order

Screen Numbers & Sequence	Description of Displayed Value
00	Real Time Clock
01	Real Energy Delivered (kWh)
02	Maximum Demand (MAX KW)
03	Max Demand Time (MAX)
04	Max Demand Date (MAX)
05	Voltage(V) Phase A
06	Voltage (V) Phase B
07	Voltage (V) Phase C
08	Voltage (V) Line A to B
09	Voltage (V) Line B to C
10	Voltage (V) Line A to C
11	Phase A Amps (A)
12	Phase B Amps (A)
13	Phase C Amps (A)
14	Real Power (kW) Phase A
15	Real Power (kW) Phase B
16	Real Power (kW) Phase C
17	Real Power (SUM kW) A+B+C
18	Power Factor (PF) Phase A
19	Power Factor (PF) Phase B
20	Power Factor (PF) Phase C
21	Frequency (HZ)

4.3 Power-on Sequence

When the Series 3300/3500 meter is initially powered on it displays the following sequence of information:

1. Hello screen.
2. Meter Serial Number

The Meter Serial Number screen displays first. The lower left number is the alphabetical digit from the meter serial number (from 01=A to 26=Z), and the main display shows the numerical portion of the Serial Number. For example, a display showing "03" on the left and "6149" on the right below represents meter serial number XXXXXC6149, with the X's indicating the manufacturing day and year. See section 2.2 for more information on meter serial numbers.

3. Hardware Version -- The Hardware Version screen displays the word 'Hard' and the meter's hardware version.
4. Software Version -- The Software Version screen displays the word "Soft' and the meter's software version.
5. CT Ratio -- The CT Ratio screen displays the meter's programmed CT ratio. For instance, "400:0.1" indicates the meter has been calibrated for CTs with a 400:0.1A ratio.
6. Compute Engine Test Runs -- The compute engine performs 10 test runs before the meter starts normal operation. The test runs are indicated by the TEST icon and the words 'Pass X', where X is the test run number.

Once the startup sequence has completed the display defaults to Screen 01, Real Energy (kWh) delivered (consumed).

4.4 Descriptions of Displayed Information

Push and release the scroll button to cycle through the display screens. Each button press moves to the next screen in the sequence shown in table 4. After 5 minutes of inactivity on the scroll button the display will return to Screen 01, Real Energy Delivered (kWh) and remain there until the scroll button is depressed again.

Refer to section 4.1 for a description of how to set the meter into auto-scroll mode. In this mode the display is updated every four seconds to cycle through the screens automatically.

All displayed values update approximately once a second.

- **Screen 00 – Real Time Clock.** Real Time Clock (RTC) is factory set to Pacific Time (GMT-8). A factory-installed battery backup maintains the RTC before the meter is installed and in power loss situations.

  For information on replacing the battery, please see section 5. The RTC can be set using the communications port as described in sections 6 and 7 or by using the procedure outlined in Section 4.5.

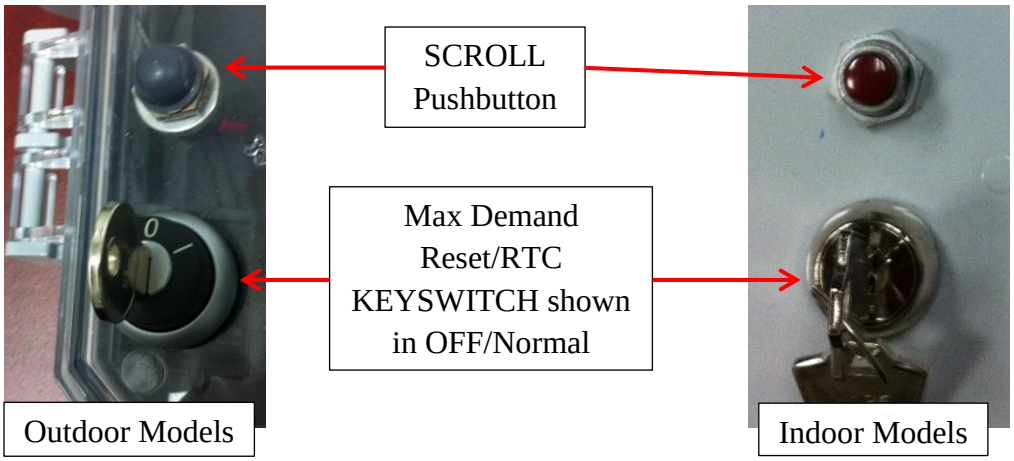
- **Screen 01 – kWh – Real Energy Delivered (consumed), non-resettable.** After initial startup the display reverts to and stays on this screen unless scroll or auto-scroll functions are initiated. The displayed value correlates to "kWh from grid" stored in Modbus or BACnet Address 0004 (see Sections 6 and 7). In the event of a power loss Real Energy Delivered data will be saved in EEPROM and retained even if backup battery is depleted. The direction arrow always points to the right to indicate energy consumed (delivered).

- **Screen 02 – kW Max – Maximum Demand** – can be calculated in 15 or 30 minute blocks. The default value from factory is 15 minutes. The interval can be changed using the RS485 communication port (see sections 6 and 7).
    - Sub-intervals – Each Max Demand data block has 3 sub-intervals in which demand is calculated. Sub-intervals are 5 minutes for a 15 minute Max Demand block and 10 minutes for a 30 minute block. For each sub-interval the total kWh consumption is divided by the number of accumulations to give average demand for the sub-interval. Accumulations occur approximately every second.
    - Max Demand calculation – After each sub-interval is finished, a new block demand is calculated. The block demand is comprised of the average of the 3 most recent sub-intervals. The largest block demand since a demand reset is stored as the maximum demand. When an update of the maximum demand occurs, the new value and current date and time are saved to EEPROM, Modbus Address 0060. Max Demand is displayed in kW.
    - Max Demand Reset. All series 3300/3500 meters have the capability to reset maximum demand. When maximum demand is reset, the maximum block demand and all current sub-interval demands are set to zero. An internal register is also incremented upon demand reset to keep a total of the times this action was taken. The register is a single byte, and rolls over at 255. The register content is accessible and Max Demand can be reset via the communications port; see sections 6 and 7. Max Demand also can be reset with the keyed switch on the meter enclosure door. Turn the key lock into the 'on' position for at least 5 seconds. When Max Demand is reset manual or via the coms port the LCD will give a visual confirmation that the demand was reset.
- **Screens 03 and 04** – Max Demand time and date – displayed immediately following the Max Demand screen.
- **Screens 05-13 – Voltage (V) and Amperage (A)**
    - Volts and Amps are saved and displayed as root mean square (RMS) values. Appropriate Phase Indicators and Display Indictors will illuminate as shown in Figure 12. On all Amps and kW screens the Energy Flow arrow will illuminate indicating energy direction. Arrow pointing to the right indicates energy delivered (from grid); arrow pointing to the left indicates energy received (to the grid, for grid-tied meters in renewable energy applications). In addition to the arrow, the Amps indicator ("A") and the corresponding phase indicator (A, B, or C) flash when Energy Flow arrow points left. If meter is installed in a mono-directional application, the Amps and kW arrows should always point to the right when load current is present.

- **Screens 14-17 – Real Power Delivered (consumed) kW A, kW B, kW C, kW SUM** - Also known as Instantaneous Demand – is a 5-point rolling average of individual and all phases (kW SUM). Displayed values correspond to "Phase A Real Power," "Phase B Real Power," "Phase C Real Power," and "Total Power (A+B+C)" in Modbus Register Map (see Appendix A).
- **Screens 18-20 – Power Factor (PF)** – Per-phase Power Factor is displayed. A lagging power factor is indicated by the Energy Flow arrow pointing to the left; for leading power factor arrow points to the right.
- **Screen 21 – Frequency (HZ)** – Displayed in Hertz.

4.5 Manually Setting the Real Time Clock

Figure 13: SCROLL and Max Demand/Clock Reset Switch on Outdoor Series 3300/3500 Meter



1. Press and hold the SCROLL pushbutton; see Figure 13.
2. While holding SCROLL, rotate the Max Demand Reset/RTC KEYSWITCH to the right into the RESET/ON position within 3 seconds and then release it. Date will be displayed and Year will flash.
3. Press SCROLL to advance the Year (you may also hold it down to advance automatically). The Year will cycle from 12 through 99 then back to 12 (for 2012 through 2099).
4. When the Year is set, rotate the KEYSWITCH to ON again and release. The Month will now flash.
5. Set the Month (1 to 12).
6. Repeat for Day of the Month (range varies by month and leap-year).
7. The next KEYSWITCH ON/release cycle will show the Time and flash the Hour.
8. Repeat the setting sequence for Hour (0-23), Minutes (0-59) and Seconds (0-59).
9. You may again perform KEYSWITCH ON/Release to cycle back to the Date settings, if desired.

10. The Date/Time setting mode will end automatically after no user activity for 10 seconds. The Date/Time settings will be stored and the meter will return to its normal display operation.

    Note:

    - The Day of the Week (Sunday through Saturday) is calculated and stored automatically by the meter.
    - Metering functions and communications are not affected during this Date/Time setting process.

5. Real Time Clock (RTC) Battery Replacement

If the battery depletes and no power is connected to the meter the RTC resets to 01/01/00 00:00:00 when power returns. The battery backup is a standard CR2025 lithium coin cell, rated at 3V and 165 mAh. The lifetime of the battery depends on the operating temperature of the meter, as shown in Table 5.

Operating Temperature (°C)	Estimated Battery Life (No external power) (Years)	Estimated Battery Life (90% power uptime) (Years)
Temp < 25	3	19
25 < Temp < 60	2	12
Temp > 60	1	9

Table 5: Battery Life Estimates

Since minimal current is drawn from the battery when the meter in powered on, most batteries do not need replaced over the lifetime of the meter. If a situation occurs in which the meter will be powered off for a prolonged period, battery life will be significantly reduced. In the event that the battery needs replaced while the meter is still in operation, follow the instructions below.

To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before servicing an electric meter. Use a properly rated voltage sensing device to confirm power is off.

1. After de-energizing, open the meter enclosure.
2. Remove four screws to remove metrology cover (see Figure 12).
3. Grip the top metering board from both sides and pull to detach from the bottom board.
4. Remove the old battery from the coin slot with a pair of tweezers, noting the polarity.
5. Insert the new battery into the slot with the same polarity.

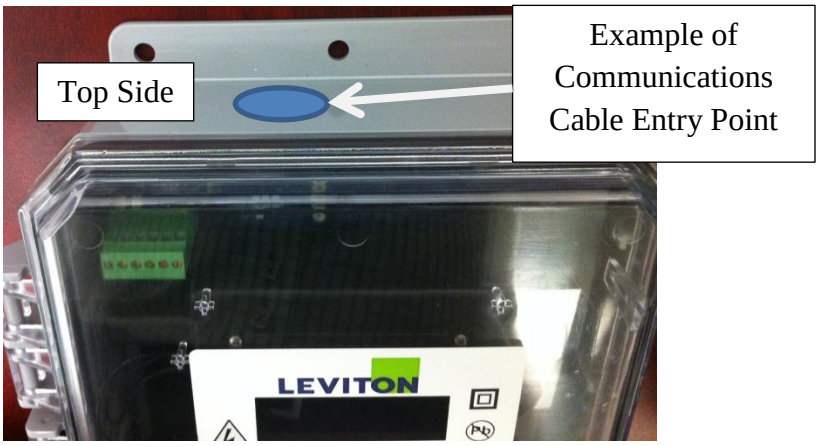
6. Reconnect the two boards, install the metrology cover with four screws, and close the enclosure.
7. Power on the circuit to verify the meter is still working properly.
8. Resynchronize the RTC using the communications port as described in Sections 6 and 7 or set manually using procedure described in Section 4.5.

Figure 12: Metrology Cover Screws

6. Communications – Series 3300 RS485 Communication Models

6.1 Modbus RTU Quick Start Guide

Figure 13: RS485 Cable Entry Location



To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before servicing an electric meter. Use a properly rated voltage sensing device to confirm power is off.

1. Install meter as outlined in Section 3.
2. Modbus cable shall enter at the TOP side of the enclosure as shown in Figure 13. Use shielded twisted-pair cable to prevent interference. Replace plastic cap 33with webbed bushing (provided).
3. Connect Inverting (-), Non-Inverting (+), and Signal Common (C) wires using the 4-pin removable terminal block shown in Figure 14. Do not over-tighten the terminal screws. Modbus output is electrically isolated from input power.
4. Select Modbus address using the upper bank of DIP switches labeled "ADDRESS" as shown in Figure 15. Switch 1 corresponds to the low-order bit of the address and setting a switch ON selects a bit value of 1. For example, set switches 1 and 3 on to select address 5.
5. Select Modbus baud rate using the switches 1 and 2 in the lower bank of DIP switches, labeled "BAUD" as shown in Figure 15. Switches 3 – 8 are reserved for future use and must be set to the OFF position. Baud rate options are shown in Table 6.
6. Before energizing the meter close and secure the enclosure door.

Table 6. Modbus RTU Baud Rate Switch Settings

Switch				Baud Rate
B1	**B2**	**B3**	**B4**	
Off	Off	Off	Off	Auto
On	Off	Off	Off	9600
Off	On	Off	Off	19200
Off	Off	On	Off	38400
Off	Off	Off	On	76800

Figure 14. Modbus RTU Connection

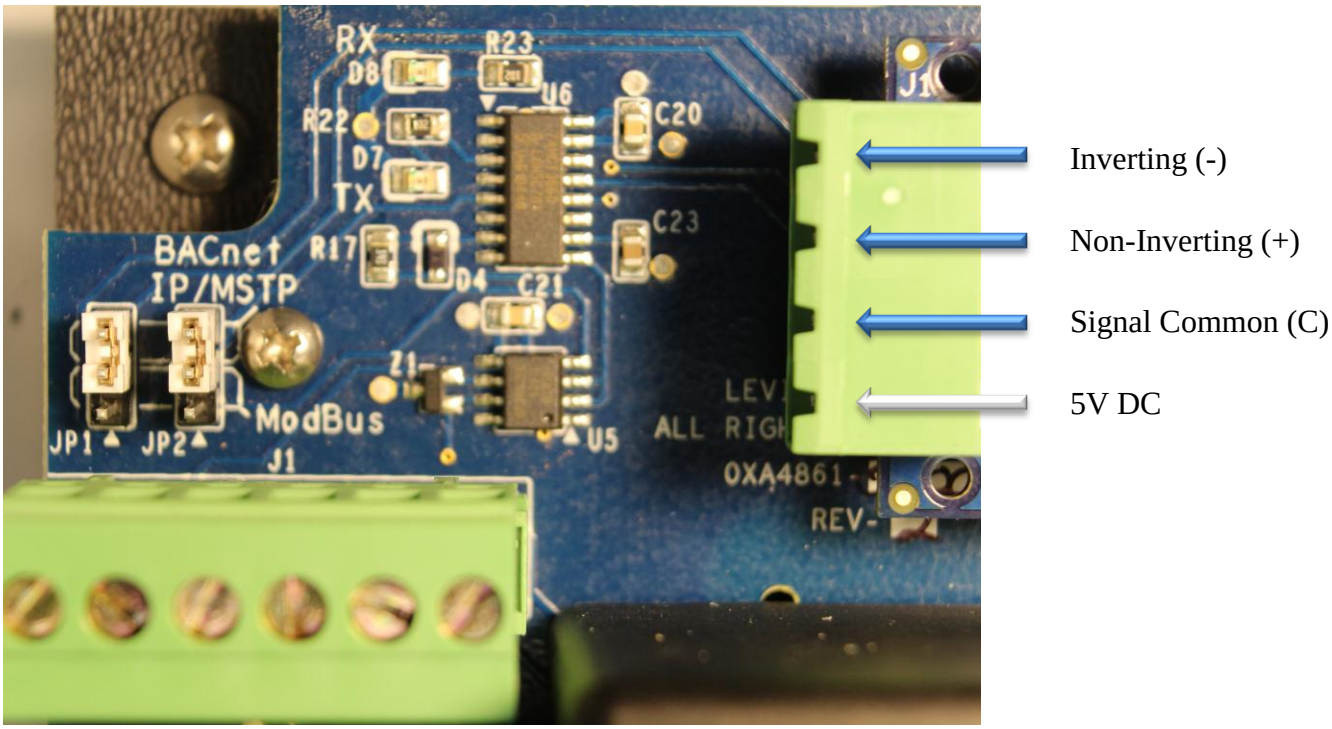
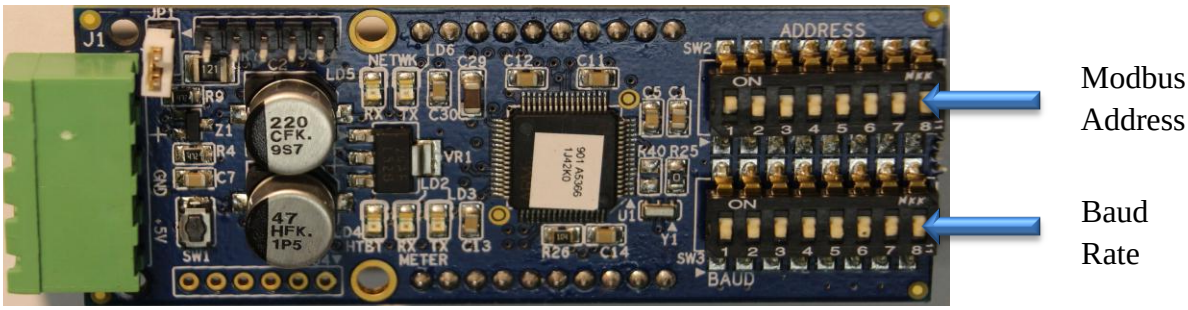


Figure 15. Modbus RTU Switches



6.2 BACnet MS/TP Quick Start Guide

To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before servicing an electric meter. Use a properly rated voltage sensing device to confirm power is off.

1. Install meter as outlined in Section 3.
2. BACnet cable shall enter at the TOP side of the enclosure as shown in Figure 13. Use shielded twisted-pair cable to prevent interference. Replace plastic cap with webbed bushing (provided).
3. Connect Inverting (-), Non-Inverting (+), and Signal Common (C) wires using the 3-pin removable terminal block shown in Figure 16. Do not over-tighten the terminal screws. BACnet output is electrically isolated from input power.
4. Select the 8-bit MS/TP MAC address using DIP switches A1 – A8 (Figure 17. Switch A1 corresponds to the low-order bit of the address and setting a switch ON selects a bit value of 1. For example, set switches 1 and 2 on to select MAC address 3 (binary value 00000011).
5. Select the baud rate using DIP switches B1 – B4 as shown in Figure 17. Baud rate options are shown in Table 7.
6. Before energizing the meter close and secure the enclosure door.

Note: For detail information refer to FieldServer Website: www.fieldserver.com

Table 7. BACnet MS/TP Baud Rate Switch Settings

Switch				Baud Rate
B1	**B2**	**B3**	**B4**	
Off	Off	Off	Off	Auto
On	Off	Off	Off	110
Off	On	Off	Off	300
On	On	Off	Off	600
Off	Off	On	Off	1200
On	Off	On	Off	2400
Off	On	On	Off	4800
On	On	On	Off	9600
Off	Off	Off	On	19200
On	Off	Off	On	20833
Off	On	Off	On	28800
On	On	Off	On	38400
Off	Off	On	On	57600
On	Off	On	On	76800
Off	On	On	On	115200

Figure 16. BACnet MS/TP Connections

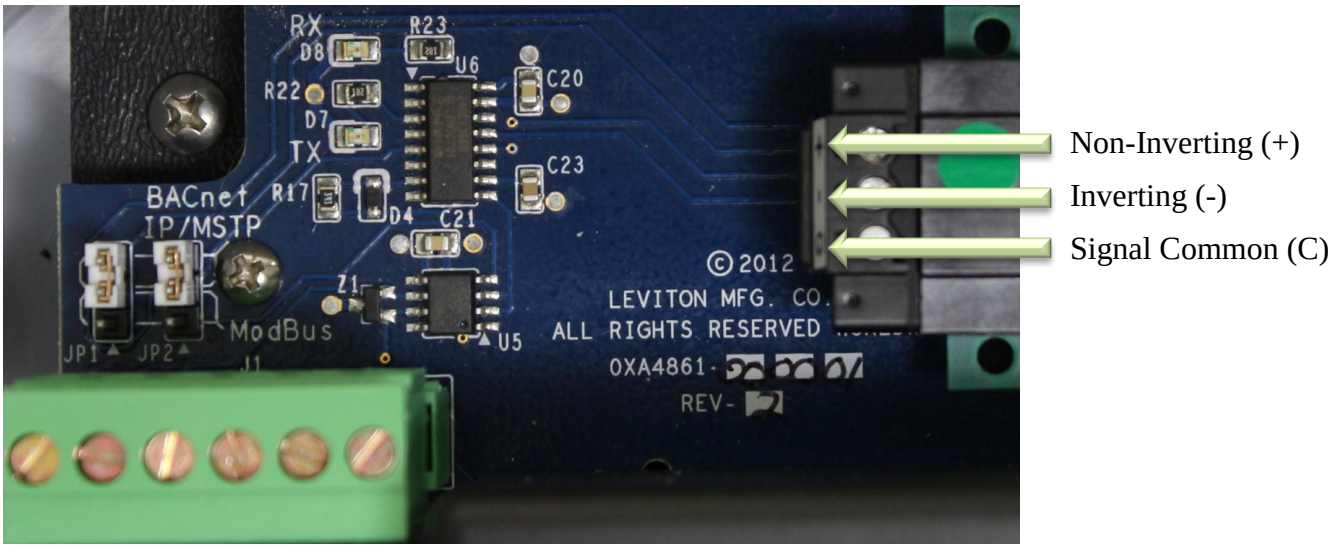


Figure 17. BACnet MS/TP Switches

7. Communications – Series 3500 Ethernet Models

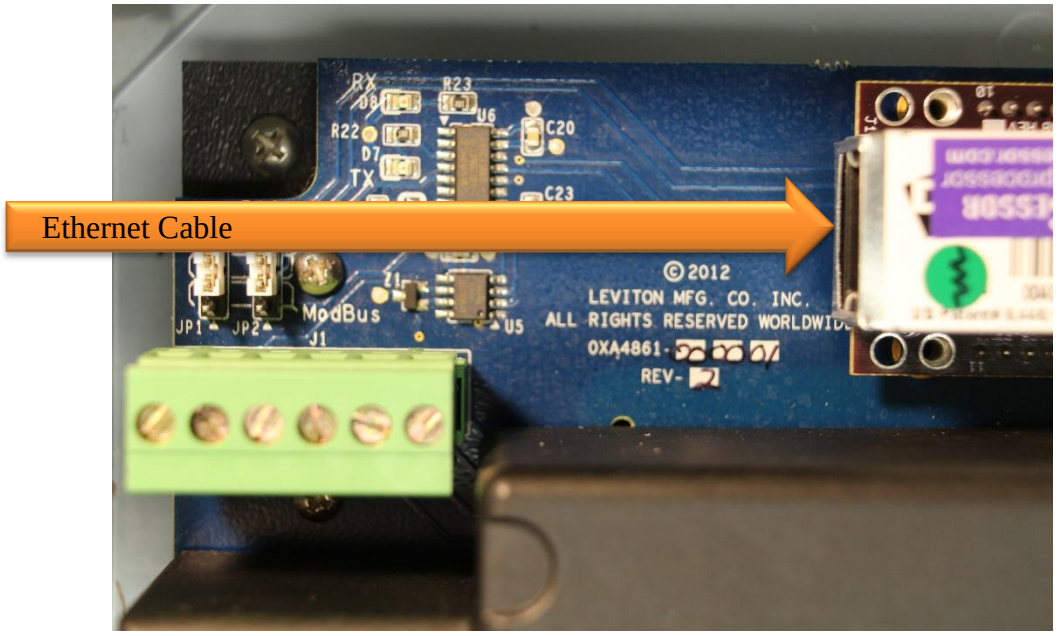
BACnet IP and Modbus TCP Quick Start Guide

To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before servicing an electric meter. Use a properly rated voltage sensing device to confirm power is off.

1. Install meter as outlined in Section 3.
2. Ethernet cable (CAT-5e) shall enter at the TOP side of the enclosure as shown in Figure 13. Replace plastic cap with webbed bushing (provided).
3. Plug Ethernet connector into the RJ-45 jack as shown in Figure 18.
4. Before energizing the meter close and secure the enclosure door.

Note: For detail information refer to FieldServer Website: www.fieldserver.com

Figure 18. Ethernet Connection



8. Communications – History Data Extraction

When communicating with the meter base unit for historical data extraction, always send messages to Modbus address 83 regardless of the meter's normal Modbus address configuration.

For diagnostic purposes, history data can be extracted from the meter using a Modbus RTU connection to the meter base unit. This feature is intended for trained field service personnel only. Contact Leviton Customer Support for assistance.

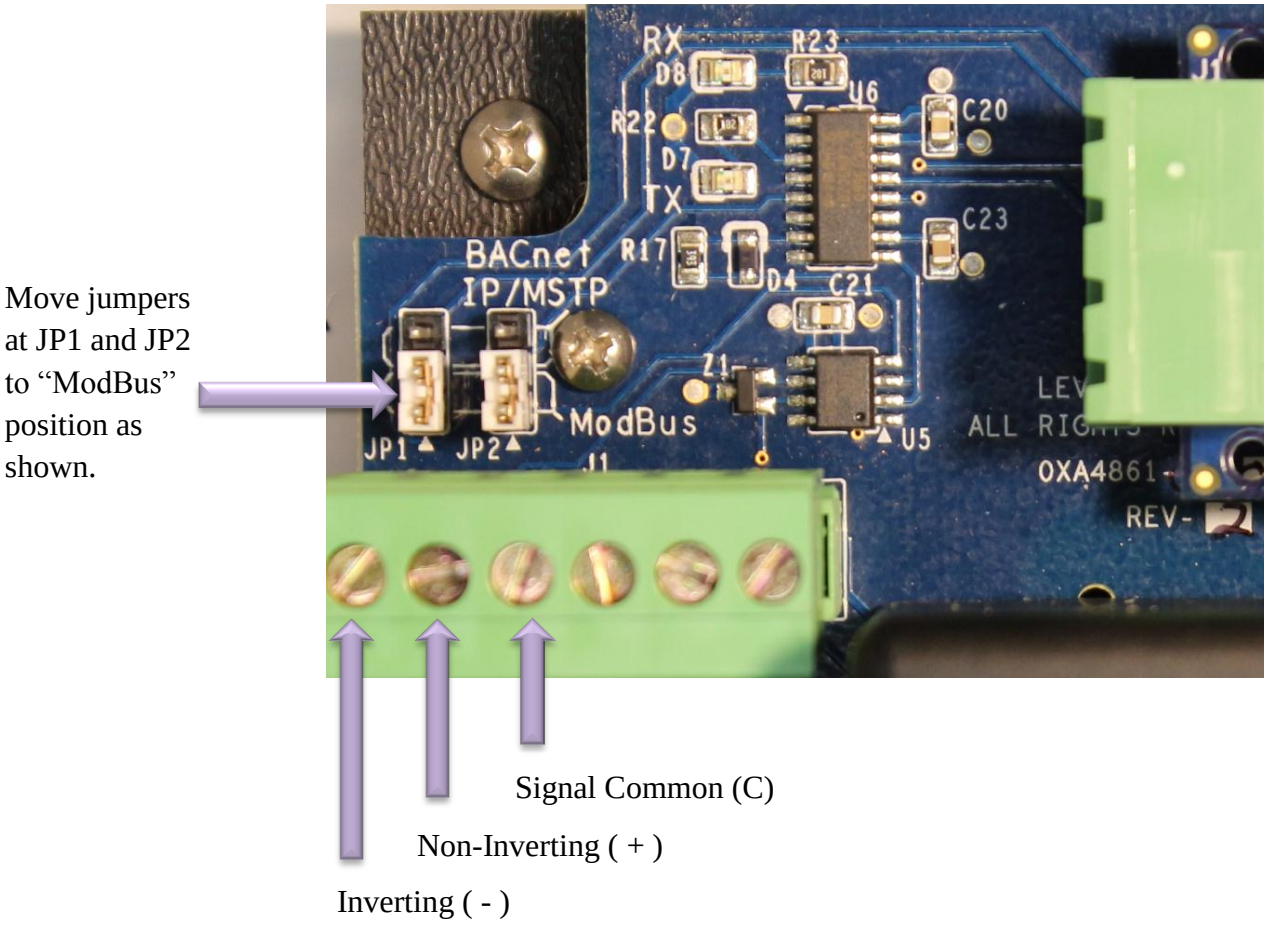
8.1 Connecting for History Data Extraction

To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before servicing an electric meter. Use a properly rated voltage sensing device to confirm power is off.

1. Install meter as outlined in Section 3.
2. Change the JP1 and JP2 jumper settings as shown in Figure 19.
3. Use shielded twisted-pair cable to prevent interference. Connect Inverting (-), Non-Inverting (+), and Signal Common (C) wires using the 6-pin removable terminal block shown in Figure 19. Do not over-tighten the terminal screws. Modbus output is electrically isolated from input power.
4. Before energizing the meter close and secure the enclosure door.

To restore the meter to normal operation, jumpers at JP1 and JP2 must be returned to their default settings.

Figure 19. Base Unit Modbus RTU Connections for History Data Extraction



8.2 Data Extraction Procedure

Historical readings or "data profiles" are not stored in standard Modbus registers. Instead, the historical readings are provided as a stream of data, controlled by a date filter and number of readings to be extracted. The control options for the date and the number of profiles are made available in registers

0504-0506. **Sending large streams of historical data halts the meter computation to avoid conflicting processor demands. As such, large historical reads should not be used on a frequent basis**. Once the transfer completes, the meter will resume normal operations.

Setting the Date

The historical data access date provides filtering criteria for data retrieval. By default, all historical data access dates are "don't care" (0xFF). When a date value is "don't care", it has no effect on the filtering of historical data. Any other value acts as a filter for the data retrieved from memory. The date value specifies the oldest data to be retrieved. For instance, setting the historical data year to 0x08 will filter out any meter readings prior to 2008. Each part of the historical date is treated as an independent filter. Some examples are provided below in Table 8 to further illustrate.

Table 8. Setting the Historical Data Access Date

Year	Month	Date	Hour	Meter Readings Sent
0xFF	0xFF	0xFF	0xFF	Any
0x08	0xFF	0xFF	0xFF	Any reading in 2008 or later
0xFF	0x06	0xFF	0xFF	Any reading from June-Dec in any year
0x09	0x06	0xFF	0xFF	Any reading in June, 2009 or later
0xFF	0xFF	0xFF	0x11	Any reading after 5:00 PM on any day of any year
0x09	0x03	0x01	0xFF	Any reading on March 01, 2009 or later
0xFF	0xFF	0x1C	0x17	Any reading after 11:00 PM on the 28th to the end of the month

The historical data access date information is stored in registers 0504 and 0505 (0x01F8 and 0x01F9). The year and month are stored in register 0504, and the date and hour are stored in register 0505.

Initiating Data Retrieval and Controlling the Number of Profiles Sent

To initiate historical data retrieval, a read holding register command is issued to address 0506. The "number of registers" variable in the read command controls the number of historical profiles to be extracted. Once the desired number of readings has been found and transferred the transmission ends.

Historical Data Profile Structure

The historical data is transmitted in frames consisting of 48 bytes each. The frame structure is shown in Table 9.

Data profile information, except RTC, kWh and VAh, is saved in 16-bit floating point format using truncation of the least significant decimal information. To increase resolution from truncating data for storage, each part of the profile has an associated multiplier. When data is extracted, first make the 16-bit value into a 32-bit float by appending 0x7FFF and then multiply by the multiplier. VAh and kWh are stored as 32-bit floating point numbers and do not need a multiplier.

As an example of using the multiplier, assume the phase A voltage reading is 276.7 V. This value is divided by the multiplier (100) to become 2.767 (0x40311687) and is stored in the data profile as 0x4031. When translated back from hex to a float, 0x40317FFFbecomes 2.7734, and using the 100 multiplier gives a value of 277.34 V. This data condensing is used to increase storage capacity, and does not affect long term meter accuracy. The running kWh and VAh totals are a combination of two floating point numbers, which maintains accuracy beyond thousandths of a kWh, even when high values are reached.

Frame Item	**Size (bytes)**	**Multiplier**
Meter Address	1	n/a
Function Code (0x03)	1	n/a
Profile Memory Address (decreases with each frame)	2	n/a
Time of use Year	1	1
Time of use Month	1	1
Time of use Day	1	1
Time of use Hour	1	1
Time of use Minute	1	1
Time of use Second	1	1
Phase A Voltage	2	100
Phase A Voltage	2	100
Phase A Voltage	2	100
Phase A Current	2	100
Phase B Current	2	100

Phase C Current	2	100
Phase A Watts	2	100
Phase A Watts	2	100
Phase A Watts	2	100
Total kWh +	4	1
Total kWh -	4	1
Total kVA +	4	1
Total kVA -	4	1
Maximum Demand	2	100
CRC	2	n/a

Once one frame is finished transmitting, the next frame will begin automatically until the number of profiles left to send reaches zero. History data is transmitted in reverse chronological order—the most recent frame is transmitted first and the oldest frame is transmitted last.

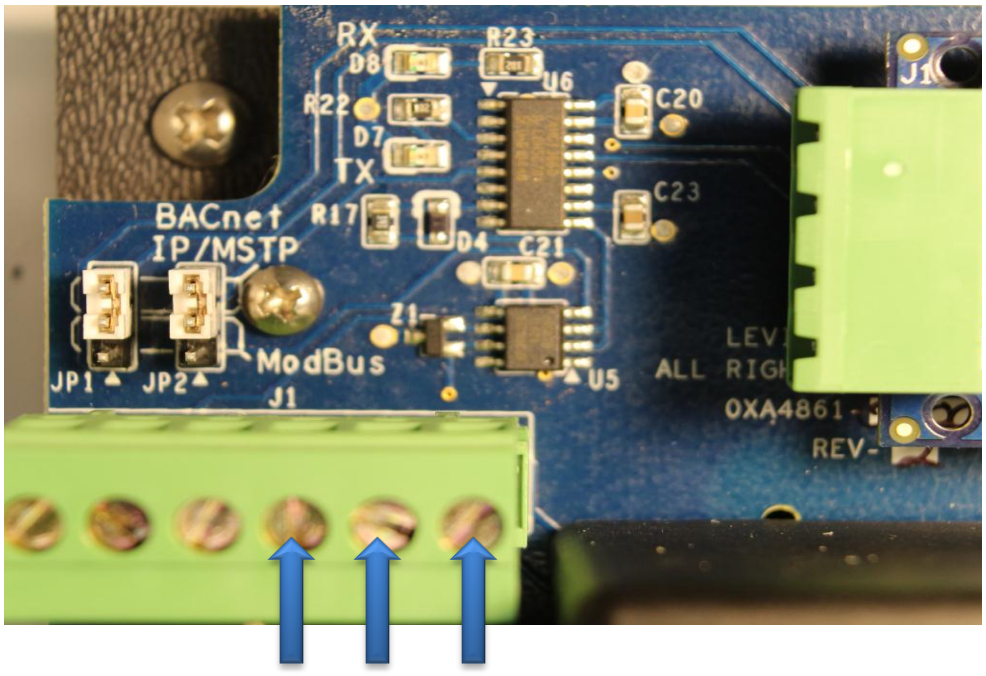
9. Series 3300/3500 Pulse Outputs

9.1 Connecting to the Pulse Output Terminals

To reduce risk of electric shock, always open or disconnect the circuit from the power distribution system of a building before servicing an electric meter. Use a properly rated voltage sensing device to confirm power is off.

1. Install meter as outlined in Section 3.
2. Communications cable shall enter at the TOP side of the enclosure as shown in Figure 13. Replace plastic cap with webbed bushing (provided).
3. Use shielded twisted-pair cable to prevent interference and connect to the 6-pin removable terminal block as shown in Figure 18. Two pins provide 10 watt-hour and 1 kWh pulse rates. Pulses at these terminals and positive (+) with respect to the shared common ("COM") terminal (-), and represent energy delivered (from grid). Do not over-tighten the terminal screws. Both pulse outputs are electrically isolated from input power and can be used independent of one another or simultaneously.
4. Before energizing the meter close and secure the enclosure door.

Figure 18. Pulse Output Connections



9.2 Connecting Pulse Outputs to Data Acquisition Equipment.

A variety of data acquisition equipment may be connected to the Series 3300/3500 pulse output terminals, included wireless pulse transceivers and data logging equipment. For information on Leviton's complete line of data acquisition products go to Leviton.com >Products>Submetering>Communication Systems. For information on Leviton's software solutions go to Leviton.com>Products>Submetering>Energy Manager Software.

10. Diagnostic Tools and Frequently Asked Questions

10.1 Diagnostic Tools

Several diagnostic tools built into the Series 3300/3500 meter should be utilized to ensure the meter and CTs are installed correctly and functioning properly.

1) Energy Flow arrow (see Section 4.1, Figure 12) – Indicates direction of 'energy flow' on amperage and kW screens.
    a. **For mono-directional metering applications the Energy Flow arrow should always point to the right**. If an Amperage or kW screen shows the arrow pointing to the left a current transformer may be installed backwards or on the wrong phase, or CT connections at the meter may be reversed or on the wrong phase. See Hookup Diagrams in Figures 8 through 11 for correct wiring and CT orientations.
    b. Blinking "A" on the Amperage screens – Indicates reverse energy flow. The
    c. Bi-directional metering is typically used in grid-tied applications where solar PV or energy from a source other than the utility grid may be interconnected to the metered service. CTs are located between the grid and the electrical service, and if the locally generated energy exceeds the service loads the grid will receive energy instead of delivering it. In such circumstances the Energy Flow arrow will point to left when energy is being received (at the grid) and point to the right when energy is being delivered from the grid.
2) Power Factor Screens – Except in rare circumstances where predominantly inductive loads are metered, Power Factor values should be between -0.5 and +0.5. An absolute value less than 0.5 indicates CTs installed on the wrong phase or backwards. Recheck wiring and CT orientations against the appropriate Hookup Diagram shown in Figures 8 through 11.

10.2 Frequently Asked Questions

Q: Can I use a single phase (split phase 3-wire) Series 3300/3500 meter on a three phase feed?
A: The Series 3300/3500 can monitor two phases of a three phase system (2 Phase 3 or 4 Wire) but cannot monitor Single Phase (Split Phase) 120/240V 3-Wire, nor 120V 2-Wire circuits. The line-to-line voltage display will not show 240V for the Split Phase.

Q: Can I route voltage input wires and current sensing leads through the same conduit?
A: Yes. CTs must have 18 AWG or heavier wires with proper VAC insulation rating (check local electrical code).

Q: Can I extend the CT leads?
A: Yes. You should try to avoid extending the native CT leads by locating the meter next to the circuit breaker. If you must extend the leads, take into consideration the following inaccuracy contributors. Here are some of the factors that will affect accuracy when using long CT leads:

1. Wire Length
   - Native CT length is best
   - Longer run decreases accuracy
2. CT wire gauge (18 AWG preferred)
   - Thinner wire > more resistance > affects accuracy
   - Thicker wire > more capacitance > affects accuracy
3. Conduit material
   - Metal conduit will effect accuracy
   - Non-metal conduit has minimal effect
4. High voltage wires run in parallel with CT wires inside the same conduit
   - Approximately 0.7%/100ft. deviation at 277V
   - Approximately 0.5%/100ft. deviation at 120V
   - Accuracy deviation increases as current increases on the voltage wires.
5. Wire type
   - When extending CT leads, twisted pair wire type gives better accuracy.

Q: How do I retrieve Data from the meter?
A: Data Acquisition equipment, also known as Automatic Meter Reading (AMR) and Middleware (between the consists of radio transmitters, repeaters, and a collector that monitors, records, and transmits data to energy management or billing software solutions. Various software solutions manage and display data in user-friendly formats. See Sections 6 and 7 or go to Leviton.com for more information.

Q: Why are solid core current transformers color coded (Black & white, red & white, and blue & white)?
A: Industry convention for color coding in 3 Phase 208V electrical systems assigns the color black to phase A, red to phase B, Blue to phase C, and white to Neutral. Leviton's 100A and 200A solid core CTs are coded with the same colors (on the body of the CTs and on the wires) to help installers get each CT placed on the correct hot leg. Further, the white half of the CT always faces incoming Line or source. Phase A CT (black) connects to CT1 at the meter, phase

B CT (Red) connects to CT2, and phase C CT (blue) connects to CT3. See hookup diagrams in figures 8 through 11.

Q: Can digital output wires be routed through the same conduit as voltage input and current sensing wires?
A: No. In accordance with NEC and UL requirements, Class 2 wiring (digital inputs/outputs) must be separated from Class 1 wiring. Digital output wires must enter the meter housing through the top of the enclosure, and voltage and CT wires must enter at bottom of enclosure. See Installation Instructions in Section 3.

Q: I still can't get my meter to work, what now?
A: Contact technical support at via phone or email; see Contact Information on following page.

11. Returned Material Policy and Warranty Information

After acceptance, all sales of meters are final. Leviton, in its sole discretion, authorizes product returns in appropriate circumstances, subject to such conditions as Leviton may specify. Any such return is subject to the express prior authorization and approval of Leviton. Buyer must notify Leviton at 800-736-6682 (telephone) or 503-404-5594 (fax) and request a Returned Material Authorization Number (RMA Number) and state the specific reason for return. Unauthorized returns will not be accepted.

When requesting an RMA Number please supply the following information:

1. Distributors name and address
2. Model number of meter
3. Original purchase order number
4. Reason for return

All paperwork and boxes must be marked with an RMA number issued by Leviton. All authorized returned materials must be shipped freight prepaid to Leviton to the address specified below. Leviton is not responsible for uninsured packages or packages lost by your carrier.

Leviton 20497 SW Teton Avenue Tualatin, Oregon 97062

All returns are subject to a handling/restocking charge, except for product shipped in error or products under warranty. All charges (modification, repair, restock etc) related to returned products will be determined by Leviton upon evaluation. All shipping costs are the responsibility of the buyer.

METERS RETURNED FOR CREDIT*

Replacement meter ordered

- *RMA Number requested by stocking distributor for credit must be accompanied by a purchase order for material of equal or greater value.* — 0% Restock Charge

NO replacement meter ordered — 25% Restock Charge

METERS RETURNED FOR REPAIR (STILL UNDER WARRANTY)*

No defects found	$75.00 evaluation charge
Defects not covered under warranty	Charges upon evaluation
Defects found covered under warranty	No Charge

METERS RETURNED FOR EVALUATION (NO LONGER UNDER WARRANTY)*

Evaluation charge of $75.00 applies

Other charges will apply depending on evaluation by Leviton

**Prices as of May 01, 2009 and subject to change*

12. Contact Information

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Appendix A

Modbus and BACnet Address Map

Address	Hex Value	Holding Register	Width (16-bit registers)	Description	Unit of Measure	Data Type	R/W	BACnet Object Type	BACnet Object Instance
Meter Readings									
0000	0000	40001	2	kWh from grid	kWh	FLOAT32	R	AI	1
0002	0002	40003	2	kWh to grid	kWh	FLOAT32	R	AI	2
0004	0004	40005	2	kVAh from grid	kVAh	FLOAT32	R	AI	3
0006	0006	40007	2	kVAh to grid	kVAh	FLOAT32	R	AI	4
0008	0008	40009	2	Total Power (A+B+C)	kW	FLOAT32	R	AI	5
0010	000A	40011	2	Total Apparent Power (A+B+C)	kVA	FLOAT32	R	AI	6
0012	000C	40013	2	Total Reactive Power (A+B+C)	kVAR	FLOAT32	R	AI	7
0014	000E	40015	2	Total Power Factor	N/A	FLOAT32	R	AI	8
0016	0010	40017	2	Phase A Voltage (L-N)	V	FLOAT32	R	AI	9
0018	0012	40019	2	Phase B Voltage (L-N)	V	FLOAT32	R	AI	10
0020	0014	40021	2	Phase C Voltage (L-N)	V	FLOAT32	R	AI	11
0022	0016	40023	2	Phase A Current	A	FLOAT32	R	AI	12
0024	0018	40025	2	Phase B Current	A	FLOAT32	R	AI	13
0026	001A	40027	2	Phase C Current	A	FLOAT32	R	AI	14
0028	001C	40029	2	Phase A Real Power	kW	FLOAT32	R	AI	15
0030	001E	40031	2	Phase B Real Power	kW	FLOAT32	R	AI	16
0032	0020	40033	2	Phase C Real Power	kW	FLOAT32	R	AI	17
0034	0022	40035	2	Phase A Apparent Power	kVA	FLOAT32	R	AI	18
0036	0024	40037	2	Phase B Apparent Power	kVA	FLOAT32	R	AI	19
0038	0026	40039	2	Phase C Apparent Power	kVA	FLOAT32	R	AI	20
0040	0028	40041	2	Phase A Reactive Power	kVAR	FLOAT32	R	AI	21
0042	002A	40043	2	Phase B Reactive Power	kVAR	FLOAT32	R	AI	22

Address	Hex Value	Holding Register	Width (16-bit registers)	Description	Unit of Measure	Data Type	R/W	BACnet Object Type	BACnet Object Instance
0044	002C	40045	2	Phase C Reactive Power	kVAR	FLOAT32	R	AI	23
0046	002E	40047	2	Phase A Power Factor	N/A	FLOAT32	R	AI	24
0048	0030	40049	2	Phase B Power Factor	N/A	FLOAT32	R	AI	25
0050	0032	40051	2	Phase C Power Factor	N/A	FLOAT32	R	AI	26
0052	0034	40053	2	Voltage A to B (L-L)	V	FLOAT32	R	AI	27
0054	0036	40055	2	Voltage B to C (L-L)	V	FLOAT32	R	AI	28
0056	0038	40057	2	Voltage C to A (L-L)	V	FLOAT32	R	AI	29
0058	003A	40059	2	Line Frequency	Hz	FLOAT32	R	AI	30
0060	003C	40061	2	Maximum Demand	kW	FLOAT32	R	AI	31
0062	003E	40063	1	Maximum Demand Timestamp: Year/Month	Year/Month	Two UINT8	R	AI	32 & 33
0063	003F	40064	1	Maximum Demand Timestamp: Day/Hour	Day/Hour	Two UINT8	R	AI	34 & 35
0064	0040	40065	1	Maximum Demand Timestamp: Minute/Second	Min/Sec	Two UINT8	R	AI	36 & 37
0065	0041	40066	1	Power Loss Timestamp: Year/Month	Year/Month	Two UINT8	R	AI	38 & 39
0066	0042	40067	1	Power Loss Timestamp: Day/Hour	Day/Hour	Two UINT8	R	AI	40 & 41
0067	0043	40068	1	Power Loss Timestamp: Minute/Second	Min/Sec	Two UINT8	R	AI	42 & 43
0068	0044	40069	1	RTC Year/Month	Year/Month	Two UINT8	R/W	AV	44 & 45
0069	0045	40070	1	RTC Day/Hour	Day/Hour	Two UINT8	R/W	AV	46 & 47
0070	0046	40071	1	RTC Minute/Second	Min/Sec	Two UINT8	R/W	AV	48 & 49
0071	0047	40072	1	RTC Day of the Week	N/A	8-bit enumerated in LSB[1]	R	AI	50
0072	0048	40073	2	Net kWh ("from grid" minus "to grid")	kWh	FLOAT32	R	AI	51
0074	004A	40075	2	Net kVAh ("from grid" minus "to grid")	kVAh	FLOAT32	R	AI	52

Address	Hex Value	Holding Register	Width (16-bit registers)	Description	Unit of Measure	Data Type	R/W	BACnet Object Type	BACnet Object Instance
Control Registers									
0500	01F4	40501	1	Maximum Demand Reset	N/A	Write 0x00AA to initiate reset	W	AV	53
Meter Information									
5000	1388	45001	2	Meter Serial Number	N/A	UINT32	R	AI	54
5002	138A	45003	1	Hardware Version/Software Version	N/A	Two 8-bit hex values[3]	R	AI	55 & 56
5003	138B	45004	1	Program Number	N/A	INT16	R	AI	57
5004	138C	45005	1	Meter Type/Demand Reset Counter	N/A	8-bit enumerated[4] and 8-bit integer	R	AI	58 & 59
5005	138D	45006	1	Demand Calc Interval/EEPROM Save Interval	N/A	8-bit enumerated in LSB[5]	R/W	AV	60

[1] To maintain cohesiveness of date, time and day of week, it is recommended that the four RTC registers be updated as a group
[2] Day of the week: 0x01 to 0x07 (0x01 = Sunday)
[3] Each 8-bit version number is encoded as two 4-bit hex digits, for example the value 0x19 represents version 1.9
[4] Meter type has a fixed value of 4
[5] See "Encoding of Demand Calculation and History Data Save Interval" below

Encoding of Demand Calculation and History Data Save Interval

Register address 5005 is encoded as two 8-bit enumerated values, with demand calculation interval in the MSB and history data save interval in the LSB.

Demand interval (MSB) defines the interval for calculation of maximum demand:

0 = 5 minute interval
1 = 10 min interval
Other values return an error

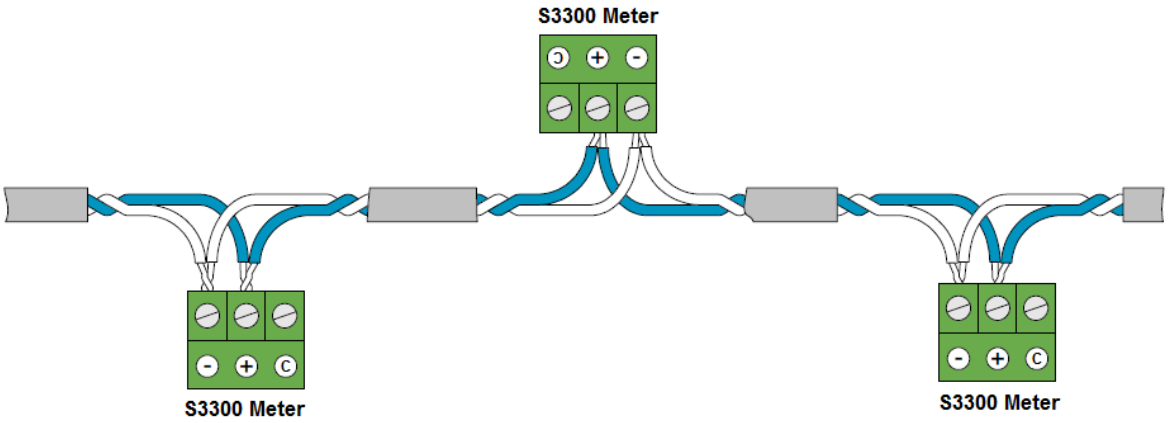
History interval (LSB) defines the interval for saving history data in EEPROM:
1 = 5 minute interval
3 = 15 minute interval
6 = 30 minute interval
12 = 60 minute interval
Other values return an error

When this register is read, the demand calculation interval appears in the MSB and history data save interval is in the LSB.

The method of writing to the register depends on the communication protocol. For Modbus RTU, the demand calculation interval value is written to the LSB and the history data save interval is fixed at 5 minutes and cannot be changed. For all other protocols, the demand calculation interval value is written to the MSB and the history data save interval value is written to the LSB.

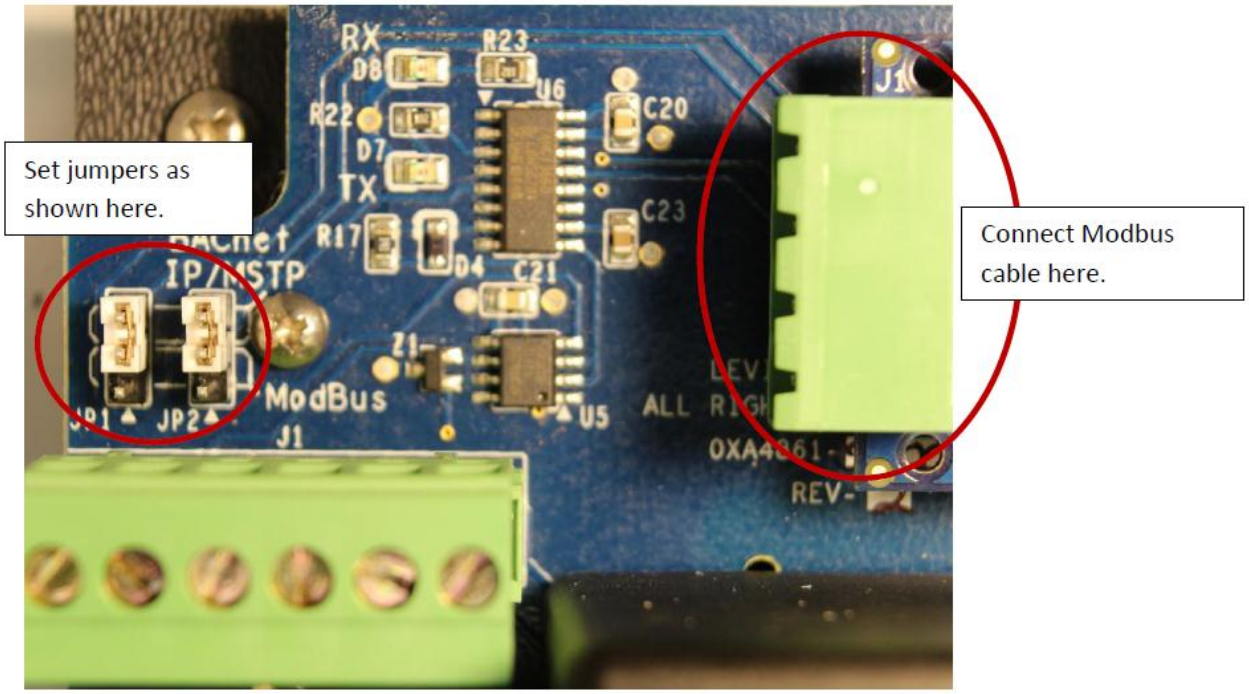
Appendix B

S3300 meters support an RS-485 communication network and meters can be daisy-chained up to 32 units. A connection example is shown below.



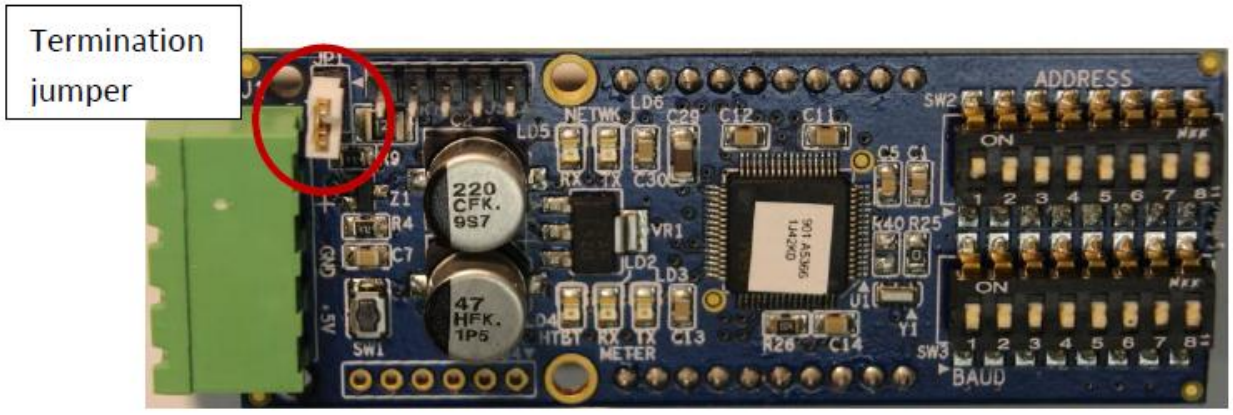
Appendix C

How to Set Up Leviton Modbus RTU Communication Modules



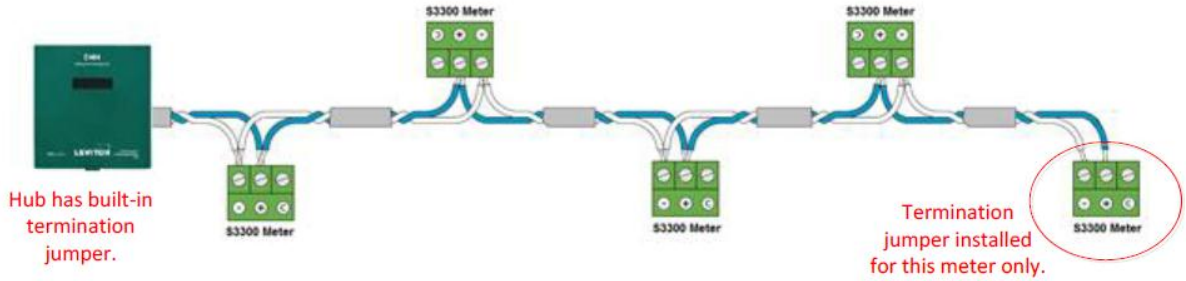
Communication Module Jumpers

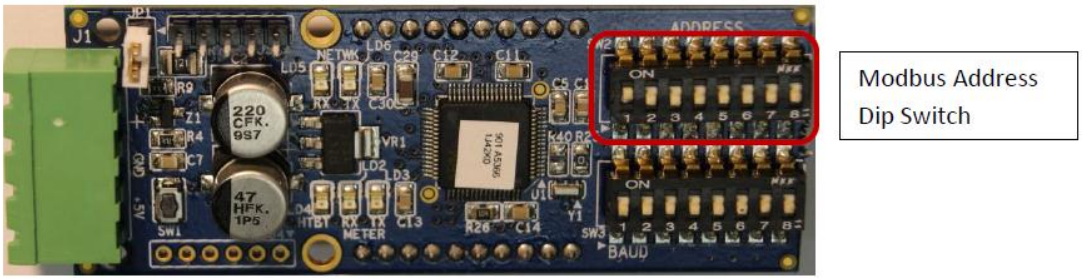
To use the Modbus RTU communication module the jumpers shown above must be set in the top position, which is the default setting from factory. *The jumpers must be set as shown in the diagram above regardless of the communication protocol in use.*



RS485 Line (Twisted Pair) Termination Jumper

When installed as shown in the diagram above, this jumper enables the internal RC line termination circuit. The jumper must be installed if the meter is the last device in the daisy chain and otherwise must be removed. In the example shown below, only the meter at the far right of the diagram needs a termination jumper because it is the last device in the daisy chain.





Modbus Address Dip Switch

The Modbus address is set using the bank of dip switches circled in red in the diagram above**. Every meter in the Modbus network must have a unique Modbus address.** The address is not set at the factory—it must be set appropriately at installation. Zero (all switches off) is not a valid Modbus address. The address 255 (all switches on) is generally reserved and not recommended. The table below shows how to set the switches for each address.

Modbus Address	Dip Switch Number							
	1	2	3	4	5	6	7	8
1	On	Off	Off	Off	Off	Off	Off	Off
2	Off	On	Off	Off	Off	Off	Off	Off
3	On	On	Off	Off	Off	Off	Off	Off
4	Off	Off	On	Off	Off	Off	Off	Off
5	On	Off	On	Off	Off	Off	Off	Off
6	Off	On	On	Off	Off	Off	Off	Off
7	On	On	On	Off	Off	Off	Off	Off
8	Off	Off	Off	On	Off	Off	Off	Off
9	On	Off	Off	On	Off	Off	Off	Off
10	Off	On	Off	On	Off	Off	Off	Off
11	On	On	Off	On	Off	Off	Off	Off
12	Off	Off	On	On	Off	Off	Off	Off
13	On	Off	On	On	Off	Off	Off	Off
14	Off	On	On	On	Off	Off	Off	Off
15	On	On	On	On	Off	Off	Off	Off
16	Off	Off	Off	Off	On	Off	Off	Off
17	On	Off	Off	Off	On	Off	Off	Off
18	Off	On	Off	Off	On	Off	Off	Off
19	On	On	Off	Off	On	Off	Off	Off
20	Off	Off	On	Off	On	Off	Off	Off
21	On	Off	On	Off	On	Off	Off	Off
22	Off	On	On	Off	On	Off	Off	Off
23	On	On	On	Off	On	Off	Off	Off
24	Off	Off	Off	On	On	Off	Off	Off
25	On	Off	Off	On	On	Off	Off	Off
26	Off	On	Off	On	On	Off	Off	Off
27	On	On	Off	On	On	Off	Off	Off
28	Off	Off	On	On	On	Off	Off	Off
29	On	Off	On	On	On	Off	Off	Off
30	Off	On	On	On	On	Off	Off	Off
31	On	On	On	On	On	Off	Off	Off
32	Off	Off	Off	Off	Off	On	Off	Off
33	On	Off	Off	Off	Off	On	Off	Off
34	Off	On	Off	Off	Off	On	Off	Off
35	On	On	Off	Off	Off	On	Off	Off
36	Off	Off	On	Off	Off	On	Off	Off
37	On	Off	On	Off	Off	On	Off	Off
38	Off	On	On	Off	Off	On	Off	Off
39	On	On	On	Off	Off	On	Off	Off
40	Off	Off	Off	On	Off	On	Off	Off
41	On	Off	Off	On	Off	On	Off	Off
42	Off	On	Off	On	Off	On	Off	Off
43	On	On	Off	On	Off	On	Off	Off

Modbus Address	Dip Switch Number							
	1	2	3	4	5	6	7	8
44	Off	Off	On	On	Off	On	Off	Off
45	On	Off	On	On	Off	On	Off	Off
46	Off	On	On	On	Off	On	Off	Off
47	On	On	On	On	Off	On	Off	Off
48	Off	Off	Off	Off	On	On	Off	Off
49	On	Off	Off	Off	On	On	Off	Off
50	Off	On	Off	Off	On	On	Off	Off
51	On	On	Off	Off	On	On	Off	Off
52	Off	Off	On	Off	On	On	Off	Off
53	On	Off	On	Off	On	On	Off	Off
54	Off	On	On	Off	On	On	Off	Off
55	On	On	On	Off	On	On	Off	Off
56	Off	Off	Off	On	On	On	Off	Off
57	On	Off	Off	On	On	On	Off	Off
58	Off	On	Off	On	On	On	Off	Off
59	On	On	Off	On	On	On	Off	Off
60	Off	Off	On	On	On	On	Off	Off
61	On	Off	On	On	On	On	Off	Off
62	Off	On	On	On	On	On	Off	Off
63	On	On	On	On	On	On	Off	Off
64	Off	Off	Off	Off	Off	Off	On	Off
65	On	Off	Off	Off	Off	Off	On	Off
66	Off	On	Off	Off	Off	Off	On	Off
67	On	On	Off	Off	Off	Off	On	Off
68	Off	Off	On	Off	Off	Off	On	Off
69	On	Off	On	Off	Off	Off	On	Off
70	Off	On	On	Off	Off	Off	On	Off
71	On	On	On	Off	Off	Off	On	Off
72	Off	Off	Off	On	Off	Off	On	Off
73	On	Off	Off	On	Off	Off	On	Off
74	Off	On	Off	On	Off	Off	On	Off
75	On	On	Off	On	Off	Off	On	Off
76	Off	Off	On	On	Off	Off	On	Off
77	On	Off	On	On	Off	Off	On	Off
78	Off	On	On	On	Off	Off	On	Off
79	On	On	On	On	Off	Off	On	Off
80	Off	Off	Off	Off	On	Off	On	Off
81	On	Off	Off	Off	On	Off	On	Off
82	Off	On	Off	Off	On	Off	On	Off
83	On	On	Off	Off	On	Off	On	Off
84	Off	Off	On	Off	On	Off	On	Off
85	On	Off	On	Off	On	Off	On	Off
86	Off	On	On	Off	On	Off	On	Off

Modbus Address	Dip Switch Number							
	1	2	3	4	5	6	7	8
87	On	On	On	Off	On	Off	On	Off
88	Off	Off	Off	On	On	Off	On	Off
89	On	Off	Off	On	On	Off	On	Off
90	Off	On	Off	On	On	Off	On	Off
91	On	On	Off	On	On	Off	On	Off
92	Off	Off	On	On	On	Off	On	Off
93	On	Off	On	On	On	Off	On	Off
94	Off	On	On	On	On	Off	On	Off
95	On	On	On	On	On	Off	On	Off
96	Off	Off	Off	Off	Off	On	On	Off
97	On	Off	Off	Off	Off	On	On	Off
98	Off	On	Off	Off	Off	On	On	Off
99	On	On	Off	Off	Off	On	On	Off
100	Off	Off	On	Off	Off	On	On	Off
101	On	Off	On	Off	Off	On	On	Off
102	Off	On	On	Off	Off	On	On	Off
103	On	On	On	Off	Off	On	On	Off
104	Off	Off	Off	On	Off	On	On	Off
105	On	Off	Off	On	Off	On	On	Off
106	Off	On	Off	On	Off	On	On	Off
107	On	On	Off	On	Off	On	On	Off
108	Off	Off	On	On	Off	On	On	Off
109	On	Off	On	On	Off	On	On	Off
110	Off	On	On	On	Off	On	On	Off
111	On	On	On	On	Off	On	On	Off
112	Off	Off	Off	Off	On	On	On	Off
113	On	Off	Off	Off	On	On	On	Off
114	Off	On	Off	Off	On	On	On	Off
115	On	On	Off	Off	On	On	On	Off
116	Off	Off	On	Off	On	On	On	Off
117	On	Off	On	Off	On	On	On	Off
118	Off	On	On	Off	On	On	On	Off
119	On	On	On	Off	On	On	On	Off
120	Off	Off	Off	On	On	On	On	Off
121	On	Off	Off	On	On	On	On	Off
122	Off	On	Off	On	On	On	On	Off
123	On	On	Off	On	On	On	On	Off
124	Off	Off	On	On	On	On	On	Off
125	On	Off	On	On	On	On	On	Off
126	Off	On	On	On	On	On	On	Off
127	On	On	On	On	On	On	On	Off
128	Off	Off	Off	Off	Off	Off	Off	On
129	On	Off	Off	Off	Off	Off	Off	On

Modbus Address	Dip Switch Number							
	1	2	3	4	5	6	7	8
130	Off	On	Off	Off	Off	Off	Off	On
131	On	On	Off	Off	Off	Off	Off	On
132	Off	Off	On	Off	Off	Off	Off	On
133	On	Off	On	Off	Off	Off	Off	On
134	Off	On	On	Off	Off	Off	Off	On
135	On	On	On	Off	Off	Off	Off	On
136	Off	Off	Off	On	Off	Off	Off	On
137	On	Off	Off	On	Off	Off	Off	On
138	Off	On	Off	On	Off	Off	Off	On
139	On	On	Off	On	Off	Off	Off	On
140	Off	Off	On	On	Off	Off	Off	On
141	On	Off	On	On	Off	Off	Off	On
142	Off	On	On	On	Off	Off	Off	On
143	On	On	On	On	Off	Off	Off	On
144	Off	Off	Off	Off	On	Off	Off	On
145	On	Off	Off	Off	On	Off	Off	On
146	Off	On	Off	Off	On	Off	Off	On
147	On	On	Off	Off	On	Off	Off	On
148	Off	Off	On	Off	On	Off	Off	On
149	On	Off	On	Off	On	Off	Off	On
150	Off	On	On	Off	On	Off	Off	On
151	On	On	On	Off	On	Off	Off	On
152	Off	Off	Off	On	On	Off	Off	On
153	On	Off	Off	On	On	Off	Off	On
154	Off	On	Off	On	On	Off	Off	On
155	On	On	Off	On	On	Off	Off	On
156	Off	Off	On	On	On	Off	Off	On
157	On	Off	On	On	On	Off	Off	On
158	Off	On	On	On	On	Off	Off	On
159	On	On	On	On	On	Off	Off	On
160	Off	Off	Off	Off	Off	On	Off	On
161	On	Off	Off	Off	Off	On	Off	On
162	Off	On	Off	Off	Off	On	Off	On
163	On	On	Off	Off	Off	On	Off	On
164	Off	Off	On	Off	Off	On	Off	On
165	On	Off	On	Off	Off	On	Off	On
166	Off	On	On	Off	Off	On	Off	On
167	On	On	On	Off	Off	On	Off	On
168	Off	Off	Off	On	Off	On	Off	On
169	On	Off	Off	On	Off	On	Off	On
170	Off	On	Off	On	Off	On	Off	On
171	On	On	Off	On	Off	On	Off	On
172	Off	Off	On	On	Off	On	Off	On

Modbus Address	Dip Switch Number							
	1	2	3	4	5	6	7	8
173	On	Off	On	On	Off	On	Off	On
174	Off	On	On	On	Off	On	Off	On
175	On	On	On	On	Off	On	Off	On
176	Off	Off	Off	Off	On	On	Off	On
177	On	Off	Off	Off	On	On	Off	On
178	Off	On	Off	Off	On	On	Off	On
179	On	On	Off	Off	On	On	Off	On
180	Off	Off	On	Off	On	On	Off	On
181	On	Off	On	Off	On	On	Off	On
182	Off	On	On	Off	On	On	Off	On
183	On	On	On	Off	On	On	Off	On
184	Off	Off	Off	On	On	On	Off	On
185	On	Off	Off	On	On	On	Off	On
186	Off	On	Off	On	On	On	Off	On
187	On	On	Off	On	On	On	Off	On
188	Off	Off	On	On	On	On	Off	On
189	On	Off	On	On	On	On	Off	On
190	Off	On	On	On	On	On	Off	On
191	On	On	On	On	On	On	Off	On
192	Off	Off	Off	Off	Off	Off	On	On
193	On	Off	Off	Off	Off	Off	On	On
194	Off	On	Off	Off	Off	Off	On	On
195	On	On	Off	Off	Off	Off	On	On
196	Off	Off	On	Off	Off	Off	On	On
197	On	Off	On	Off	Off	Off	On	On
198	Off	On	On	Off	Off	Off	On	On
199	On	On	On	Off	Off	Off	On	On
200	Off	Off	Off	On	Off	Off	On	On
201	On	Off	Off	On	Off	Off	On	On
202	Off	On	Off	On	Off	Off	On	On
203	On	On	Off	On	Off	Off	On	On
204	Off	Off	On	On	Off	Off	On	On
205	On	Off	On	On	Off	Off	On	On
206	Off	On	On	On	Off	Off	On	On
207	On	On	On	On	Off	Off	On	On
208	Off	Off	Off	Off	On	Off	On	On
209	On	Off	Off	Off	On	Off	On	On
210	Off	On	Off	Off	On	Off	On	On
211	On	On	Off	Off	On	Off	On	On
212	Off	Off	On	Off	On	Off	On	On
213	On	Off	On	Off	On	Off	On	On
214	Off	On	On	Off	On	Off	On	On

Modbus Address	Dip Switch Number							
	1	2	3	4	5	6	7	8
215	On	On	On	Off	On	Off	On	On
216	Off	Off	Off	On	On	Off	On	On
217	On	Off	Off	On	On	Off	On	On
218	Off	On	Off	On	On	Off	On	On
219	On	On	Off	On	On	Off	On	On
220	Off	Off	On	On	On	Off	On	On
221	On	Off	On	On	On	Off	On	On
222	Off	On	On	On	On	Off	On	On
223	On	On	On	On	On	Off	On	On
224	Off	Off	Off	Off	Off	On	On	On
225	On	Off	Off	Off	Off	On	On	On
226	Off	On	Off	Off	Off	On	On	On
227	On	On	Off	Off	Off	On	On	On
228	Off	Off	On	Off	Off	On	On	On
229	On	Off	On	Off	Off	On	On	On
230	Off	On	On	Off	Off	On	On	On
231	On	On	On	Off	Off	On	On	On
232	Off	Off	Off	On	Off	On	On	On
233	On	Off	Off	On	Off	On	On	On
234	Off	On	Off	On	Off	On	On	On
235	On	On	Off	On	Off	On	On	On
236	Off	Off	On	On	Off	On	On	On
237	On	Off	On	On	Off	On	On	On
238	Off	On	On	On	Off	On	On	On
239	On	On	On	On	Off	On	On	On
240	Off	Off	Off	Off	On	On	On	On
241	On	Off	Off	Off	On	On	On	On
242	Off	On	Off	Off	On	On	On	On
243	On	On	Off	Off	On	On	On	On
244	Off	Off	On	Off	On	On	On	On
245	On	Off	On	Off	On	On	On	On
246	Off	On	On	Off	On	On	On	On
247	On	On	On	Off	On	On	On	On
248	Off	Off	Off	On	On	On	On	On
249	On	Off	Off	On	On	On	On	On
250	Off	On	Off	On	On	On	On	On
251	On	On	Off	On	On	On	On	On
252	Off	Off	On	On	On	On	On	On
253	On	Off	On	On	On	On	On	On
254	Off	On	On	On	On	On	On	On

Product data sheet
Characteristics

ZB5AS844
red Ø40 Emergency stop pushbutton head Ø22 trigger and latching turn release

Product availability: Stock - Normally stocked in distribution facility

Main

Commercial Status	Commercialised
Range of product	Harmony XB5
Product or component type	Head for emergency stop pushbutton
Device short name	ZB5
Bezel material	Plastic
Mounting diameter	0.87 in (22 mm)
Sale per indivisible quantity	1
Shape of signaling unit head	Round
Type of operator	Trigger action and mechanical latching
Reset	Turn to release
Operator profile	Red mushroom Ø 40 mm unmarked

Complementary

CAD overall width	1.57 in (40 mm)
CAD overall height	1.57 in (40 mm)
CAD overall depth	2.24 in (57 mm)
Product weight	0.1 lb(US) (0.046 kg)
Mechanical durability	300000 cycles
Station name	XALK 1 cut-out XALD 1 cut-out
Electrical composition code	C10 for <= 4 contacts using single and double blocks in front mounting SR1 for <= 3 contacts using single blocks in rear mounting SF1 for <= 3 contacts using single blocks in front mounting C15 for 1 contacts using single blocks in front mounting C11 for <= 3 contacts using single blocks in front mounting C8 for <= 4 contacts using single and double blocks in front mounting C7 for <= 4 contacts using single blocks in front mounting

Environment

Protective treatment	TH
Ambient air temperature for storage	-40...158 °F (-40...70 °C)
Ambient air temperature for operation	-13...158 °F (-25...70 °C)
Class of protection against electric shock	Class II conforming to IEC 60536
IP degree of protection	IP66 conforming to IEC 60529
NEMA degree of protection	NEMA 4X NEMA 13
Resistance to high pressure washer	1015.26 psi (7000000 Pa) at 131 °F (55 °C),distance: 0.1 m
IK degree of protection	IK03 conforming to IEC 50102
Standards	EN/IEC 60204-1 EN/IEC 60947-1 EN/IEC 60947-5-1 EN/IEC 60947-5-4 EN/IEC 60947-5-5 EN/ISO 13850 JIS C 4520 UL 508 GB 14048.5 CSA C22.2 No 14

Product certifications	BV CSA DNV GL LROS (Lloyds register of shipping) RINA UL listed
Vibration resistance	5 gn (f = 2...500 Hz) conforming to IEC 60068-2-6
Shock resistance	50 gn for 11 ms half sine wave acceleration conforming to IEC 60068-2-27 30 gn for 18 ms half sine wave acceleration conforming to IEC 60068-2-27

Ordering and shipping details

Category	22467 - PUSHBUTTONS,22MM(PLASTIC) NEW
Discount Schedule	CS2
GTIN	00785901376682
Nbr. of units in pkg.	1
Package weight(Lbs)	0.09
Product availability	Stock - Normally stocked in distribution facility
Returnability	Y
Country of origin	CZ

Contractual warranty

Period	18 months

SECTION 20 - MOTOR CONTROL CENTER PANEL EQUIPMENT

MOTOR CONTROL CENTER ENCLOSURE - HAMMOND MODEL EN4SD24208GY

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Panel Sold Separately

Single Door with latching handle

Single Door with quarter turns

Single Door with 3-point latching handle and quarter turns

Application

- Designed to enclose electrical and/or electronic equipment and protect against harsh, industrial environments for wallmount applications.
- Impressive styling features like hidden hinges, attractive latching systems make the Eclipse a suitable addition to any high-tech equipment installation.
- A wide range of sizes and practical accessories make this product line a complete package.
- For high temperature applications, a gasket retainer may be required, please refer to factory.

Standards

- UL 508 Type 3R, 4, and 12
- CSA Type 3R, 4, and 12
- **Complies with**
  - NEMA Type 3R, 4, and 12
  - IEC 60529, IP66

Construction

- Formed 14 or 16 gauge steel.
- Smooth, continuously welded seams ground smooth.
- Door stiffeners are provided where required for increased strength and rigidity - designed to also permit additional mounting options.
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Doors may be easily removed for modifications and are interchangeable.
- Oil resistant gaskets are permanently secured.
- Collar studs provided for mounting inner panel.
- Includes hardware kit with panel mounting nuts and sealing washers for wall mounting holes.
- Bonding stud provided on door and grounding stud installed in enclosure
- Hinges are constructed from 304 stainless steel.
- Hinge pins are stainless steel.
- Quarter turn latch and 3 point handle (key lockable) are zinc diecast with black epoxy finish.

Finish

- Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with choice of ANSI 61 smooth Gray (GY) or RAL7035 textured light gray (LG).
- RAL7032 textured beige (CG) versions with gland plates are available as non-stock items.

Accessories

- Air conditioners...see page 387-405
- Blowers...see page 406
- Breather kits...see page 423
- DIN rails...see page 29
- DIN rail mounting kit...see page 29
- Door stop kit...see page 447
- Filter fans...see page 408-413
- Gland Plates...see page 441
- Heaters...see page 418-420
- Handles...see page 30
- Inner panel...see page 28
- Quarter turn inserts and keys...see page 30
- Literature pocket...see page 451
- Mounting foot kit...see page 30
- Swing frame...see page 29
- Swing panel...see page 28
- Replacement hinge pins...see page 28
- Replacement quarter turn assemblies...see page 30
- Thermostats...see page 421
- Touch up paint...see page 450
- UL/CSA approved hardware kit...see page 430
- Padlock Adapter (EPA)...see page 431

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

Quality Enclosures. Service Excellence.

Canada: 519.822.2960 or 905.456.3770 USA: 716.630.7030

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Part No. (ANSI 61 Gray)	Part No. (RAL7035 Light Gray)	Overall Dimensions			Door/ Body Gauge	Latches		Opt. Panel Part No.	Panel Size		# Hinges	F	Ship Wt. Lbs.
		A	B	C		Qty	Type		D	E			
EN4SD12126GY	EN4SD12126LG	12	12	6	16	1	Qtr Turn	EP1212	10.2	10.2	2	6	12
EN4SD12246GY	EN4SD12246LG	12	24	6	16	1	Qtr Turn	EP1224	10.2	22.2	2	18	24
EN4SD16126GY	EN4SD16126LG	16	12	6	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16166GY	EN4SD16166LG	16	16	6	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	19
EN4SD16206GY	EN4SD16206LG	16	20	6	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	22
EN4SD20126GY	EN4SD20126LG	20	12	6	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	20
EN4SD20166GY	EN4SD20166LG	20	16	6	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	22
EN4SD20206GY	EN4SD20206LG	20	20	6	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	26
EN4SD20246GY	EN4SD20246LG	20	24	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	14	32
EN4SD24126GY	EN4SD24126LG	24	12	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	24
EN4SD24166GY	EN4SD24166LG	24	16	6	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24206GY	EN4SD24206LG	24	20	6	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	30
EN4SD24246GY	EN4SD24246LG	24	24	6	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	37
EN4SD30166GY	EN4SD30166LG	30	16	6	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	35
EN4SD30206GY	EN4SD30206LG	30	20	6	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	38
EN4SD30246GY	EN4SD30246LG	30	24	6	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	40
EN4SD36246GY	EN4SD36246LG	36	24	6	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	52
EN4SD36306GY	EN4SD36306LG	36	30	6	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	60
EN4SD12248GY	EN4SD12248LG	12	24	8	16	1	Qtr Turn	EP1224	10.2	22.2	2	6	25
EN4SD16128GY	EN4SD16128LG	16	12	8	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16168GY	EN4SD16168LG	16	16	8	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	21
EN4SD16208GY	EN4SD16208LG	16	20	8	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	25
EN4SD20128GY	EN4SD20128LG	20	12	8	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	22
EN4SD20168GY	EN4SD20168LG	20	16	8	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	25
EN4SD20208GY	EN4SD20208LG	20	20	8	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	28
EN4SD20248GY	EN4SD20248LG	20	24	8	16	1	Qtr Turn	EP2024	18.2	22.2	2	14	32
EN4SD24128GY	EN4SD24128LG	24	12	8	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	25
EN4SD24168GY	EN4SD24168LG	24	16	8	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24208GY	EN4SD24208LG	24	20	8	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	32
EN4SD24248GY	EN4SD24248LG	24	24	8	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	40
EN4SD24308GY	EN4SD24308LG	24	30	8	14	2	Qtr Turn	EP2430	22.2	28.2	2	18	48
EN4SD30128GY	EN4SD30128LG	30	12	8	14	2	Qtr Turn	EP3012	28.2	10.2	3	12	34
EN4SD30168GY	EN4SD30168LG	30	16	8	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	40
EN4SD30208GY	EN4SD30208LG	30	20	8	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	42
EN4SD30248GY	EN4SD30248LG	30	24	8	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	46
EN4SD30308GY	EN4SD30308LG	30	30	8	14	2	Qtr Turn	EP3030	28.2	28.2	3	12	67
EN4SD30368GY	EN4SD30368LG	30	36	8	14	2	Qtr Turn	EP3036	28.2	34.2	3	12	77
EN4SD36248GY	EN4SD36248LG	36	24	8	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	55
EN4SD36308GY	EN4SD36308LG	36	30	8	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	77
EN4SD36368GY	EN4SD36368LG	36	36	8	14	2	Qtr Turn	EP3636	34.2	34.2	3	15	94
EN4SD42248GY	EN4SD42248LG	42	24	8	14	1	3-point	EP4224	40.2	22.2	4	12	80
EN4SD42308GY	EN4SD42308LG	42	30	8	14	1	3-point	EP4230	40.2	28.2	4	12	95
EN4SD42368GY	EN4SD42368LG	42	36	8	14	1	3-point	EP4236	40.2	34.2	4	12	105
EN4SD48248GY	EN4SD48248LG	48	24	8	14	1	3-point	EP4824	46.2	22.2	4	14	110
EN4SD48308GY	EN4SD48308LG	48	30	8	14	1	3-point	EP4830	46.2	28.2	4	14	115
EN4SD48368GY	EN4SD48368LG	48	36	8	14	1	3-point	EP4836	46.2	34.2	4	14	120
EN4SD60368GY	EN4SD60368LG	60	36	8	14	1	3-point	EP6036	58.2	34.2	4	18	150
EN4SD161210GY	EN4SD161210LG	16	12	10	16	1	Qtr. Turn	EP1612	14.2	10.2	2	10	18
EN4SD161610GY	EN4SD161610LG	16	16	10	16	1	Qtr. Turn	EP1616	14.2	14.2	2	10	23
EN4SD162010GY	EN4SD162010LG	16	20	10	16	1	Qtr. Turn	EP1620	14.2	18.2	2	10	28
EN4SD201610GY	EN4SD201610LG	20	16	10	16	1	Qtr. Turn	EP2016	18.2	14.2	2	14	28
EN4SD202010GY	EN4SD202010LG	20	20	10	16	1	Qtr. Turn	EP2020	18.2	18.2	2	14	31
EN4SD202410GY	EN4SD202410LG	20	24	10	16	1	Qtr. Turn	EP2024	18.2	22.2	2	14	36
EN4SD241210GY	EN4SD241210LG	24	12	10	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	26
EN4SD241610GY	EN4SD241610LG	24	16	10	16	1	Qtr. Turn	EP2416	22.2	14.2	2	18	30

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

SECTION 21 - MASTER CONTROL PANEL EQUIPMENT

MASTER CONTROL PANEL ENCLOSURE - HAMMOND MODEL EN4SD42368

P3000 CPU - AUTOMATION DIRECT MODEL P3-550

16 POINT DC INPUT CARD - AUTOMATION DIRECT MODEL P3-16ND3

ANALOG COMBO CARD (8 IN 4 OUT) - AUTOMATION DIRECT MODEL P3-8AD4DA-1

16 POINT RELAY OUTPUT CARD - AUTOMATION DIRECT MODEL P3-16TR

TOUCH SCREEN 8 INCH COLOR - AUTOMATION DIRECT MODEL EA9-T8CL

CELLULAR 3G GATEWAY - STATIC IP HMI - AT&T - SIERRA WIRELESS MODEL LS300 / 1101489

MODEM ANTENNA - WILSON MODEL 301125

24VDC POWER SUPPLY - IDEC MODEL PS5R-D24

INTRINSIC SAFETY BARRIERS DIGITAL - MTL MODEL 7728+

INTRINSIC SAFETY BARRIERS ANALOG - MTL MODEL 7787+

INTRINSIC SAFETY RELAY - SYMCOM MODEL ISS-101

INTRINSIC SAFETY LEVEL CONTROL - SYMCOM MODEL ISS-102-ACI-MC

CONVERTER (PULSE TO 4-20mA) - LMI MODEL MP100

FLOW METER DISPLAY/TRANSMITTER - SIGNET MODEL 3-9900-1P

SIGNAL CONVERTER / ISOLATOR - DWYER MODEL SC4380

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Panel Sold Separately

Single Door with latching handle

Single Door with quarter turns

Single Door with 3-point latching handle and quarter turns

Application

- Designed to enclose electrical and/or electronic equipment and protect against harsh, industrial environments for wallmount applications.
- Impressive styling features like hidden hinges, attractive latching systems make the Eclipse a suitable addition to any high-tech equipment installation.
- A wide range of sizes and practical accessories make this product line a complete package.
- For high temperature applications, a gasket retainer may be required, please refer to factory.

Standards

- UL 508 Type 3R, 4, and 12
- CSA Type 3R, 4, and 12
- **Complies with**
  - NEMA Type 3R, 4, and 12
  - IEC 60529, IP66

Construction

- Formed 14 or 16 gauge steel.
- Smooth, continuously welded seams ground smooth.
- Door stiffeners are provided where required for increased strength and rigidity - designed to also permit additional mounting options.
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Doors may be easily removed for modifications and are interchangeable.
- Oil resistant gaskets are permanently secured.
- Collar studs provided for mounting inner panel.
- Includes hardware kit with panel mounting nuts and sealing washers for wall mounting holes.
- Bonding stud provided on door and grounding stud installed in enclosure
- Hinges are constructed from 304 stainless steel.
- Hinge pins are stainless steel.
- Quarter turn latch and 3 point handle (key lockable) are zinc diecast with black epoxy finish.

Finish

- Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with choice of ANSI 61 smooth Gray (GY) or RAL7035 textured light gray (LG).
- RAL7032 textured beige (CG) versions with gland plates are available as non-stock items.

Accessories

- Air conditioners...see page 387-405
- Blowers...see page 406
- Breather kits...see page 423
- DIN rails...see page 29
- DIN rail mounting kit...see page 29
- Door stop kit...see page 447
- Filter fans...see page 408-413
- Gland Plates...see page 441
- Heaters...see page 418-420
- Handles...see page 30
- Inner panel...see page 28
- Quarter turn inserts and keys...see page 30
- Literature pocket...see page 451
- Mounting foot kit...see page 30
- Swing frame...see page 29
- Swing panel...see page 28
- Replacement hinge pins...see page 28
- Replacement quarter turn assemblies...see page 30
- Thermostats...see page 421
- Touch up paint...see page 450
- UL/CSA approved hardware kit...see page 430
- Padlock Adapter (EPA)...see page 431

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

Quality Enclosures. Service Excellence.

Canada: 519.822.2960 or 905.456.3770 USA: 716.630.7030

Eclipse Series - NEMA 4, 12

Single Door Enclosures

Part No. (ANSI 61 Gray)	Part No. (RAL7035 Light Gray)	Overall Dimensions			Door/ Body Gauge	Latches		Opt. Panel Part No.	Panel Size		# Hinges	F	Ship Wt. Lbs.
		A	B	C		Qty	Type		D	E			
EN4SD12126GY	EN4SD12126LG	12	12	6	16	1	Qtr Turn	EP1212	10.2	10.2	2	6	12
EN4SD12246GY	EN4SD12246LG	12	24	6	16	1	Qtr Turn	EP1224	10.2	22.2	2	18	24
EN4SD16126GY	EN4SD16126LG	16	12	6	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16166GY	EN4SD16166LG	16	16	6	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	19
EN4SD16206GY	EN4SD16206LG	16	20	6	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	22
EN4SD20126GY	EN4SD20126LG	20	12	6	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	20
EN4SD20166GY	EN4SD20166LG	20	16	6	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	22
EN4SD20206GY	EN4SD20206LG	20	20	6	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	26
EN4SD20246GY	EN4SD20246LG	20	24	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	14	32
EN4SD24126GY	EN4SD24126LG	24	12	6	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	24
EN4SD24166GY	EN4SD24166LG	24	16	6	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24206GY	EN4SD24206LG	24	20	6	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	30
EN4SD24246GY	EN4SD24246LG	24	24	6	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	37
EN4SD30166GY	EN4SD30166LG	30	16	6	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	35
EN4SD30206GY	EN4SD30206LG	30	20	6	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	38
EN4SD30246GY	EN4SD30246LG	30	24	6	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	40
EN4SD36246GY	EN4SD36246LG	36	24	6	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	52
EN4SD36306GY	EN4SD36306LG	36	30	6	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	60
EN4SD12248GY	EN4SD12248LG	12	24	8	16	1	Qtr Turn	EP1224	10.2	22.2	2	6	25
EN4SD16128GY	EN4SD16128LG	16	12	8	16	1	Qtr Turn	EP1612	14.2	10.2	2	10	16
EN4SD16168GY	EN4SD16168LG	16	16	8	16	1	Qtr Turn	EP1616	14.2	14.2	2	10	21
EN4SD16208GY	EN4SD16208LG	16	20	8	16	1	Qtr Turn	EP1620	14.2	18.2	2	10	25
EN4SD20128GY	EN4SD20128LG	20	12	8	16	1	Qtr Turn	EP2012	18.2	10.2	2	14	22
EN4SD20168GY	EN4SD20168LG	20	16	8	16	1	Qtr Turn	EP2016	18.2	14.2	2	14	25
EN4SD20208GY	EN4SD20208LG	20	20	8	16	1	Qtr Turn	EP2020	18.2	18.2	2	14	28
EN4SD20248GY	EN4SD20248LG	20	24	8	16	1	Qtr Turn	EP2024	18.2	22.2	2	14	32
EN4SD24128GY	EN4SD24128LG	24	12	8	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	25
EN4SD24168GY	EN4SD24168LG	24	16	8	16	1	Qtr Turn	EP2416	22.2	14.2	2	18	26
EN4SD24208GY	EN4SD24208LG	24	20	8	16	1	Qtr Turn	EP2420	22.2	18.2	2	18	32
EN4SD24248GY	EN4SD24248LG	24	24	8	14	2	Qtr Turn	EP2424	22.2	22.2	2	18	40
EN4SD24308GY	EN4SD24308LG	24	30	8	14	2	Qtr Turn	EP2430	22.2	28.2	2	18	48
EN4SD30128GY	EN4SD30128LG	30	12	8	14	2	Qtr Turn	EP3012	28.2	10.2	3	12	34
EN4SD30168GY	EN4SD30168LG	30	16	8	14	2	Qtr Turn	EP3016	28.2	14.2	3	12	40
EN4SD30208GY	EN4SD30208LG	30	20	8	14	2	Qtr Turn	EP3020	28.2	18.2	3	12	42
EN4SD30248GY	EN4SD30248LG	30	24	8	14	2	Qtr Turn	EP3024	28.2	22.2	3	12	46
EN4SD30308GY	EN4SD30308LG	30	30	8	14	2	Qtr Turn	EP3030	28.2	28.2	3	12	67
EN4SD30368GY	EN4SD30368LG	30	36	8	14	2	Qtr Turn	EP3036	28.2	34.2	3	12	77
EN4SD36248GY	EN4SD36248LG	36	24	8	14	2	Qtr Turn	EP3624	34.2	22.2	3	15	55
EN4SD36308GY	EN4SD36308LG	36	30	8	14	2	Qtr Turn	EP3630	34.2	28.2	3	15	77
EN4SD36368GY	EN4SD36368LG	36	36	8	14	2	Qtr Turn	EP3636	34.2	34.2	3	15	94
EN4SD42248GY	EN4SD42248LG	42	24	8	14	1	3-point	EP4224	40.2	22.2	4	12	80
EN4SD42308GY	EN4SD42308LG	42	30	8	14	1	3-point	EP4230	40.2	28.2	4	12	95
EN4SD42368GY	EN4SD42368LG	42	36	8	14	1	3-point	EP4236	40.2	34.2	4	12	105
EN4SD48248GY	EN4SD48248LG	48	24	8	14	1	3-point	EP4824	46.2	22.2	4	14	110
EN4SD48308GY	EN4SD48308LG	48	30	8	14	1	3-point	EP4830	46.2	28.2	4	14	115
EN4SD48368GY	EN4SD48368LG	48	36	8	14	1	3-point	EP4836	46.2	34.2	4	14	120
EN4SD60368GY	EN4SD60368LG	60	36	8	14	1	3-point	EP6036	58.2	34.2	4	18	150
EN4SD161210GY	EN4SD161210LG	16	12	10	16	1	Qtr. Turn	EP1612	14.2	10.2	2	10	18
EN4SD161610GY	EN4SD161610LG	16	16	10	16	1	Qtr. Turn	EP1616	14.2	14.2	2	10	23
EN4SD162010GY	EN4SD162010LG	16	20	10	16	1	Qtr. Turn	EP1620	14.2	18.2	2	10	28
EN4SD201610GY	EN4SD201610LG	20	16	10	16	1	Qtr. Turn	EP2016	18.2	14.2	2	14	28
EN4SD202010GY	EN4SD202010LG	20	20	10	16	1	Qtr. Turn	EP2020	18.2	18.2	2	14	31
EN4SD202410GY	EN4SD202410LG	20	24	10	16	1	Qtr. Turn	EP2024	18.2	22.2	2	14	36
EN4SD241210GY	EN4SD241210LG	24	12	10	16	1	Qtr Turn	EP2412	22.2	10.2	2	18	26
EN4SD241610GY	EN4SD241610LG	24	16	10	16	1	Qtr. Turn	EP2416	22.2	14.2	2	18	30

Technical references and DXF downloads available at www.hammfg.com

All dimensions in inches unless specified otherwise

CPU Modules

P3-550	$599.00
P3-530	$419.00

The P3-550 Standard and P3-530 Basic are high-performance CPUs. Both have several communications ports which support USB, Ethernet and serial devices. The P3-550 also includes a 4 line x 10 character LCD, remote I/O capability and a USB programming port.

Each Productivity3000 system requires one CPU module mounted in the controller slot in the first base of the local base group. The CPU stores and executes the user's program.

The system can be expanded with the P3-RS, P3-RX or P3-EX modules when using the P3-550 CPU, or expanded with the P3-EX module when using the P3-530 CPU. The local, expansion, and remote I/O (P3-550 only) are assigned preconfigured or user-defined tagnames which can be easily referenced in the ladder logic program.

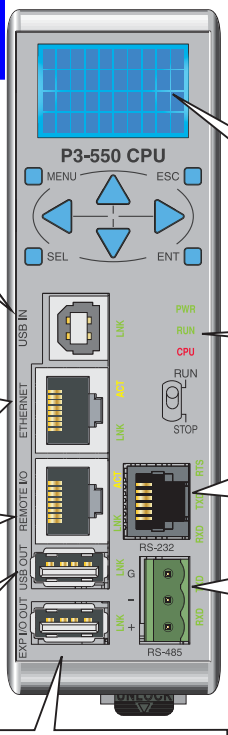
CPU Status Indicators

PWR	Green LED is illuminated when power is on
RUN	Green LED is illuminated when CPU is in RUN mode
CPU	Red LED is illuminated during power on reset, power down, or watch-dog time-out.

CPU Run/Stop Switch

RUN position	Executes user program, run-time edits possible
STOP position	Does not execute user program, normal program load position

P3-550



LCD
- 4 x 10 character
- 8 control buttons
- User defined messages
- User adjustable settings
- PAC system errors / information

USB 2.0 (Type B) Port
- Programming
- Online monitoring

CPU Status Indicators

10/100 MB Ethernet Port
- Programming
- Online monitoring
- Email (SMTP client)
- Modbus TCP Client and Server
- EtherNet/IP Scanner and Adapter

RS-232 Serial Port (RJ12)
- Modbus/ASCII (master or slave, half or full duplex) peripheral device

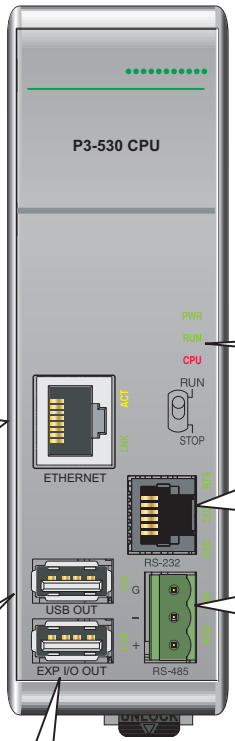
Local Ethernet Network
- GS Series drives
- Remote IO

RS-485 Serial Port (TB Style)
- Modbus/ASCII (master peripheral device or multiple slave devices) using the same protocol

USB 2.0 (Type A) Port
- USB Flash Drive data logger
- Project Transfer

USB 2.0 (Type A) Port
Local expansion bases (connect up to 4 expansion bases per base group)

P3-530



10/100 MB Ethernet Port
- Programming
- Online monitoring
- Email (SMTP client)
- Modbus TCP Client and Server

CPU Status Indicators

RS-232 Serial Port (RJ12)
- Modbus/ASCII (master or slave, half or full duplex) peripheral device

USB 2.0 (Type A) Port
- USB Flash Drive data logger

RS-485 Serial Port (TB Style)
- Modbus/ASCII (master peripheral device or multiple slave devices) using the same protocol

USB 2.0 (Type A) Port
Local expansion bases (connect up to 4 expansion bases per base group)

CPU Modules

Specifications

CPU Specifications	P3-550	P3-530
User Memory	50MB (Includes program, data and documention)	25MB (Includes program, data and documention)
Memory Type	Flash and Battery Backed RAM	
Retentive Memory	Models C3 and earlier: 100K Models D and later: 492K	492K
Scan Time	600µs (3K Boolean, 1K I/O)	
Display	LCD, 4x10 characters, backlit, 8 control buttons; LCD characters are 5x7 with a dot pitch of 0.45mm; 2.25mm x 3.15mm	N/A
Communications	**USB IN:** Programming, Monitoring, Debug, Firmware	N/A
	ETHERNET: (10/100Mbps Ethernet) Programming, Monitoring, Debug, Firmware, Email SMTP Client, Modbus TCP Client (32 slaves) and Server (32 masters), EtherNet/IP Scanner/Adapter (128 Scanner connections)	**ETHERNET:** (10/100Mbps Ethernet) Programming, Monitoring, Debug, Firmware, Email SMTP Client, Modbus TCP Client (32 slaves) and Server (32 masters)
	REMOTE I/O: (10/100Mbps Ethernet) 16 P3-RS/RX Remote Base Groups, and 32 GS Drives	N/A
	USB OUT: (2.0) Data Logging and Project Transfer using pen drive (SDCZ4-2048-A10 recommended)	**USB OUT:** (2.0) Data Logging using pen drive (SDCZ4-2048-A10 recommended)
	EXP I/O OUT: (2.0 Proprietary) 4 P3-EX Local Expansion Bases	
	RS-232: (RJ12, 1200-115.2k Baud) Modbus RTU, ASCII full or half duplex	
	RS-485: Removable Terminal Included, (1200-115.2k Baud) ASCII, Modbus	
Hardware Limits of System	**17 Base Groups** 1 Local (P3-550) + 16 Remote (P3-RS/RX) **5 Bases per Base Group** 1 P3-550 or P3-RS/RX + 4 Expansion (P3-EX) **85 Bases Total** 1 P3-550, 16 P3-RS/RX, & 68 P3-EX **59,840 Hardware I/O Points** (All 64-point I/O Modules) **32 GS Series Drives** as Remote I/O	**5 Bases Total** 1 P3-530 + 4 Expansion (P3-EX) **3,520 Hardware I/O Points** (All 64-point I/O Modules)
Instruction Types	Application Functions, Array Functions, Counters/Timers, Communications, Data Handlings, Drum Sequencers, Math Functions, PID, Program Control, String Functions, System Functions, High Speed I/O	
Real Time Clock Accuracy	+/-2s typical at 25°C +/-10s per day maximum at 60°C	

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F)
Storage Temperature	-20° to 70°C (-4° to 158°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Heat Dissipation	7W
Enclosure Type	Open Equipment
Agency Approvals	UL508 file E157382, Canada & USA UL1604 file E200031, Canada & USA CE (EN61131-2*) This equipment is suitable for use in Class 1, Division 2, Groups A, B, C and D or non-hazardous locations only.
Module Location	Controller slot in the local base in a Productivity3000 System
EU Directive	See the "EU Directive" topic in the Productivity3000 Help File. Information can also be obtained at: www.productivitypac.com
Weight	260g (9 oz)

*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

P3-550/P3-530 Product Comparison		
Item	**P3-550**	**P3-530**
LCD Display	✓	
USB Prog/Mon Port	✓	
Ethernet Port	✓	✓
EtherNet/IP Protocol	✓	
Remote Expansion Port	✓	
USB Memory Stick Port	✓	✓
USB Local Expansion Port	✓	✓
RS-232 RJ12 Port	✓	✓
RS-485 Port	✓	✓
User Memory	50 MB	25 MB

IMPORTANT!

Hot-Swapping Information
Note: This device cannot be Hot Swapped.

***NOTE**: To utilize the 492K of retentive memory in the P3-550 rev. D or later CPU, you must use Productivity3000 software version 1.0.7.XX and firmware version 1.1.13.XX or later.*

***NOTE:** When using the P3-530 CPU, you must use Productivity3000 software version 1.0.7.XX and firmware version 1.1.13.XX or later.*

***NOTE:** For EtherNet/IP support in the P3-550 CPU, you must use ProductivitySuite software version 1.10.0.11 and firmware version 1.1.15.97 or later.*

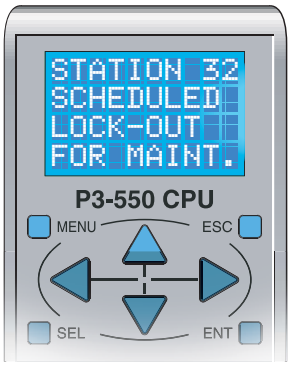
CPU Modules

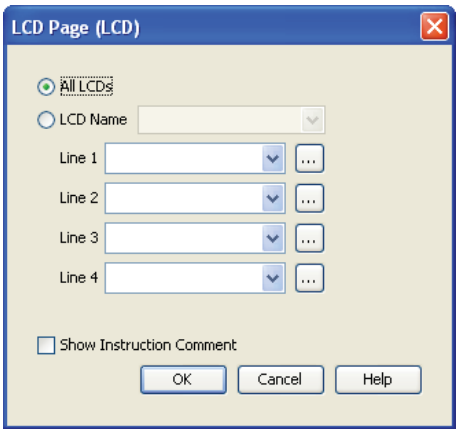
LCD Message Display (P3-550 only)

The P3-550 CPU incorporates a 4 line x 10 character LCD Display for system alarms and information or for displaying user-defined messages.

LCD control buttons located beneath the display allow the user to navigate through a menu, and arrow buttons allow for configuration of time and date settings.

For user-defined messages, the display is configured using the Productivity Suite Programming Software. An LCD Page instruction allows the user to program text into user-defined tags and display the messages based on the ladder execution.





CPU Installation

Step One:
Locate the two sockets next to the power supply; the CPU will be inserted into this location.

Step Two:
Insert the CPU at a 45° angle into the notch located at the top of the base and rotate down until seated.

Step Three:
Snap retaining tab into the locked position.

WARNING: **Explosion hazard – Do not connect or disconnect connectors or operate switches while circuit is live unless the area is known to be non-hazardous. Do not hot swap.**

Battery (Optional)

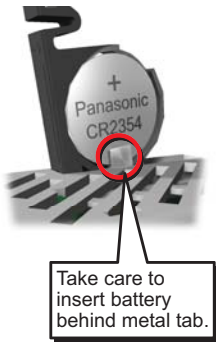
A battery is included with the P3-550 and P3-530 CPUs, but is not installed. The battery can be installed to retain the Time and Date along with any Tagname values that are set up as retentive.

The battery is not needed for program backup.

Battery (Optional)	
D2-BAT-1	Coin type, 3.0V Lithium battery, 560mA, battery number CR2354

Step One:
Press spring lock and swing battery compartment away from CPU.

Step Two:
Insert battery and close compartment.

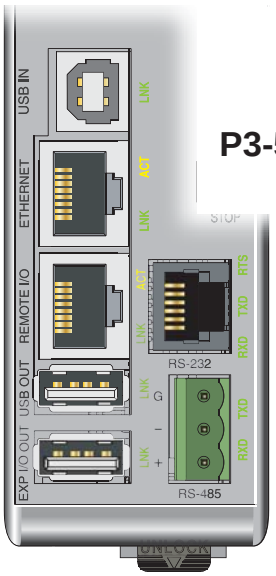


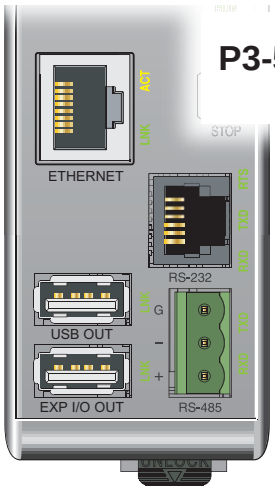
Take care to insert battery behind metal tab.

CPU Modules - Communications

Port Specifications

The P3-550 and P3-530 CPUs have several communications ports. The following pages list specifications and pin-out diagrams for these ports.

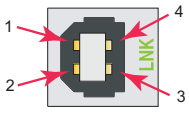




USB IN Port (P3-550 only)

Used exclusively for connecting to a PC running the Productivity Suite programming software.

USB Type B Slave Input Specifications	
Port Name	**USB IN**
Description	Standard USB 2.0 Slave input for programming and online monitoring, with built-in surge protection. Not compatible with older full speed USB devices.
Transfer Rate	480 Mbps
Port Status LED	Green LED is illuminated when LINK is established to programming software.
Cables	USB Type A to USB Type B: 3 ft. cable part # USB-CBL-AB3 6 ft. cable part # USB-CBL-AB6 10 ft. cable part # USB-CBL-AB10 15 ft. cable part # USB-CBL-AB15



Mating face of USB type B female

Pin #	Signal
1	+5
2	–Data
3	+Data
4	GND

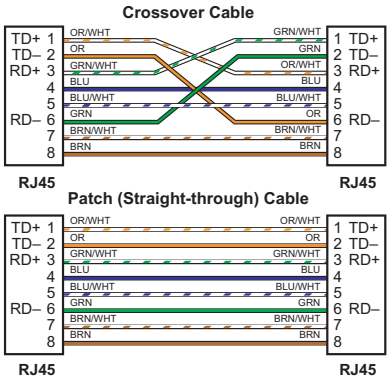
Ethernet Port

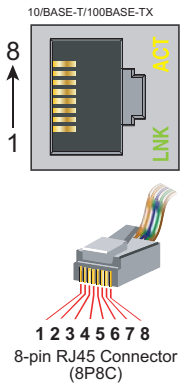
RJ-45 style connector used for:

- Connection to a PC running the Productivity Suite programming software
- EtherNet/IP Scanner (CPU is the originator, up to 128 connections, max 32 devices) *P3-550 only
- EtherNet/IP Adapter (CPU is the target, up to 16 connections, max 4 devices) *P3-550 only
- Modbus TCP Client connections (Modbus requests sent from the CPU)
- Modbus TCP Server connections (Modbus requests received by the CPU)
- Outgoing E-mail

Remote I/O Port (P3-550 only)

RJ-45 style connector used for connecting to a Remote I/O network consisting of P3-RS/P3-RX Remote Slaves and/or GS-EDRV100 units with GS drives.





Ethernet Specifications		
Port Name	**ETHERNET**	**REMOTE I/O (P3-550 only)**
Description	Standard transformer isolated Ethernet port with built-in surge protection for programming, online monitoring, Email (SMTP client), EtherNet/IP Scanner/Adapter and Modbus/TCP client/server connections (fixed IP or DHCP).	Standard transformer isolated Ethernet port with built-in surge protection for connection to the P3-RS/P3-RX Remote I/O system. Supports 16 Remote I/O slaves and 32 GS Series drives.
Transfer Rate	10/100 Mbps	
Port Status LED	Green LED illuminated when network LINK is established. Yellow LED is illuminated when port is active (ACT).	
Cables	Use a Patch (straight through) cable when a switch or hub is used. Use a Crossover cable when a switch or hub is not used. (Cables available at automationdirect.com)	

CPU Modules - Communications

Port Specifications

USB OUT Port

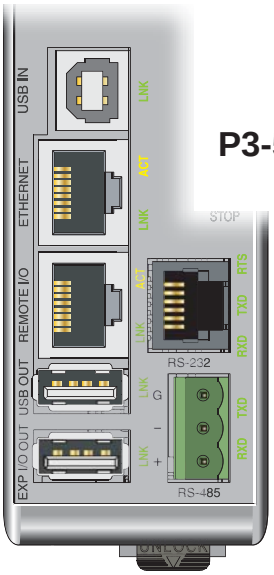
Used for data logging (P3-530) or data logging and project transfers (P3-550) to and from a SDCZ4-2048-A10 Pen Drive.

EXP I/O OUT Port

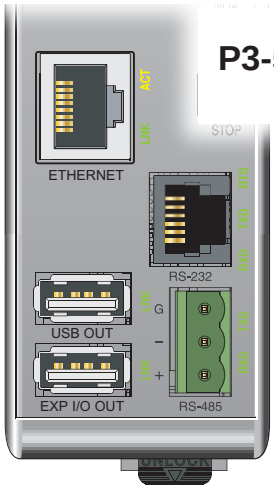
USB port used only for Expansion I/O connections to local P3-EX modules in a Productivity3000 base with I/O.

USB Type A Master Output Specifications

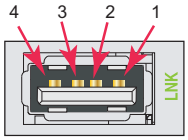
Port Name	USB OUT	EXP I/O OUT
Description	Standard USB 2.0 Master output for connection to high-speed Flash drive (Sandisk SDCZ4-2048-A10 recommended) for data logging (P3-550/P3-530) or program transfer (P3-550 only), with built-in surge protection. Not compatible with older full speed USB devices. A 0.5m male-to-female "port extender" cable is included to assist with Flash drive connection.	Proprietary USB 2.0 Master output for connection to up to four P3-EX local expansion bases, with built-in surge protection.
Transfer Rate	480 Mbps	
Port Status LED	Green LED is illuminated when LINK is established to connected device	
Cables	None required	USB Type A to USB Type B: 6 ft. cable part # P3-EX-CBL6 (included with P3-EX module)



P3-550



P3-530



Mating face of USB type A female

USB OUT

Pin #	Signal
1	+5
2	– Data
3	+ Data
4	GND

EXP I/O OUT

Pin #	Signal
1	Reset
2	– Data
3	+ Data
4	GND

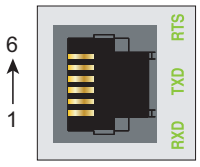
RS-232 Port

RJ-12 style connector used for:

- Modbus RTU Master connections
- Modbus RTU Slave connections
- ASCII full or half duplex communications
- Custom Protocol Incoming and Outgoing communications

RS-232 Specifications

Port Name	RS-232
Description	Non-isolated RS-232 DTE port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD and built-in surge protection.
Data Rates	Selectable,1200, 2400, 9600, 19200, 33600, 38400, 57600, and 115200 bps.
+5V Cable Power Source	210mA maximum at 5V, +/- 5%. Reverse polarity and overload protected.
TXD	RS-232 Transmit output
RXD	RS-232 Receive input
RTS	Handshaking output for modem control.
GND	Logic ground
Maximum Output Load (TXD/RTS)	3KΩ, 1,000pf
Minimum Output Voltage Swing	+/-5V
Output Short Circuit Protection	+/-15mA
Port Status LED	Green LED is illuminated when active for TXD, RXD and RTS
Cable Options	FA-ISOCON for converting RS-232 to isolated RS-485



6-pin RJ12 Female Modular Connector

Pin #	Signal	
1	GND	Logic Ground
2	+5V	210 mA Maximum
3	RXD	RS-232 Input
4	TXD	RS-232 Output
5	RTS	RS-232 Output
6	GND	Logic Ground

CPU Modules - Communications

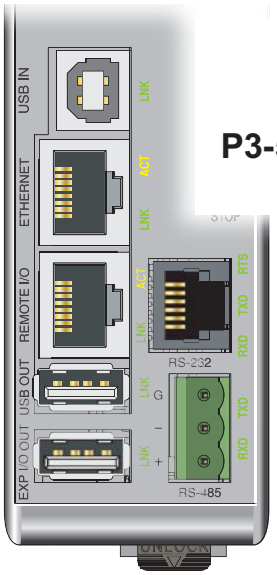
Port Specifications

RS-485 Port

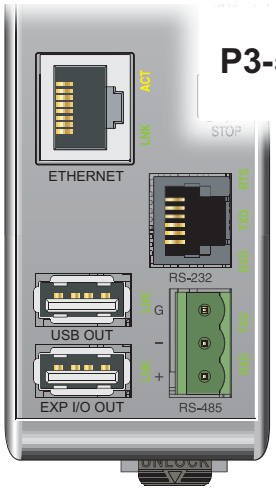
A 3-pin removable terminal block used for:

- Modbus RTU Master connections
- Modbus RTU Slave connections
- ASCII Incoming and Outgoing communications
- Custom Protocol Incoming and Outgoing communications

Removable connector included. Spare connectors available (part no. P3-RS485CON).

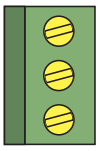


P3-550

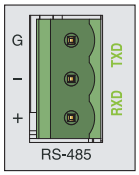


P3-530

RS-485 Port Specifications	
Port Name	**RS-485**
Description	Non-isolated RS-485 port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD/EFT protection and automatic echo cancellation when transmitter is active.
Data Rates	Selectable, 1200, 2400, 9600, 19200, 33600, 38400, 57600, and 115200 bps.
TXD+/RXD+	RS-485 transceiver high
TXD-/RXD-	RS-485 transceiver low
GND	Logic ground
Input Impedance	19KΩ
Maximum load	50 transceivers, 19KΩ each, 60Ω termination
Output Short Circuit Protection	+/- 250mA, thermal shut-down protection
Electrostatic Discharge Protection	+/-8KV per IEC1000-4-2
Electrical Fast Transient Protection	+/-2KV per IEC1000-4-4.
Minimum Differential Output Voltage	1.5V with 60Ω load
Fail safe inputs	Logic high input state if inputs are unconnected
Maximum Common Mode Voltage	-7.5V to 12.5V.
Port Status LED	Green LED illuminated when active for TXD and RXD
Cable Options	L19827-100 L19827-500 L19827-1000 Belden 9841 equivalent



Removable connector included. Spare connectors available (part no. P3-RS485CON).



Pin #	Signal
G	GND
–	TXD-/RXD-
+	TXD+/RXD+

Terminal Block Specifications	
Number of Positions	3
Pitch	5 MM
Wire Range	28-12AWG Solid Conductor 30-12AWG Stranded Conductor
Screw Driver Width	1/8 inch (3.175mm) maximum
Screw Size	M2.5
Screw Torque	4.5 Lb-in

DC Input Modules

P3-16ND3 $116.00

Sinking/Sourcing Input

The P3-16ND3 DC Input Module provides sixteen 12-24 VDC sinking or sourcing inputs with four isolated commons.

Terminal block sold separately; terminal block cover included with module.

We recommend using prewired *ZIP*Link cables and connection modules. See Wiring Solutions.

Terminal block cover included. If you wish to hand-wire your module, a removable terminal block is sold separately. Order part number P3-RTB.

Input Specifications

Inputs per Module		16 (sinking / sourcing)
Operating Voltage Range (Tolerance)	CE	12-24 VDC (± 10%)
	UL	12-24 VDC (± 10%)
Peak Voltage		26.4 VDC
Input Current (Typical)		5 mA @ 12 VDC 11 mA @ 24 VDC
Maximum Input Current @ Temp		12.5 mA @ 60° C (26.4 VDC)
Input Impedance		2.2k Ω @ 12-24 VDC
ON Voltage Level		> 10 VDC
OFF Voltage Level		< 3 VDC
Minimum ON Current		4 mA
Maximum OFF Current		2 mA
OFF to ON Response		Max. 2 ms Typical 1ms
ON to OFF Response		Max. 2 ms Typical 1ms
Status Indicators		Logic Side (16 points)
Terminal Type (not included)		20-position removable terminal block
Commons		4 Isolated (4 points / common)

General Specifications

Operating Temperature	0° to 60°C (32° to 140°F),
Storage Temperature	-20° to 70°C (-4° to 158°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Field to Logic Side Isolation	1500VAC applied for 1 minute
Insulation Resistance	>10MΩ @ 500 VDC
Heat Dissipation	5.61W
Enclosure Type	Open Equipment
Agency Approvals	UL508 file E157382, Canada & USA UL1604 file E200031, Canada & USA CE (EN61131-2*) This equipment is suitable for use in Class 1, Division 2, Groups A, B, C and D or non-hazardous locations only.
Module Keying to Backplane	Electronic
Module Location	Any I/O slot in any local, expansion, or remote base in a Productivity3000 System.
Field Wiring	Removable terminal block (not included). Use ZIPLink wiring system or optional terminal block. See Wiring Solutions.
EU Directive	See the "EU Directive" topic in the Productivity3000 Help File. Information can also be obtained at: www.productivitypac.com
Weight	80g (2.82 oz)

*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

Removable Terminal Block Specifications

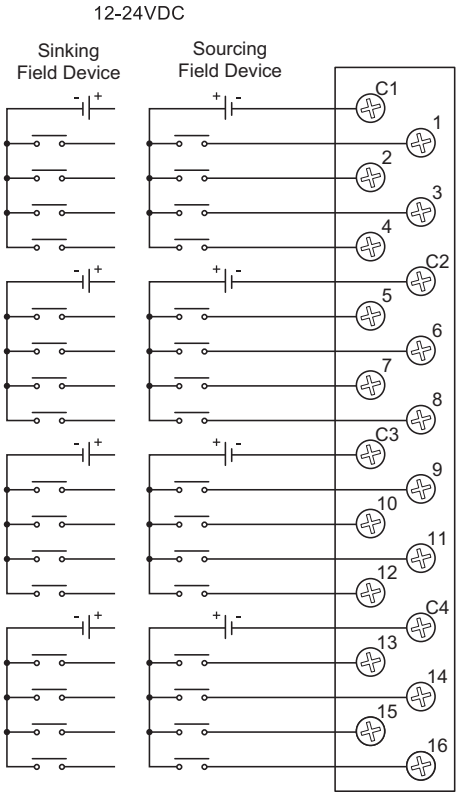
Description	Part No. P3-RTB; 20 screw terminals
Wire Range	22-14 AWG (0.324 to 2.08 sq. mm) Solid / stranded conductor 3/64 in. (1.2 mm) insulation maximum "USE COPPER CONDUCTORS , 60°C" or equivalent.
Screw Driver Width	1/4 inch (6.5 mm) maximum
Screw Size	M3 size
Screw Torque	Field terminals – 7 - 9 in./lb (.0.882 - 1.02 Nm) Self-jacking screws – 2.7 - 3.6 in./lb (0.3 - 0.4 Nm). Do not overtighten screws when installing terminal block.

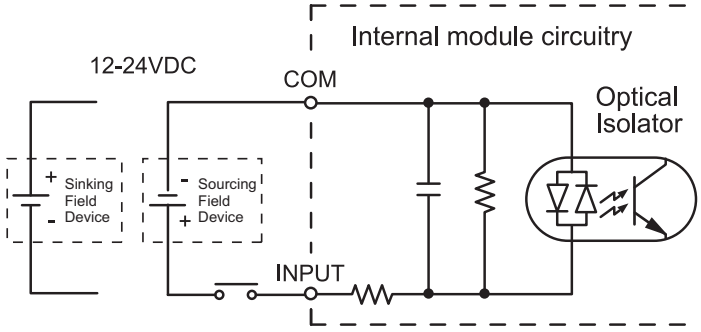
WARNING: Explosion hazard – Substitution of components may impair suitability for Class I, Division 2.

DC Input Modules

P3-16ND3 (cont'd)

Wiring Diagrams





Analog Input/Output Modules

P3-8AD4DA-1 $332.00

Current Analog Input/Output

The P3-8AD4DA-1 Current Analog Input/Output Module provides eight channels of current sinking 0-20mA inputs and four channels of current sourcing 4-20mA outputs.

Patent-pending LCD gives access to field signal values, as well as module and signal faults.

Terminal block sold separately; terminal block cover included with module.

Input Specifications

Input channels	8 (1 common)
Module Signal Input Range	0 - 20mA
Signal Resolution	12-16 bit, depending on input resolution
Input Resolution & Update Rate *See Note 1*	Fine: 7.1ms, 0.305µA, 16 bit Medium: 1.78ms, 1.22µA, 14 bit Coarse: 444µs, 4.88µA, 12 bit
Data Range	0-65535 counts
Input Type	Single Ended (one common)
Maximum Continuous Overload	±31mA
Input Impedance	250Ω ±0.1% ¼W
Hardware Filter Characteristics	Low pass 1st order, -3dB @ 48Hz
All Channel Update Rate *See Note 2*	Fine: 56.8ms Medium: 14.24ms Coarse: 3.55ms
All Channel Update Rate	56.8ms
Open Circuit Detection Time	Zero reading within 1s
Conversion Method	Successive approximation
Accuracy vs. Temperature	±15PPM / °C maximum
Maximum Inaccuracy	0.1% of range
Linearity Error (end to end)	0.015% of range maximum Monotonic with no missing codes
Input Stability and Repeatability	±0.015% of range (after 10 min. warm up)
Full Scale Calibration Error (not including offset)	±0.05% of range maximum
Offset Calibration Error	±.0.05% of range maximum
Maximum Crosstalk	-96 dB ±1 - 0.015% of full scale maximum
Recommended Fuse (external)	Edison S500-32-R, 0.032A fuse
External DC Power Required	24 VDC (-20% / + 25%), 183mA maximum

Note 1: The Input Resolution of Fine returns 16 bit resolution. Medium and Coarse are 14 and 12 bit respectively. The 12 and 14 bit input values are scaled to 0-65535.

Note 2: Valid when all channels are set for the same Input Resolution.

Output Specifications

Outputs per module	4 (1 common)
Module signal output range	4-20mA
Output Signal resolution	16-bit
Resolution Value of LSB (least significant bit)	0.244µA/count 1 LSB = 1 count
Data Range	0 - 65535 counts
Output Type	Current sourcing, 20mA max
Output Value in Fault Mode	≤ 4mA
Load Impedance (Minimum Ext. Power Supply)	0-480Ω (19.2 VDC) 0-600Ω (21.6 VDC) 0-715Ω (24.0 VDC) 0-840Ω (26.4 VDC) 0-1010Ω(30.0 VDC)
Maximum Inductive Load	1 mH
Allowed Load Type	Grounded
Maximum Inaccuracy	± 0.1% of range
Maximum Full Scale Calibration Error (not including offset error)	± 0.065% of full scale
Maximum Offset Calibration Error	± 0.065% of full scale
Accuracy vs. Temperature	±15 ppm/ °C maximum full scale calibration change (± 0.025% of range / °C)
Maximum Crosstalk	-96 dB
Linearity Error (end to end)	±0.015% of range maximum Monotonic with no missing codes
Output Stability and Repeatability	±.015% after 10 min. warm-up typical
Output Ripple	.01% of Full Scale at 50/60 Hz
Output Settling Time	Rising Time 200µs Falling Time 135µs (full scale change)
All Channel Update Rate	3.55 ms
Maximum Continuous Overload	Outputs open circuit protected
Type of Output Protection	Electronically current limited to 20mA or less
Output Signal (power-up, -down)	≤ 4mA

Removable Terminal Block Specifications

Description	Part No. P3-RTB; 20 screw terminals
Wire Range	22-14 AWG (0.324 to 2.08 sq. mm) Solid / stranded conductor 3/64 in. (1.2 mm) insulation maximum "USE COPPER CONDUCTORS , 60°C" or equivalent.
Screw Driver Width	1/4 inch (6.5 mm) maximum
Screw Size	M3 size
Screw Torque	Field terminals – 7 - 9 in./lb (.0.882 - 1.02 Nm) Self-jacking screws – 2.7 - 3.6 in./lb (0.3 - 0.4 Nm). Do not overtighten screws when installing terminal block.

We recommend using prewired *ZIP*Link cables and connection modules. See Wiring Solutions.

Terminal block cover included. If you wish to hand-wire your module, a removable terminal block is sold separately. Order part number P3-RTB.

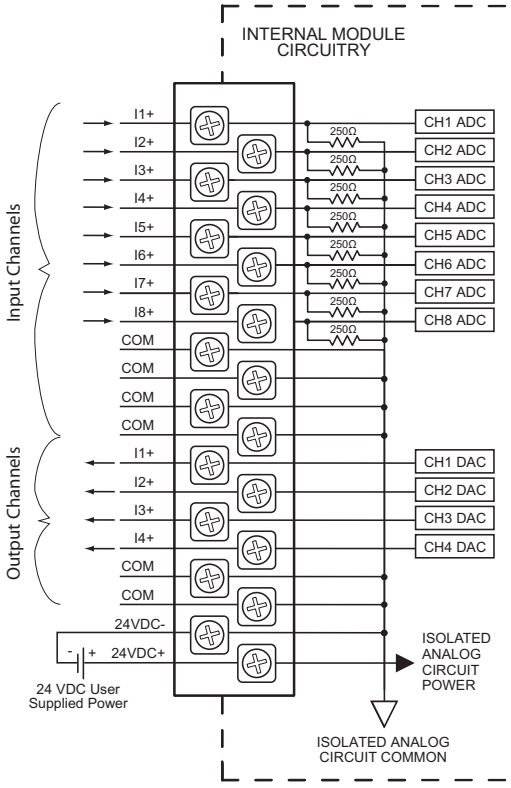
Analog Input/Output Modules

P3-8AD4DA-1 (cont'd)

General Specifications	
Operating Temperature	0° to 60°C (32° to 140°F),
Storage Temperature	-20° to 70°C (-4° to 158°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Field to Logic Side Isolation	1800VAC applied for 1 second
Insulation Resistance	>10MΩ @ 500 VDC
Heat Dissipation	3.8 W
Enclosure Type	Open Equipment
Agency Approvals	UL508 file E157382, Canada & USA UL1604 file E200031, Canada & USA CE (EN61131-2*) This equipment is suitable for use in Class 1, Division 2, Groups A, B, C and D or non-hazardous locations only.
Module Keying to Backplane	Electronic
Module Location	Any I/O slot in any local, expansion, or remote base in a Productivity3000 System.
Field Wiring	Removable terminal block (not included). Use *ZIP*Link wiring system or optional terminal block. See Wiring Solutions.
EU Directive	See the "EU Directive" topic in the Productivity3000 Help File. Information can also be obtained at: www.productivitypac.com
Terminal Type (not included)	20-position removable terminal block
Weight	106.9g (3.76 oz)

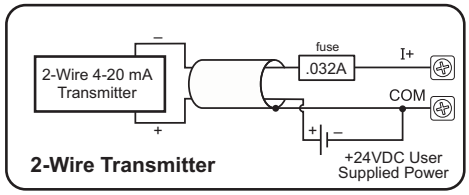
*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

WARNING: Explosion hazard – Substitution of components may impair suitability for Class I, Division 2.

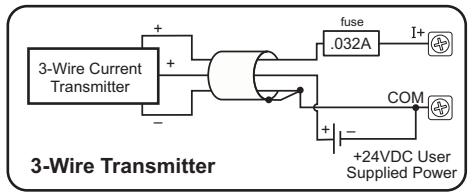


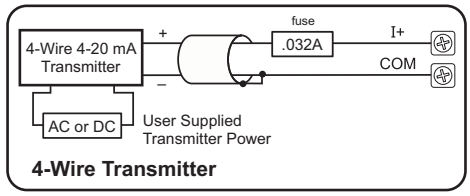
Note: This module includes input and output channels. Before connecting field wiring, verify that you are connecting to the appropriate terminals.

Current Input Circuits



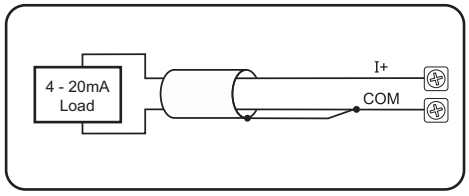
An Edison S500-32-R 0.032A fast-acting fuse is recommended for all current loops.





Note: Do not connect both ends of shield.

Current Output Circuits



Note: Shield is connected to common at the source device.

Relay Output Modules

P3-16TR $135.00

Relay Output

The P3-16TR Relay Output Module provides sixteen 1.25A relay outputs with two isolated fused commons.

Terminal block sold separately; terminal block cover included with module.

Typical Relay Life

Voltage & Type of Load	Load Current 1.25A
30VDC Resistive	240K
30VDC Solenoid	110K
120VAC Resistive	320K
120VAC Solenoid	210K
240VAC Resistive	240K
240VAC Solenoid	140K

We recommend using prewired *ZIP*Link cables and connection modules. See Wiring Solutions.

Terminal block cover included. If you wish to hand-wire your module, a removable terminal block is sold separately. Order part number P3-RTB.

Output Specifications

Outputs per Module		16
Operating Voltage Range (Tolerance)	(CE)	6.25 - 24 VDC (-15% / + 20%) 6 - 240 VAC (-15% / + 10%)
	(UL)	6 - 27 VDC (-15% / + 10%) 6 - 240 VAC (-10% / + 10%)
Output type		Relay, form A (SPST)
AC Frequency		47 - 63 Hz
Maximum Output Current @ Temp		1.25A / point, 6.3A / common @ 60°C for both AC and DC
Minimum Load Current		5 mA @ 5 VDC
Maximum Inrush Current		4A for 10 ms
OFF to ON Response		≤ 10 ms
ON to OFF Response		≤ 10 ms
Status Indicators		Logic Side (16 points)
Error Status Indicator		Blown Fuse (one for each common)
Terminal Type (not included)		20-position removable terminal block
Commons per module		2 Isolated (8 point / common)
Fuses		6.3A user replaceable fuse per common For replacement, order P3-FUSE-2. (Qty. 5/pkg.)

General Specifications

Operating Temperature	0° to 60°C (32° to 140°F),
Storage Temperature	-20° to 70°C (-4° to 158°F)
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gases permitted
Vibration	IEC60068-2-6 (Test Fc)
Shock	IEC60068-2-27 (Test Ea)
Field to Logic Side Isolation	1500VAC applied for 1 minute
Insulation Resistance	>10MΩ @ 500 VDC
Heat Dissipation	3.93W
Enclosure Type	Open Equipment
Agency Approvals	UL508 file E157382, Canada & USA UL1604 file E200031, Canada & USA CE (EN61131-2*) This equipment is suitable for use in Class 1, Division 2, Groups A, B, C and D or non-hazardous locations only.
Module Keying to Backplane	Electronic
Module Location	Any I/O slot in any local, expansion, or remote base in a Productivity3000 System.
Field Wiring	Removable terminal block (not included). Use *ZIP*Link wiring system or optional terminal block. See Wiring Solutions.
EU Directive	See the "EU Directive" topic in the Productivity3000 Help File. Information can also be obtained at: www.productivitypac.com
Weight	160g (5.64 oz)

*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

WARNING: Explosion hazard – Substitution of components may impair suitability for Class I, Division 2.

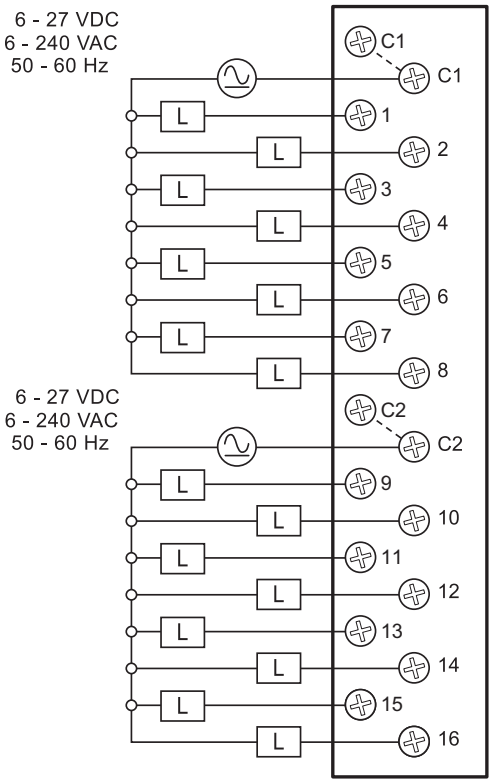
Removable Terminal Block Specifications

Description	Part No. P3-RTB; 20 screw terminals
Wire Range	22-14 AWG (0.324 to 2.08 sq. mm) Solid / stranded conductor 3/64 in. (1.2 mm) insulation maximum "USE COPPER CONDUCTORS , 60°C" or equivalent.
Screw Driver Width	1/4 inch (6.5 mm) maximum
Screw Size	M3 size
Screw Torque	Field terminals – 7 - 9 in./lb (.0882 - 1.02 Nm) Self-jacking screws – 2.7 - 3.6 in./lb (0.3 - 0.4 Nm). Do not overtighten screws when installing terminal block.

Relay Output Modules

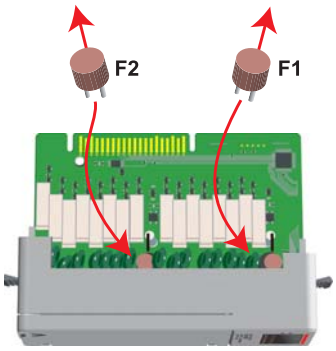
P3-16TR (cont'd)

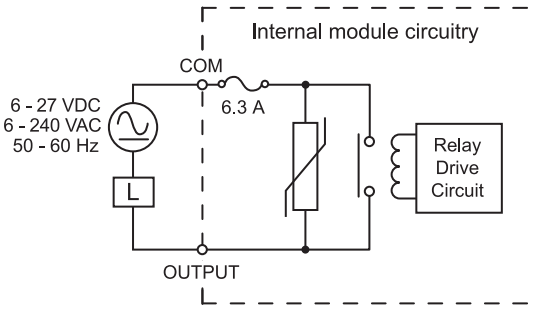
Wiring Diagrams



Replaceable Fuses

Order Part Number P3-FUSE-2. (Qty. 5 per pkg.) One spare included with this module.





C-more Operator Panels Overview

Getting started

Installing the software and configuring the *C-more* panel is simple. You will need the following to successfully connect, configure and send a project to the panel:

- ***C-more*** touch panel - 6", 8", 10", 12" or 15" model
- ***C-more*** Programming Software, p/n EA9-PGMSW
- ***C-more*** programming cable, USB or Ethernet
- 12-24 VDC switching power supply or the optional ***C-more*** AC Power Adapter, p/n EA-AC
- Personal Computer - to run ***C-more*** programming software
- PLC communications cable (serial or Ethernet) to connect the ***C-more*** Touch Panel to your controller

Part Number	Description	Price
EA9-T6CL-R	***C-more*** EA9 series touch screen interface panel, 6-inch color TFT (5.7 inch viewable screen), base model, 64k colors, 320 x 240 pixel QVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (1) serial port, USB 2.0 Type A and B ports, supports SD memory card, no Ethernet support. Compatible with EA9-PGMSW programming software version 5.0 or later.	<--->
EA9-T6CL	***C-more*** EA9 series touch screen interface panel, 6-inch color TFT (5.7 inch viewable screen), 64k colors, 320 x 240 pixel QVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later.	<--->
EA9-T8CL	***C-more*** EA9 series touch screen interface panel, 8-inch color TFT (8.4 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later.	<--->
EA9-T10CL	***C-more*** EA9 series touch screen interface panel, 10-inch color TFT (10.4 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later.	<--->
EA9-T12CL	***C-more*** EA9 series touch screen interface panel, 12-inch color TFT (12.1 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports (2) SD memory cards. Includes HDMI video out. Compatible with EA9-PGMSW programming software version 5.0 or later.	<--->
EA9-T15CL	***C-more*** EA9 series touch screen interface panel, 15-inch color TFT (15 inch viewable screen), 64k colors, 1024 x 768 pixel XGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB <None>2.0 Type A and B ports and Ethernet port; supports (2) SD memory cards. Includes HDMI video out. Compatible with EA9-PGMSW programming software version 5.0 or later.	<--->
EA9-PGMSW	***C-more*** Windows-based programming software on CD for the ***C-more*** EA9 series touch panels. Requires Windows XP Pro 32-bit, Windows 7 (Pro, Ultimate, 32 or 64-bit) or Windows 8 (Pro, Ultimate, 32 or 64-bit). Requires USB or Ethernet connection to touch panel. Cables sold separately. (Does not support ***C-more*** EA7 series panels.)	<--->
USB-CBL-AB3	Standard 3-ft. (0.9m) USB 2.0 cable, A-type connector to B-type connector, used to connect personal computer to any ***C-more*** touch panel for setup and programming. (Note: Touch panels require a power source for configuration and operation.)	<--->
USB-CBL-AB6	Standard 6-ft. (1.8m) USB 2.0 cable, A-type connector to B-type connector, used to connect personal computer to any ***C-more*** touch panel for setup and programming. (Note: Touch panels require a power source for configuration and operation.)	<--->
USB-CBL-AB10	Standard 10-ft (3 meter) USB 2.0 cable, A-type connector to B-type connector, used to connect personal computer to any ***C-more*** touch panel for setup and programming. (Note: Touch panels require a power source for configuration and operation.)	<--->
USB-CBL-AB15	Standard 15-ft. (4.6m) USB 2.0 cable, A-type connector to B-type connector, used to connect personal computer to any ***C-more*** touch panel for setup and programming. (Note: Touch panels require a power source for configuration and operation.)	<--->

C-more Selection Guide & Specifications

Specification \ Model	6" TFT color w/ base features	6" TFT color w/ full features	8" TFT color w/ full features	10" TFT color w/ full features	12" TFT color w/ full features	15" TFT color w/ full features
Part Number	EA9-T6CL-R	EA9-T6CL	EA9-T8CL	EA9-T10CL	EA9-T12CL	EA9-T15CL
Price	<--->	<--->	<--->	<--->	<--->	<--->
Display Actual Size and Type	5.7" TFT color		8.4" TFT color	10.4" TFT color	12.1" TFT color	15.0" TFT color
Display Viewing Area	4.54" x 3.40" [115.2 mm x 86.4 mm]		6.71" x 5.03" [170.4 mm x127.8mm]	8.31" x 6.24" [211.2 mm x 158.4 mm]	9.69" x 7.26" [246.0 mm x 184.5 mm]	11.97" x 8.98" [304.1 mm x 228.0 mm]
Weight	1.56 lb [710g]	1.59 lb [720g]	2.93 lb [1330g]	4.19 lb [1900g]	4.89 lb [2200g]	6.50 lb [2950g]
Screen Pixels	320 x 240 (QVGA)		800 x 600 (SVGA)			1024 x 768 (XGA)
Display Brightness	280 nits (typ)		310 nits (typ)	280 nits (typ)		
LCD Panel Dot Pitch	0.18 mm x 0.18 mm		0.213 mm x 0.213 mm	0.264 mm x 0.264 mm	0.3075 mm x 0.3075 mm	0.297 mm x 0.297 mm
Color Scale	65,536 colors					
Backlight Average Lifetime*	50,000 hours @ 25°C					
Touch Panel Type	Four-wire analog resistive					
Project Memory	26MB				82MB	
Number of Screens	Up to 999 screens – limited by project memory					
Realtime Clock	Realtime Clock Built into panel, backed up for 30 days at 25°C					
Calendar - Month / Day / Year	Yes - monthly deviation 60 sec (Reference)					
Serial Port 1	15-pin D-sub female - RS232C, RS-422/485					
Serial Port 2	N/A	3-wire terminal block - RS-485				
Serial Port 3	N/A	RJ-12 modular jack - RS-232C				
USB Port - Type B	USB 2.0 High speed (480 Mbps) Type B - Download/Program					
USB Port - Type A	USB 2.0 High speed (480 Mbps) Type A -for USB device options					
Ethernet Port	N/A	Ethernet Port Ethernet 10/100 Base-T, auto MDI/MDI-X				
Audio Line Out	N/A	3.5 mm mini jack – requires amplifier and speaker(s)				
Mic In	N/A	3.5 mm mini jack				
SD Card Slot	1 slot supports max 2 GB (SD,) max 32 GB (SDHC)				2 slots support max 2 GB (SD), max 32 GB (SDHC)	
HDMI Out	N/A				Yes	
Supply Power	12-24 VDC Class 2, or use the AC/DC Power Adapter, EA-AC, to power the touch panel from a 100-240 VAC, 50/60 Hz power source. Reverse Polarity Protected					
Power Consumption	16.0 W 1.30 A @ 12VDC 0.66 A @ 24VDC		18.0 W 1.50 A @ 12VDC 0.75 A @ 24VDC	18.0 W 1.50 A @ 12VDC 0.75 A @ 24VDC	21.0 W 1.75 A @ 12VDC 0.88 A @ 24VDC	29.0 W 2.40 A @ 12VDC 1.20 A @ 24VDC
Internal Fuse (non-replaceable)	4.0 A		6.3 A			
Operating Temperature	0 to 50 °C (32 to 122 °F) Maximum surrounding air temperature rating: 50°C (122°F) IEC 60068-2-14 (Test Nb, Thermal Shock)					
Storage Temperature	–20 to +60°C (–4 to +140 °F) IEC 60068-2-1 (Test Ab, Cold) IEC 60068-2-2 (Test Bb, Dry Heat) IEC 60068-2-14 (Test Na, Thermal Shock)					
Humidity	5–95% RH (non-condensing)					
Environment	For use in Pollution Degree 2 environment, no corrosive gases permitted					
Noise Immunity	NEMA ICS3-304 (EN61131-2) RFI, (145MHz, 440Mhz 10W @ 10cm) Impulse 1000V @ 1mS pulse EN61000-4-2 (ESD), EN61000-4-3 (RFI) EN61000-4-4 (FTB) EN61000-4-5 (Serge) EN61000-4-6 (Conducted) EN61000-4-8 (Power frequency magnetic field immunity)					
Withstand Voltage	1000 VAC, 1 min. (FG to Power supply)					
Insulation Resistance	> 10M ohm @ 500VDC (FG to Power supply)					
Vibration	IEC60068-2-6 (Test Fc)					
Shock	IEC60068-2-27 (Test Ea)					
Emission	EN55011 Class A (Radiated RF emission)					
Enclosure	NEMA 250 type 4/4X indoor use only UL50 type 4X indoor use only IP-65 indoor use only (When mounted correctly)					
Agency Approvals	UL508, E157382 CE (EN61131-2), RoHS (2011/65/EU) CUL Canadian C22.2					

**** NOTE: The backlight average lifetime is defined as the average usage time it takes before the brightness becomes 50% of the initial brightness. The lifetime of the backlight depends on the ambient temperature. The lifetime will decrease under low or high temperature usage.***

C-more 8" TFT Color Touch Panel - Full Model

Part No. EA9-T8CL

C-more EA9 series touch screen interface panel, 8-inch color TFT (8.4 inch viewable screen), 64k colors, 800 x 600 pixel SVGA screen resolution, 800 MHz CPU, 12-24 VDC powered, NEMA 4/4X, IP65 (when mounted correctly; for indoor use only), non-replaceable LED backlight. Includes (3) serial ports, USB 2.0 Type A and B ports and Ethernet port; supports SD memory card. Compatible with EA9-PGMSW programming software version 5.0 or later.

<---->

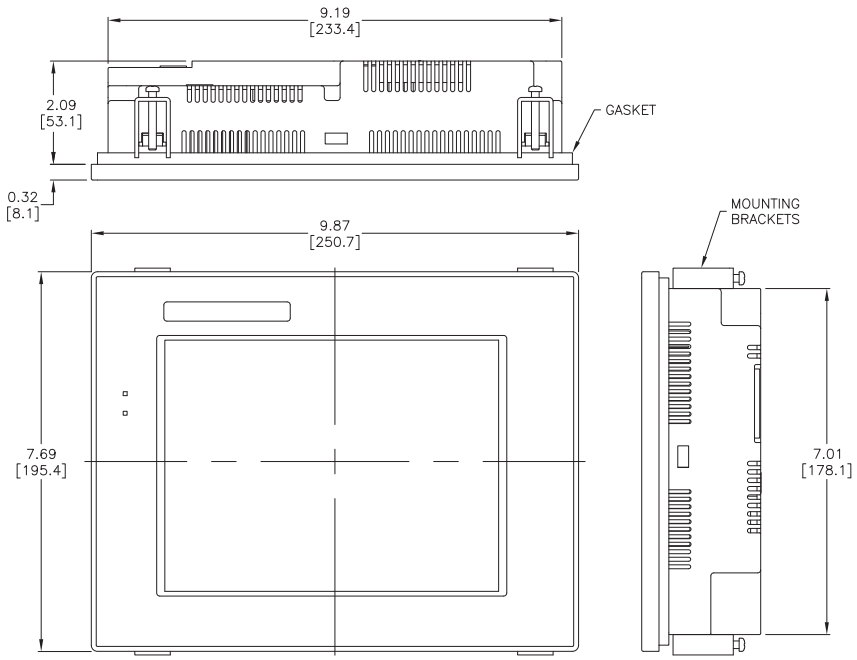
Features

- 8.4" diagonal color TFT (Thin Film Transistor) LCD display with 64K colors
- 800 x 600 pixel resolution
- 310 NITS display brightness
- 50,000 hour average backlight half-life
- Analog resistive (1024 X 1024) touch screen allowing unlimited touch areas
- USB port B (program/download) and USB port A (USB device options)
- Ethernet 10/100 Base-T port (program/download & PLC communication)
- Remote Internet Access
- Serial PLC interface (RS-232/422/485)
- One built-in SD memory card slot
- 12–24 VDC powered, 110VAC power adapter (optional)
- Audio Line Out, stereo - requires amplifier and speaker(s)
- Microphone in
- 26MB project memory
- Data logging
- 0 to 50°C [32 to 122°F] operating temperature range
- NEMA 4/4X, IP65 compliant when mounted correctly, indoor use only
- Slim design saves panel space
- UL, cUL CE agency approvals
- 2-year warranty from date of purchase

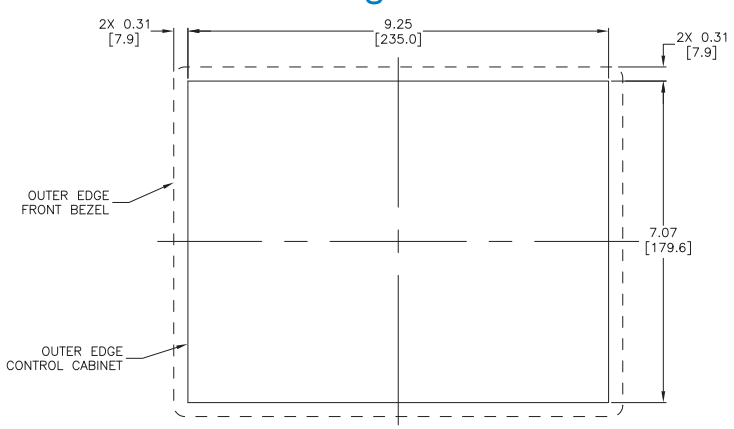
Function	Available
Ethernet	Yes
USB	Yes
SD Card	Yes
Audio Out	Yes
Mic In	Yes
HDMI Out	No

Dimensions

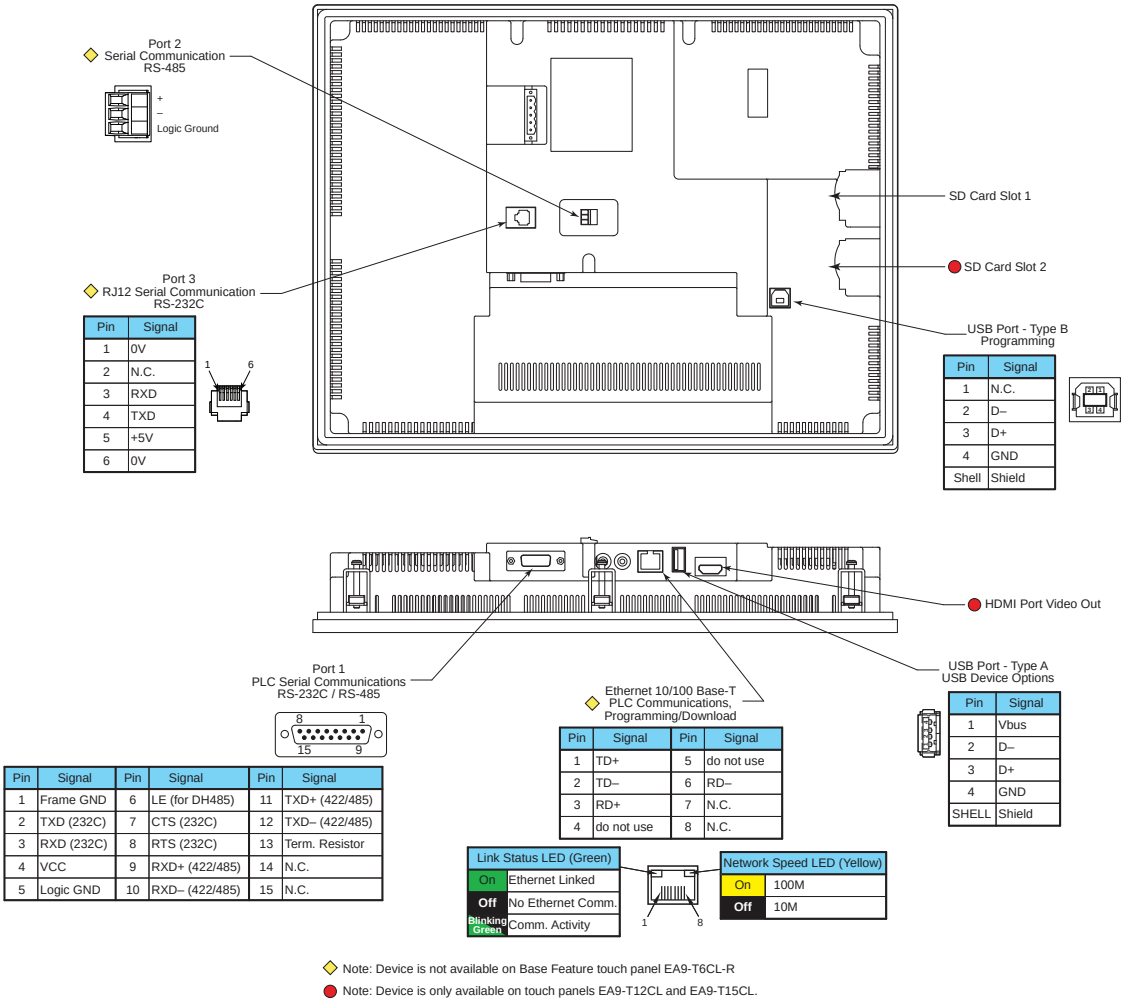
inches / [mm]



Mounting Cutout



C-more Communication Ports



Pin	Signal
1	0V
2	N.C.
3	RXD
4	TXD
5	+5V
6	0V

Pin	Signal
1	N.C.
2	D–
3	D+
4	GND
Shell	Shield

Pin	Signal	Pin	Signal	Pin	Signal
1	Frame GND	6	LE (for DH485)	11	TXD+ (422/485)
2	TXD (232C)	7	CTS (232C)	12	TXD– (422/485)
3	RXD (232C)	8	RTS (232C)	13	Term. Resistor
4	VCC	9	RXD+ (422/485)	14	N.C.
5	Logic GND	10	RXD– (422/485)	15	N.C.

Pin	Signal	Pin	Signal
1	TD+	5	do not use
2	TD–	6	RD–
3	RD+	7	N.C.
4	do not use	8	N.C.

Pin	Signal
1	Vbus
2	D–
3	D+
4	GND
SHELL	Shield

Note: Device is not available on Base Feature touch panel EA9-T6CL-R

Note: Device is only available on touch panels EA9-T12CL and EA9-T15CL.

Ethernet Port

The Ethernet port has several uses:

- **Download program to panel**
- **Communicate to PLCs/PCs**
- **Send e-mail**
- **Access FTP server**
- **Act as a Web server**
- **Remote Internet Access**

The Ethernet port has an RJ-45 8-wire modular connector with green and yellow LEDs.

- **The yellow LED indicates network speed; off for a 10 Mbps connection and illuminated for a 100 Mbps connection.**
- **The green LED indicates link status and illuminates when a link is established.**

Note: The base panels (-R part numbers) do not include an Ethernet port, and do not have these capabilities.

USB Port B

Program *C-more* via the USB programming port. It's fast and easy, with no baud rate settings, parity, or stop bits to worry about. We stock standard USB cables for your convenience. USB Port B can be used to upload or download projects to and from a PC.

USB Port A

The Universal Serial Bus (USB) Port A is a standard feature for all models and can be used to connect various USB HID (Human Input Device) devices to the panel, such as:

- **USB pen drives, (USB-FLASH)**
- **USB keyboards**
- **USB barcode scanners**
- **USB card scanners**

C-more can log data to the USB pen drive as well as load projects to the panel from the pen drive. You can also back up project files and panel firmware.

Sound Interface (Audio Line Out)

When attached to an amplifier and speaker(s), *C-more* can play warning sounds or pre-recorded messages such as: "conveyor is jammed". *C-more* supports WAV type files. The output is stereo.

Serial Port

Port 1 - Connect to your serial controller network via Port 1. Port 1 is a 15-pin port that supports RS-232 or RS-422/485.

Port 2 - Connect your RS-485 network via Port 2. Port 2 is provided with a 3-wire removable terminal block.

Port 3 - Connect to your RS-232C device via Port 3. Port 3 is an RJ12 connection.

HDMI Port

EA9-T12CL and EA9-T15CL include an HDMI Type A port to provide video output to a projector or remote monitor.

C-more Communication Protocols & Cables

Compatibility Table			
PLC Family	**Model**		**Protocols**
Allen-Bradley	MicroLogix 1000/1100/1200/1400/1500, SLC 5-/01/02/03, PLC5		DH485/AIC/AIC+
	MicroLogix 1000, 1100, 1200 and 1500		DF1 Half Duplex; DF1 Full Duplex
	SLC 5-/03/04/05		
	ControlLogix™, CompactLogix™, FlexLogix™		
	PLC-5		DF1 Full Duplex
	ControlLogix, CompactLogix, FlexLogix - Tag Based		DF1 Half Duplex; DF1 Full Duplex
	ControlLogix, CompactLogix, FlexLogix - Generic I/O Messaging		EtherNet/IP Server
	ControlLogix, CompactLogix, FlexLogix - Tag Based		EtherNet/IP Client
	MicroLogix 1100 & SLC 5/05, both via native Ethernet port		
	MicroLogix 1000, 1100, 1200, 1400,1500 & SLC 5-03/04/05, all via ENI Adapter		
	Micro 800 series		Modbus RTU
			Modbus TCP
Modbus TCP/IP	Modbus TCP/IP devices		Modbus TCP/IP
GE	90/30, 90/70, Micro 90, VersaMax Micro		SNPX
Mitsubishi	FX Series		FX Direct
	Q02, Q02H, Q06H, Q12H, Q25H		Q CPU
	Q, QnA Serial		QnA Serial
	Q, QnA Ethernet		QnA Ethernet
Omron	C200 Adapter, C500		Host Link
	CJ1/CS1 Serial, CJ1/CS1 Ethernet		FINS
Modicon	984 CPU, Quantum 113 CPU, AEG Modicon Micro Series 110 CPU: 311-xx, 411-xx, 512-xx, 612-xx		Modbus RTU
Siemens	S7-200 CPU, RS-485 Serial		PPI
	S7-200 CPU, S7-300 CPU, S7-400, S7-1200 CPU; Ethernet		Ethernet ISO over TCP
Productivity Series	Productivity3000 Serial (P3-550)		AutomationDirect P3000 Serial
	Productivity3000 Ethernet (P3-550)		AutomationDirect P3000 Ethernet
Do-more	all		Do-more Serial
			Do-more Ethernet
CLICK	all		AutomationDirect Modbus (CLICK)
***Direct*LOGIC**	DL05/DL06	all	K-Sequence
			***Direct*NET**
			Modbus (Koyo addressing)
		H0-ECOM/H0-ECOM100	***Direct*LOGIC Ethernet**
	DL105	all	K-Sequence
	DL205	D2-230	K-Sequence
		D2-240	K-Sequence
			***Direct*NET**
		D2-250/D2-250-1/D2-260	K-Sequence
			***Direct*NET**
			Modbus (Koyo addressing)
		D2-240/D2-250-1/D2-260 using D2-DCM	***Direct*NET**
			Modbus (Koyo addressing)
		H2-ECOM/H2-ECOM100	***Direct*LOGIC Ethernet**
	DL305	D3-330/330P (Requires the use of a Data Communications Unit)	***Direct*NET**
		D3-340	***Direct*NET**
		D3-350	K-Sequence
			***Direct*NET**
			Modbus (Koyo addressing)
		D3-350 using D3-DCM	***Direct*NET**
			Modbus (Koyo addressing)
	DL405	D4-430	K-Sequence
			***Direct*NET**
		D4-440	K-Sequence
			***Direct*NET**
		D4-450	K-Sequence
			***Direct*NET**
			Modbus (Koyo addressing)
		All with D4-DCM	***Direct*NET**
			Modbus (Koyo addressing)
		H4-ECOM/H4-ECOM100	***Direct*LOGIC Ethernet**
	H2-WinPLC (Think & Do) Live V5.2 or later and Studio any version		Think & Do Modbus RTU (serial port)
	H2-WinPLC (Think & Do) Live V5.5.1 or later and Studio V7.2.1 or later		Think & Do Modbus TCP/IP (Ethernet port)

Cable Description	Cable Part Number	Price
AutomationDirect Productivity Series, Do-more, CLICK, ***Direct*LOGIC PLC RJ-12 port, DL05, DL06, DL105, DL205, D3-350, D4-450 & H2-WinPLC (RS-232C)	***EA-2CBL***	<--->
***Direct*LOGIC (VGA Style) 15-pin port, DL06, D2-250 (250-1), D2-260 (RS-232C)	***EA-2CBL-1***	<--->
***Direct*LOGIC PLC RJ-11 port, D3-340 (RS-232C)	***EA-3CBL***	<--->
***Direct*LOGIC DL405 PLC 15-pin D-sub port, DL405 (RS-232C)	***EA-4CBL-1***	<--->
***Direct*LOGIC PLC 25-pin D-sub port, DL405, D3-350, DL305 DCU and all DCM's (RS-232C)	***EA-4CBL-2***	<--->
Allen-Bradley MicroLogix 1000, 1100, 1200, 1400 & 1500 (RS-232C)	***EA-MLOGIX-CBL***	<--->
Allen-Bradley SLC 5-03/04/05 ControlLogix, CompactLogix, FlexLogix, DF1 port (RS-232C)	***EA-SLC-232-CBL***	<--->
Allen-Bradley PLC-5 DF1 port (RS-232C)	***EA-PLC5-232-CBL***	<--->
Allen-Bradley SLC 500 DH485 port (RS-485A)	***EA-DH485-CBL***	<--->
GE 90/30, 90/70, Micro 90, VersaMax Micro 15-pin D-sub port (RS-422A)	***EA-90-30-CBL***	<--->
MITSUBISHI FX Series 25-pin port (RS-422A)	***EA-MITSU-CBL***	<--->
MITSUBISHI FX Series 8-pin mini-DIN (RS-422A)	***EA-MITSU-CBL-1***	<--->
OMRON Host Link C200 Adapter, C500 (RS-232C)	***EA-OMRON-CBL***	<--->

Example Cables:

EA-2CBL

EA-2CBL-1

C-more Computer Programming Connections

Using the *C-more* Programming Software EA9-PGMSW for project development, the touch panel can be connected to a PC (personal computer) in one of several ways:

- Connect a USB Programming Cable such as (USB-CBL-AB15) from a USB port type A on the PC to the USB type B programming port on the C-more touch panel. The USB connection is for direct connection only and does not support USB hubs.
- Connect the ***C-more*** touch panel to a PC with a Cat5 Ethernet cable via an Ethernet switch. Multiple panels can be programmed in this configuration.

Following are the minimum system requirements for running *C-more* Programming Software, p/n EA9-PGMSW, on a PC:

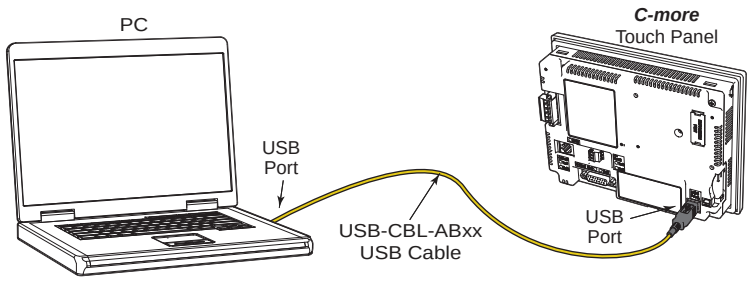
- Keyboard and Mouse or compatible pointing device
- Super VGA color video adapter and monitor with at least 800 x 600 pixels resolution (1024 x 768 pixels recommended) 64K color minimum
- 300 MB free hard-disk space
- CD-ROM or DVD drive for installing software from the CD
- USB port or Ethernet 10/100 Mbps port for project transfer from software to touch panel (Ethernet port not available on -R models)
- Operating System - Windows® XP Professional Edition (32 bit), Windows 7 (32 or 64 bit) or Windows 8 (32 or 64 bit)

NOTE: Regarding Ethernet access to a C-more panel.

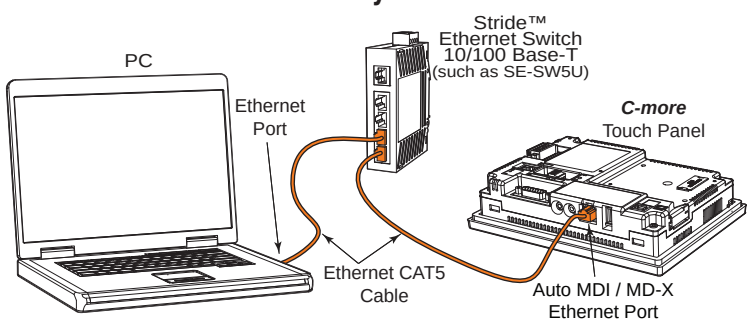
If you intend to take advantage of the methods of remote access to the panel, including the web server, PC remote access, FTP, iPhone or iPad app, you need to consider the security exposure in order to minimize the risks to your process and your C-more panel.

Security measures may include password protection, changing the ports exposed on your network, including a VPN in your network, and other methods. Security should always be carefully evaluated for each installation.

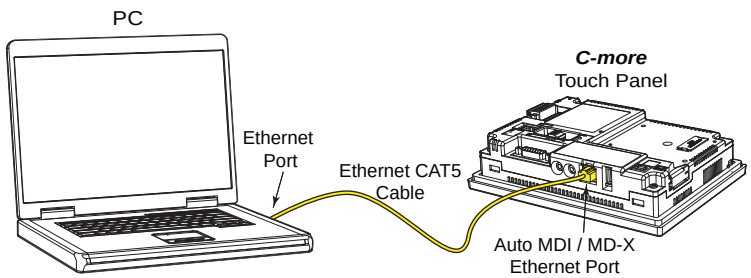
USB Connectivity



Ethernet Connectivity via a Hub or Switch



Ethernet Direct Connection



USB Programming Cable

Part No. USB-CBL-AB15

<--->

Other lengths available see
USB-CBL-AB3, USB-CBL-AB6, USB-CBL-AB10

Stride™ Ethernet Switch

Part No. SE-SW5U

<--->

Ethernet Configuration Kit

Part No. RT-CNFGKIT

<--->

The Ethernet Configuration Kit includes a five-port 10/100 Base-T Ethernet switch, four straight-through cables, and one crossover cable. (The cables are at least five feet in length.) The kit provides a great convenience for configuring systems, demonstration systems or basic control projects using Ethernet.

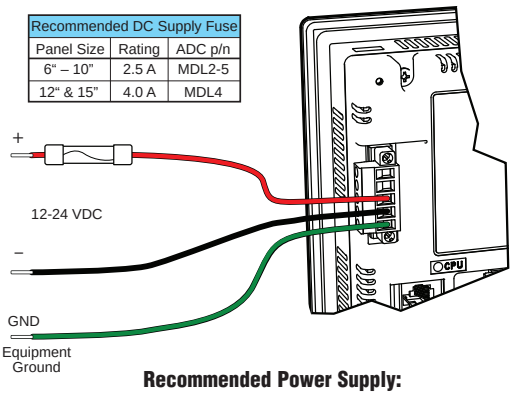
C-more Power Connection Wiring

Providing Power to the Touch Panel

- Connect a dedicated 12–24 VDC Class 2 power supply to the DC connector on the rear of the ***C-more*** touch panel. Connect the ground terminal to a proper equipment ground.
- or, install a ***C-more*** AC Power Adapter (EA-AC) to the rear of the touch panel and connect an AC voltage source of 100-240 VAC, 50/60 Hz, to its AC connector.
- then, turn on the power source and check the LED status indicators on the front and rear of the ***C-more*** touch panel for proper operation.

DC Wiring

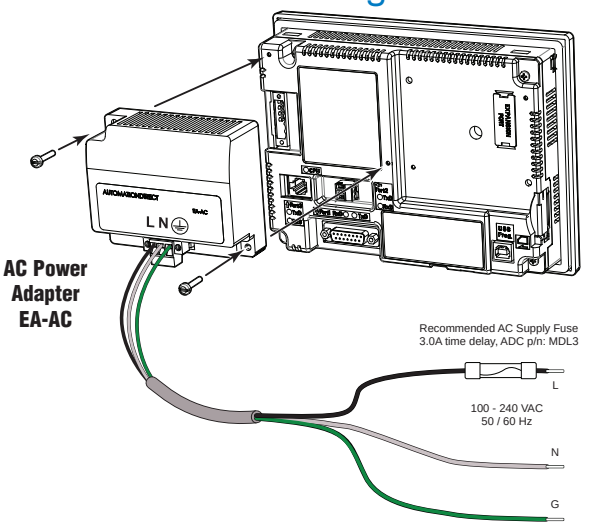
Recommended DC Supply Fuse		
Panel Size	Rating	ADC p/n
6" – 10"	2.5 A	MDL2-5
12" & 15"	4.0 A	MDL4



Recommended Power Supply:
AutomationDirect Part No. PSC-24-060

DC-CON Tightening Torque	
Power connector screw torque	70.4 oz-in [0.5 Nm]
Power connector mounting torque	56 oz-in [0.4 Nm]

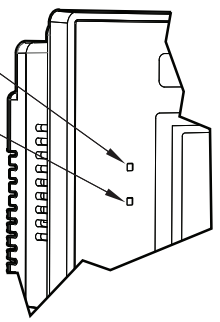
AC Wiring



EA-AC Tightening Torque	
Power supply cable torque	71 - 85 oz-in [0.5 - 0.6 Nm]
Power connector mounting torque	71 - 85 oz-in [0.5 - 0.6 Nm]
Mounting flange screw torque	57 - 71 oz-in [0.4 - 0.5 Nm]

Power LED (Green)	
On	Power On
Off	Power Off

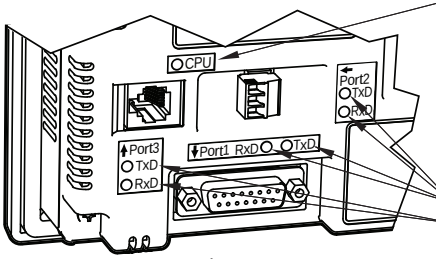
User Defined LED (Green, Orange & Red)	
Off	User Defined (Refer to online help file for further details)
Green	
Red	
Orange	
Blinking Red	
Blinking Orange	
Blinking Green	



Front View

CPU Status LED (Green, Orange & Red)	
Off	Power Off
Green	Normal – CPU Run State
Red	Memory Error
Blinking Red	Watchdog Timer Error
Blinking Orange	OS Error
Blinking Green	Power Loss Detection

Serial TxD/RxD LED (Green)	
On	Comm. is active
Off	No communication



Rear View

WARNING: To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and it is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

If you have any questions concerning the installation or operation of this equipment, or if you need additional information, please call us at 1-800-633-0405 or 770-844-4200.

This publication is based on information that was available at the time it was printed.

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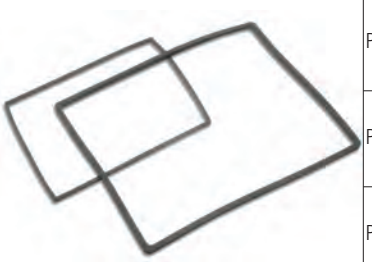
C-more Replacement Parts

The optional replacement parts can be used to replace damaged, worn or lost *C-more* components.

Replacement parts at a glance:

Part Number		Description
EA9-BRK		Panel mounting brackets, replacement, for C-more EA9 series touch panels. Package of 8 brackets and screws.
EA9-LBL		Blank label insert for front bezel, replacement, for C-more EA9 series touch panels. Package of 10.
EA9-3TB		3-pole terminal block, replacement, for 3-wire RS485 communications port on C-more EA9 series panels. Package of 2.
EA-DC-CON		5-terminal DC power connector, replacement, for C-more EA7 and EA9 series touch panels
EA-AC-CON		3-terminal AC power connector, replacement, for C-more EA7 and EA9 series touch panels
EA9-15-GSK		Panel mounting gasket, replacement, for C-more EA9-T15CL 15-inch touch panel, NEMA 4/4X
EA9-12-GSK		Panel mounting gasket, replacement, for C-more EA9-T12CL 12-inch touch panel, NEMA 4/4X
EA9-10-GSK		Panel mounting gasket, replacement, for C-more EA9-T10CL 10-inch touch panel, NEMA 4/4X
EA9-8-GSK		Panel mounting gasket, replacement, for C-more EA9-T8CL 8-inch touch panel, NEMA 4/4X
EA9-6-GSK		Panel mounting gasket, replacement, for C-more EA9-T6CL(-R) 6-inch touch panels, NEMA 4/4X

Sierra Wireless AirLink® LS300 Gateway

Small, rugged, and intelligent 3G gateway.

Want to remotely control, monitor, or track the location of field equipment? Need a reliable alternative to landlines when they go down or are not an option in remote or temporary locations?

ONE GATEWAY, MULTIPLE POSSIBILITIES

The AirLink LS300 gateway is the smallest, most compact 3G gateway from Sierra Wireless. Designed to be the next generation, all-in-one successor to the market leading Raven series, the intelligent LS300 gateway comes standard with multiple interfaces (Ethernet, Serial, USB), GPS, and all features that AirLink customers have come to rely on for over 15 years:

- Best-in-class session persistence keep AirLink gateways connected to the cellular network 24/7
- Rugged, military spec design keep AirLink gateways operating in the harshest environments
- AirVantage™ Management Service provides remote device management to centrally configure, deploy, and monitor AirLink gateways over-the-air (OTA)
- Industry-leading warranties and world class support keep AirLink customers coming back

QUICKLY CONFIGURE AND DEPLOY

The comprehensive set of configurable options makes the LS300 quick and easy to deploy in the field. With ALEOS™ embedded intelligence powering AirLink gateways, the LS300 can be deployed in most industrial, enterprise, and transportation applications out-of-the-box.

In addition to configuring connection settings, ALEOS enables users to setup custom security, networking, and routing parameters, GPS location tracking, and events reporting without any programming. With over a decade of experience in real-world deployments, ALEOS has been developed to ease integration and configuration for a wide range of deployment scenarios.

ADD CUSTOM LOGIC WITHOUT ANY EMBEDDED EXPERTISE

ALEOS Application Framework makes it easy to add custom logic to the LS300 gateway for collecting information from connected equipment or optimizing data transfers. This scripting framework allows users to create applications without deep embedded expertise or C/C++ programming skills.

USE CASE EXAMPLES

- Industrial: remotely monitor and control pipelines, meters, pumps, valves in any energy or utility application.
- Enterprise: instantly deploy reliable internet connectivity to remote point-of-sale locations, temporary installations, or retail operations.
- Transportation: track the location and speed of vehicles or heavy equipment and provide reliable internet to a mobile workforce.

SIERRA WIRELESS™ | AirLink®

Sierra Wireless AirLink® LS300 Gateway

Technical Specifications

HSPA+ MODELS

fallback to quad-band GSM/GPRS/EDGE

- HSPA+ North America 800/850/1900/2100 MHz
- HSPA+ EMEA 900/2100 MHz

EV-DO MODELS

fallback to CDMA 1xRTT

- Dual Band EV-DO Rev. A 800/1900 MHz

HOST INTERFACES

- 10/100 Base-T RJ45 Ethernet
- RS-232 Serial Port
- USB V2.0 Micro-B Connector
- 2 SMA Antenna Connectors (RF, GPS/Rx Diversity)
- Support for active antenna

PROTOCOLS

- Network: TCP/IP, UDP/IP, DNS
- Routing: NAT, Host Port Routing, DHCP, PPPoE, VLAN, VRRP
- Application: SMS, Telnet/SSH, SMTP, SNMP, SNTP
- Serial: TCP/UDP PAD Mode, Modbus (ASCII, RTU, Variable), PPP
- GPS: TAIP, NMEA, RAP

INPUT/OUTPUT

- Configurable I/O on power connector
- Input ON Voltage 3.3 to 30 VDC
- Input OFF Voltage 0 to 1.2 VDC
- Output max. switching capability 200mA @ 30VDC

DIMENSIONS

- 3.0 in x 3.5 in x 1.0 in (76 mm x 90 mm x 25 mm)
- 6.7 oz (190G)

POWER CONSUMPTION

All figures in mA @ 12VDC

- HSPA+: Min 219, Peak 624, Idle 104
- CDMA: Min 164, Peak 280, Idle 132
- Low Power Standby Mode: <35

GPS TECHNOLOGY

HSPA+ Models

- Acquisition Time: <3 Sec Hot Start, <45 Sec Cold Start
- Accuracy: <10m
- Tracking Sensitivity: -155 dBm

EV-DO Models

- 12 Channel, Continuous tracking
- Acquisition Time: 9 sec Hot Start, 39 Sec Cold Start
- Accuracy: <3m (50%), <8m (90%)
- Tracking Sensitivity: -160 dBm

EVENTS REPORTING

- Event Types: Digital Input, GPS/AVL, Network Parameters, Data Usage, Timer, Power, Device Temperature
- Report/Action Types: SMS, Email, SNMP Trap, Relay Output, GPS Rap Report, Events Protocol Message to Server

VPN/SECURITY

- IPsec, SSL, and GRE VPN Client
- Up to 5 VPN Tunnels
- IKE Encryption
- Port Forwarding and DMZ
- Port Filtering
- Trusted IP
- MAC Address Filtering

DEVICE MANAGEMENT

- AirVantage Management Service next-generation device management application
- ACEManager device configuration utility

ALEOS APPLICATION FRAMEWORK

- Lua language coding platform
- Remote application management
- Eclipse-based IDE
- Integrated real-time debugging

ENVIRONMENTAL

- Operating Temperature: -30°C to +70°C / -22°F to +158°F
- Storage Temperature: -40°C to +85°C / -40°F to +185°F
- Humidity: 90% RH @ 60 °C
- Military Spec MIL-STD-810 conformance to thermal, mechanical shock and humidity

INDUSTRY CERTIFICATIONS

- PTCRB
- FCC, Industry Canada
- CE, E-Mark
- RoHS Compliant
- Class I, Div 2

CARRIER APPROVALS

- AT&T
- Sprint
- Verizon Wireless

WARRANTY

- 3-year

SIERRA WIRELESS™ | AirLink®

Wilson Electronics
Say Goodbye to Dropped Calls

General Mobile External Antennas

Stay Connected on the Road with Wilson Electronics Mobile Antennas

Designed for use with our mobile signal boosters, Wilson Electronics wide range of mobile antennas offers top performance and multiple mounting options. Our best-selling magnet-mount antennas install in seconds and are transferable between vehicles. For a more permanent installation, users can choose from glass- or NMO-mount options.

301103 • 301125 • 301128 • 301703 • 304202
Magnet-Mount Antenna

301113 • 301126 • 301131 • 301132
Mini Magnet-Mount Antenna

FEATURES

- Perfect for cars, vans and light trucks
- Mobile and indoor use

SPECIFICATIONS

	Magnet-Mount Antennas					Mini Magnet-Mount Antennas			
Part Number	HOT 301103	301125	301128	301703	304202	301113	301126	301131 WHITE	301132 WHITE
Frequency Range (MHz)	Refer to table on page 40								
Impedance	50 ohms								
Antenna Gain	Refer to table on page 40								
Signal Pattern	Omni								
Polarization	Vertical								
Ground Plane	Metal ground plane required								
Connector	FME Female	SMA Male	TNC Male	FME Female	FME Female	FME Female	SMA Male	FME Male	N Male
Material	Whip - Stainless Steel					Whip - Plastic Coated Steel Wire			
Coax Cable	RG174 - 10 feet / 3.05 meters								
Height	12.25 inches / 31.12 cm					4.175 inches / 10.60 cm			
Mount	Rare earth magnet					Rare earth magnet			

Wilson Electronics
Say Goodbye to Dropped Calls

Antenna Frequency Specific Gain Chart (dBi)

		FREQUENCY IN MHz					
		700-800	824-894	880-960	1710-1880	1850-1990	2110-2170
MAGNET MOUNT ANTENNAS	301103	1.9	5.1	3.1	-4.0	6.1	2.3
	301125	1.9	5.1	3.1	-4.0	6.1	2.3
	301126	1.9	5.1	3.1	-4.0	6.1	2.3
	304202	1.9	5.1	3.1	-4.0	6.1	2.3
	301703	-1.9	4.8	4.6	0.3	4.1	0.6
MINI MAGNET MOUNT ANTENNAS	301113	1.7	2.1	0.5	2.2	3.1	1.4
	301126	1.7	2.1	0.5	2.2	3.1	1.4
	301131	1.7	2.1	0.5	2.2	3.1	1.4
	301132	1.7	2.1	0.5	2.2	3.1	1.4
DUAL BAND TRUCKER ANTENNAS	301101		5.1			6.1	
	301701			5.1	6.1		
RV TRUCKER W/SPRING ANTENNAS	301119	3.1	4.1	2.0	-1.8	5.1	-2.6
	301133	3.1	4.1	2.0	-1.8	5.1	-2.6
GLASS MOUNT ANTENNAS	301102	1.8	3.5	2.8	-1.5	4.8	1.0
	304201	1.8	3.5	2.8	-1.5	4.8	1.0
MINI GLASS MOUNT ANTENNAS	301114		1.4			2.4	
NMO ANTENNAS	301104	2.0	4.9	0.0	-3.1	5.9	1.3
	301112	2.4	5.5	-0.9	-1.2	5.5	1.7
	304203	3.7	4.4	4.3	-4.1	3.7	0.3
	301105	4.1	1.4	2.4	-3.5	-7.0	-10.2
DUAL BAND LOW PROFILE ANTENNAS	301106	3.4	2.2	1.2	1.4	3.2	4.3
	301127	3.4	2.2	1.2	1.4	3.2	4.3
	301208	-0.8	1.5	1.2	2.4	3.4	1.2
	301209	-0.8	1.5	1.2	2.4	3.4	1.2
YAGI ANTENNAS	301111	10.0	10.8	8.8	-16.4	-14.9	-13.8
	301124	-18.7	-23.4	-21.6	9.1	12.5	-10.6
	301129	-0.9	10.1	-7.9	-10.3	-11.9	-8.7
	301142	-3.6	3.7	10.1	-12.1	-10.2	-13.4
	304411	7.3	8.1	7.4	9.2	10.6	10.4
	304475	7.3	8.1	7.4	9.2	10.6	10.4
DOME ANTENNAS	301121	-2.5	2.5	-0.5	3.5	4.1	1.5
	301123	3.3	5.4	-2.3	-4.3	0.5	-8.0
MARINE ANTENNAS	301130	3.4	4.1	3.5	3.1	5.1	0.2
PANEL ANTENNAS	301135	5.2	4.4	4.2	10.1	10.6	8.2
	301155	5.2	4.4	4.2	10.1	10.6	8.2
	304451	5.2	4.4	4.2	10.1	10.6	8.2
	304471	5.2	4.4	4.2	10.1	10.6	8.2
	304452	5.2	4.4	4.2	10.1	10.6	8.2
	304472	5.2	4.4	4.2	10.1	10.6	8.2
	304453	5.2	4.4	4.2	10.1	10.6	8.2
	304473	5.2	4.4	4.2	10.1	10.6	8.2
ULTRA SLIM ANTENNAS	301143	-5.7	-6.8	-9.5	3.1	3.9	5.0
	301149	-5.7	-6.8	-9.5	3.1	3.9	5.0
CRADLE PLUS - PHONE CRADLE	301146	-5.0	0.7	-0.8	2.3	2.6	1.5
	301148	-5.0	0.7	-0.8	2.3	2.6	1.5
EXTERIOR BUILDING ANTENNAS	301141	0.7	4.0	3.6	-1.7	5.5	4.7
	301201	3.2	4.1	2.7	0.6	5.1	-7.5
	301202	3.2	4.1	2.7	0.6	5.1	-7.5

Cellular Data Cards

Adapter plugs into the adapter port on the end of the cellular data card or plugs in as an antenna replacement for data cards with this feature. Check the model for a specific adapter type.

For information about Wilson's cellular adapters for modems and data cards visit www.WilsonElectronics.com

Dual-Band Magnet Mount Installation Instructions

1. Antenna Adapter Required *(Sold Separately)*

In order to attach your antenna to your cell phone you will need an adapter. The adapter connects the phone to the antenna cable and transfers power to and from the antenna. If you need help locating an adapter for your phone, call Wilson toll-free at 1-866-294-6996.

2. Installing the Magnet Mount Antenna

Attach the Magnet Mount Antenna to any metal area on top of the roof of the vehicle. The best location is clear of obstacles and as high on the vehicle as possible. Although small, the rare earth magnet is quite strong and won't fall off at high speeds. Make sure the area under the magnet is clean so as not to damage the vehicle's paint and to ensure a strong connection. Bring the cable into the vehicle through a door frame - the cable is protected by the doors rubber molding. **Do not run the cable through a window** because when the window is rolled up and the door is opened the antenna's cable will be pulled - this is likely to destroy your antenna and/or scratch your paint. Connect the magnet mount antenna's cable to the adapter cable.

1

2

Item List

- Various examples of Adapters are shown - yours may vary.
(Adapter Sold Separately)

Items for Magnet Mount
1 - Magnet Mount Antenna
2 - Antenna Adapter ***(Sold Separately)***

Technical Support

Additional help may be obtained at tech@wilsonelectronics.com or by calling Toll-Free 866-294-1660 Monday through Friday between 7:00 AM and 6:00 PM Mountain Time. Wilson Electronics is closed Saturday, Sunday, and Holidays.

90 Day Warranty

The Wilson Electronics Dual-Band Magnet Mount is warranted for 90 days against defects in workmanship and/or materials and will be repaired or replaced, at the discretion of the manufacturer, to the original purchaser with dated sales receipt. The antenna and a copy of the receipt must be sent to the factory at purchaser's expense where it will be repaired or replaced and returned shipping paid. Warranty does not cover damages caused by abuse, misuse, negligence, improper installation, etc. These are considered to be avoidable circumstances and are not covered by warranty. All Wilson warranties are limited to the specific Wilson product only and do not include phone, vehicle or other external product.

Wilson
Electronics, Inc.
1-866-294-6996
wilsonelectronics.com
info@wilsonelectroincs.com

Part # 103019 DBMM 003 / 09.06.07

PS5R Standard Series
Switching Power Supplies

Key features of the PS5R standard series include:

- Wide power range: 7.5W-240W
- Universal input :
  7.5W-50W: 85-264V AC/105-370V DC
  100W: 85-132V AC/170-264V AC
  240-370V DC (selectable)
  75W, 120W, 240W: 85-264V AC/110-350V DC
- Overcurrent/overvoltage protection
- Power Factor Correction (75W, 120W, 240W models)
  EN61000-3-3
  EN61000-3-2
- Voltage adjustment +10%
- Spring-up crew terminal, IP20 (finger-safe)
- DIN rail or panel surface mount
- Approvals:
  CE marked
  UL 508 Listed
  UL, c-UL
  TÜV approved
  EMC Directives:
  EN50081-2
  EN50082-2
  EN61000-6-2
  LVD EN60950:2000

UL 508 Listed
File #E177168

Cert No.
BL980213332392

Part Numbers

Item	Watts	Rated Voltage	Rated Current	Part Number
	7.5	5V DC	1.5A	PS5R-A05
		12V DC	0.6A	PS5R-A12
		24V DC	0.3A	PS5R-A24
	15	5V DC	2.5A	PS5R-B05
		12V DC	1.2A	PS5R-B12
		24V DC	0.6A	PS5R-B24
	30	12V DC	2.5A	PS5R-C12
		24V DC	1.3A	PS5R-C24
	50	24V DC	2.1A	PS5R-D24

Item	Watts	Rated Voltage	Rated Current	Part Number
	75	24V DC	3.1A	PS5R-Q24
	100	24V DC	4.2A	PS5R-E24
	120	24V DC	5A	PS5R-F24
	240	24V DC	10A	PS5R-G24

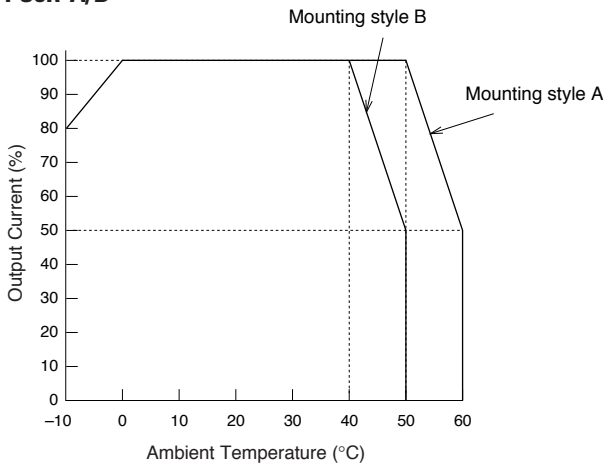
Specifications

Part Numbers		**PS5R-A05**	**PS5R-B05***	—	—		—		—
		PS5R-A12	**PS5R-B12**	**PS5R-C12**	—		—		—
		PS5R-A24	**PS5R-B24**	**PS5R-C24**	**PS5R-D24**	**PS5R-Q24**	**PS5R-E24**	**PS5R-F24**	**PS5R-G24**
Output Capacity		7.5W	15W	30W	50W	75W	100W	120W	240W
Input	**Input Voltage (single-phase, 2-wire)**	100 to 240V AC nominal (85 to 264V AC), 50/60Hz (47 to 63Hz) 110 to 340V DC nominal (105 to 370V DC)					100 to 120V AC, 50/60Hz 200 to 240V AC, 50/60Hz (jumper selectable) 240 to 370V DC	100 to 240V AC, 50/60Hz, 110 to 340V DC	
	Input Current (typical)	0.17A at 100V AC	0.3A at 100V AC	0.68A at 100V AC	1.15A at 100V AC	1.1A at 100V AC	2.5A at 100V AC 1.5A at 200V AC	1.8A at 100V AC	4A at 100V AC
	Internal Fuse Rating	2A	2A	3.15A	3.15A	3.15A	4A	4A	6.3A
	Inrush Current	50A maximum (at cold start at 200V AC)				70A maximum (at cold start at 230V AC)	50A maximum (at cold start at 200V AC)	70A maximum (at cold start at 230V AC)	
	Leakage Current (at no load)	0.75mA maximum (60Hz, measured in conformance with UL, CSA, VDE)							
	Typical Efficiency	69% at 5V 75% at 12V 79% at 24V		75% at 12V 75% at 24V	79% at 24V	83% at 24V	85% at 24V	83% at 24V	
	Overvoltage Protection	Outputs turns off at 105% (typical)							
Output	**Voltage and Current Ratings**	5V, 1.5A 12V, 0.6A 24V, 0.3A	5V, 2.5A 12V, 1.2A 24V, 0.6A	12V, 2.5A 24V, 1.3A	24V, 2.1A	24V, 3.1A	24V, 4.2A	24V, 5A	24V, 10A
	Voltage Adjustments	±10% (V.ADJ screw on top)							
	Output Holding Time	20ms minimum (at full rated input and output)							
	Rise Time	200ms maximum (at full rated input and output)							150ms max.
	Line Regulation	0.4% maximum							
	Load Regulation	1.5% maximum							
	Fluctuation due to Ambient Temperature Change	0.05% maximum							
	Ripple Voltage	2% peak to peak maximum (including noise)							
	Overload Protection	120% typical (Zener-limiting)		120% typical, auto reset					
Operation Indicator		LED (green)							
Parallel Operation Allowed		PS5R-A	PS5R-B	PS5R-C	PS5R-D	PS5R-Q	PS5R-E	PS5R-F	PS5R-G
		No				Yes	No	Yes	
Dielectric Strength		Between input and output terminals: 3,000V AC, 1 minute Between input terminals and housing: 2,000V AC, 1 minute Between output terminal and housing: 500V AC, 1 minute							
Insulation Resistance		Between input and output terminals/input terminals and housing: 100MΩ minimum (500V DC megger)							
Operating Temperature		–10˚ to +60˚C (14˚ to 140˚F) (see derating curves)							
Storage Temperature		–30˚ to +85˚C (-22˚ to 185˚F)							
Operating Humidity		20 to 90% relative humidity (no condensation)							
Vibration Resistance		45m/s^2, 10 to 55Hz, 2 hours on each of 3 axes				10 to 50Hz, 0.75mm p-p, 2 hrs on each of 3 axes			
Shock Resistance		300m/s^2 (30G), 3 shocks in each of 6 directions							
Approvals		Conforms to EMC Directives EN50081-2 & EN50082-2. LVD Directive EN60529 — Certified to EN60950. UL508 listed. UL, c-UL, TUV approved. CE marked. EN61000-3-2							
Weight		150g	170g	360g	390g	800g	600g	1200g	2000g
Termination		Spring-up, fingersafe terminals with captive M3.5 screws							
IP protection		IP20 (finger safe)							
Dimensions H x W x D (mm)		75 x 45 x 70	75 x 45 x95	75 x 90 x 95	75 x 90 x 95	120 x 85 x 140	75 x 145 x 95	120 x 115 x140	120 x 200x 140
Dimensions H x W x D (inches)		2.95 x 1.77 x 2.76	2.95 x 1.77 x 3.74	2.95 x 3.54 x 3.74	2.95 x 3.54 x 3.74	4.72 x 3.35 x 5.52	2.95 x 5.71 x 3.74	4.72 x 4.53 x 5.52	4.72 x 7.87 x 5.51

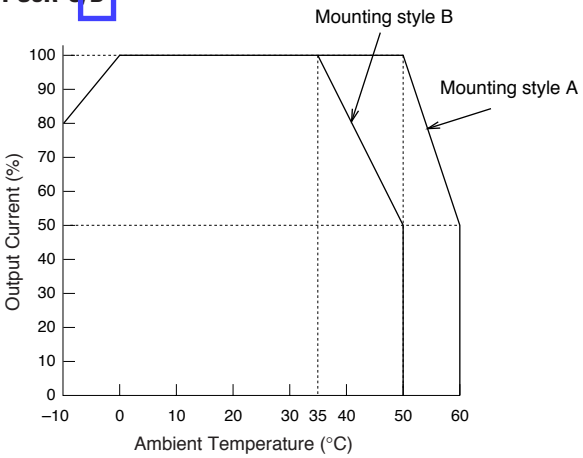
1. For dimensions, see page 117.
2. For usage instructions, see page 116.
3. *12.5W for 5VDC model.

Temperature Derating Curves

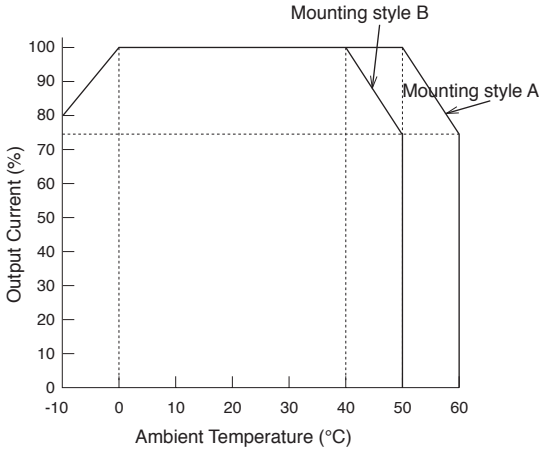
PS5R-A/B



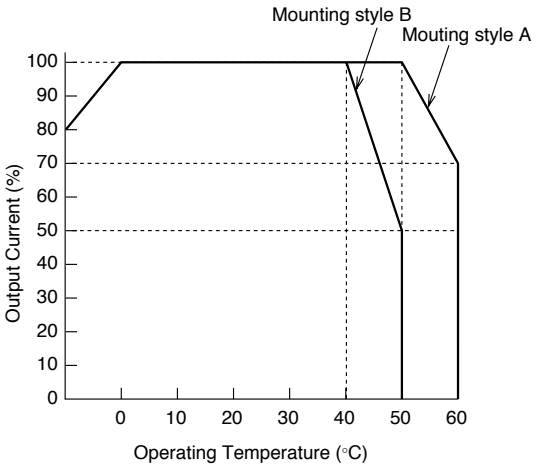
PS5R-C/D



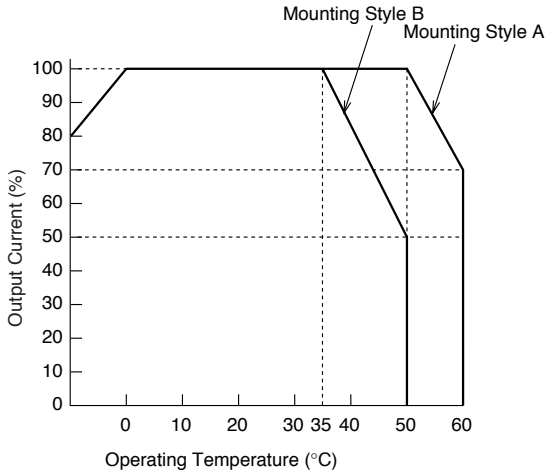
PS5R-E



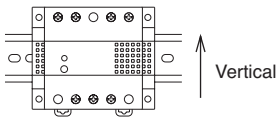
PS5R-Q



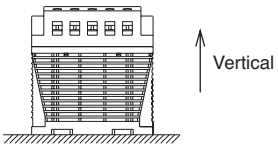
PS5R-F/G



A Mounting (standard)



B Mounting (Facing Upward)



Accessories

Part Numbers: PS5R Accessories

Appearance	Description	Part Number
	DIN rail (1000mm)	BNDN1000
	DIN rail end clip	BNL5

Installation Instructions

Time-Saving Spring-up Terminals

The innovative terminals on the PS5R series use a special, spring-loaded screw. This makes installation as easy as pushing down and turning with a screwdriver. Installation time is cut in half since the screws do not need to be backed out to install wiring. The screws are held captive once installed and are 100% finger-safe. Screw terminals accept bare wire or ring or fork connectors.

1. Insert the wire connector into the slot on the side of the power supply.

2. Using a flat head or Phillips screwdriver, push down and turn the screw.

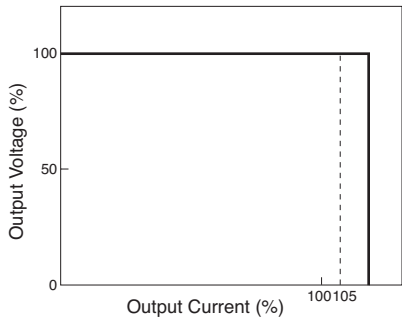
The wire is now connected, and the screw terminal is finger-safe!

Front Panel (terminals)

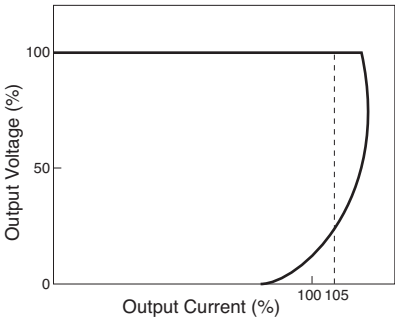
Markings	Name	Description
V. ADJ	Voltage adjustment	Adjusts within ±10%; turn clockwise to increase output voltage
DC ON	Operation indicator	Green LED is lit when output voltage is on
+V, –V	DC output terminals	+V: Positive output Terminal –V: Negative output terminal
⏚	Frame ground	Ground this terminal to reduce high-frequency currents caused by switching
L, N	Input terminals	Accept a wide range of voltages and frequencies (no polarity at DC input)
NC	No connection	Do not insert wires here, as this may damage the power supply

Overcurrent Protection Characteristics

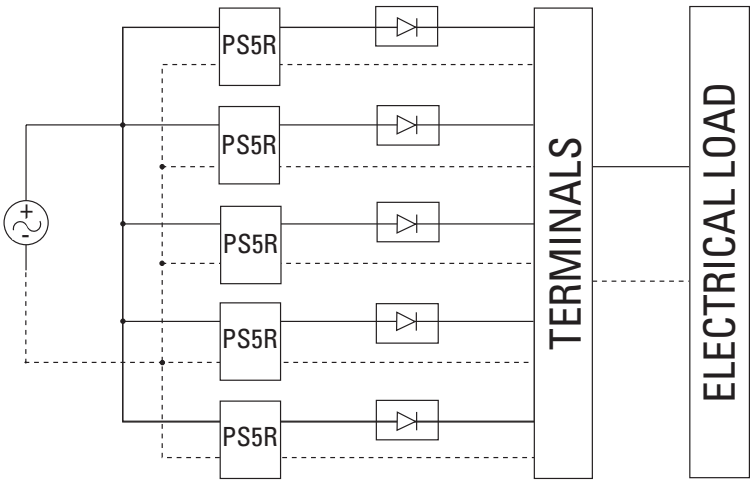
PS5R-A/B



PS5R-C/D/E



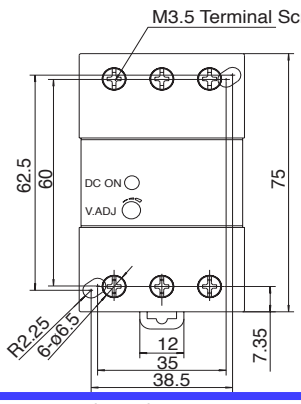
Parallel Operation



1. Parallel operation only recommended for PS5R-Q24, PS5R-F24 and PS5R-G24.
2. Factory recommended diode ST Microelectronics BYV54V-50, BYV54V-100, BYV54V-200, BYV541V-200 or with equivalent electrical specifications.
3. Using the voltage adjustment make sure out-voltage is the same for all power supplies.

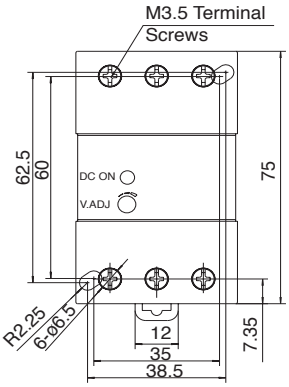
Dimensions

PS5R-A (7.5W)



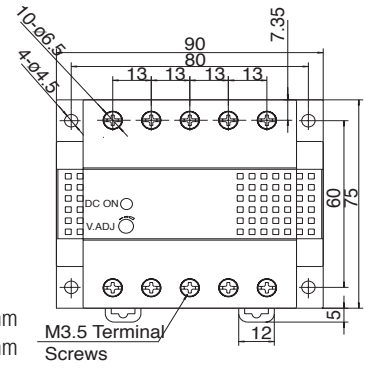
Height 75.0mm
Width 45.0mm
Depth 70.0mm

PS5R-B (15W)



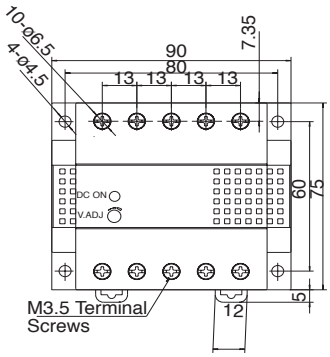
Height 75.0mm
Width 45.0mm
Depth 95.0mm

PS5R-C (30W)



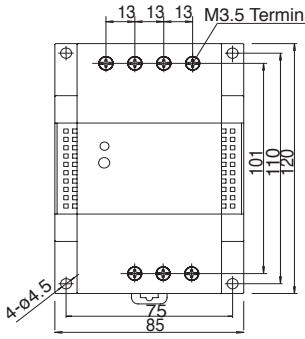
Height 75.0mm
Width 90.0mm
Depth 95.0mm

PS5R-D (50W)



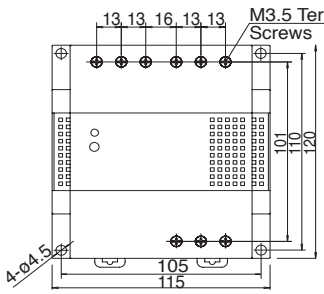
Height 75.0mm
Width 90.0mm
Depth 95.0mm

PS5R-Q (75W)



Height 120.0mm
Width 85.0mm
Depth 140.0mm

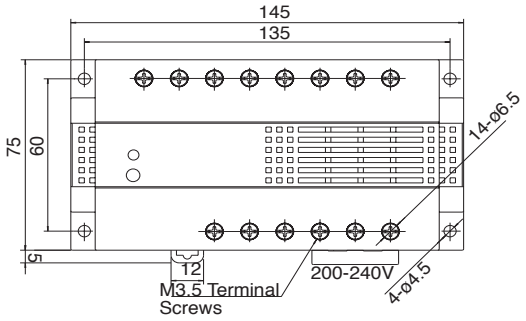
PS5R-F (120W)



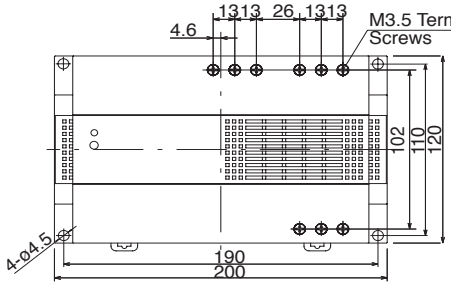
Height 120.0mm
Width 115.0mm
Depth 140.0mm

PS5R-E (100W)

Height 120.0mm
Width 115.0mm
Depth 140.0mm



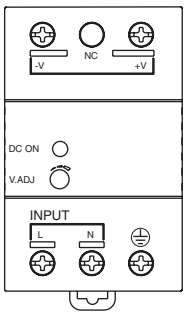
PS5R-G (240W)



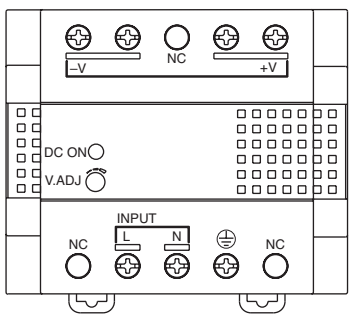
Height 120.0mm
Width 200.0mm
Depth 140.0mm

Terminal Markings

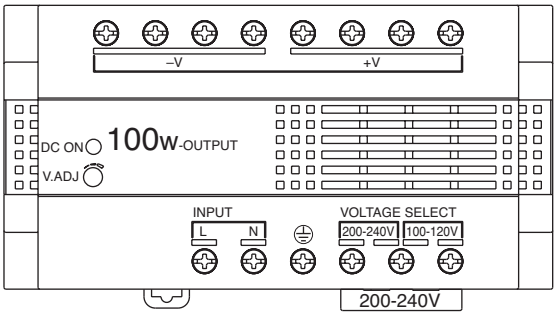
PS5R-A/B



PS5R-C/D/Q/F/G



PS5R-E

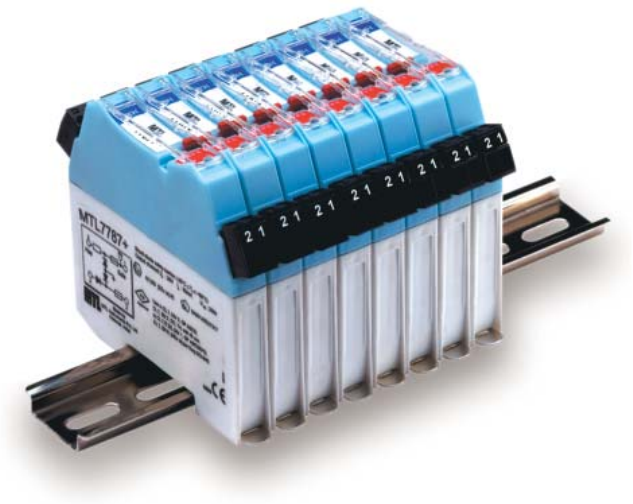


technical datasheet

MTL7700 Series

DIN-rail mounting safety barriers

- Removable terminals
- Bussed power feed to other modules
- Relay and solid state switch modules
- Dual channel variants – 6.3mm per channel
- Proximity detector inputs
- Electronic fusing
- Direct replacement for MTL700 Series barriers
- Compatible terminal numbering and safety descriptions



Since its introduction in 1984 the MTL700 Series barrier has established itself as the worldwide standard for safety barriers. Known for its quality and reliability, the MTL700 Series is widely used in applications all over the world.

The MTL7700 Series follows closely in the footsteps of the MTL700, but as a DIN rail mounting barrier, providing quick and easy installation without the need for special hardware.

Removable terminals are used for ease of installation, maintenance and for providing a loop disconnect by simply unplugging the terminals from the side of the module. Wire entry is also angled to assist wiring within limited space enclosures.

MTL7700 barriers clamp simply and securely onto standard T-section DIN rail, simultaneously making a reliable IS earth connection.

For applications where field power is required for switch inputs or 2-wire transmitters, the MTL7700 Series provides a bussed power feed facility. When used in conjunction with the MTL7798 power feed module the user has a fully protected, electronically fused supply to many barriers with no additional wiring required.

MTL7700 active modules are protected with an electronic fuse for the majority of applications. The MTL7798 active fused, power feed module can protect up to 40 other modules using the bussed power facility and provides a clear indication of a trip condition via a red LED.

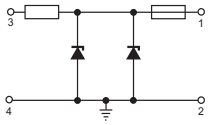
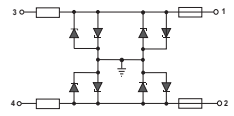
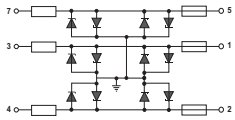
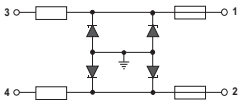
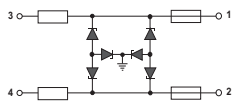
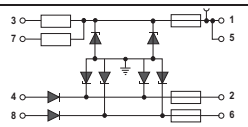
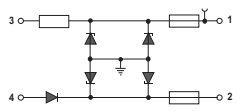
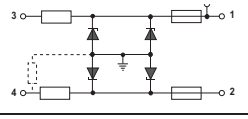
The MTL774X range of barriers offer a NAMUR compatible input and a choice of relay or solid state output. The solid state outputs are floating so switching to ground or from a power rail into an input is also possible. The solid state interface also provides a high frequency transfer for use in flow or rotation applications.

Dual channel relay or solid state modules offer the highest packing density with only 6.3mm per channel and when used in conjunction with the power bus, offer users the minimum of wiring with the maximum packing density and the lowest cost per channel.

SPECIFICATIONS

'Key' barriers shown in blue

For notes 1 to 7 see 'Terminology' (later in this section)

Model No.	Safety description [1]			Polarities available [2]			Application	Basic circuit	Max. end-to-end resistance [3]	Vwkg at [4] 10µA or (1µA)	Vmax [5]	Fuse rating [6]
MTL	V	W	mA	+	–	ac		Hazardous Safe	W	V	V	mA
7706+	28	300	93	✓			Transmitters	See 'HOW THEY WORK' and 'ACTIVE / ELECTRONICALLY PROTECTED BARRIERS'	See additional specification		35	50
7707+	28	300	93	✓			Switches				35	50
	28	diode									35	50
7707P+	28	164	171	✓			Transmitters, switches, controller outputs IIB				35	50
	28	diode	–								35	50
7710+	10	50	200	✓					75	6.0	7.0	50
7715+	15	100	150	✓			6V dc & 4V ac systems		119	12.0	13.1	100
7715P+	15	50	291	✓			12V systems		64	12.6	13.7	100
7722+	22	150	147	✓			12V dc systems		174	19.6	20.2	50
7728+	28	300	93	✓			18V dc systems		333	25.9	26.5	50
7728-	28	300	93		✓		Controller outputs, solenoids		333	25.9	26.5	50
7728ac	28	300	93			✓	Transmitters		333	25.0	25.9	50
7728P+	28	234	119	✓			Controller outputs, solenoid valves		252	24.9	25.9	100
7729P+	28	164	170	✓			Controller outputs, solenoid valves IIB		184	24.9	25.9	100
774X	10	—	19				Prox sw input, solid state output and line fault detect	See 'ACTIVE / ELECTRONICALLY PROTECTED BARRIERS'	—	—	30/35	50
7755ac	3	10	300			✓	2- or 3- Wire RTDs (floating bridge)		19.0	(1)	3.4	250
	3	10	300			✓			19.0	(1)	3.4	250
7756ac	3	10	300			✓	3- Wire RTDs (grounded bridge)		19.0	(0.7)	2.7	250
	3	10	300			✓			19.0	(0.7)	2.7	250
	3	10	300			✓			19.0	(0.7)	2.7	250
7758+/-	7.5	10	750	✓	✓		Gas detectors		17	6.0	7.3	200
	7.5	10	750						17	6.0	7.3	200
7761ac	9	90	100			✓			107	6.0	7.0	100
	9	90	100						107	6.0	7.0	100
7761Pac	9	350	26			✓	Strain-gauge bridges		378	6.8	7.5	50
	9	350	26						378	6.8	7.5	50
7764+/ac	12	1k	12	✓		✓	Strain-gauge bridges		1050	10.0	10.9	50
	12	1k	12						1050	10.0	10.9	50
7766ac	12	150	80			✓			174	10.0	10.6	50
	12	150	80						174	10.0	10.6	50
7766Pac	12	75	157			✓	Strain-gauge bridges		92	9.6	10.5	100
	12	75	157				Strain-gauge bridges		92	9.6	10.5	100
7767+	15	100	150	✓			12V dc systems		119	12.0	13.1	100
	15	100	150				12V dc systems		119	12.0	13.1	100
7779+	28	300	93	✓			Controller outputs	requires channels	333	25.9	26.5	50
	28	300	93				Controller outputs	separate in IIC	333	25.9	26.5	50
7796+	26	300	87	✓			Vibration probes		333	23.9	24.5	50
	20	390	51						428	18.3	18.9	50
7796-	26	300	87		✓		Vibration probes		333	23.9	24.5	50
	20	390	51						428	18.3	18.9	50
7760ac	10	50	200			✓	Active dc & ac sensors		75	6.0	6.7	50
	10	50	200				Thermocouples		75	6.0	6.7	50
7765ac	15	100	150			✓			124	12.0	12.5	50
	15	100	150						124	12.0	12.5	50
7778ac	28	600	47			✓			651	24.0	25.4	50
	28	600	47						651	24.0	25.4	50
7789+	28	300	93[a]	✓			Switch inputs / Signal returns		651	26.6	27.2	50
									651	26.6	27.2	50
	28	diode	—						0.9V+26Ω	26.6	27.2	50
	28	diode	—						0.9V+26Ω	26.6	27.2	50
7787+/-	28	300	93	✓	✓		Transmitters		333	26.6	27.2	50
	28	diode	—				Controller outputs, switches		0.9V+21Ω	26.6	27.2	50
7787P+	28	234	119	✓					253	26.4	27.2	80
	28	diode	—						0.9V+21Ω	26.4	27.2	80
7788+	28	300	93	✓			Transmitters		333	25.9	26.5	50
	10	50	200	✓					75	6.0	7.0	50
7788R+	28	300	93	✓					333	25.9	26.5	50
	10	50	200	✓					75	6.0	7.0	50

[a] Terminals 3 & 7 connected together

* Diagrams show positive versions. All diodes reversed on negative versions. Additional diodes fitted on ac versions.

HOW THEY WORK

All MTL7700 Series barriers are based on the same simple principle. Each channel contains two stages of pulse-tested Zener or forward-connected diodes and an 'infallible' terminating resistor. In the event of an electrical fault in the safe area, the diodes limit the voltage that can reach the hazardous area and the resistor limits the current. A fuse protects the diodes, and the two stages of voltage limitation ensure continued safety if either stage should fail. No active output-current limiting circuits are employed. All models are certified 'ia' for all zones and 'IIC' for all explosive atmospheres (except MTL7707P+ and MTL7729P+, 'ia' 'IIB').

TERMINOLOGY

1. Safety description
The safety description of a barrier, eg '10V 50Ω 200mA', refers to the maximum voltage of the terminating Zener or forward diode while the fuse is blowing, the minimum value of the terminating resistor, and the corresponding maximum short-circuit current. It is an indication of the fault energy that can be developed in the hazardous area, and not of the working voltage or end-to-end resistance.

2. Polarity
Barriers may be polarised + or –, or non-polarised ('ac'). Polarised barriers accept and/or deliver safe-area voltages of the specified polarity only. Non-polarised barriers support voltages of either polarity applied at either end.

3. End-to-end resistance
The resistance between the two ends of a barrier channel at 20°C, i.e. of the resistors and the fuse. If diodes or transistors are present, their voltage drop (transistors ON) is quoted in addition.

4. Working voltage (Vwkg)
The greatest steady voltage, of appropriate polarity, that can be applied between the safe-area terminal of a 'basic' barrier channel and earth at 20°C for the specified leakage current, with the hazardous-area terminal open circuit.

5. Maximum voltage (Vmax)
The greatest steady voltage, of appropriate polarity, that can be applied continuously between the safe-area terminal of any barrier channel and earth at 20°C without blowing the fuse. For 'basic' barriers, it is specified with the hazardous-area terminal open circuit; if current is drawn in the hazardous area, the maximum voltage for these barriers is reduced. The 'ac' channels of 'basic' barriers and most channels of overvolt-protected barriers withstand voltages of the opposite polarity also – see circuit diagrams.

6. Fuse rating
The greatest current that can be passed continuously (for 1000 hours at 35°C) through the fuse.

7. Star connection
In star-connected barriers, the two channels are interlocked such that the voltage between them cannot exceed the working voltage, Vwkg: this allows for higher cable capacitance or inductance.

8. Maximum safe-area voltage (U_m)
The maximum permissible safe-area voltage (U_m) for MTL7700 Series barriers is 250V ac/dc.

GENERAL SPECIFICATION

Ambient temperature and humidity limits
–20 to +60°C continuous working
–40 to +80°C storage
5–95% RH

Leakage current
For 'basic' barriers with a working voltage of 5V or more, the leakage current decreases by at least one decade per volt reduction in applied voltage below the working voltage, over two decades. For the MTL7755ac/7756ac it decreases by at least one decade for a 0.4V reduction in applied voltage.

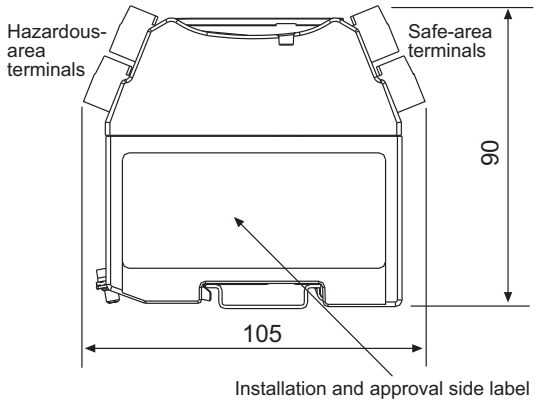
Terminations
Removable terminals accommodate conductors up to 2.5mm^2 (13AWG). Hazardous-area terminals are identified by blue labels. Removal force >15N

Colour coding of barrier label
Grey: non-polarised
Red: positive polarity (MTL7706 negative to transmitter)
Black: negative polarity
White: dummy barrier, MTL7799

Weight
140g approx

Mounting and earthing
By 35mm Top Hat DIN rail

DIMENSIONS (mm)



MTL7700 SERIES KEY BARRIERS SUMMARISED

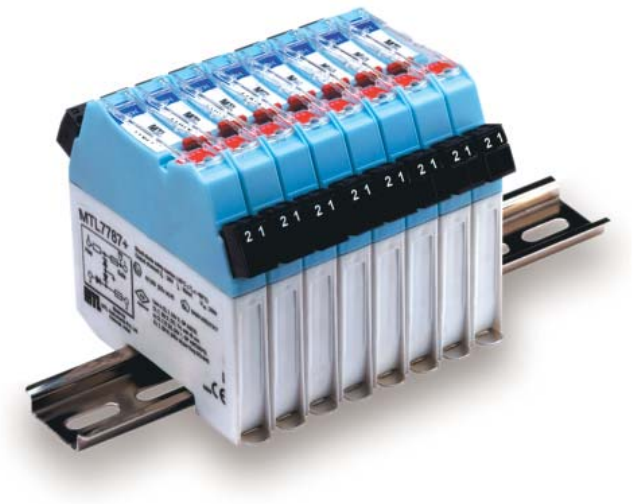
TYPE	APPLICATION	KEY BARRIER
Analogue input (low-level)	Resistance temperature detectors Thermocouples, ac sensors	7756ac 7760ac
Analogue input (high-level)	Transmitters, 2-wire, 4/20mA	7706+ 7787+
Analogue output	Controller outputs, one line earthed Controller outputs, neither line earthed	7728+ ~~7787+~~
Digital (on/off) input	Switches	7787+ 7741/3
Digital (on/off) output	Solenoids, alarms, LEDs	7728

technical datasheet

MTL7700 Series

DIN-rail mounting safety barriers

- Removable terminals
- Bussed power feed to other modules
- Relay and solid state switch modules
- Dual channel variants – 6.3mm per channel
- Proximity detector inputs
- Electronic fusing
- Direct replacement for MTL700 Series barriers
- Compatible terminal numbering and safety descriptions



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'Key' barriers shown in blue

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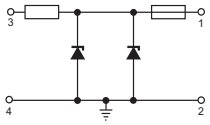
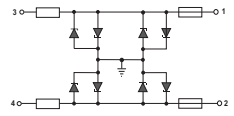
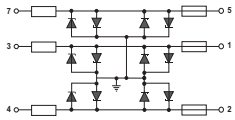
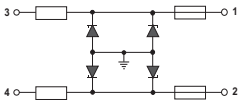
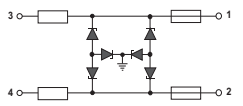
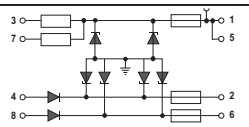
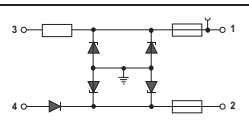
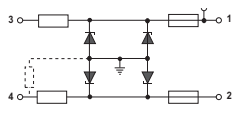
MTL	V	W	mA	+	–	ac		Hazardous Safe	W	V	V	mA
7706+	28	300	93	✓			Transmitters Switches	See 'HOW THEY WORK' and 'ACTIVE / ELECTRONICALLY PROTECTED BARRIERS'	See additional specification		35	50
7707+	28	300	93	✓							35	50
	28	diode									35	50
7707P+	28	164	171	✓			Transmitters, switches, controller outputs IIB				35	50
	28	diode	–								35	50
7710+	10	50	200	✓					75	6.0	7.0	50
7715+	15	100	150	✓			6V dc & 4V ac systems		119	12.0	13.1	100
7715P+	15	50	291	✓			12V systems		64	12.6	13.7	100
7722+	22	150	147	✓			12V dc systems 18V dc systems		174	19.6	20.2	50
7728+	28	300	93	✓			Controller outputs, solenoids		333	25.9	26.5	50
7728-	28	300	93		✓		Transmitters		333	25.9	26.5	50
7728ac	28	300	93			✓	Controller outputs, solenoid valves		333	25.0	25.9	50
7728P+	28	234	119	✓			Controller outputs, solenoid valves IIB		252	24.9	25.9	100
7729P+	28	164	170	✓					184	24.9	25.9	100
774X	10	–	19				Prox sw input, solid state output and line fault detect	See 'ACTIVE / ELECTRONICALLY PROTECTED BARRIERS'	–	–	30/35	50
7755ac	3	10	300			✓	2- or 3- Wire RTDs (floating bridge)		19.0	(1)	3.4	250
	3	10	300			✓			19.0	(1)	3.4	250
7756ac	3	10	300			✓	3- Wire RTDs (grounded bridge)		19.0	(0.7)	2.7	250
	3	10	300			✓			19.0	(0.7)	2.7	250
	3	10	300			✓			19.0	(0.7)	2.7	250
7758+/-	7.5	10	750	✓	✓		Gas detectors		17	6.0	7.3	200
	7.5	10	750						17	6.0	7.3	200
7761ac	9	90	100			✓			107	6.0	7.0	100
	9	90	100						107	6.0	7.0	100
7761Pac	9	350	26			✓	Strain-gauge bridges		378	6.8	7.5	50
	9	350	26						378	6.8	7.5	50
7764+/ac	12	1k	12	✓		✓	Strain-gauge bridges		1050	10.0	10.9	50
	12	1k	12						1050	10.0	10.9	50
7766ac	12	150	80			✓			174	10.0	10.6	50
	12	150	80						174	10.0	10.6	50
7766Pac	12	75	157			✓	Strain-gauge bridges		92	9.6	10.5	100
	12	75	157				Strain-gauge bridges		92	9.6	10.5	100
7767+	15	100	150	✓			12V dc systems		119	12.0	13.1	100
	15	100	150				12V dc systems		119	12.0	13.1	100
7779+	28	300	93	✓			Controller outputs	requires channels separate in IIC	333	25.9	26.5	50
	28	300	93				Controller outputs		333	25.9	26.5	50
7796+	26	300	87	✓			Vibration probes		333	23.9	24.5	50
	20	390	51						428	18.3	18.9	50
7796-	26	300	87		✓		Vibration probes		333	23.9	24.5	50
	20	390	51						428	18.3	18.9	50
7760ac	10	50	200			✓	Active dc & ac sensors Thermocouples		75	6.0	6.7	50
	10	50	200						75	6.0	6.7	50
7765ac	15	100	150			✓			124	12.0	12.5	50
	15	100	150						124	12.0	12.5	50
7778ac	28	600	47			✓			651	24.0	25.4	50
	28	600	47						651	24.0	25.4	50
7789+	28	300	93[a]	✓			Switch inputs / Signal returns		651	26.6	27.2	50
									651	26.6	27.2	50
	28	diode	–						0.9V+26Ω	26.6	27.2	50
	28	diode	–						0.9V+26Ω	26.6	27.2	50
7787+/-	28	300	93	✓	✓		Transmitters Controller outputs, switches		333	26.6	27.2	50
	28	diode	–						0.9V+21Ω	26.6	27.2	50
7787P+	28	234	119	✓					253	26.4	27.2	80
	28	diode	–						0.9V+21Ω	26.4	27.2	80
7788+	28	300	93	✓			Transmitters		333	25.9	26.5	50
	10	50	200	✓					75	6.0	7.0	50
7788R+	28	300	93	✓					333	25.9	26.5	50
	10	50	200	✓					75	6.0	7.0	50

[a] Terminals 3 & 7 connected together

* Diagrams show positive versions. All diodes reversed on negative versions. Additional diodes fitted on ac versions.

HOW THEY WORK

All MTL7700 Series barriers are based on the same simple principle. Each channel contains two stages of pulse-tested Zener or forward-connected diodes and an 'infallible' terminating resistor. In the event of an electrical fault in the safe area, the diodes limit the voltage that can reach the hazardous area and the resistor limits the current. A fuse protects the diodes, and the two stages of voltage limitation ensure continued safety if either stage should fail. No active output-current limiting circuits are employed. All models are certified 'ia' for all zones and 'IIC' for all explosive atmospheres (except MTL7707P+ and MTL7729P+, 'ia' 'IIB').

TERMINOLOGY

1. Safety description
The safety description of a barrier, eg '10V 50Ω 200mA', refers to the maximum voltage of the terminating Zener or forward diode while the fuse is blowing, the minimum value of the terminating resistor, and the corresponding maximum short-circuit current. It is an indication of the fault energy that can be developed in the hazardous area, and not of the working voltage or end-to-end resistance.

2. Polarity
Barriers may be polarised + or –, or non-polarised ('ac'). Polarised barriers accept and/or deliver safe-area voltages of the specified polarity only. Non-polarised barriers support voltages of either polarity applied at either end.

3. End-to-end resistance
The resistance between the two ends of a barrier channel at 20°C, i.e. of the resistors and the fuse. If diodes or transistors are present, their voltage drop (transistors ON) is quoted in addition.

4. Working voltage (Vwkg)
The greatest steady voltage, of appropriate polarity, that can be applied between the safe-area terminal of a 'basic' barrier channel and earth at 20°C for the specified leakage current, with the hazardous-area terminal open circuit.

5. Maximum voltage (Vmax)
The greatest steady voltage, of appropriate polarity, that can be applied continuously between the safe-area terminal of any barrier channel and earth at 20°C without blowing the fuse. For 'basic' barriers, it is specified with the hazardous-area terminal open circuit; if current is drawn in the hazardous area, the maximum voltage for these barriers is reduced. The 'ac' channels of 'basic' barriers and most channels of overvolt-protected barriers withstand voltages of the opposite polarity also – see circuit diagrams.

6. Fuse rating
The greatest current that can be passed continuously (for 1000 hours at 35°C) through the fuse.

7. Star connection
In star-connected barriers, the two channels are interlocked such that the voltage between them cannot exceed the working voltage, Vwkg: this allows for higher cable capacitance or inductance.

8. Maximum safe-area voltage (U_m)
The maximum permissible safe-area voltage (U_m) for MTL7700 Series barriers is 250V ac/dc.

GENERAL SPECIFICATION

Ambient temperature and humidity limits
–20 to +60°C continuous working
–40 to +80°C storage
5–95% RH

Leakage current
For 'basic' barriers with a working voltage of 5V or more, the leakage current decreases by at least one decade per volt reduction in applied voltage below the working voltage, over two decades. For the MTL7755ac/7756ac it decreases by at least one decade for a 0.4V reduction in applied voltage.

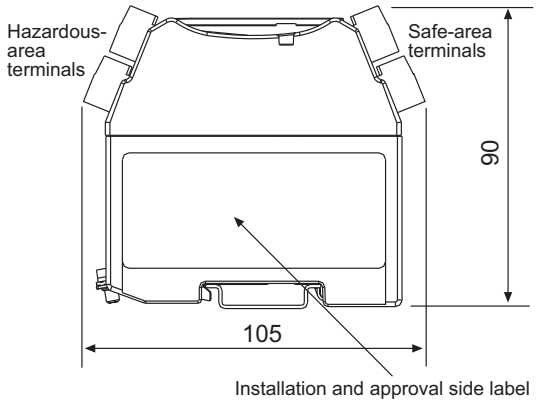
Terminations
Removable terminals accommodate conductors up to 2.5mm^2 (13AWG). Hazardous-area terminals are identified by blue labels. Removal force >15N

Colour coding of barrier label
Grey: non-polarised
Red: positive polarity (MTL7706 negative to transmitter)
Black: negative polarity
White: dummy barrier, MTL7799

Weight
140g approx

Mounting and earthing
By 35mm Top Hat DIN rail

DIMENSIONS (mm)



MTL7700 SERIES KEY BARRIERS SUMMARISED

TYPE	APPLICATION	KEY BARRIER
Analogue input (low-level)	Resistance temperature detectors Thermocouples, ac sensors	7756ac 7760ac
Analogue input (high-level)	Transmitters, 2-wire, 4/20mA	7706+ 7787+
Analogue output	Controller outputs, one line earthed Controller outputs, neither line earthed	7728+ ~~7787+~~
Digital (on/off) input	Switches	7787+ 7741/3
Digital (on/off) output	Solenoids, alarms, LEDs	7728

Installation Instructions for
ISS-101 Intrinsically Safe Switch

WARNING: TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTABLE ATMOSPHERES, DISCONNECT POWER FROM THE SYSTEM PRIOR TO INSTALLATION OR SERVICE.

CAUTION: Installation must comply with all national, state, and local codes. Installation of this equipment should only be performed by personnel trained in intrinsically safe systems. Improper installation may result in serious injury or damage. Before proceeding with installation, read and understand these instructions completely.

The ISS-101 Isolated Switch is UL913 listed as an associated apparatus for interfacing between hazardous and non-hazardous areas. The ISS-101 must be installed in a non-hazardous area. Follow SymCom's Control Drawing ISS-101 on the back of this sheet for proper installation.

All wiring connected to a hazardous location must be separated from all non-intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.

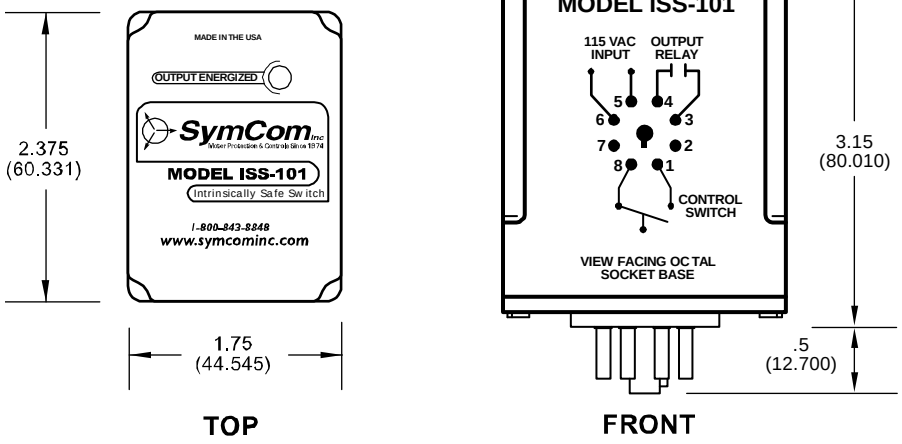
WARNING: REMOVE POWER FROM THE SYSTEM PRIOR TO INSTALLING OR SERVICING THE ISS-101.

Installation:

1. Mount the ISS-101 in a non-hazardous location on 35mm DIN rail, or by installing two #6-#8 screws into the surface mounting holes provided.
2. Connect wiring per SymCom's Control Drawing ISS-101. Follow all hazardous code requirements while installing wiring to switch input terminals.

Operation:

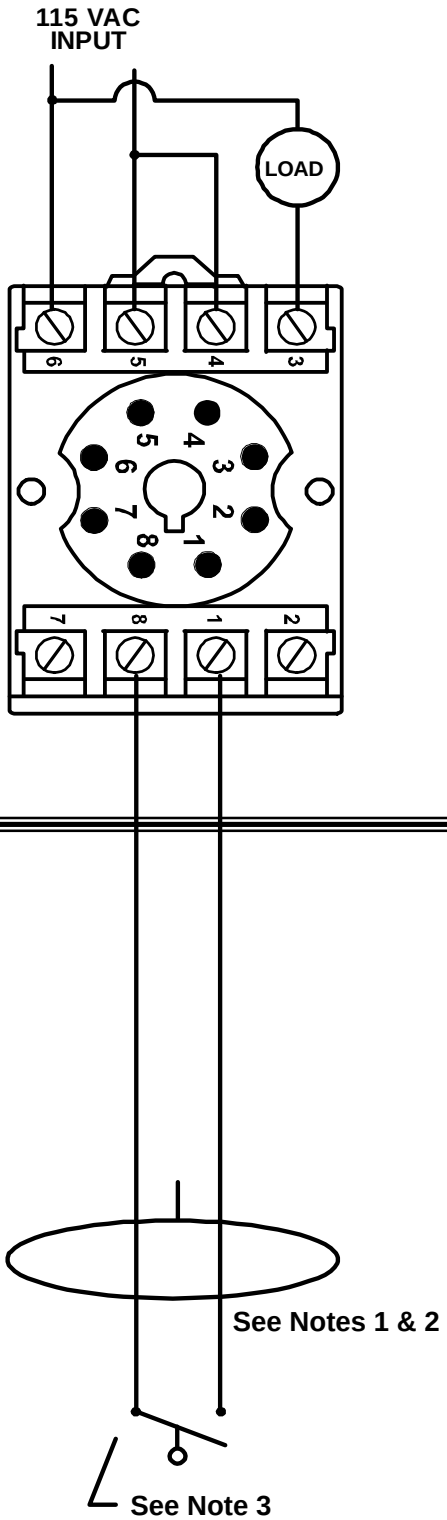
The ISS-101 relay is powered with 115VAC and is designed as an isolated switch suitable for applications with switch inputs in a hazardous location. In a powered state, the ISS-101 will close its output relay when the input switch is closed. The green LED on the cover will illuminate when the relay is energized and extinguish when the relay is de-energized.



II-ISS-101-B

CONTROL DRAWING ISS-101

ASSOCIATED APPARATUS / APPAREILLAGE CONNEXE



Non-Hazardous Location

Supply Voltage
90 - 120VAC

Relay Output Rating
8 Amps @ 120VAC General Purpose
Pilot Duty 180VA @ 120VAC, C300

Maximum Ambient Temperature Rating
55°C

NOTE: UL Listed when used with p/n OT08-PC manufactured by Custom Connector Corp. or p/n PF083A-E, manufactured by OMRON.

DEVICE MUST BE INSTALLED IN A SUITABLE ENCLOSURE

WARNING!

TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTABLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING.

DEVICE MAY ONLY BE REPAIRED BY THE MANUFACTURER

WARNING!

SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

AVERTISSEMENT!

LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.

Hazardous Location

Class I, Divisions I & II, Groups A, B, C & D;
Class II, Divisions I & II, Groups E, F & G; and
Class III locations

NOTES:

1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically safe wiring shall be separated from intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.
4. Entity Parameters:

V_{oc} = 16.8V	C_a = 0.39µF
I_{sc} = 1.2mA	$P_o = \frac{V_{oc} * I_{sc}}{4}$
L_a = 100mH	

5. Entity Parameter Relationships:

IS Equipment		Associated Apparatus
V_{max} (or U_i)	≥	V_{oc} or V_t (or U_o)
I_{max} (or I_i)	≥	I_{sc} or I_t (or I_o)
P_{max}, P_i	≥	P_o
$C_i + C_{cable}$	≤	C_a (or C_o)
$L_i + L_{cable}$	≤	L_a (or L_o)

Capacitance and inductance of the field wiring from the intrinsically safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in the table above. Cable capacitance, C_{cable}, plus intrinsically safe equipment capacitance, C_i, must be less than the marked capacitance, C_a (or C_o), shown on any associated apparatus used. The same applies for inductance (L_{cable}, L_i and L_a or L_o, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: C_{cable} = 60pF/ft., L_{cable} = 0.2µH/ft.

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Installation Instructions for ISS-102ACI-MC Intrinsically-Safe Switch

WARNING: TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTABLE ATMOSPHERES, DISCONNECT POWER FROM THE SYSTEM PRIOR TO INSTALLATION OR SERVICE.

CAUTION: Installation must comply with all national, state, and local codes. Installation of this equipment should only be performed by personnel trained in intrinsically-safe systems. Improper installation may result in serious injury or damage. Before proceeding with installation, read and understand these instructions completely.

The ISS-102 Isolated Switch is UL913 listed (E233355 1.3) as an associated apparatus for interfacing between hazardous and non-hazardous areas. The ISS-102 must be installed in a non-hazardous area. Follow SymCom's Control Drawing ISS-102ACI on page 4 for proper installation.

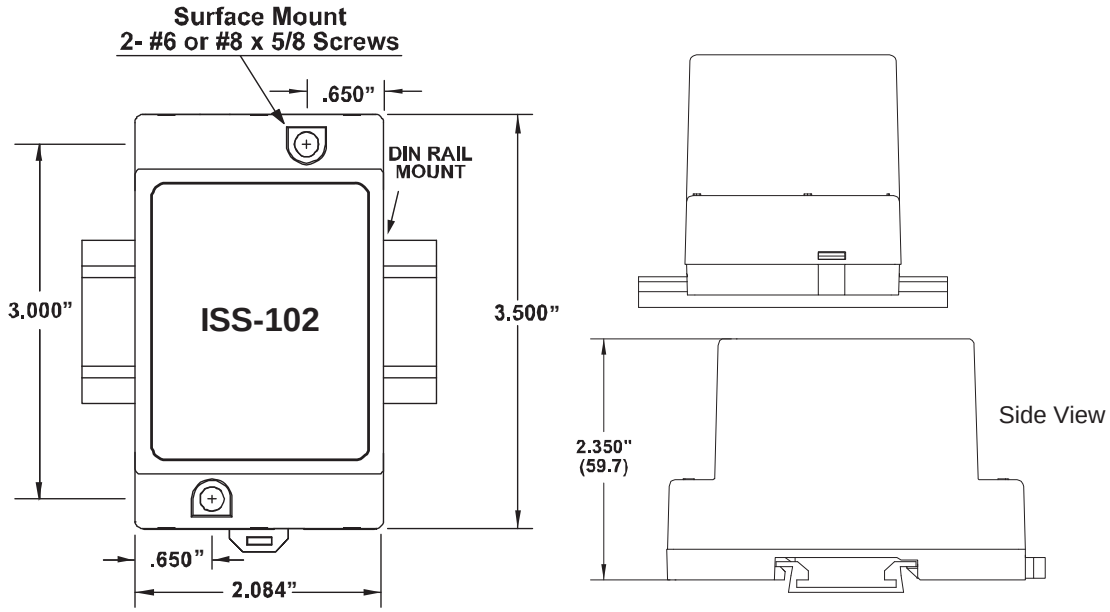
All wiring connected to a hazardous location must be separated from all non-intrinsically-safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically-Safe Systems. Check your state and local codes for additional requirements.

WARNING: REMOVE POWER FROM THE SYSTEM PRIOR TO INSTALLING OR SERVICING THE ISS-102.

INSTALLATION

1. Mount the ISS-102 in a non-hazardous location on 35mm DIN rail, or by installing two #6 or #8 screws into the surface mounting holes provided.

2. Connect wiring per SymCom's Control Drawing ISS-102ACI on page 4. Follow all hazardous code requirements while installing wiring to switch input terminals.



II_ISS-102ACI-MC_A1

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OPERATION

The ISS-102ACI-MC (Multi-function Controller) is user-configurable as a single or dual-channel switch, or pump-up/pump-down controller. The intrinsically-safe inputs are compatible with normally open (N.O.) or normally closed (N.C.) switches, as well as resistive probes. **NOTE: Prior to installation, set the DIP switches according to your specific system configuration (refer to Table 1).**

DIP SWITCH*	DESCRIPTION	SWITCH POSITION (ON = ↑ ,OFF = ↓)	
S1, S2	MODE SELECT	OFF, OFF =	Differential/ Latching Logic
		ON, OFF =	1-Channel Switch
		OFF, ON =	2-Channel Switch
S3	LOGIC	OFF = Direct Logic	
		ON = Inverted Logic	
S4	DEBOUNCE	OFF = .5 second	
		ON = 2 seconds	

***S1, S2, S3, and S4 refer to the DIP switches on the side of the ISS-102.**

TABLE 1: Setting the DIP Switches

Definitions

Normally Open (N.O.) – switch is "open" when water is **not** present

Normally Closed (N.C.) – switch is "closed" when water is **not** present

Direct Logic – input channels are active when "low" resistance (or closed switch) is detected

Inverted Logic – input channels are active when "high" resistance (or open switch) is detected

Debounce – the time delay required between changes of state (prevents nuisance tripping)

Sensitivity – resistance level required to change the state of the input channels

NOTE: if using resistive probes, set the sensitivity to the desired resistance limit, 4.7–100kΩ. If using switches, set the sensitivity to 100kΩ.

LED1 and LED2 – Each LED illuminates when its corresponding output relay is energized

Single-Channel Switch Mode

In single-channel switch mode, RELAY 1 (form A) and RELAY 2 (form C) will energize when **CH1** is activated (CH2 is disabled in this mode). Refer to Table 2 for proper DIP switch configuration.

FUNCTION	S1	S2	S3
1-Channel Switch with Direct Logic	ON	OFF	OFF
1-Channel Switch with Inverted Logic	ON	OFF	ON

TABLE 2: Single-Channel Mode

Dual-Channel Switch (non-latching)

In dual-channel mode, RELAY 1 (form A) will energize when **CH1** is activated, and RELAY 2 (form C) will energize when **CH2** is activated. Refer to Table 3 for proper DIP switch configuration.

FUNCTION	S1	S2	S3
2-Channel Switch with Direct Logic	OFF	ON	OFF
2-Channel Switch with Inverted Logic	OFF	ON	ON

TABLE 3: Dual-Channel Mode

Dual-Channel Differential / Latching Mode

Normally-Open (N.O.) Switches or Resistive Probes:

Pump-Down: Connect the **lower** float/probe to **CH1** (lead) and the **upper** float/probe to **CH2** (lag). Once the water level in the tank rises enough to activate the lag input, both output relays will energize and turn on the pump. After enough water is pumped from the tank to deactivate the lead input, the relays will de-energize and turn off the pump. Refer to Table 4 for proper DIP switch configuration.

FUNCTION	S1	S2	S3
Pump-Down with N.O. Switches or Resistive Probes (see Examples 1 & 2)	OFF	OFF	OFF

TABLE 4: Dual-Channel Latching Mode

Pump-Up: Connect the **upper** float/probe to **CH1** (lead) and the **lower** float/probe to **CH2** (lag). Once the water level in the tank drops enough to activate the lag input, both output relays will energize and turn on the pump. After enough water is pumped into the tank to deactivate the lead input, the relays will de-energize and turn off the pump. Refer to Table 5 for proper switch configuration.

FUNCTION	S1	S2	S3
Pump-Up with N.O. Switches or Resistive Probes (see Examples 3 & 4)	OFF	OFF	ON

TABLE 5: Dual-Channel Latching Mode

Dual-Channel Differential / Latching Mode (cont.)

Normally-Closed (N.C.) Switches:

Pump-Down: Connect the **lower** float to **CH1** (lead) and the **upper** float/probe to **CH2** (lag). Once the water level in the tank rises enough to activate the lag input, both output relays will energize and turn on the pump. After enough water is pumped from the tank to deactivate the lead input, the relays will de-energize and turn off the pump. Refer to Table 6 for proper DIP switch configuration.

FUNCTION	S1	S2	S3
Pump-Down with N.C. Switches (see Example 5)	OFF	OFF	ON

TABLE 6: Dual-Channel Latching Mode

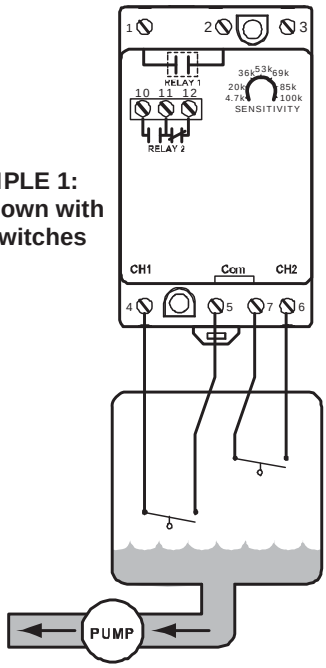
Pump-Up: Connect the **upper** float to **CH1** (lead) and the **lower** float/probe to **CH2** (lag). Once the water level in the tank drops enough to activate the lag input, both output relays will energize and turn on the pump. After enough water is pumped into the tank to deactivate the lead input, the relays will de-energize and turn off the pump. Refer to Table 7 for proper DIP switch configuration.

FUNCTION	S1	S2	S3
Pump-Up with N.C. Switches (see Example 6)	OFF	OFF	OFF

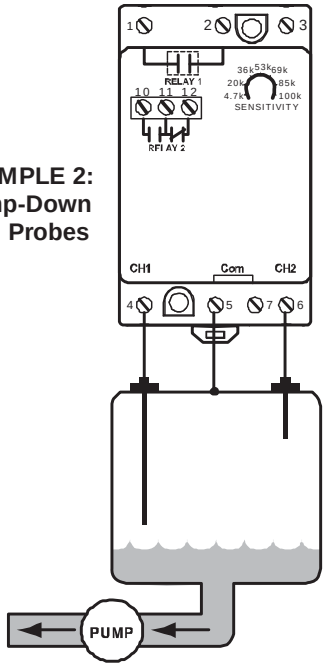
TABLE 7: Dual-Channel Latching Mode

EXAMPLE WIRING DIAGRAMS (examples apply to **Differential / Latching Mode** only)

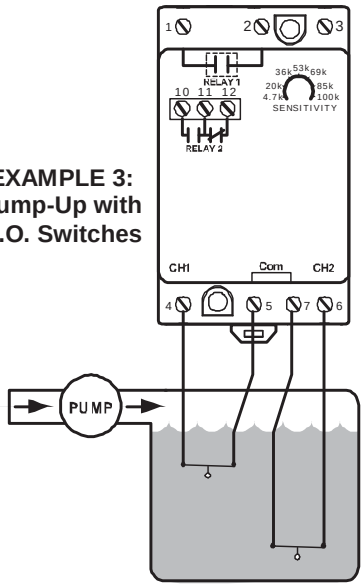
EXAMPLE 1: Pump-Down with N.O. Switches



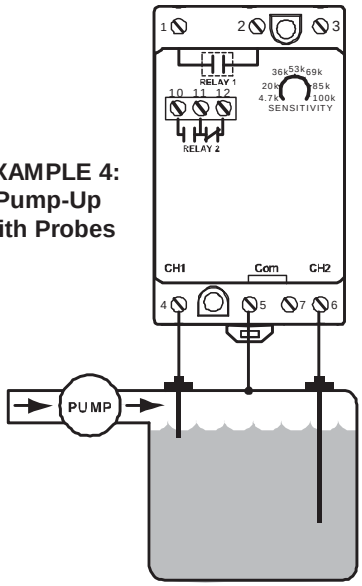
EXAMPLE 2: Pump-Down with Probes



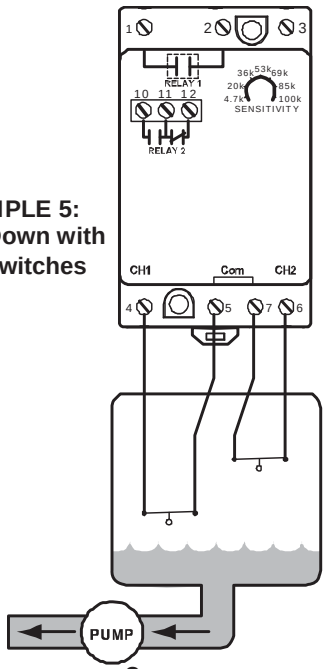
EXAMPLE 3: Pump-Up with N.O. Switches



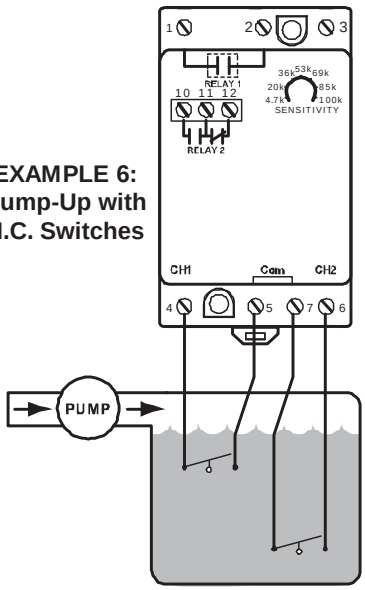
EXAMPLE 4: Pump-Up with Probes



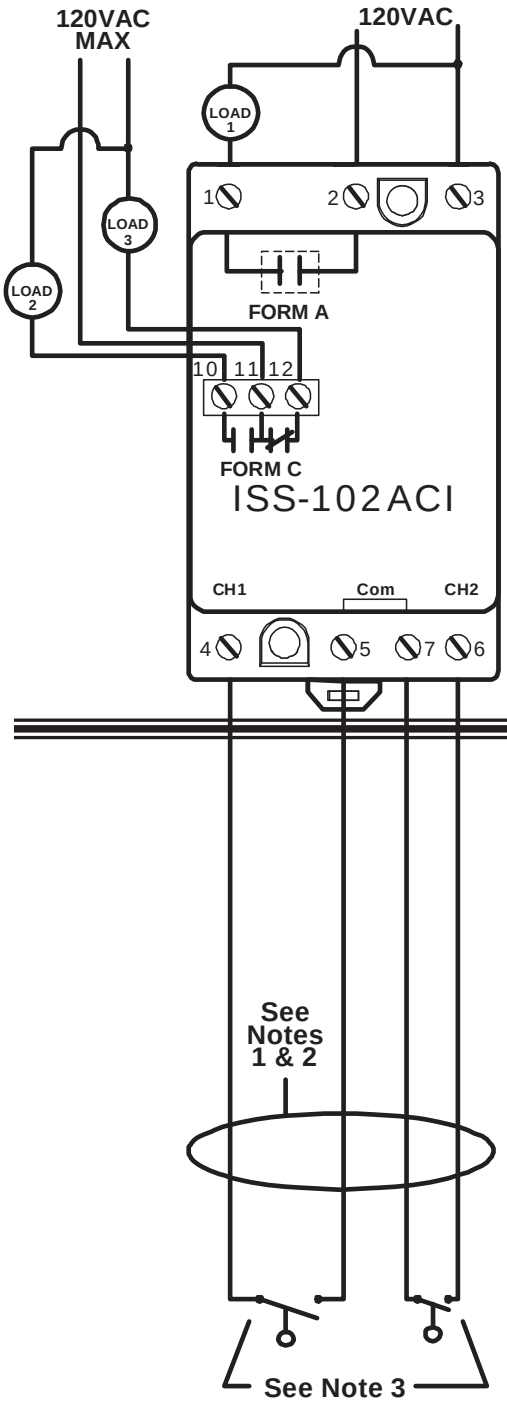
EXAMPLE 5: Pump-Down with N.C. Switches



EXAMPLE 6: Pump-Up with N.C. Switches



CONTROL DRAWING ISS-102ACI
ASSOCIATED APPARATUS / APPAREILLAGE CONNEXE



Non-Hazardous Location

Supply Voltage
120VAC

Relay Output Rating
5 Amps @ 120VAC General Purpose
Pilot Duty 180VA @ 120VAC, C150

Maximum Ambient Temperature Rating
55°C

DEVICE MUST BE INSTALLED IN A SUITABLE ENCLOSURE

WARNING!
TO PREVENT IGNITION OF FLAMMABLE OR COMBUSTABLE ATMOSPHERES, DISCONNECT POWER BEFORE SERVICING.

DEVICE MAY ONLY BE REPAIRED BY THE MANUFACTURER

WARNING!
SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

AVERTISSEMENT!
LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.

Hazardous Location

Class I, Divisions I & II, Groups A, B, C & D;
Class II, Divisions I & II, Groups E, F & G; and
Class III locations

NOTES:

1. Maximum distance between unit and switch contact is 10,000 feet.
2. All non-intrinsically safe wiring shall be separated from intrinsically safe wiring. Description of special wiring methods can be found in the National Electrical Code ANSI/NFPA 70, Article 504 Intrinsically Safe Systems. Check your state and local codes for additional requirements.
3. All switch contacts shall be non-energy storing, containing no inductance or capacitance.
4. Entity Parameters:
   Voc = 16.8V Ca = 0.39μF
   Isc = 1.2mA Po = $\frac{Voc * Isc}{4}$
   La = 100mH
5. Entity Parameter Relationships:

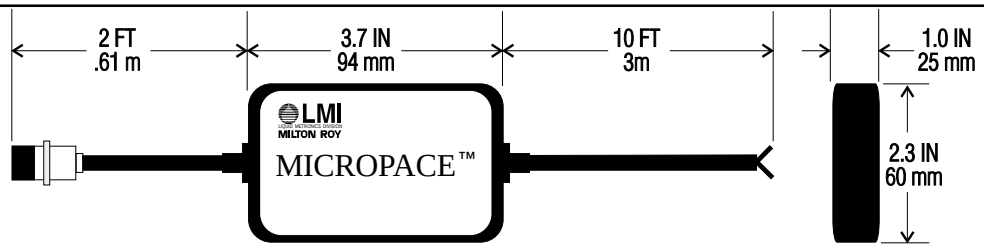
IS Equipment		Associated Apparatus
Vmax (or Ui)	≥	Voc or Vt (or Uo)
Imax (or Ii)	≥	Isc or It (or Io)
Pmax, Pi	≥	Po
Ci + Ccable	≤	Ca (or Co)
Li + Lcable	≤	La (or Lo)

Capacitance and inductance of the field wiring from the intrinsically-safe equipment to the associated apparatus shall be calculated and must be included in the system calculations as shown in the table above. Cable capacitance, Ccable, plus intrinsically-safe equipment capacitance, Ci, must be less than the marked capacitance, Ca (or Co), shown on any associated apparatus used. The same applies for inductance (Lcable, Li and La or Lo, respectively). Where the cable capacitance and inductance per foot are not known, the following values shall be used: Ccable = 60pF/ft., Lcable = 0.2μH/ft.

2880 North Plaza Drive, Rapid City, South Dakota 57702
(800) 843-8848 · (605) 348-5580 · fax (605) 348-5685
www.symcom.com

Instruction **Sheet**

Micropace™ Electronic Metering Control Modules



Power Supply:
15 VDC, Supplied by LMI pump
Ambient Temperature:
0^0F to 140^0F
(-20^0C to 60^0C)
Enclosure:
Splash & dust proof, IP-65 rated

Specifications and dimensions shown above are typical for all models.

MP-100 Analog to Digital Converter

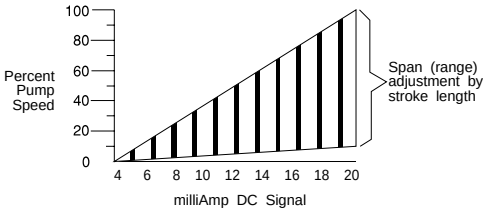
Input Signal Source: 4-20 mA (isolated) only.
Max Input Voltage: 42VDC
Impedance: 100 Ohms

INSTALLATION

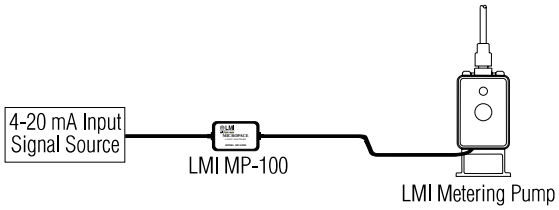
1. Disconnect signal source supply voltage prior to connecting your MP-100. Failure to do so may damage the MP-100 circuit.

2. Insert the 4-pin connector into the socket on your LMI Series A7, B7 or C7 Metering Pump. The socket is located on the bottom right under the pump control panel.

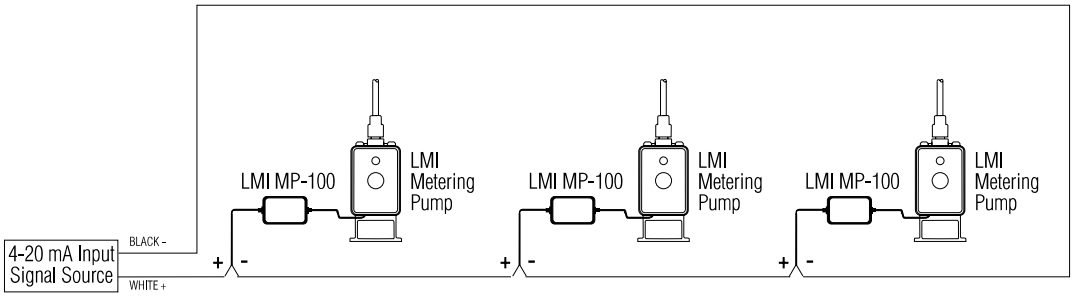
3. Connect the other end of the cable to your input signal source. Polarity is:
white = positive(+); black = negative (-).



MP-100 Adjustment Range



MP-100 Typical Installation



MP-100 Series Loop Control

LMI
LIQUID METRONICS DIVISION
MILTON ROY
A unit of Sundstrand Corporation

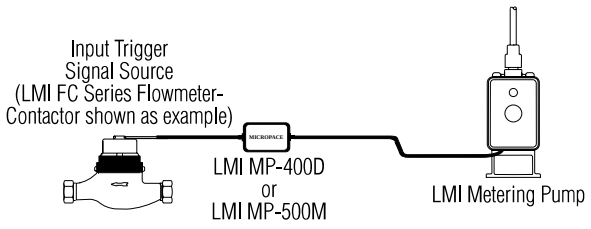
8 Post Office Square
Acton, MA 01720 USA
TEL: (508) 263-9800
FAX: (508) 264-9172
http: //www.lmipumps.com

Replaces same of Rev. B 5/96
1631.B 7/97

MP-400D Pulse Divider (Counter)
MP-500M Pulse Multiplier (Batch Signal Converter)

Switch Input (MP-400D & MP-500M):
A. 'On' Resistance: 5K ohms max.
B. 'Off' Resistance: 100K ohms min.
Min. switch closure time (MP-400D & MP-500M)
low impedance state (on) : 10 milliseconds
Min. switch opening time (MP-400D & MP-500M)
high impedance state (off) : 20 milliseconds
Max. count speed or frequency (MP-400D):
1800 pulses per minute (30Hz)

Max. batch count or multiplier (MP-500M): 1023 pulses
Pulse output rate or speed (MP-500M):
fixed, 100 ± 2 pulses per minute



MP-400D or 500M Typical Installation

INSTALLATION

1. The MP-400D and MP-500M Signal Converters may be preset before connection to the pump or signal source, or may also be adjusted after connection.

2. Open the MP-400D or MP-500M cover by removing the four screws that hold the back cover on.

3. Follow the instructions inside the cover to set your Signal Converter. Use a pencil or ball point pen to slide the switches.

4. Replace the cover and the four screws.

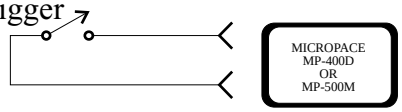
5. Insert the 4-pin connector into the socket on your LMI Series A7, B7 or C7 Metering Pump. The socket is located on the bottom right under the pump control panel.

6. Connect the other cable to your input signal source.
Polarity is: white = positive(+); black = negative (-).

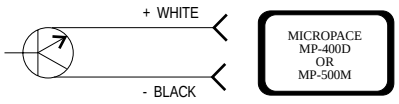
7. Switch your pump to EXTERNAL. The count, division or multiplication will begin immediately. Switching the pump to OFF or unplugging the pump will reset the count.

METHODS OF TRIGGERING MP-400 AND MP-500M

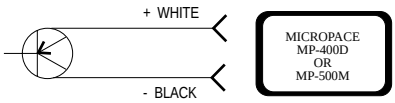
1. Switch Closure
switch closing trigger



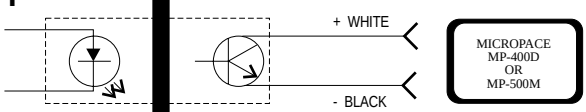
2. NPN Transistor
Base goes high



3. PNP Transistor
Base goes low



4. Opto Isolator



NOTE: *Switch or transistors must be capable of switching 2 milliamperes @ 15V DC. Combining additional* **MICROPACE** ™ *units will increase the milliampere demand.*

Georg Fischer Signet LLC
Signet 9900 Transmitter

+GF+

Test Certificate

Part information

Code:	159 001 695
Mfr. Part #:	3-9900-1P
Serial number:	61410240625
Description:	One input with 4 to 20 mA output and one open collector, panel mount
Test date:	10/24/2014 8:33:34 AM

Measuring Standard(s)

Meter ID#:	SSC-734
Cal due date:	3/31/2015

Test Data

Fixture ID	TF-233,RS-50	Open Col.	PASS
Automation	PASS	Keypad	PASS
Comm / Echo	PASS		
Display	PASS		
Contrast	PASS		

Current output

Set current	Specification	Measured (mA)	Result
4.000 mA	3.968 - 4.032	4.000	PASS
8.000 mA	7.968 - 8.032	7.998	PASS
12.000 mA	11.968 - 12.032	11.998	PASS
16.000 mA	15.968 - 16.032	16.000	PASS
20.000 mA	19.968 - 20.032	20.000	PASS

Refer to Signet Transmitter manual (PN 3-9900.090-1) for technical specifications.

Georg Fischer Signet LLC certifies that the reference used in the calibration of this transmitter is traceable to NIST (National Institute of Standards and Technology). Improper handling may adversely affect the accuracy.

Georg Fischer Signet LLC products are manufactured under ISO 9001 for Quality and ISO 14001 for Environmental Management.

Georg Fischer Signet LLC
3401 Aerojet Avenue
El Monte, CA 91731-2882
www.gfsignet.com

English

Signet 9900 Transmitter

3-9900.090 Rev. E 06/14

Operating Instructions

Panel Mount

Field Mount

- English
- Deutsch
- Français
- Español
- Italiano
- 中文

Quick Start

Look for the Quick Start icon to quickly set up your new 9900.

Your new Signet 9900 Transmitter needs to be calibrated and the sensor needs to be initialized prior to use. The following steps outline the recommended procedure to start up a new system.

1. **Module Installation (page 3)**
2. **Installation (page 7)**
3. **Wiring (page 8)**
4. **Sensor Wiring (page 11)**
5. **Power Wiring (page 17)**
6. **Relay and Open Collector Wiring (page 18)**
7. **Relay Functions (page 19)**
8. **Operation (page 23)**
9. **Menu System (page 25)**

Description

The 9900 Transmitter, a member of Signet's line of SmartPro™ instruments, provides a single-channel interface for all Flow, pH/ORP, Conductivity/Resistivity, Salinity, Pressure, Temperature, Level, Dissolved Oxygen, Turbidity, Batch and other applications.

The 9900 is available in either Panel or Field Mount. Both versions run on 10.8 to 35.2 VDC power (24 VDC nominal), and can power certain sensors on loop power (see NOTE on page 11).

The 9900 Transmitter, also allows third-party 4 to 20 mA signals to be used as an input (optional Signet 8058 i-Go™ Signal Converter required, sold separately).

Compatibility

The 9900 is compatible with all GF Signet products listed in the column to the right.

- pH and ORP electrodes require the Signet 2750/2751 DryLoc® Sensor Electronics (sold separately).
- Conductivity/Resistivity or Salinity measurement requires either the optional Direct Conductivity/Resistivity Module (part number 3-9900.394) or the Signet 2850 Conductivity/Resistivity Sensor Electronics (sold separately).
  NOTE: If using the 2850, use the one-channel Digital (S^3L) models. The two-channel model 3-2850-63 may be used with only one channel connected. Do not use with both channels connected. The 4 to 20 mA models 3-2850-52 and 3-2850-62 are incompatible with the 9900.
- Turbidity measurement using Signet 4150 or Dissolved Oxygen measurement using Signet 2610-31 requires Signet 8058 i-Go™ Signal Converter (sold separately).

Flow
515*/8510*, 525*, 2000, 2100, 2507, 2536*/8512*, 2537, 2540*, 2551, 2552

pH/ORP
2724-2726 with 2750*/2751
2734-2736 with 2750*/2751
2756-WTx–2757-WTx with 3719 and 2750*/2751
2764-2767 with 2750*/2751
2774-2777 with 2750*/2751

Conductivity/Resistivity, Salinity
2819-2823 with 2850 or Cond/Res Module
2839-2842 with 2850 or Cond/Res Module

Level, Temperature, Pressure
2250*, 2350*, 2450*

Turbidity
4150 requires 8058

Dissolved Oxygen
2610-41 direct to 9900
2610-31 requires 8058

* Can be run on Loop Power (see NOTE on page 11)

Warranty Information

Refer to your local Georg Fischer Sales office for the most current warranty statement.

All warranty and non-warranty repairs being returned must include a fully completed Service Form and goods must be returned to your local GF Sales office or distributor.
Product returned without a Service Form may not be warranty replaced or repaired.

Signet products with limited shelf-life (e.g. pH, ORP, chlorine electrodes, calibration solutions; e.g. pH buffers, turbidity standards or other solutions) are warranted out of box but not warranted against any damage, due to process or application failures (e.g. high temperature, chemical poisoning, dry-out) or mishandling (e.g. broken glass, damaged membrane, freezing and/or extreme temperatures).

Product Registration

Thank you for purchasing the Signet line of Georg Fischer measurement products.
If you would like to register your product(s), you can now register online in one of the following ways:

- Visit our website **www.gfsignet.com.** Under **Service and Support** click **Product Registration Form**
- If this is a pdf manual (digital copy), **click here**

Safety Information

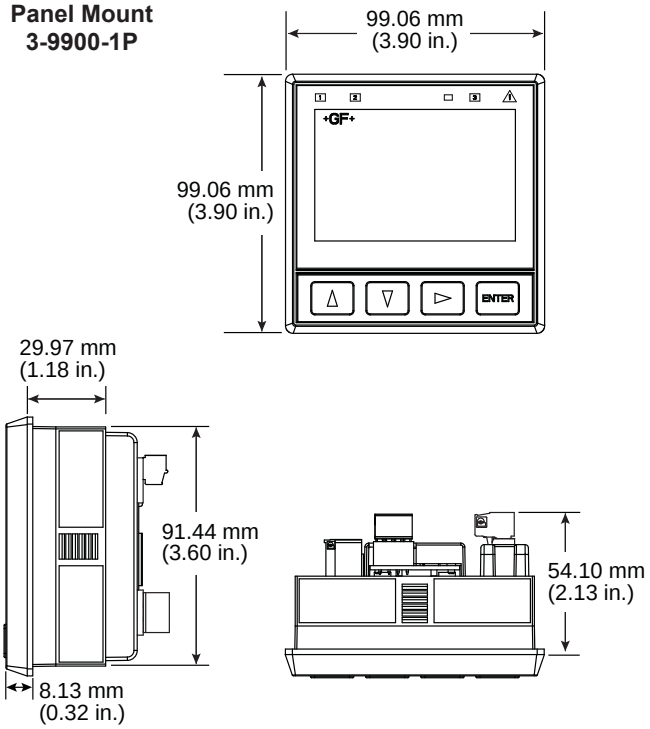
- Follow instructions carefully to avoid personal injury.
- This unit is designed to be connected to equipment which can be hazardous to persons and property if used incorrectly.
- Read and understand all associated equipment manuals and safety warnings before using with this product.
- Remove power to unit before wiring connections.
- Wiring connections to this product should only be performed by qualified personnel.
- Do not use unit if front panel is cracked or broken.

	**Warning / Caution / Danger** Indicates a potential hazard. Failure to follow all warnings may lead to equipment damage, injury, or death.
	**Electrostatic Discharge (ESD) / Electrocution Danger** Alerts user to risk of potential damage to product by ESD, and/or risk of potential of injury or death via electrocution.
	**Personal Protective Equipment (PPE)** Always utilize the most appropriate PPE during installation and service of Signet products.
	**NOTE / Technical Notes** Highlights additional information or detailed procedure.

Table of Contents

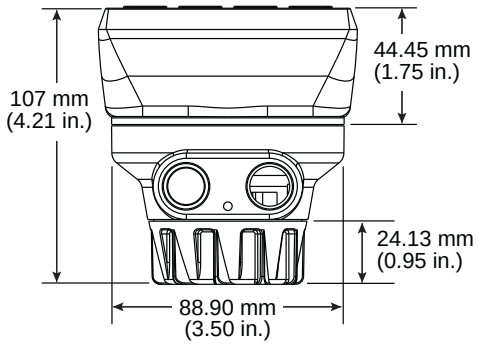
Dimensions

Panel Mount
3-9900-1P



Side View Top View

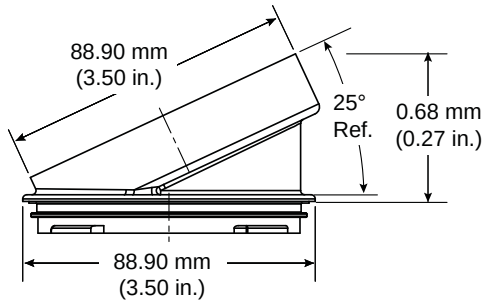
Field Mount
3-9900-1



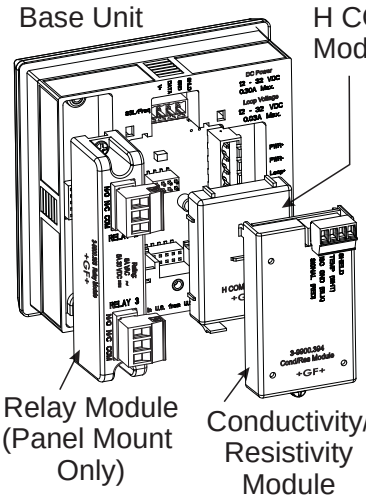
(3-8051-X shown)

NOTE: 3-8051-X Integral Mounting Kit sold separately.

3-9900.396 Angle Adjustment Adapter Kit



Module Installation



If the 9900 Base Unit will be mounted in a panel, the plug-in modules may be installed either before or after the base unit is mounted. If the 9900 Base Unit will be mounted using the wall mount accessory kit (3-9900.392), install plug-in modules first.

If installing both the Conductivity/Resistivity (Cond/Res) and the H COMM Modules, install the H COMM Module first, then the Cond/Res Module on top of it (see illustration on page 5).

CAUTION
Exercise care when installing modules.
Do not bend connecting pins.

To install modules:
Remove power from the 9900. Carefully align pins and connectors (do not bend connecting pins) and push module firmly into place, then attach with screw(s) (except H COMM Module).

CAUTION
LOOP as well as DC power MUST be removed BEFORE installing H COMM Module.

To remove modules:
Remove power from the 9900.

For Relay, Cond/Res, and 4 to 20 mA Output Modules, unplug connectors, remove screw(s), and carefully pull module straight out from the base unit. Do not bend the connecting pins.

For H COMM Module, squeeze the tabs on the bottom edge, grasp the module and pull straight out. Do not bend the connecting pins.

For Batch Module, remove the Relay module. Loosen bottom screw of Batch module. Carefully grip and squeeze the tabs at the top of the module to release. Pull module away from the unit. Do not bend the connecting pins.

WARNING
Relays may be connected to external high-voltage power sources or multiple power sources creating an electrocution hazard.

Plug-In Modules

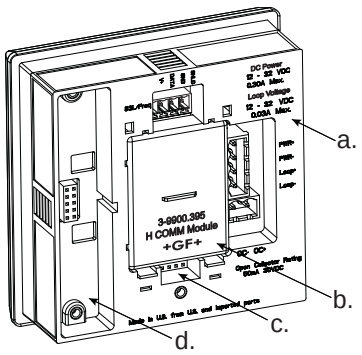
Optional modules and accessories are available for the 9900:

a. Base Unit (required)
b. Slot for optional H COMM Module
c. Slot for optional Conductivity/Resistivity, Batch, or 4 to 20 mA Output Module
d. Slot for optional Relay Module (not available on field mount)

Each item is ordered separately.

Modules are field-replaceable at any time.

See Module Installation (pg. 3) and Ordering Information (pg. 72) sections for more details.



9900 Module	9900 Generation			
	I	II	III	IV
H COMM*	X	X	X	X
Relay	X	X	X	X
Conductivity/ Resistivity	X	X	X	X
Batch		X	X	X
4-20mA Output*			X	X

*Able to run on Loop power

CAUTION
Avoid Electrostatic Discharge (ESD).

- Minimize handling of the plug-in modules to reduce the possibility of damage due to ESD.
- Handle modules by the edges. Never touch any exposed circuitry or contacts.
- Wear an anti-static wristband or stand on an anti-static mat, or keep one hand touching a properly grounded pipe or other piece of properly grounded metal when handling modules.

Relay Module

(Panel Mount installations only)

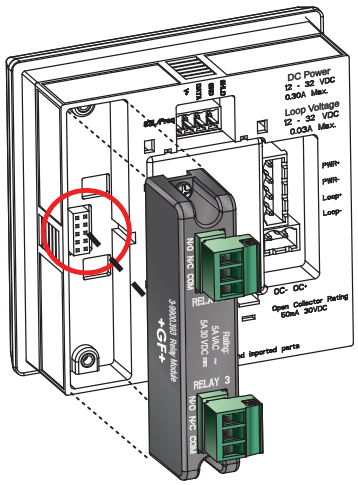
Mfr. Part No.	Code	Description
3-9900.393	159 001 698	Relay Module - Two dry-contact relays

In addition to the standard programmable Open Collector output in the base unit, the Panel Mount version of the 9900 has a slot for an optional Relay Module, which adds two programmable dry-contact relays. The Open Collector output in the base unit uses the Relay 1 setting in the menus. If the optional Relay Module is installed, these are assigned to relays 2 and 3 in the menus.

Dry-contact relays are electromechanical switches with a moving contact armature. They are suitable for many general-purpose applications, AC or DC, including AC loads up to 250 V. Install RC Filter Kits, 3-8050.396, on relays used to switch motor or inductive loads.

- Two (2) SPDT dry-contact relay (DCR) inputs
- User programmable
- 250 V, 5 A maximum resistive loading (AC).
- Can switch line voltage (typically 120 to 240 VAC)
- Can switch DC voltage (< 30 VDC @ 5A)
- Larger voltage and current ratings than Open Collector outputs.

For wiring information, refer to the Relay and Open Collector Wiring section, page 18.



NOTE:
The Relay Module requires 10.8-35.2 VDC, 300 mA power connection to DC PWR Terminals. The Relay Module cannot be used with loop power.

- The two red Mechanical Relay Indicator LEDs on the front panel of the 9900 show the status of relays 2 and 3. (Status of all relays and Open Collector is available at all times in a single screen in View mode.)
- Hysteresis and time delay are adjustable for each relay.

CAUTION

Switching active loads (usually inductive) can cause contact arcing sufficient to damage the relays.

The RC Filter Kit or “snubber” (part number 3-8050.396) is available as an accessory to reduce or eliminate these damaging effects. Recommended for inductive loads greater than 50 VAC (remote relays, solenoids, pumps, etc.)

CAUTION

DO NOT bundle Relay Module wiring with other wiring.

Doing so may cause injury and/or damage to 9900 Transmitter, Relay Module, and Batch Module.

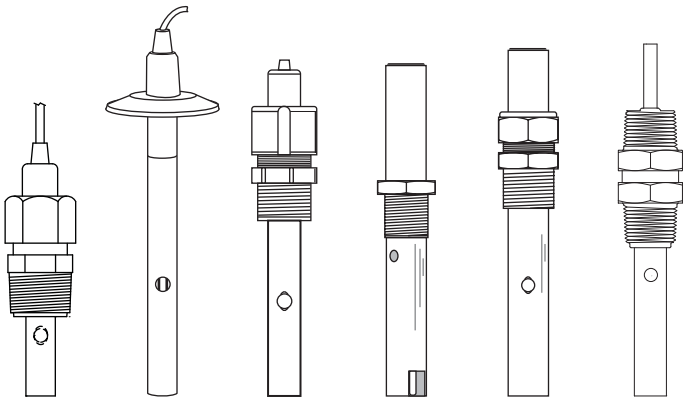
Direct Conductivity/Resistivity Module

Mfr. Part No.	Code	Description
3-9900.394	159 001 699	Direct Conductivity/Resistivity Module

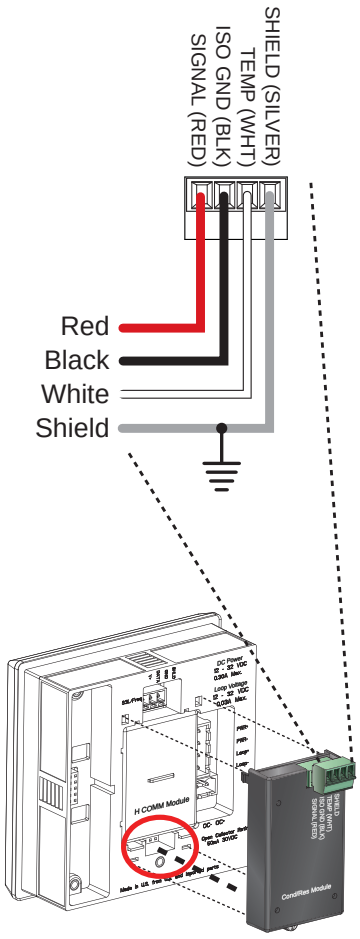
The Direct Conductivity/Resistivity (Cond/Res) Module interfaces Signet 2818-2823 and 2839-2842 Conductivity electrodes directly to the 9900. (Conductivity/Resistivity and Salinity measurements may also be performed via the 2850 Sensor Electronics connected through the 9900 Digital (S^3L) input.)

- Provides filtering and conditioning.
- Sensor cable length can be extended to 30 m (100 ft).
- 2839 - 2842 sensors come with a cell constant certificate to improve the accuracy of the sensor measurements (see page 38).

For additional wiring information, refer to the Conductivity/Resistivity Module Instruction Sheet 3-9900.092.



2818 Sanitary 2819-2821 2822 2823 2839-2842



H COMM Module

Mfr. Part No.	Code	Description
3-9900.395	159 001 697	H COMM Module

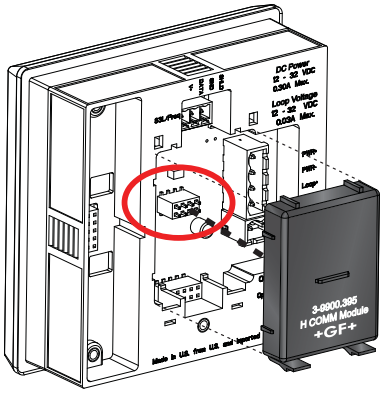
The H COMM Module enables communication between the 9900 and a HART®-enabled device. The HART (**H**ighway **A**ddressable **R**emote **T**ransducer) Protocol superimposes digital signals on top of the 4 to 20 mA analog signal.

Refer to the 9900 H COMM Module Instruction Sheet 3-9900.094 for further details.

NOTE:
With H COMM Module installed, a minimum of 24 V is required for loop-powered systems.

NOTE:
The black rubber jumper adjacent to the power terminal should only be removed when both the H COMM Module is utilized and the required sensor cable length is over 304 m (1000 ft).

See Appendix for H COMM Module Overview, Installation, Wiring, Operation, HART Commands, and Unit Code information. (See page 64-69)



NOTE:
The H COMM Module can run on Loop Power.

Batch Module

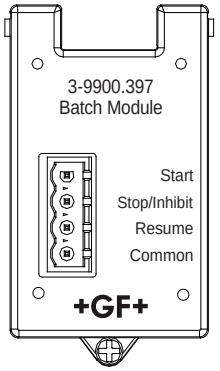
Mfr. Part No.	Code	Description
3-9900.397	159 310 163	Batch Module

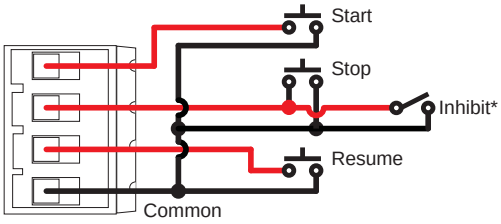
Convert a 9900-1P Transmitter (Generation II** or later) into a Batch Controller system by utilizing a Batch Module (3-9900.397) and a Relay Module (3-9900.393).

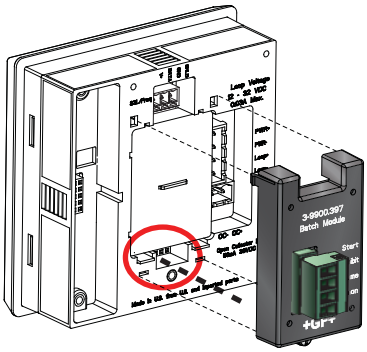
Optional Module Wiring:

- Wire an external button or keypad (customer supplied) to stop, start or resume a batch remotely.
- *Wire an external input that can inhibit a batch from starting.

Full 9900-1BC Batch Controller System manual available at www.gfsignet.com







**NOTE:
Verify 9900 Transmitter generation in the OPTIONS Menu.

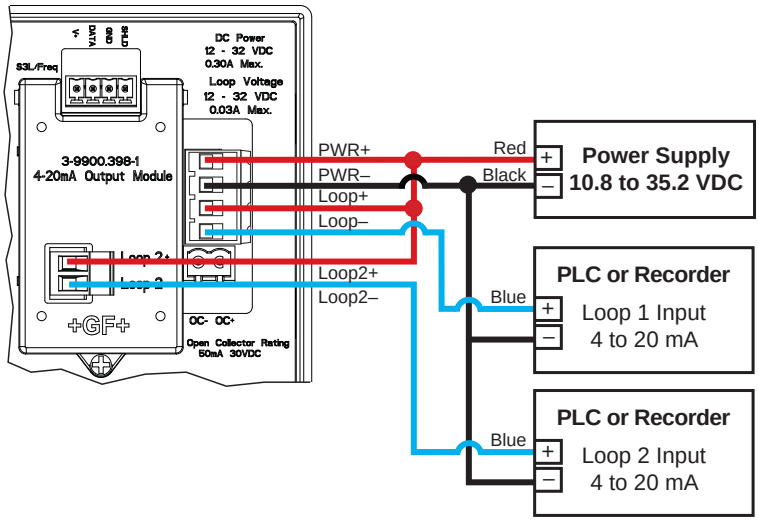
4 to 20 mA Output Module

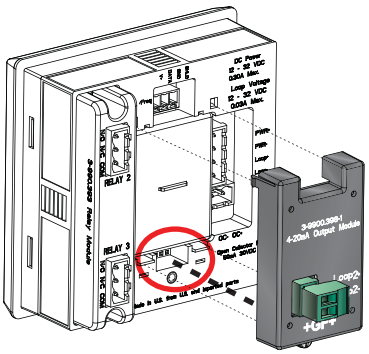
Mfr. Part No.	Code	Description
3-9900.398-1	159 001 784	4 to 20 mA Output Module

The optional 4 to 20 mA Output Module adds an additional 4 to 20 mA loop output to a Signet 9900 Transmitter (Panel or Field Mount). Requires the 9900 Generation III** or later.

Features:

- 4 to 20 mA Output Module can be powered using Loop Power or DC Power in the 9900 base unit.
- Independent settings for the loop currents of the Output Module and 9900 base unit (Error, Loop Adjustments, etc.).
- The Primary or Secondary (if applicable) measurement of a compatible sensor can be selected as the loop source.
- The same source (Primary or Secondary measurement) can be used for Loop 1 in the 9900 base unit and Loop 2 in the Output Module.





NOTE:
The 4 to 20 mA Output, Direct Conductivity, and Batch Modules share the same installation site on the 9900 base units.

Only one of these modules can be used per 9900 Transmitter.

NOTE:
The Output Module can run on Loop Power.

Installation

System Start-up: Step 1

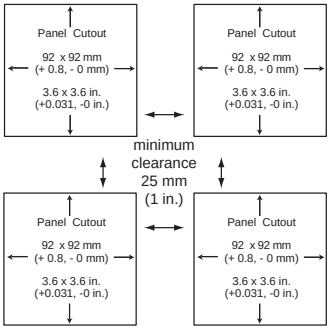
Prepare the transmitter installation location. If the back of the transmitter is difficult to access when installed, wire the removable terminal blocks first, then install it completely.

Next step: Wiring (see page 8).

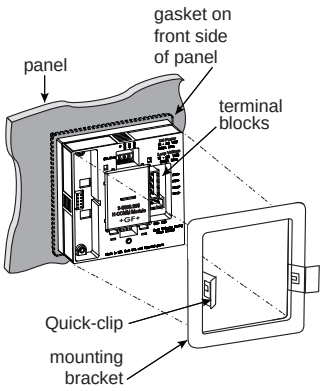
For future reference, for each installation, it is recommended to record the part number and serial number of each of the components listed here:

Facility Tag Number or System ID (user assigned):_____

Base unit	3-9900-____	S/N _____
Relay Module	3-9900.393	S/N _____
Cond/Res Module	3-9900.394	S/N _____
H COMM Module	3-9900.395	S/N _____
Batch Module	3-9900.397	S/N _____
4 to 20 mA Output Module	3-9900.398-1	S/N _____



Do not mount in direct sunlight.



Panel Mount Installation

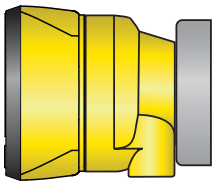
Tools and Equipment Required

- Fine-tooth file
- ¼ DIN punch or jigsaw suitable for cutting panel opening to within 1 mm (0.04 in) tolerance.
- ¼ DIN punches are available and recommended for creating clean, precise openings quickly and easily in most instrument panels.
- If a punch is not available, a jigsaw or other cutting tool can be used. An adhesive template is provided to help guide the cutting process. De-burr and smooth the opening with a file.

1. The panel mount transmitter is designed for installation using a ¼ DIN punch. Recommended clearance on all sides between instruments is 25 mm (1 in).
2. Place gasket on instrument, and install in panel.
3. Slide mounting bracket over back of instrument until bracket snaps into latches on sides of instrument.

To remove:

1. Secure instrument temporarily with tape from front or grip from rear of instrument. DO NOT RELEASE.
2. Press bracket clips outward and remove.

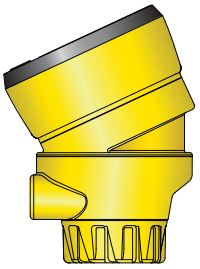


Field Mount with
3-8050 Universal Mount Kit

Field Mount Installation

Field mounting requires a separate mounting kit. The 3-8050 Universal Mount Kit, the 3-8051 or 3-8052 Integral Mount Kits, and the 3-9900.396 Angle Adjustment Adapter Kit enable the transmitter to be installed virtually anywhere. Detailed instructions for field installation options are included with the 3-8050, 3-8051 and 3-8052 adapter kits (see Ordering Information section).

For Field Mount installations with a Cond/Res Module, the 3-9900.396 Angle Adjustment Adapter is required along with a 3-8050 or 3-8052 adapter kit to allow for sufficient clearance for the wiring.



Field Mount with
3-8051 Integral Mount Kit
and Angle Adjustment Adapter

Wiring

System Start-up: Step 2

Wire the transmitter for all connections with the power off. Keep any 4 to 20 mA and relay-actuated output devices that are connected to it offline at this time. Connect the sensors (page 11), power (page 17) and relay(s) (page 18).

Next step: Relay Functions (see page 19).

Wiring Tips:

- Do not route the sensor, DC power, or 4 to 20 mA cables in conduit containing AC power wiring. Electrical noise may interfere with sensor signal.
- Routing the sensor cable in grounded metal conduit can help prevent electrical noise and mechanical damage.
- Seal the cable entry points to prevent moisture damage.
- Only one wire should be inserted into a terminal.
- Splice double wires outside the terminal or use appropriate wire ferrule, not to exceed 2 mm (0.08 in) diameter.

Tools Required

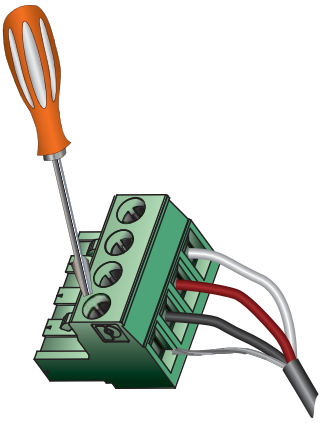
- Phillips screwdriver
- Flat-head screwdriver
- Wire strippers

For Field Mount installations, refer to the wiring diagram inside the Field Mount housing.

All wiring connections to the 9900 are made via removable terminals.

In general:

- The Power, Loop and Open Collector plugs and the Relay Module plug accept 12 to 28 AWG wire.
  The S^3L/Freq plug and the Cond/Res Module plug accept 16 to 28 AWG wire.
- Strip 7 mm (0.28 in.) of insulation from wire tips and tin bare ends to eliminate fraying.
- Insert wire tip or ferrule completely into the terminal and secure with the screw.
- Do not allow any AC leads that may be connected to the internal relays to come in contact with low voltage wiring.



CAUTION:
Avoid Electrostatic Discharge (ESD)

- Minimize handling of plug-in modules to reduce the possibility of damage due to ESD.
- Handle modules by the edges. Never touch any exposed circuitry or contacts.
- Wear an anti-static wristband or stand on an anti-static mat, or keep one hand touching a properly grounded pipe or other properly grounded piece of metal when handling modules.

Signal Type: Frequency

Signet flow sensors 515/8510, 525, 2000, 2100, 2507, 2536/8512 and 2540 provide a frequency output. (Flow sensors 2551 and 2552 can be configured with either Digital (S^3L) or Frequency outputs, see page 13.)

The maximum allowable cable length for sensors with frequency output is dependent upon the output signal strength of the sensors themselves, and the degree to which the signals are susceptible to EMI or "noise." This is largely a function of whether the sensors are self-powered (515/8510 and 525), or powered by an external source.

- The input terminals on the 9900 carry frequency data signals from the sensor.
- Do not route sensor or output cables in conduit containing AC power wiring. Electrical noise may interfere with sensor signal.
- Routing cable in grounded metal conduit will help prevent electrical noise and mechanical damage.
- Seal cable entry points to prevent moisture damage.
- Only one wire should be inserted into a terminal. Splice double wires outside the terminal.
- In case of noise interference, ground the sensor SHIELD wire to a local earth ground at a point near the sensor.
- Consult the sensor manual for additional wiring information.

Flow sensor models with Frequency Output	Maximum Cable Length	
	60 m (200 ft)	305 m (1000 ft)
515/8510	X	
525	X	
2000		X
2100		X
2507		X
2536/8512		X
2537		X
2540		X
2551		X
2552		X

Signal Type: Digital (S^3L)

- The input terminals on the 9900 carry Digital (S^3L) serial data from the sensor.
- Do not route sensor or output cables in conduit containing AC power wiring. Electrical noise may interfere with sensor signal.
- Routing cable in grounded metal conduit will help prevent electrical noise and mechanical damage.
- Seal cable entry points to prevent moisture damage.
- Only one wire should be inserted into a terminal. Splice double wires outside the terminal.
- The TOTAL cable length from I/O devices to the transmitter must not exceed 305 m (1000 ft).
- In case of noise interference, ground the sensor SHIELD wire to a local earth ground at a point near the sensor.
- Consult the sensor manual for additional wiring information.
- The maximum cable length of the Digital (S^3L) bus varies depending on the types of sensors connected and the size of the conductors in the cable. For best results, determine the maximum cable length for the system before routing cables.
- There are several methods that can help route the digital cables and remain within the distance limitations.

In case of noise interference, connect the cable shield to earth ground.

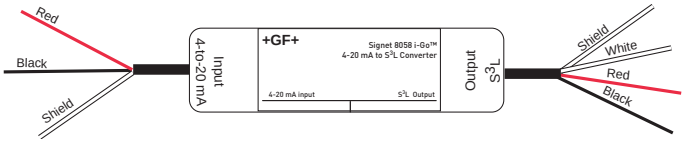
Maximum total cable length of the Digital (S^3L) Bus:

The quality of the cable used in the bus determines the maximum length of all branches combined. The maximum cable length may not exceed 305 m (1000 ft), regardless of current requirements.

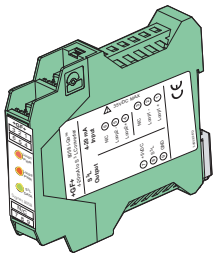
Signal Type: 4 to 20 mA

When connecting a non-Signet sensor to the 9900, the sensor's 4 to 20 mA signal must be converted to Digital (S^3L). The 8058 i-Go Signal Converter accepts any 4 to 20 mA signal and converts it into Digital (S^3L).

1. Wire the 8058 between the 4 to 20 mA loop source and the 9900 Digital (S^3L) input terminals (see page 14).
2. In the 9900 INPUT TYPE menu (see System Setup Menu discussion, page 25), specify 4 to 20 mA INPUT.
3. Set additional labels and abbreviations as described on pgs. 42-43.



8058-1



8058-2

For the 8058-2, connect Channel 1 ONLY

Terminal Identification

The 9900 requires regulated **10.8 to 35.2 VDC (24 VDC nominal)** from an external power supply (not supplied).
Maximum current draw is:
200 mA = 9900 without Relay module
300 mA = 9900 with Relay module

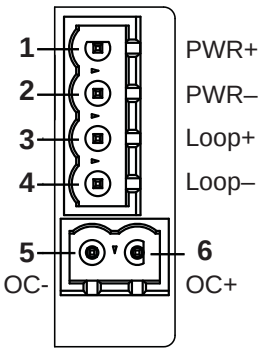
Terminals 1-2: DC Power
Required by the instrument
- 10.8 to 35.2 VDC input power to sensors, relays and the LCD backlight

Terminals 3-4: Loop Power (may also be used for system power)
- 10.8 to 35.2 VDC
  NOTE: Backlight, LEDs and optional Relay Module do not operate on loop power. Any connected sensors or sensor electronics that cannot operate on loop power will also be inoperative.

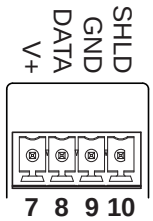
Terminals 5-6: Open Collector
- Software selectable for Normally Open or Normally Closed.
- May be disabled (Off) if not used.

Terminals 7-10: Digital (S^3L)/Frequency Input
7: V+: +5 VDC out to sensor (black wire)
8: DATA: Input signal from sensor (red wire)
9: GND: Sensor ground (white wire)
10: SHLD: Cable shield

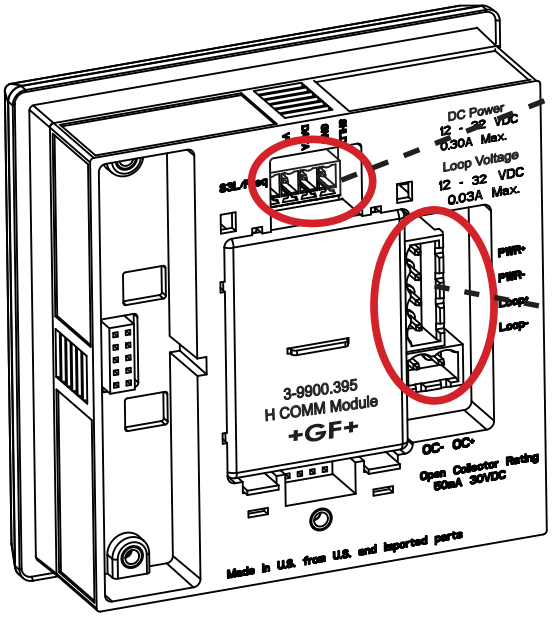
Power

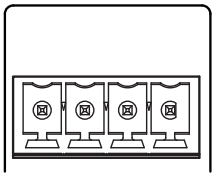


Digital (S^3L)/Freq

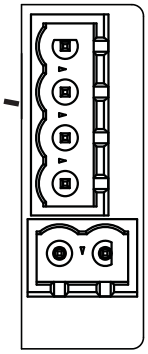


Sensor Wiring





Connect sensor wires here as shown in the following figures.



Connect power and open collector wires here as shown on pages 17 and 18.

Loop powered systems cannot power both an H COMM Module and pH sensor.

If using both an H COMM Module and pH sensor, DC power is required.

Sensor model	Freq Output	Digital (S^3L) Output	Run on Loop Power	9900 Generation			
				I	II	III	IV
515/8510	X		X	X	X	X	X
525	X		X	X	X	X	X
2000	X			X	X	X	X
2100	X			X	X	X	X
2250		X	X	X	X	X	X
2350		X	X	X	X	X	X
2450		X	X	X	X	X	X
2507	X			X	X	X	X
2536/8512	X		X	X	X	X	X
2537-5		X		X	X	X	X
2540	X		X	X	X	X	X
2551	X	X		X	X	X	X
2552	X	X		X	X	X	X
2610-41		X				X	X
2610 + 8058		X		X	X	X	X
2724-2726		X		X	X	X	X
2734-2736		X		X	X	X	X
2750		X	X*	X	X	X	X
2751		X		X	X	X	X
2756-2757		X		X	X	X	X
2764-2767		X		X	X	X	X
2774-2777		X		X	X	X	X
2819-2823		X		X	X	X	X
2839-2842		X		X	X	X	X
2850		X		X	X	X	X
4150 + 8058		X		X	X	X	X

Loop Power can be used ONLY for the following sensors:

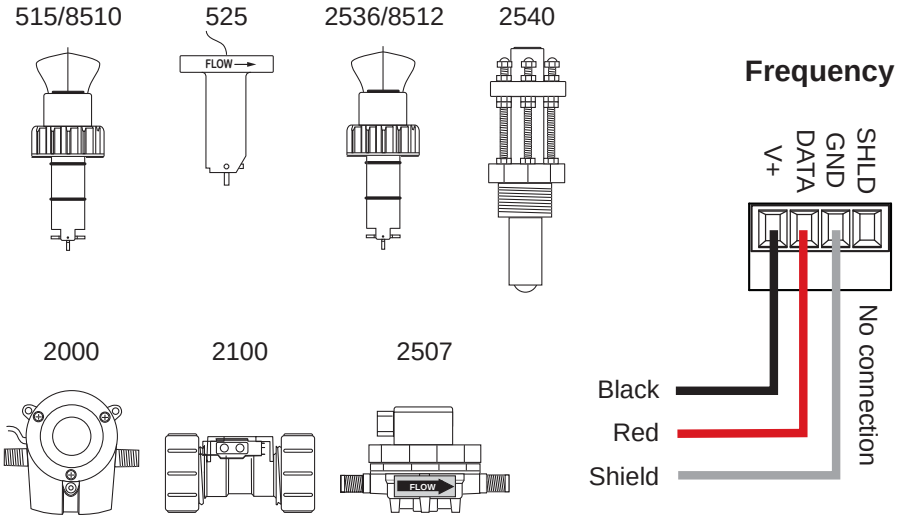
515/8510, 525, 2250, 2350, 2450, 2536/8512, 2540, 8058 and pH/ORP sensors with 2750; all other measurement sensors require DC power.

*A minimum of 24 VDC Loop Power is required for the 2750.

Sensor Wiring

NOTE: Loop Power cannot be used to power Signet models 2000, 2100, 2507, 2537, 2551 or 2552 Flow sensors.

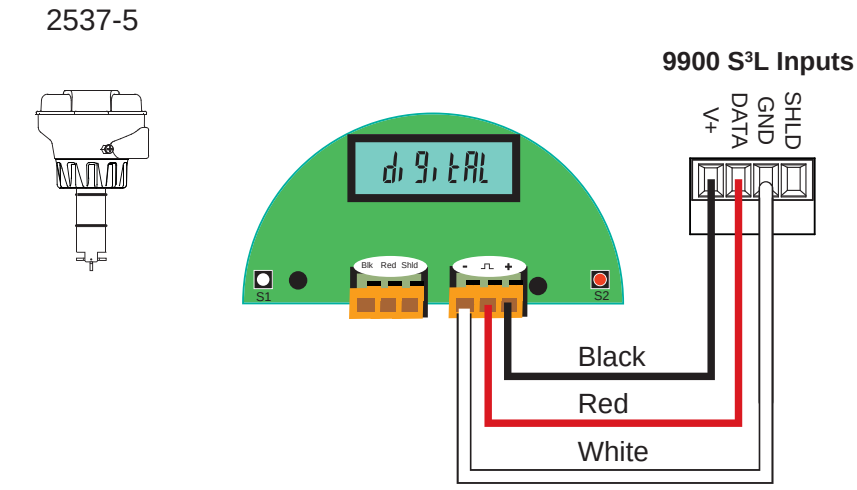
Wiring for:



Technical Notes:

- See corresponding product manuals for maximum cable length.
- Maintain cable shield through cable splice.
- Route sensor cable away from AC power lines.
- 515/8510 and 525 installations, connect the silver (shield) wire to earth ground in case of EMI noise interference.

Wiring for:

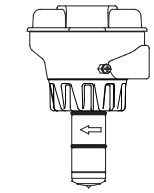


Technical Notes:

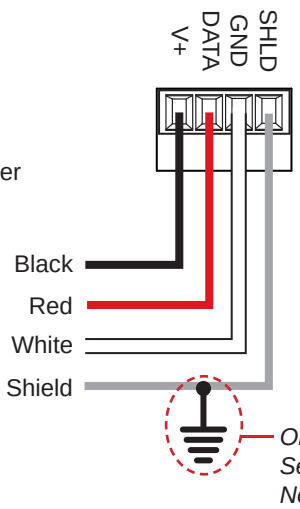
- Wiring terminals on the 2537 are rated for 16 to 22 AWG wires.
- The cable must be 7 mm to 10 mm in diameter (0.275 in. to 0.394 in.) to seal properly in the liquid-tight connector.
- The conduit ports have ½-inch NPT threads. After routing the cables, seal the port with a liquid-tight conduit connector (3-9000.392-1) or with conduit.
- The 2537 models can connect to the 9900 via a relay frequency signal or with a Digital (S^3L) output. Signet recommends installing the Digital (S^3L) output model (2537-5) because Digital (S^3L) is more accurate.
- See 2537 instruction manual for additional installation information.

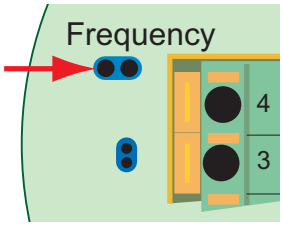
Sensor Wiring

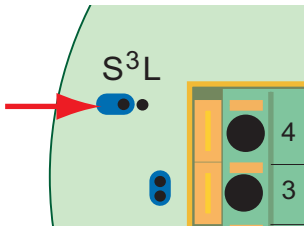
Wiring for:



2551-XX-11
Blind Magmeter







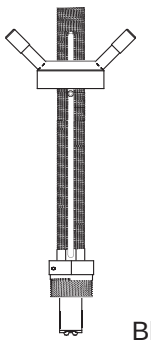
Only in case of EMI interference. See Frequency Output Technical Notes (2551 & 2552) at right

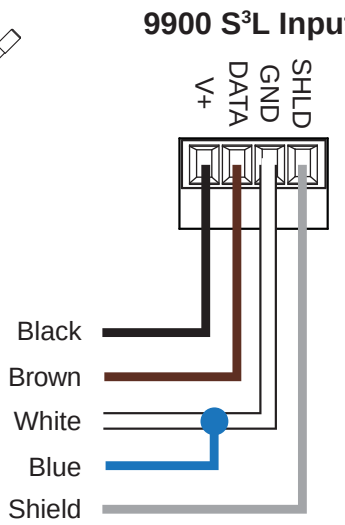
Input Wiring for 2551 and 2552 sensors

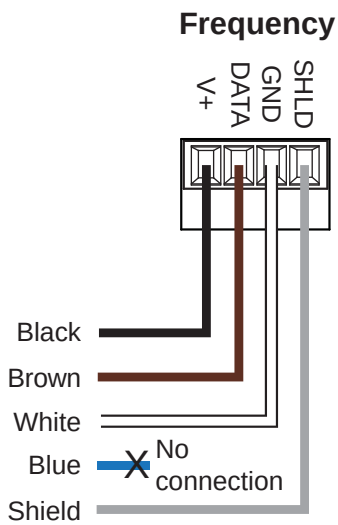
- Either Frequency or Digital (S^3L) may be used.
- **Signet recommends configuring these sensors with the Digital (S^3L) output because it is more accurate and will also display reverse flow (negative numbers).**
- Input type is selected by choosing between “SENSOR FREQ” and "SENSOR S3L" in the FLOW sensor type INPUT menu (see page 32).
- Loop Power cannot be used to power these sensors.

Wiring for:

2552







2551 Technical Notes:

- When the blue jumper illustrated here is placed over both pins, the 2551-XX-11 (Blind Magmeter) outputs an open collector frequency signal. When the jumper is removed (or placed over one pin for storage) the 2551-XX-11 outputs a digital (S^3L) signal (recommended).

Frequency Output Technical Notes (2551 & 2552):

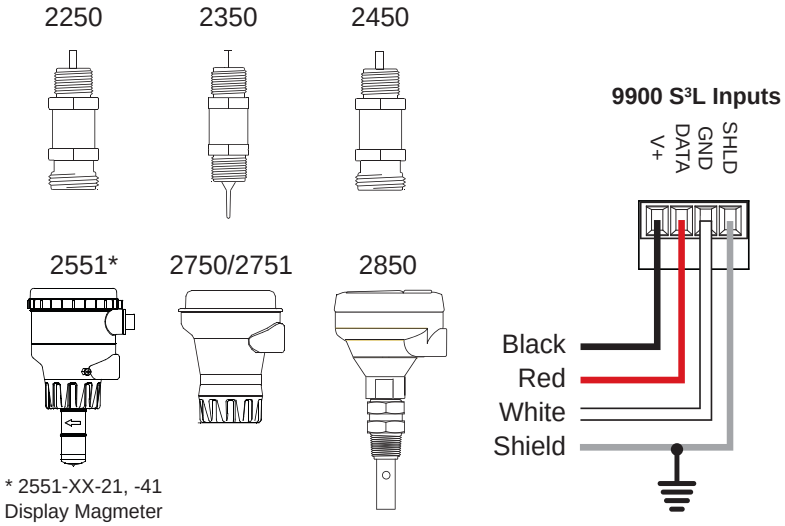
- The frequency output will be displayed as positive flow regardless of the flow direction.
- 5 VDC power required by the 2551 & 2552 is supplied by the 9900. No additional power is required.
- Connect the silver wire (shield) to earth ground in case of EMI noise interference.
- If EMI noise interference continues, disconnect silver wire (shield) from 9900

2552 Technical Notes:

- The 2552 outputs an open collector frequency signal that can be connected to the 9900.

Sensor Wiring

Wiring for:



NOTE: The 2850 has no SHIELD wire.

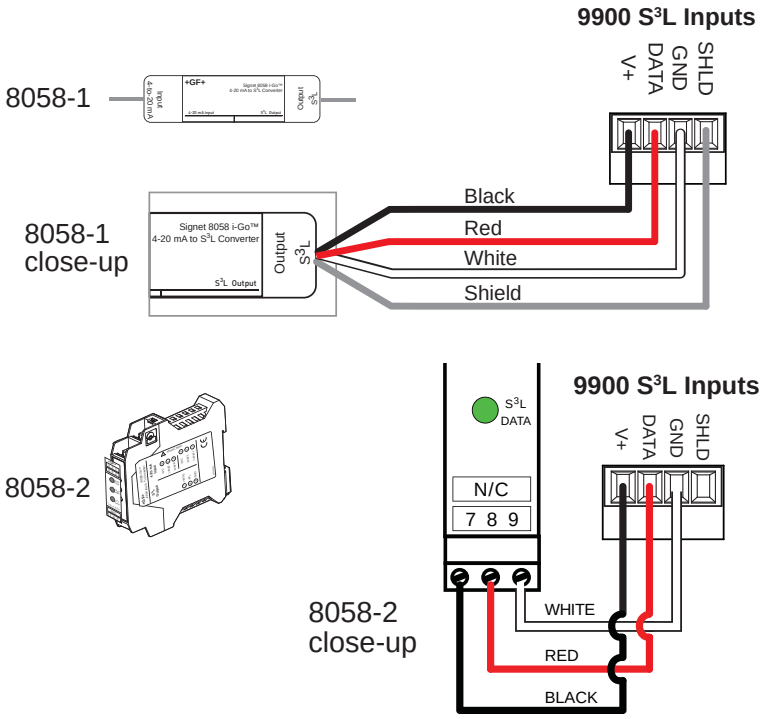
Technical Notes:

- Use three conductor shielded cable for sensor cable splices up to 305 m (1000 ft) max.
- Maintain cable shield through cable splice.
- Route sensor cable away from AC power lines.
- Connect the silver (shield) wire to earth ground in case of EMI noise interference.

Technical Notes:

- The 2850 has no SHIELD wire.
- To work correctly with the 9900, the 2850 must be set for the custom cell constant or the actual probe cell constant and the 9900 set for a 1.0 cell constant.

Wiring for:



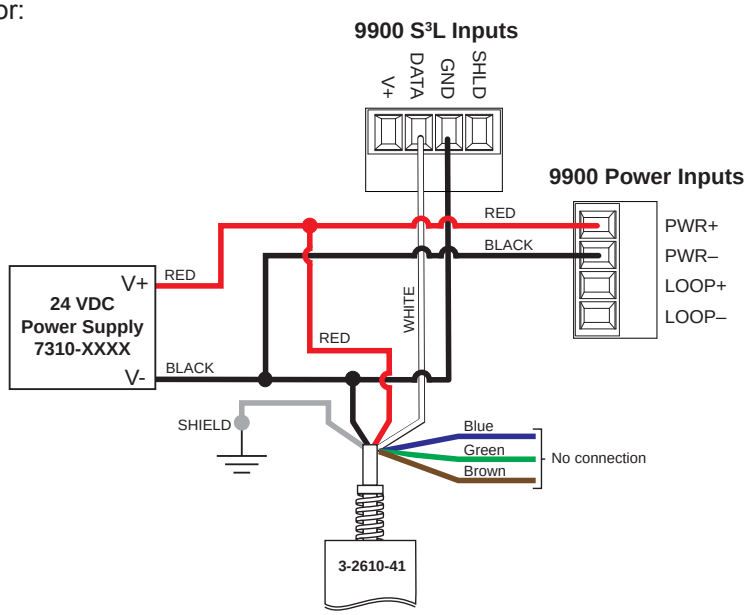
Technical Notes:

- The cable length from the 8058 to the 9900 must not exceed 60 m (200 ft).
- When using the 8058-2, connect the loop source to Channel 1 input ONLY.
- See the 8058 manual for more information.

Sensor Wiring

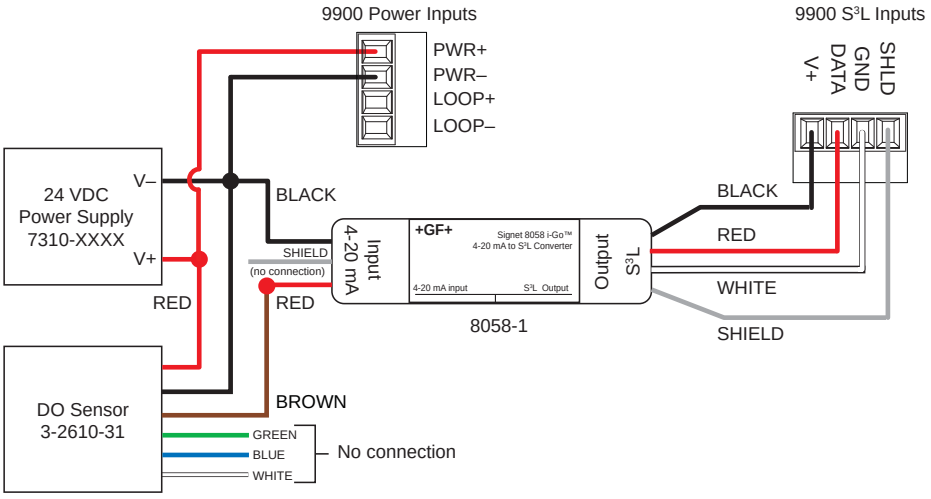
Wiring for:

2610-41



Technical Notes:
The wiring of the 3-2610-41 is non-standard:
- RED is 12 to 24 VDC
- WHITE is Data
- BLACK is VDC Ground
- A jumper MUST be installed between PWR- and S³L GND.

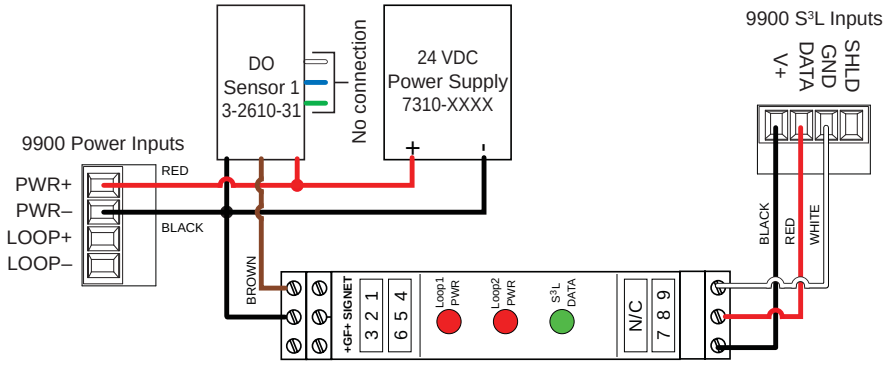
2610-31 via 8058-1



Technical Notes:
- 3-2610-31 Dissolved Oxygen Sensor can be connected to the 9900 only via a 3-8058-1 or 3-8058-2 i-Go Signal Converter.
- Program the 9900 for the 2610 DO sensor via the 4 to 20 mA sensor settings on the 9900 (see page 44).
- See the 2610 manual for more information.

Technical Notes:
- The cable length from the 8058 to the 9900 must not exceed 60 m (200 ft).

2610-31 via 8058-2

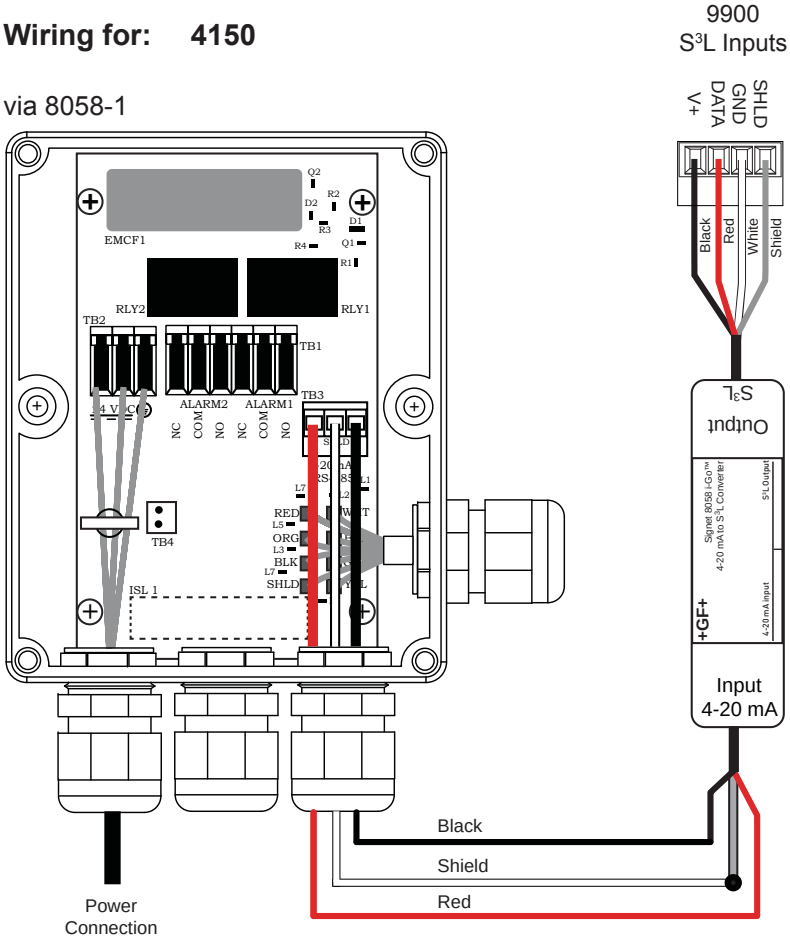


Technical Notes:
- When using the 8058-2 with the 9900, connect the loop power supply to 8058-2 Loop 1 inputs ONLY as shown in the figure.
- See the 8058 manual for more information.

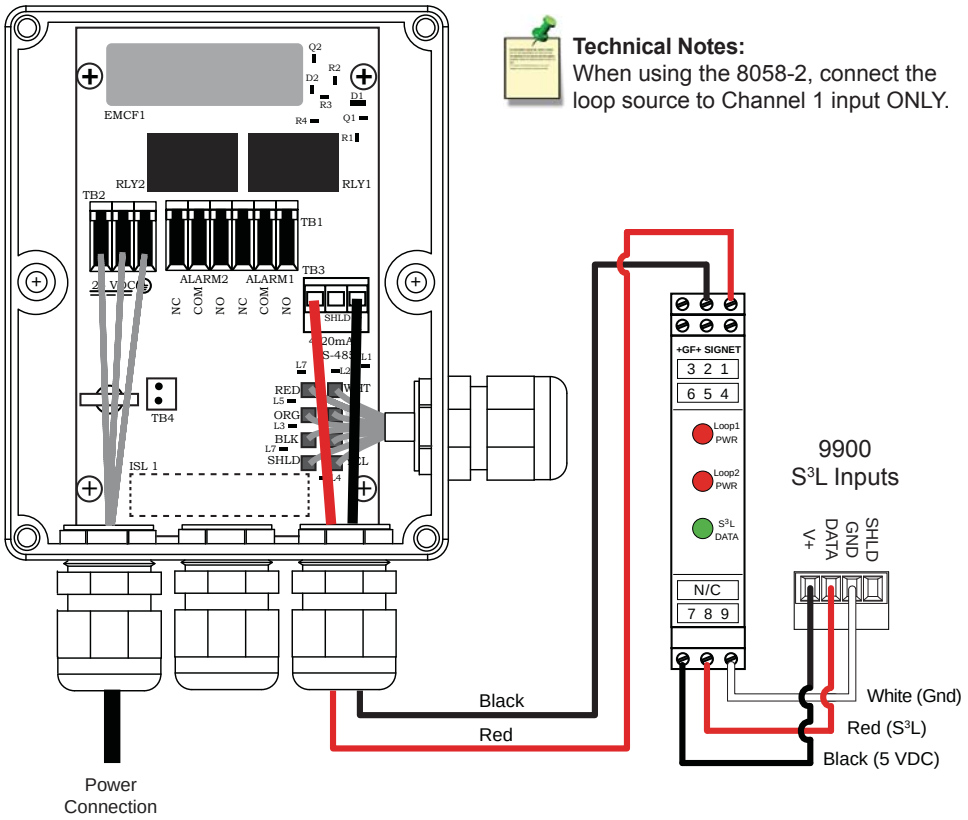
Sensor Wiring

Wiring for: 4150

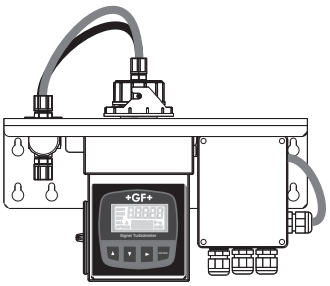
via 8058-1



via 8058-2



Technical Notes:
When using the 8058-2, connect the loop source to Channel 1 input ONLY.



Connect 4 to 20 mA wires to terminal board TB3 as shown in the figure.

Refer to the latest revision of the Signet 4150 Turbidimeter Manual (3-4150.090) for further information.

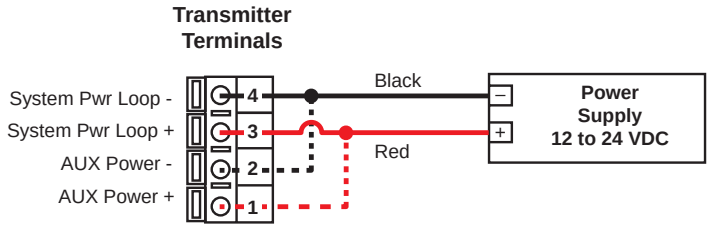
Technical Notes:

- All of the electrical connections to the instrument are made through the terminal box. The connections are labeled within the terminal box and are self-descriptive.
- A plug is inserted into the RS-485 cable bulkhead when shipped to ensure a watertight seal. Remove and discard this plug when cabling to this connection.
- The bulkhead will accept cable diameters from 5.8 mm (0.23 in.) up to 10 mm (0.34 in.). The terminals are designed to accept wires in the range of 14-28 AWG. All wires should be stripped to a length of 6 mm (0.25 in.).
- Ensure that the watertight seal is maintained after the terminal box has been wired for operation. If any of the bulkheads are not tightened properly around a cable or plug, the ratings of the instrument will be jeopardized and there is a possibility of creating a shock hazard.
- Do not run 4 to 20 mA cables in the same conduit as power.

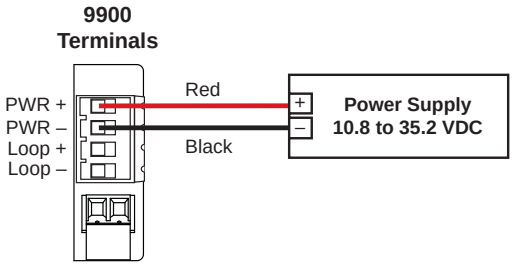
CAUTION!
DO NOT connect your 9900 to AC power.
The 9900 MUST be powered by
10.8 to 35.2 VDC ONLY.

Stand-alone application, no current loop used

ProcessPro
(for reference only)

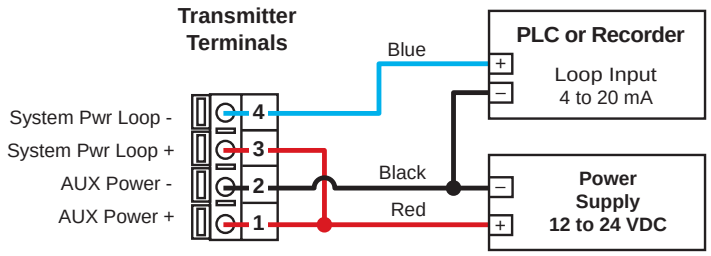


9900



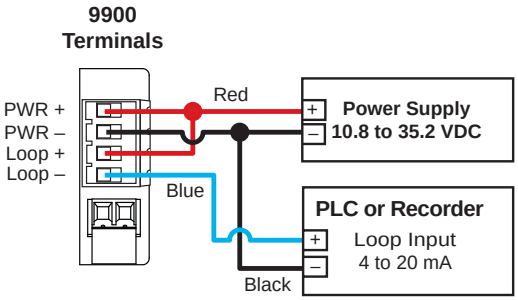
Connection to a PLC/Recorder, separate supply

ProcessPro
(for reference only)



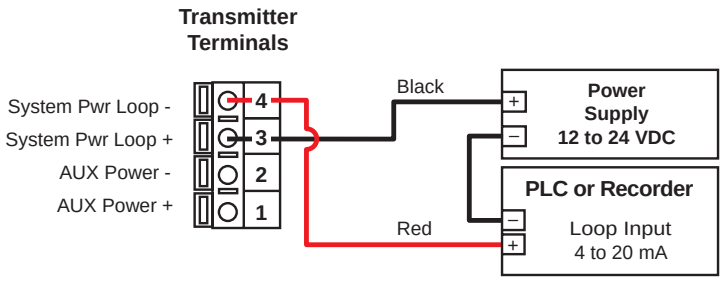
AUX power required for all 8750-2 systems

9900

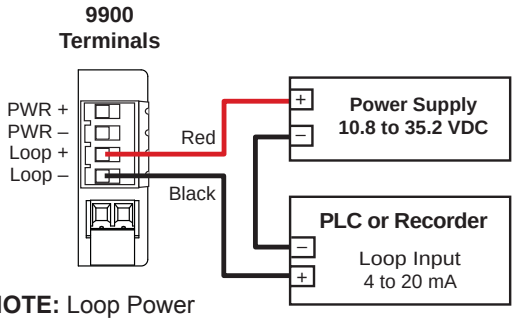


Loop Powered

ProcessPro
(for reference only)



9900

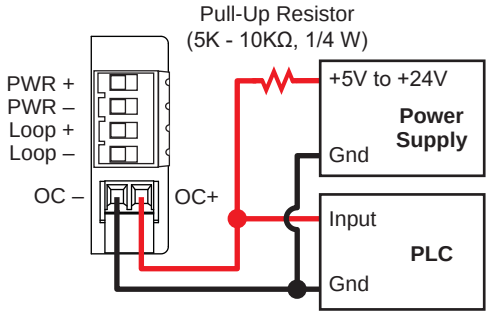


NOTE: Loop Power cannot be used to power certain Signet sensors. See table on page 11.

Relay and Open Collector Wiring

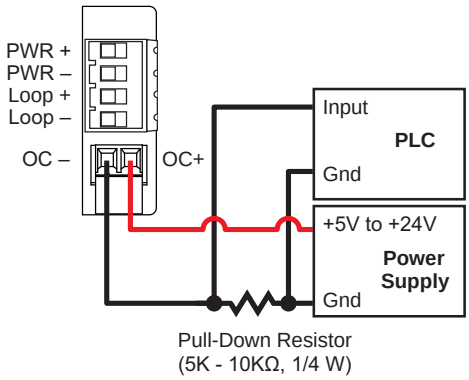
Open Collector wiring

NPN Style Wiring

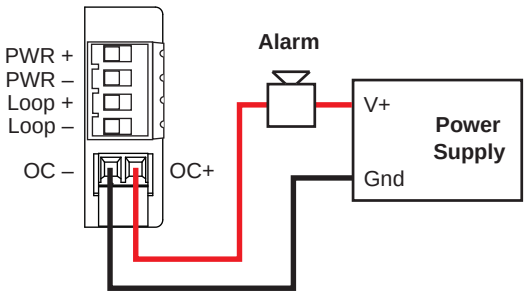


If PLC needs 0 logic input when relay is not energized, set NORMAL to CLOSED in the RELAY menu when using the Open Collector (R1) with NPN style wiring.

PNP Style Wiring



with NORMAL set to OPEN.

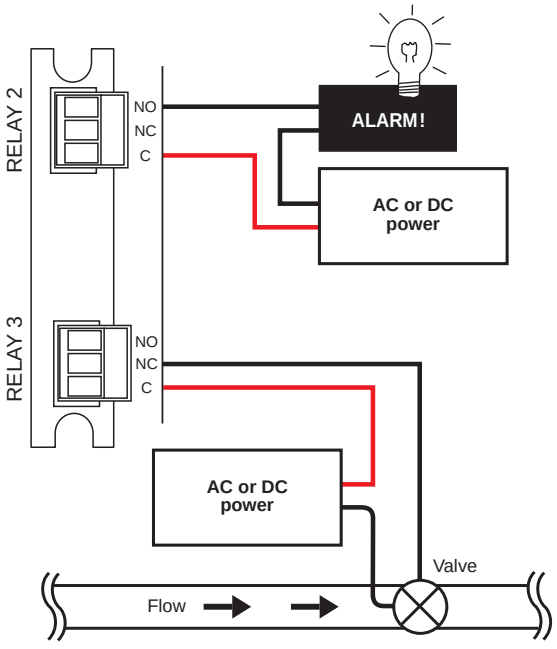


- The 9900 Open Collector (R1) output provides high-speed switching capability. Signal frequencies can reach 400 pulses per minute.
- The 9900 Open Collector (R1) output connection is dependent upon the type of circuit being controlled by the output.
- Most indicating instruments or control system inputs require a signal voltage of 0 to 5 V (TTL or CMOS logic levels) or 0 to 24 V. Therefore, the 9900 Open Collector output circuits must be equipped with a pull-up or pull-down resistor (not supplied), and a quality regulated 5 to 24 V (depending on the application) power supply (not supplied) is recommended to function properly.

Relay Module wiring

The alarm is OFF during normal operation, and will go ON when relay energizes according to 9900 Relay settings.

The valve is ON during normal operation, and will go OFF when relay energizes according to 9900 Relay settings.



NO = normally open (closes when energized)
NC = normally closed (opens when energized)

Relay Functions

System Start-up: Step 3

Set your relay functions to your own application requirements.

Next step: System Setup (see page 25).

Once a setting is saved it becomes immediately active.

1. Go to the Relay Menu (RELAY flashing on screen, press ENTER).
2. If prompted, select desired source.
3. Press ▼ to relay **MODE** selection screen.
4. If necessary, press ► and then ▼ or ▲ to select **R1 MODE LOW**. Press ENTER to confirm.
5. Press ▼ to **R1 SET LOW**. Press ► to enter GPM value of 5.5.
6. Press ENTER to save.
7. Scroll ▼ to the **R1 HYSTERESIS** menu.
8. Press ► to edit.
9. Set the hysteresis for this relay. This affects the turn off only: **2.5 gpm**.
10. Press ENTER.
11. Scroll down ▼ to the **R1 ON DELAY** menu.
12. Press ► to edit.
13. Set the turn-on delay in seconds for the relay: **15.0**.
14. Press ENTER.
15. Exit to View Mode. (▲▼) (▲▼)

- Relay function can be tested in the RELAY menu.

Example: Set a relay R1 to turn on at a low setpoint of 5.5 gpm with a time delay of 15 seconds and turn off at 8.0 gpm.

Remember,
SET LOW + hysteresis = OFF point:
5.5 + 2.5 = 8.0

Relay and Open Collector Outputs

RELAY HIGH and LOW Settings

Depending on the desired function of the circuit attached to the Open Collector (R1) output, it may be necessary to have the Open Collector turned “on” or “off” when the criteria for the activation of this output are met.

If the 9900 is set to operate in RELAY LOW mode, when the user-defined condition for the activation is met (e.g. exceeding an alarm limit) the Open Collector switch is turned “on.” If wired as standard “NPN-style” output (see previous page) the logic level of the attached control system or PLC input consequently becomes “low” logic level (when NORMAL is set to OPEN).

If a high input logic level is required for activation, it can be accomplished in one of three ways.
In order of preference,

1. Change the Open Collector (Relay 1) output function to “high” in the instrument's RELAY menu, or
2. Wire the Open Collector (R1) output “PNP” style as described on the previous page, or
3. Set the Open Collector (R1) to NORMAL CLOSED in the RELAY menu.

Fail-Safe Behavior

No matter the setting, the Open Collector output turns off if the 9900 loses power. This must be taken into account when evaluating system failure consequences. If the system layout requires a “closed” or “on” condition for the output in case of power loss, a mechanical dry-contact relay (NC contacts) must be used instead of the Open Collector (R1) output.

Voltage and Current Limitation

The supply voltage in the Open Collector output circuit MUST be limited to the specified maximum Open Collector voltage (see operating manual for specific instrument). The use of a quality 5 to 24 V (depending on the application) regulated power supply (not supplied) is recommended.

The current through the Open Collector switch also must be limited. Typical Open Collector outputs allow only for 10 to 50 mA switch current. Exceeding this current limit can burn out the Open Collector output components immediately.

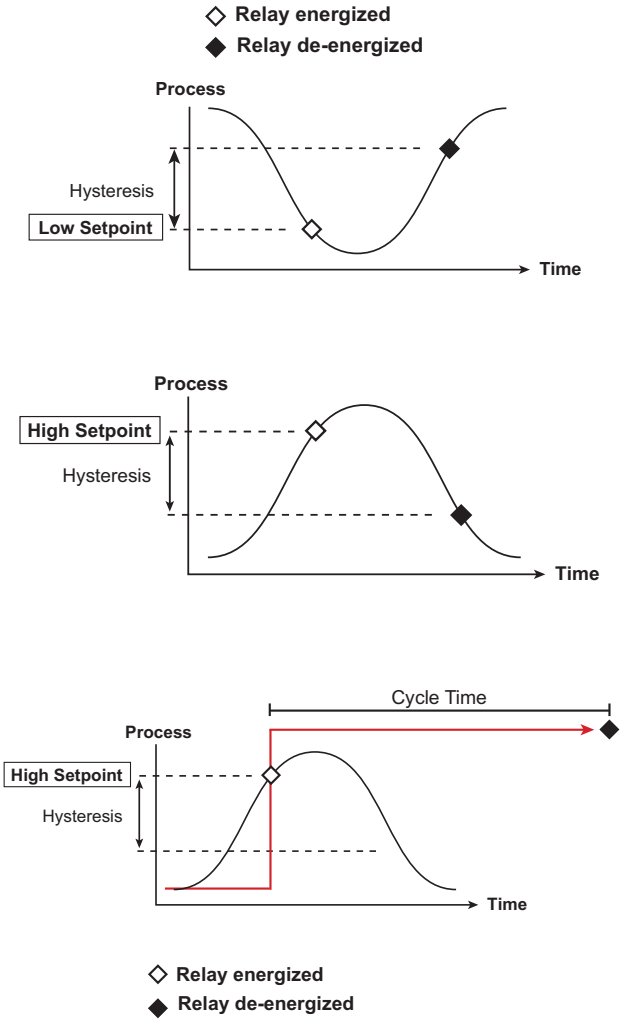
Load and Pull-Up/Down Resistor Considerations

By utilizing basic arithmetic and Ohm’s Law, the safe limits of load resistance can be determined. When the Open Collector switch is closed, almost the entire supply voltage is applied to the load (e.g., the pull-up or pull-down resistor, the alarm horn input, a potential power relay coil or annunciator lamp).The resulting current through the load and through the Open Collector switch, as well, can be calculated as:

(Current) **=** (Supply Voltage) **/** (Load Resistance)

Relay Outputs

The 9900 open collector and relays are selectable and configurable and can be used as switches that respond when the process value moves above or below a user-defined setpoint or it can be used to generate a pulse at a rate proportional to the process value.
They can be used for Low Alarm, High Alarm or Proportional Pulse triggering related to the process value. All relay functions are set up in the RELAY menus.



Open Collector Output

- Longer life than a mechanical relay
- No moving parts
- Faster ON/OFF switching capabilities than mechanical relays
- Can switch DC voltage only (< 30 VDC)
- Not recommended for use with inductive loads.

◇ **Low Setpoint:**
Relay is on when the measured value is less than the setpoint.

◇ **High Setpoint:**
Relay is on when the measured value is higher than the setpoint.

Cycle High/Low:
The relay can stay energized for a set length of time after the process value goes above (or below) the setpoint.
The relay will stay on for the CYCLE TIME and then turn off, even if the process value is still above (or below) the setpoint. The cycle will not repeat until the process value goes below (or above) the setpoint minus the hysteresis after the relay times out.

In FLOW, Cycle High activates the relay each time the volume reaches the SET VOLUME setpoint (see page 28).

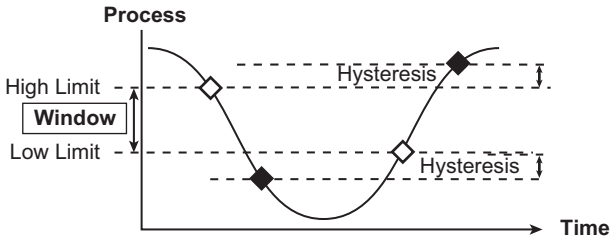
NOTE: To reset the timer (or volume in Flow): in the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAUTION!

If power is lost to the 9900 Transmitter during a cycle, the Cycle Time will reset. If the condition still exists after power is restored, the relay will be energized for the complete Cycle Time.

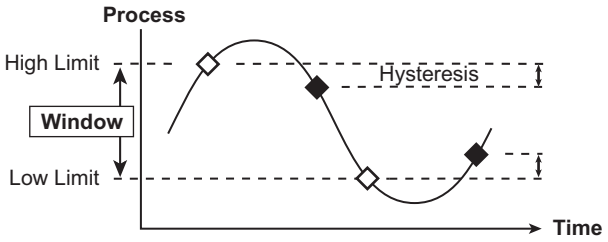
Relay Outputs

◆ **Window In/Out:**
Relay is on when the value is higher or lower than the high or low setpoint.
WINDow IN = relay on if measurement is inside the window of two setpoints. Measurement inside the two setpoints is abnormal condition.
WINDow OUT = relay on if measurement is outside the window of two setpoints.



Window IN example

◇ **Relay energized**
◆ **Relay de-energized**



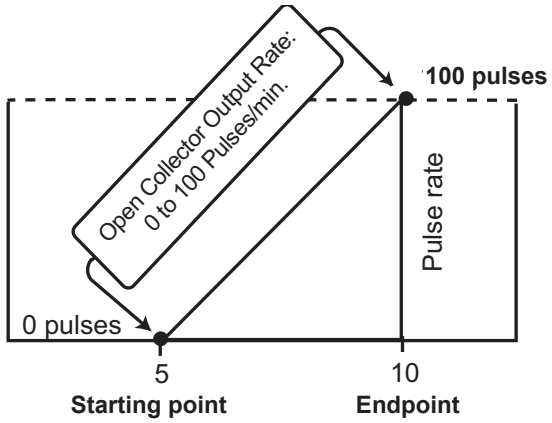
Window OUT example

⎍⎍ **Proportional Pulse Operation:**
The transmitter can output a pulse at the rate defined by the settings in the CAL menu and the sensor input. The maximum pulse output from the relays is 300 pulses per minute. Example usage would be to control solenoid-operated dosing pumps.

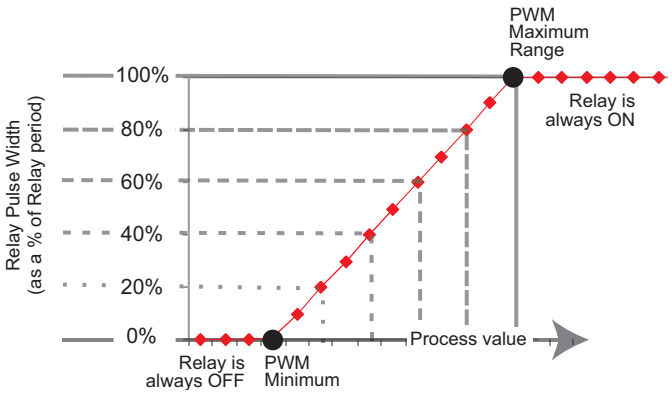
For example: As the process value drops below the setpoint, the output will start pulsing in relation to the process value, the maximum pulse endpoint and the programmed pulses/minute. The pulse rate will change as the process value changes and approaches the programmed endpoint. This functionality can be used to precisely control the process.

The starting point, endpoint and maximum pulse rate are selectable in the RELAY menus.

NOTE: Relay LEDs are not lit in PULSE mode.



In the example:
- The output will be 0 pulses/min. when value is less than 5.
- The output will be 50 pulses/min. when value is 7.5.
- The output will be 100 pulses/min. when value is greater than 10.



- **Pulse Width Modulation**

PWM automatically varies the ratio of ON time to OFF time proportional to minimum and maximum range settings.

The relay period is the sum of the time a relay is ON and the time it is OFF.

Relay pulse width is the time the relay is ON.

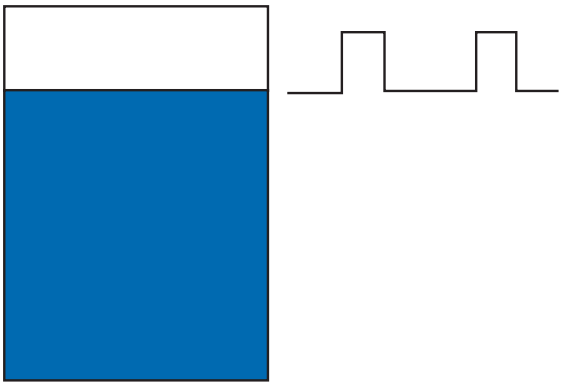
The 9900 must be programmed with the relay period, and with the low and high setpoints.

NOTE: The PWM mode is not used for Pressure applications.

NOTE: Relay LEDs are not lit in PWM mode.

Example:

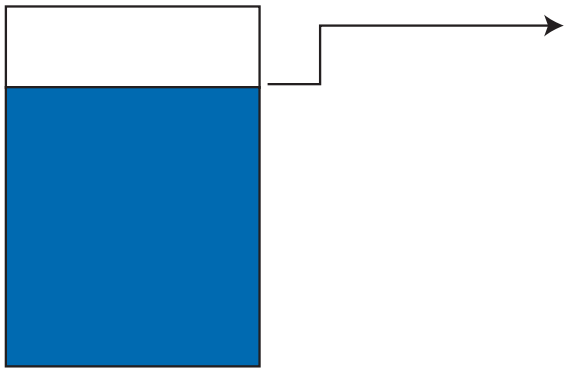
- The pulse width will be 0% of the relay period (relay always OFF) when the process value is less than the minimum range.
- The pulse width will be 100% of the relay period (relay always ON) when the process value is greater than the maximum range.
- The pulse width will be 60% of the relay period when the process value is at 60% of the span between the minimum and maximum range.



- **Volumetric Pulse**

A pulse is generated each time a specified volume of fluid is registered. For flow inputs only.

NOTE: Relay LEDs are not lit in VOLUMETRIC PULSE mode.



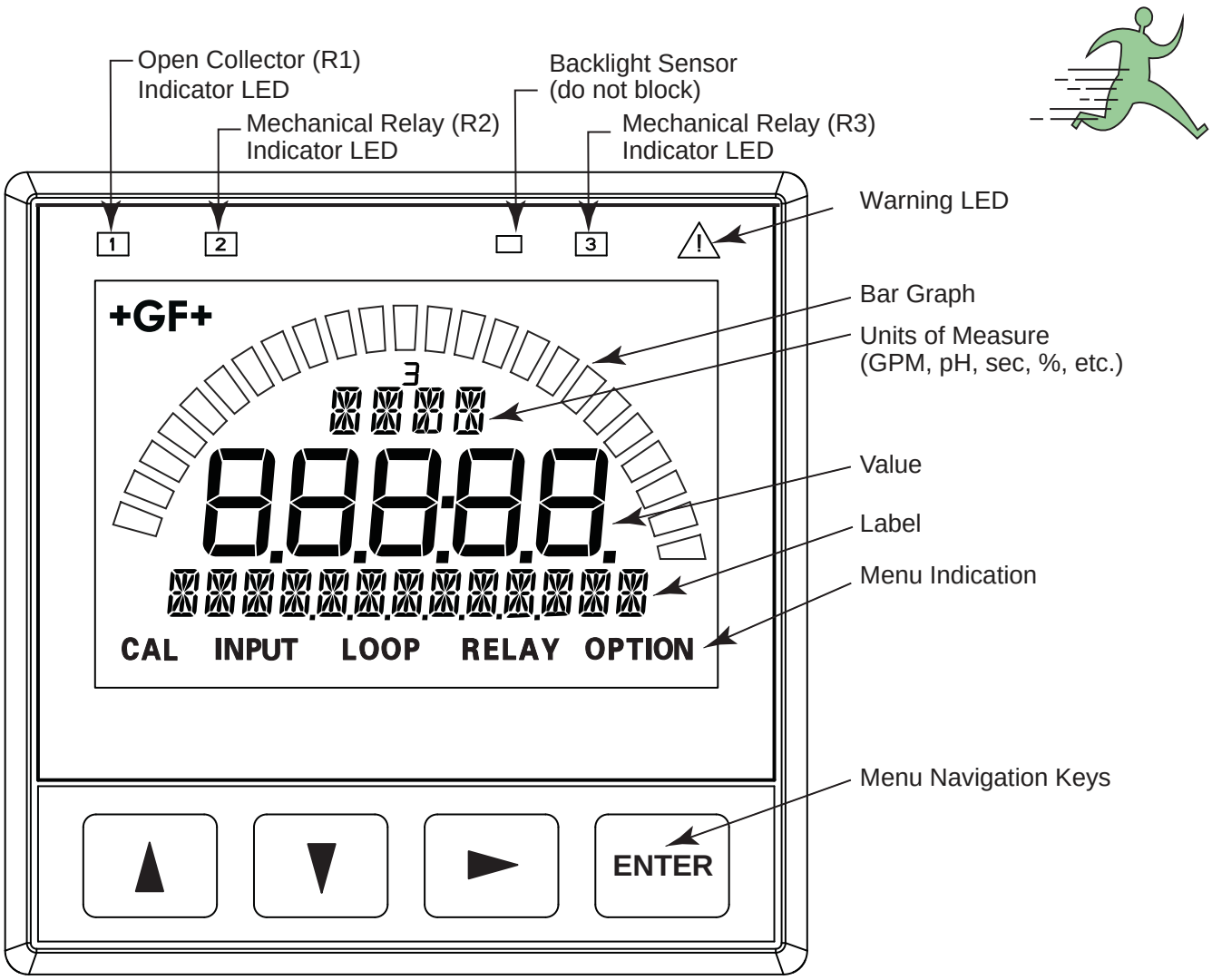
- **Totalizer Volume**

Relay activates and latches when a specified volume of fluid is registered. For Flow inputs only.

Total Volume mode counts the TOTALIZER Units until the setpoint volume is reached, then turns on the relay until the resettable totalizer is reset.

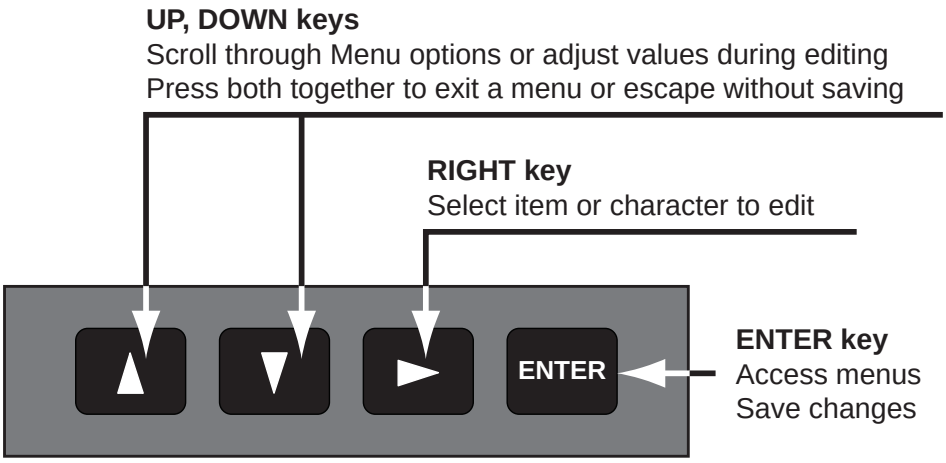
If the Resettable Totalizer reading is greater than the setpoint, the relay will be turned on immediately. The relay will be off when the totalizer is reset to zero.

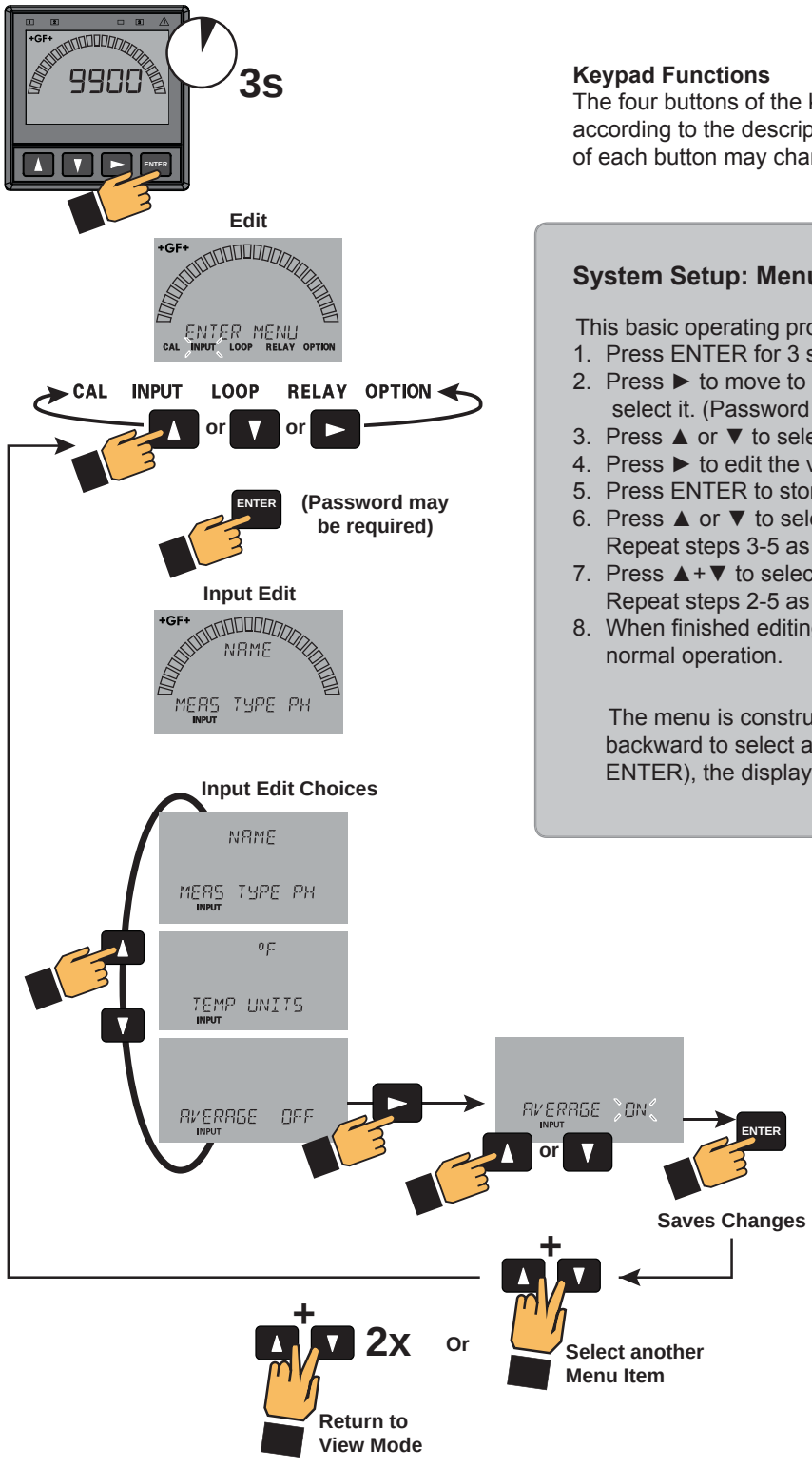
This mode is useful to trigger a reminder when a process is due, as for a backwash cycle or filter change.



All possible segments shown in this illustration. The instrument's software controls which segments are shown at any particular time. Only the bar graph and GF logo are visible when the unit is turned off.

Warning LED will be lit when No Sensor or Wrong Sensor is detected in Digital (S^3L) mode.





Keypad Functions
The four buttons of the keypad are used to navigate display modes according to the descriptions in this table. Notice that the function of each button may change depending on the display mode.

System Setup: Menu Navigation

This basic operating procedure repeats throughout the 9900 program:

1. Press ENTER for 3 seconds to enter MENU mode.
2. Press ► to move to the desired menu then press ENTER to select it. (Password may be required.)
3. Press ▲ or ▼ to select the desired menu item for editing.
4. Press ► to edit the value/selection.
5. Press ENTER to store the new value/selection.
6. Press ▲ or ▼ to select another menu item if desired. Repeat steps 3-5 as required.
7. Press ▲+▼ to select a different menu to edit. Repeat steps 2-5 as required.
8. When finished editing all menus, press ▲+▼ again to return to normal operation.

The menu is constructed in a loop, so you can move forward and backward to select an item. After any item is saved (by pressing ENTER), the display will return to the previous menu.

System Setup Menu

All of the basic system setup functions are automated in the 9900 for many sensors and sensor electronics. This includes identifying the sensor connected to the 9900, and configuring the display for the sensor. After installation and wiring is completed, apply power to the 9900.

When the 9900 is first powered on, it will attempt to determine the sensor type connected when ENTER is pressed (unit will display LOOKING FOR).

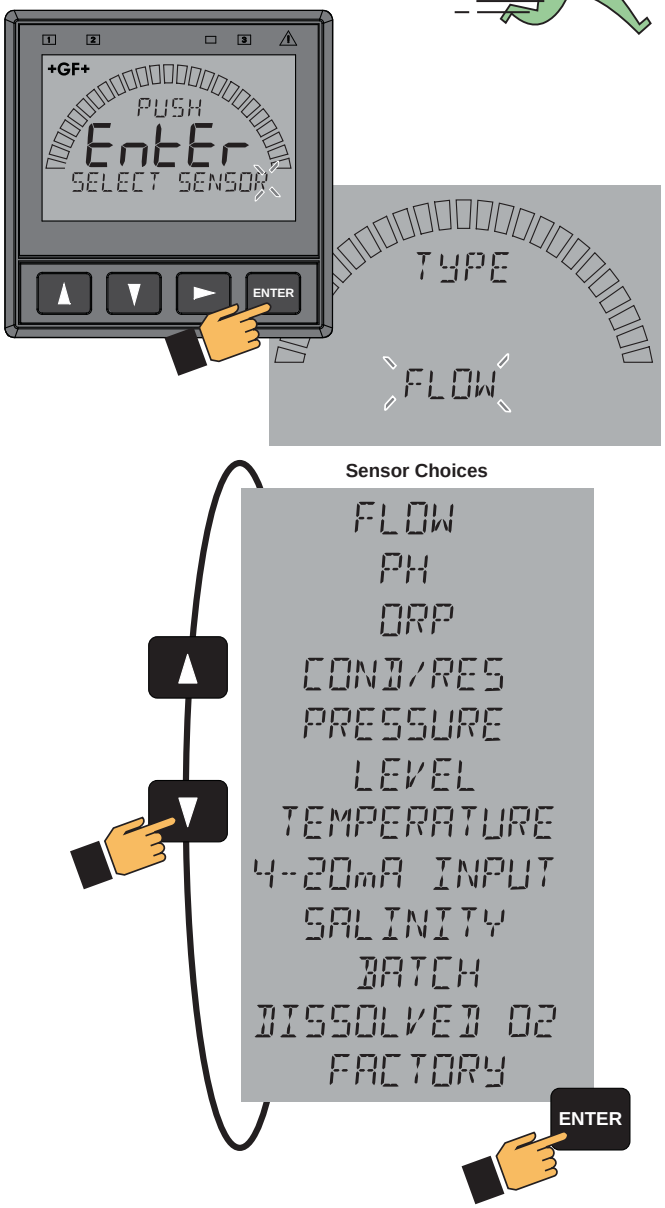
If no sensor is attached to the 9900, the words “TYPE” and “FLOW” are displayed.

If the 9900 does not identify your sensor type correctly, use the ▲ and ▼ keys to select your sensor type.

As you scroll through the available sensor types, press ► to select the desired sensor and then press ENTER.

You may change sensor type after initial power-on (if the sensor type is changed after your 9900 is already in service). Enter the INPUT menu, scroll to TYPE, press ►, and scroll to select the desired sensor type (you may be prompted for your password).
Press ENTER. The bottom line will display ALL SETTINGS WILL BE RESET. ARE YOU SURE? The top line of the display will blink NO (unless switching from Factory mode).
Press ▼ or ▲ to select YES.
Press **ENTER** again to finalize your selection.

NOTE: User is **strongly** discouraged from changing the sensor type away from the correct sensor.



NOTE:
The 9900 displays the BATCH instrument type ONLY if the Batch Module is installed.

VIEW Mode Overview

The top level of menus is referred to as the **VIEW Mode**. This view displays measurement values as well as current outputs and relay status. The radial bar graph represents the measurement value that is also displayed in the 7-segment numeric field below the bar graph. The bar graph is primarily used to display the full scale range of the sensor, but can be scaled via a menu item.

During normal operation, the 9900 displays the VIEW mode.

- To select a display, press the ▲ or ▼ arrow keys.
  The display selections scroll in a continuous loop.
- Changing the display selection does not interrupt system operations.
- No password is necessary to change display selection.
- Output settings cannot be edited from the View Mode.
- The display will return to the VIEW mode if no button is pressed for 10 minutes.

MENU Mode Overview

The MENU mode enables the user to view and configure all menu items.
The five menus available are: **CAL**, **INPUT**, **LOOP**, **RELAY**, and **OPTION**.

MENU Mode is entered by pressing and holding ENTER for three seconds.

The ► button is used to change the position of the blinking cursor.
When the desired menu is blinking, press ENTER.

In the selected menu, use the ▲ and ▼ keys to navigate through the menu.
Use the ▲, ▼ and ► keys to edit the selected item
(see Menu Navigation discussion, page 24).

To save the new selection, press the **ENTER** key. A message displaying “Saving…” will be displayed for 3 seconds. After this message is displayed, the newly selected value will be displayed, if applicable.

Password Overview

The password is often required to start editing. Once entered correctly, this password will not be needed for subsequent edits. However, once the menu system is exited, the password will again be required when edit mode is re-entered.

Your choice of password (STD or CODE) is selected in the Options Mode.

- **STD**
  The standard (STD) password is ▲▲▲▼, pressed in sequence. This password is designed to protect the 9900 from unintentional changes. It is best suited for systems where a group of people need to be able to change settings.
- **CODE**
  The CODE default setting is 0000, adjustable to any 4-digit numerical code up to 9999. Using a personal code provides the maximum degree of security.
  This code can be modified in the Options mode.

Error Handling

Errors occurring while in the VIEW Mode show a specific message (e.g., CHECK SENSOR). This message is displayed every 10 seconds and stays on for 5 seconds. Once the error is resolved or cleared, the error message stops.

Scrolling

In some cases, more than one message or measurement may need to be displayed. This is accomplished by alternating the message portions across the screen.

In the MENU mode, if the wrong code or password is entered, an ERROR message is displayed.

To change your CODE, go to OPTIONS mode, enter your desired code and press ENTER. (The STD password cannot be changed.)

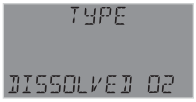
System Start-up: Step 4
Customize your 9900 to your own installed sensors.

Common Menus

The menu system shares certain modes between sensor types.
The following describes the EDIT Mode menus found in common between most sensor types.

NOTE:
Menu and Mode displays shown are examples only.
Your displays may vary.

INPUT Menu

	(ALL) Manually select Sensor Type (See page 25 for further instruction). Allows user to reset 9900 Transmitter to Factory settings. Note: User is strongly discouraged from changing the sensor type away from the correct sensor.

LOOP Menu

The following can individually be set for each current loop
(Loop1 = 9900 base unit, Loop2 = Output Module)

	(pH, COND/RES, LEVEL, SALINITY, DO only) Set LOOP output source; select between Primary and Secondary measurements of applicable sensor. Secondary measurements: DO, pH, COND/RES, and SALINITY = TEMP; LEVEL = VOL.
	(COND/RES only) Select LIN/LOG. Default = LIN. See LOG Current LOOP Output discussion in Appendix.
	(ALL) Set value corresponding to desired 4 mA output. 5 digits max. Default = 0 (ORP = -999).
	(ALL) (Not shown in COND/RES LOG Mode) Set value corresponding to desired 20 mA output. 5 digits max. Defaults = 100 (Flow, Cond/Res, Temp), 14 (pH), 1000 (ORP), 10 (Lvl/Prs), 5 (4 to 20 mA), 80 (Sal).
	(ALL) Set desired LOOP output value when sensor error (e.g., bad sensor, broken wire) is detected. Select (3.6 mA, 22 mA). Default = 22.
	(ALL) Allows fine-tuning to compensate for errors in other equipment connected to the 9900. Adjust the minimum and maximum current output. The display value represents the precise current output. Adjustment limits: from 3.80 mA minimum to 5.00 mA maximum. Default = 4.00 mA.
	(ALL) Allows fine-tuning to compensate for errors in other equipment connected to the 9900. Adjust the minimum and maximum current output. The display value represents the precise current output. Adjustment limits: from 19.00 mA minimum to 21.00 mA maximum. Default = 20 mA.
	(ALL) Press ▲ or ▼ to manually order any output current value from 3.8 mA to 21.00 mA to test the output of LOOP.

RELAY Menu *The following can individually be set for each relay (R1 = open collector, R2/R3 = Relay Module)*

	(pH, LEVEL/VOL, COND/RES, SALINITY and DO only.) Select source for each of R1, R2 and R3 outputs. Choose pH/TEMP, LEVEL/VOLUME, COND/TEMP, SAL/TEMP, (DO)PPM/TEMP. Defaults = pH, COND, LEVEL, SAL, PPM.
	(ALL) Set Open Collector (R1) as Normally Open or Normally Closed. Default = OPEN.
	(ALL) Select the desired mode of operation for the open-collector (R1) output (OFF, LOW, HIGH, WINDow IN, WINDow OUT, CYC LOW (except FLOW), CYC HIGH, PROP PuLSe, VOL PuLSe, PWM, TOTAL, USP, ERROR mode) (See chart on page 29). Default = OFF. Continue stepping through to select R2 and R3 output modes. When MODE is set to ERROR, delays energizing relay until after ON DELAY time expires if sensor problem is detected. See Cycle High/Low discussion on page 20.
	(ALL) (Shown if LOW, WIND IN/OUT or CYC LOW mode) Relay turns on if process measurement goes lower than this value. Set desired value. **NOTE:** The corresponding indicator lights do not light up in PROP PLS and PWM modes. The LEDs light up only when the Test Relay options are selected.
	(ALL) (Shown if HIGH or WIND IN/OUT mode) Relay turns on if process measurement goes higher than this value. Set desired value. **NOTE:** The corresponding indicator lights do not light up in PROP PLS and PWM modes. The LEDs light only when the Test Relay options are selected.
	(FLOW only) (Shown if CYC HIGH or VOL PLS mode) Amount of accumulated flow that must be counted before a pulse is sent out. Relay turns on if flow volume exceeds this value. Set desired value. Default = 100.00.
	(ALL) (Shown if LOW, HIGH, WIND IN/OUT, CYC LOW/HIGH or USP mode) Hysteresis prevents the system from chattering around the set point. Set amount (in units of measure from INPUT Mode) to add to SET LOW or SET HIGH values.
	(COND/RES only) (Shown only in USP mode) Relay turns on if USP value drifts by this value away from USP limit. See USP Limits discussion in the Appendix.
	(ALL) (Shown if Low, High, WIND IN/OUT, CYC LOW/HIGH or Error mode) Set seconds (up to 9999.9) to wait before activating relay.
	(ALL except PRESSURE) (Shown only if PROP PLS mode) Set minimum setpoint value for proportional pulsing.
	(ALL except PRESSURE) (Shown only if PROP PLS mode) Set maximum setpoint value for proportional pulsing.
	(ALL except PRESSURE) (Shown only if PROP PLS mode) Set desired maximum pulse rate (300 max) **NOTE:** Pulse width fixed at 100 ms.
	(ALL except PRESSURE and FLOW) (Shown only if PWM mode) Set minimum value for pulse width modulation.
	(ALL except PRESSURE and FLOW) (Shown only if PWM mode) Set maximum value for pulse width modulation.

NOTE: Defaults for most relay functions are dependent upon sensor type and are not listed here.

RELAY Menu *The following can individually be set for each relay (R1 = open collector, R2/R3 = Relay Module)*

(ALL) (Shown only if CYC LOW/HIGH mode)
Set time in seconds (up to 99999) for relay to remain on. See discussion on page 20.

(FLOW only) (Shown only if VOL PULS mode)
Amount of accumulated flow that must be counted before a pulse is sent out. Set value.

(FLOW only) (Shown only if VOL PULS mode) Set time value for one pulse width.

(ALL except PRESSURE and FLOW) (Shown only if PWM mode)
Set time value for one complete pulse cycle. (relay ON time + relay OFF time).

(FLOW only) (Shown only if TOTAL) Resettable value that, when exceeded, turns relay on.
Must reset Totalizer (in VIEW Mode) to clear relay. Set maximum value.

(ALL) Press ▲ or ▼ to turn relay on or off for testing purposes.
Can also be used to reset or latch/unlatch the relay. Does NOT reset the Totalizer.

Available Relay Modes by Sensor Type

	Flow	pH	ORP	Cond/Res	Pressure	Lvl/Vol	Temp	4 to 20 mA	Salinity	DO
Off	X	X	X	X	X	X	X	X	X	X
Low	X	X	X	X	X	X	X	X	X	X
High	X	X	X	X	X	X	X	X	X	X
Wind In	X	X	X	X	X	X	X	X	X	X
Wind Out	X	X	X	X	X	X	X	X	X	X
Cyc Low		X	X	X	X	X	X	X	X	X
Cyc High	X	X	X	X	X	X	X	X	X	X
Prop Pulse	X	X	X	X		X	X	X	X	X
Vol Pulse	X									
PWM		X	X	X		X	X	X	X	X
Total	X									
USP				X*						
Error	X	X	X	X	X	X	X	X	X	X

* In USP Relay Mode in Conductivity, Relay Source must be set to COND, TEMP COMP must be set to NONE and Unit Of Measure must be set to µS.

OPTION Menu

	Adjust the LCD contrast for best viewing for your environment. A setting of 1 is lowest contrast, 5 is highest. Default = 3.
	Select backlight level (OFF, LOW, HIGH, AUTO). Default = AUTO. **NOTE:** No backlight when operating on loop power.
	Enter 5 digit value to represent bar at minimum. Default = 0 (ORP = -999).
	Enter 5 digit value to represent bar at maximum. Defaults = 100 (Flow, Cond/Res, Temp), 14 (pH), 1000 (ORP), 10 (Lvl/Prs), 5 (4 to 20 mA), 80 (Sal), 20 (DO)
	(ALL) Set the decimal to the best resolution for your application. The display will automatically scale up to this resolution. Select -----., ----.-, ---.--, --.---, or -.---- (varies by parameter). Default = ----.-.
	(pH, COND/RES, TEMP, SAL, DO only) Set the Temperature decimal to the best resolution for your application. The display will automatically scale up to this resolution. Select -----., ----.-, or ---.--. Default = ----.-.
	(FLOW only) Set the decimal to the best resolution for the Permanent Totalizer display. The display will automatically scale up to this resolution. Select -----., ----.-, ---.-- or --.---. Default = ----.-
	(COND/RES only) Displays mS or µS as set in COND UNITS in INPUT Mode. Set ON/OFF. Default = OFF.
	(FLOW only) Locks the TOTALIZER output. Select OFF, ON (Does not affect Permanent Totalizer). Default = OFF.
	(ALL) Select STD, CODE. Default = STD.
	(ALL) Enter desired password code. 4-character entry not displayed, ---- displayed instead. (Shown if type = CODE.)
	(ALL) Enter 13-character string, if desired. Default = Blank.
	Enables Remote Setup to configure the 9900 via a computer and the optional PC COMM tool. Press ► and select YES to enable. REMOTE SETUP flashes when mode is enabled. **NOTE:** Communication with PC COMM tool is automatic when 9900 is in FACTORY state (Enter flashing). Refer to the PC COMM Configuration/Diagnostic Tool manual, 3-0251.090, included with your PC COMM tool.
	Displays Transmitter Generation Version.

Sensor-Specific Menus

The following pages list the sensor-specific settings for each sensor type.

Flow

This is the normal display and does not time out.

FLOW Setup Checklist

1. Make sure FLOW sensor type is selected (see System Setup Menu, page 25).
2. Set the Units of Measurement.
3. Set Sensor Type (Freq or S^3L).
4. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
5. Set K-Factor (pulses per Unit Volume) from Flow Sensor manual.
6. Set Totalizer factor.
7. Set Last Cal Date and initials.
8. If desired, set up relay functions for your own application.

VIEW Mode Menu

0 1 2 3 4 5 6 7 8 →	Display the flow rate and the resettable totalizer. Press ► to reset the totalizer. (If Reset is locked, enter the password first.) Lock or Unlock the totalizer in the OPTIONS menu. This is the resettable totalizer View display.
P 0 1 2 3 4 5 6 7 8 →	Display the Permanent Totalizer value (note the "P" indicating Permanent). Pressing ► displays units of measure.
LOOP 7.20 mA	Displays the 4 to 20 mA LOOP output.
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	YES prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select YES/NO. Default = NO.
KF 60.0000	Set K-Factor (pulses per unit volume) from Flow Sensor manual. Min: 0.0001, max 999999. Cannot be zero. Default = 60.0000.
TF 1.000	Sets the volume of each count of the Totalizer as a multiple of the volume unit of the K-Factor. Min: 0.0001, max 999999. Cannot be zero. Default = 1.0000.
RATE CAL	Select to calibrate using Rate method (see Appendix).
VOLUME CAL	Select to calibrate using Volume method (see Appendix).
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (ii).

INPUT Menu

	If desired, a custom name can be entered. Enter 13-character string. Default = FLOW.
	If your flow sensor is configured for frequency output, select FREQ. If configured for Digital (S^3L) output (recommended), select S^3L. Default = FREQ.
	Set the units of measure. The last character sets the timebase: S (seconds) M (minutes) H (hours) D (days). Default = GPM.
	Identifies the Totalizer units. It has no effect on any calculation. Default = GALLONS.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF. (See discussion in Appendix.) Default = OFF.
	The Sensitivity setting determines how the 9900 responds to sudden changes in the flow rate. The value is expressed in units of measurement. If the setting is exceeded, it "overrides" the Averaging function breifly to allow for the actual change in flow rate to be displayed. Averaging resumes shortly after. The result is a smooth flow display and a quick response to large shifts in the flow rate. (See discussion in Appendix, page 51.)

This is the normal display and does not time out.

pH Setup Checklist

1. Make sure pH sensor type is selected (see System Setup Menu, page 25).
2. Set the Temperature Units (°C or °F).
3. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
4. Perform calibration (EasyCal, Standard or Standard and Slope).
5. Set Last Cal Date and initials.
6. Select source for Open Collector and Relay output (pH or Temp).
7. If desired, set up relay functions for your own application.

VIEW Mode Menu

TEMP ------ °C	Displays temperature at the sensor.
RAW ------ mV	Displays the millivolt input from the electrode. Use this display to determine the relative condition of your electrode during periodic calibration. (7 pH buffer = 0 mV, ± 50 mV)
MOHM 350 GLASS IMP -›	(2751 preamp only) Displays last **AUTOMATED** or **MANUAL GLASS IMPEDANCE** measurement. Press ► to MANUALLY measure GLASS IMPEDANCE. AUTOMATED GLASS IMPEDANCE update time is set under the pH INPUT menu (see next page). **NOTE:** While AUTOMATED/MANUAL GLASS IMPEDANCE measurement is in progress, all outputs are held and an "UPDATING" message will be displayed until the measurement is completed.
SENSOR DATA-›	(2751 preamp with memory chip enabled sensors only) Press ► to access sensor data stored in sensor memory chip. **NOTE:** Pressing ▲+▼, or changing to a sensor without a memory chip, while viewing SENSOR DATA, will return the 9900 to the top VIEW mode display (current pH measurement).
S/n 6140122 1234	(2751 preamp with memory chip enabled sensors only) Sub-menu of stored sensor data, accessed by pressing ► on the above SENSOR DATA menu. **SENSOR DATA includes:** Sensor Serial Number (S/n), Sensor Model Number (MOD), pH Slope, pH Offset, Temperature Offset, Factory Reference Impedance, Total Usage Time (HRS), Minimum pH value measured (MIN PH), Maximum pH value measured (MAX PH), Minimum Temperature value measured (MIN TEMP), Maximum Temperature value measured (MAX TEMP).
LOOP 450 mA	Displays the 4 to 20 mA LOOP output.
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

	Select AT SENSOR to perform calibration using the Signet 2750/2751 sensor electronics. Select AT INSTRUMENT to perform calibration at the 9900 via EasyCal or manual calibration. (See pH Calibration procedures in the Appendix.) Default = AT INSTRUMENT.
	YES prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select YES/NO. Default = NO.
	(CAL AT INSTRUMENT only) Press ► to start the EasyCal process. You will be prompted to enter your password. (See pH EasyCal procedure in the Appendix).
	(CAL AT INSTRUMENT only) Applies a linear offset to the pH measurement. The ideal value is the average pH of your application. (A sample of your application at process temperature is recommended) (See pH Calibration procedures in the Appendix) Shows error message if offset too high.
	(CAL AT INSTRUMENT only) Applies a slope to the pH measurement. The slope value and the standard value must be at least 2 pH units apart. The ideal values are the minimum and maximum values of your process. (See pH Calibration procedures in the Appendix.) Shows error message if slope is too low or high.
	(CAL AT INSTRUMENT only) Applies a linear offset to the temperature measurement. The ideal value is the average temperature of your application. "SAVING" will appear if offset is acceptable, "ERR TOO LARGE TO CALIBRATE" if offset is outside of range.
	(CAL AT INSTRUMENT only) Press ► to reset pH Calibration to factory default.
	(CAL AT INSTRUMENT only) Press ► to reset temperature calibration to factory default.
	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (ii).

INPUT Menu

	Enter string up to 13 characters (optional). Default = MEAS TYPE PH.
	Select °F or °C. Default = °C.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF. Default = OFF. (see discussion in Appendix). **NOTE:** Signet strongly recommends leaving averaging OFF for pH and Pressure measurements
	(2751 preamp only) Set AUTOMATED GLASS IMPEDANCE update time from 0 to 1440 minutes. Setting update time to 0 turns off automatic glass impedance updates. Default = 60 minutes.
	(2751 preamp with memory chip enabled sensors only) **High Impedance Warning** is activated when the AUTOMATED GLASS IMPEDANCE measurement is greater than the Factory Glass Impedance by selected multiplier. Select multiplier of 3, 4, 5, or OFF. Default = OFF. **NOTE:** Factory Glass Impedance can be found under the VIEW mode by pressing ► on SENSOR DATA.

This is the normal display
and does not time out.

ORP Setup Checklist

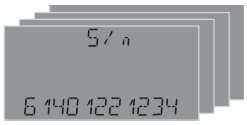
1. Make sure ORP sensor type is selected
   (see System Setup Menu, page 25).
2. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
3. Set Averaging.
4. Perform calibration or set Standard (and Slope if desired).
5. Set Last Cal Date and initials.
6. If desired, set up relay functions for your own application.

VIEW Mode Menu

Displays the millivolt input from the electrode.
Use this display to determine the relative condition of your electrode during periodic calibration.

(2751 preamp with memory chip enabled sensors only)
Press ► to access sensor data stored on sensor memory chip.

NOTE: Pressing ▲+▼, or changing to a sensor without a memorychip, while viewing SENSOR DATA, will return the 9900 to the top VIEW mode display (current ORP measurement).



(2751 preamp with memory chip enabled sensors only)
Sub-menu of stored sensor data, accessed by pressing ► on the above SENSOR DATA menu.

SENSOR DATA includes: Sensor Serial Number (S/n), Sensor Model Number (MOD), ORP Slope, ORP Offset, Total Usage Time (HRS), Minimum ORP value measured (MIN mV), Maximum ORP value measured (MAX mV)

Displays the 4 to 20 mA LOOP output

Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays.
Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down.
NOTE: (Reset the Timer) In the RELAY menu, select TEST RELAY function.
The timer will reset to 0 if the condition no longer exists when the TEST is performed.
The timer will restart if the condition still exists.

CAL Menu

	Select AT SENSOR to perform calibration using the Signet 2750/2751 sensor electronics. Select AT INSTRUMENT to perform calibration at the 9900 via EasyCal or manual calibration. (See ORP Calibration procedures in the Appendix.). Default = AT INSTRUMENT.
	YES prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select YES/NO. Default = NO.
	(CAL AT INSTRUMENT only) Press ► to start the EasyCal process. You will be prompted to enter your password. (See ORP EasyCal procedure in the Appendix).
	(CAL AT INSTRUMENT only) Applies a linear offset to the ORP measurement. For single point calibrations, assign the average value of your process to ORP STANDARD. For two-point calibrations, assign the min or max value of your process to ORP STANDARD. (See ORP Calibration procedures in the Appendix).
	(CAL AT INSTRUMENT only) Applies a slope to the ORP measurement. The ORP SLOPE is used for two-point calibration along with the ORP STANDARD. If you applied the min value of your process to the ORP STANDARD, then apply the max value to the ORP SLOPE. Else, apply the min value to the ORP SLOPE. The slope value and the standard value must be at least 30 mV apart. (See ORP Calibration procedures in the Appendix)
	(CAL AT INSTRUMENT only) Resets calibration to factory settings. After pressing ►, select YES/NO.
	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (ii).

INPUT Menu

	Enter string up to 13 characters (optional). Default = ORP.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF. (See discussion in Appendix.) Default = OFF.

This is the normal display and does not time out.

Cond/Res Setup Checklist

1. Make sure COND/RES sensor type is selected (see System Setup Menu, page 25).
2. Set Cell Constant.
3. Set the Temperature Units (°C or °F).
4. Set Conductivity units.
5. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
6. Set Temperature Compensation.
7. Set Last Cal Date and initials.
8. Select source for Open Collector and Relay output (COND or TEMP).
9. If desired, setup relay functions for your own application.

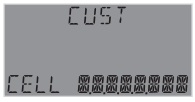
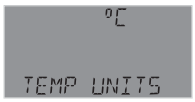
VIEW Mode Menu

TEMP ----- mV	Same as above with temperature, does not time out.
LOOP 720 mA	Displays the 4 to 20 mA LOOP output.
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	YES prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select YES/NO. Default = NO.
AUTO CAL	Shows real-time value and selected standard. “PLACE SENSOR IN STANDARD”. Unit waits until reading is stable; if bad cal, returns “ERROR, CANNOT DETERMINE STANDARD”. Refer to buffer values and AUTO CAL Procedure in the Appendix.
MANUAL CAL	Shows “CONDUCTIVITY” on bottom line; when user presses any button the live value is frozen and the user edits that value. If bad cal, returns “ERR TOO LARGE TO CALIBRATE”. See Manual Cal procedure in Appendix.
SET TEMPERATURE	Shows “TEMPERATURE” on bottom line; when user presses any button the live value is frozen and the user edits that value. If bad cal, returns “ERR TOO LARGE TO CALIBRATE”.
RESET CONDCAL	Resets Conductivity calibration. After pressing ►, select YES/NO.
RESET TEMPCAL	Resets Temperature calibration. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (II).

INPUT Menu

	Enter string up to 13 characters (optional). Default = COND/RES
	Enter cell constant of sensor. Select 20.0, 10.0, 1.0, 0.1, 0.01, or CUSTOM. Default = 1.0 (See NOTE below)
	Enter the precise cell constant from the certificate provided with your sensor, or from the information label on the sensor. Shown if CELL CONSTANT = CUSTOM. (See NOTE below)
	Select °C, °F. Default = °C
	Select µS, mS, PPM, PPB, KOhm, or MOhm. Default = µS. **NOTE:** In USP Relay Mode, TEMP COMP must be set to NONE and Unit Of Measure must be set to µS.
	If the COND UNITS selection is PPM or PPB, set the ratio of Total Dissolved Solids to µS. Default = 0.50
	Dampens display, output and relay response rates. Select Low, Med, High, or OFF. (See discussion in Appendix) Default = OFF
	Select temperature compensation (NONE, LINEAR, PURE H2O). Default = LINEAR. **NOTE:** In USP Relay Mode in Conductivity, Relay Source must be set to COND, TEMP COMP must be set to NONE and Unit Of Measure must be set to µS.
	For LINEAR or PURE H2O temperature compensation, select a % per ºC slope. Maximum slope setting is 9.99 % per ºC. Default = 2.0 (If Temperature Compensation setting is NONE, this item will not be displayed)

Factory-Set Span:

0.01 cell (2819, 2839) ..... 0 to 100 µS
0.10 cell (2820, 2840) ..... 0 to 1000 µS
1.0 cell (2821, 2841) ..... 0 to 10,000 µS
10.0 cell (2822, 2842) ..... 0 to 200,000 µS
20.0 cell (2823) ..... 0 to 400,000 µS

NOTE: If using a 2850 Conductivity/Resistivity Sensor Electronics in conjunction with your 9900, the 2850 must be set for the custom cell constant or the actual probe cell constant and the 9900 set for a 1.0 cell constant.

This is the normal display and does not time out.

PRESSURE Setup Checklist

1. Make sure PRESSURE sensor type is selected (see System Setup Menu, page 25).
2. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
3. Set Units of Measurement (PSI, BAR, KPa).
4. Set Last Cal Date and initials.
5. If desired, set up relay functions for your own application.

VIEW Mode Menu

LOOP 7.20 mA	Displays the 4 to 20 mA LOOP output
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	ON prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select OFF/ON. Default = OFF.
SET ZERO	With process pressure at zero, set zero point for measurement.
SET PPRESSURE	Calibrate pressure reading to external reference. Provides a maximum 5 psi offset.
RESET CAL	Resets calibration to factory default. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (II)

INPUT Menu

NAME PRESSURE	Enter string up to 13 characters (optional). Default = PRESSURE.
PSI UNITS	Enter units of pressure measurement. Select PSI, BAR, or KPa. Default = PSI.
AVERAGE OFF	Dampens display, output and relay response rates. Select: Low, Med, High, OFF (see discussion in Appendix.) Default = OFF. Signet strongly recommends leaving averaging OFF for pH and pressure measurements (see discussion in Appendix).

This is the normal display and does not time out.

LEVEL/VOLUME Setup Checklist

1. Make sure LEVEL/VOLUME sensor type is selected (see System Setup Menu, page 25).
2. Select Main Measurement (Level or Volume).
3. Set Units of Measurement for LEVEL display (FT, IN, M, CM).
4. If desired, set Units of Measurement for VOLUME display.
5. Set the minimum and maximum 4 to 20 mA setpoints.
6. Set Specific Gravity.
7. Set Sensor Offset.
8. If VOLUME is used, set Shape.
9. Set Last Cal Date and initials.
10. If desired, set up relay functions for your own application.

VIEW Mode Menu

VOL 0.0 GAL	Displays the Volume value on the bottom line of the screen when LVL is the MAIN MEAS selection in INPUT menu.
LVL 0.0 FT	Displays the Level value on the bottom line of the screen when VOL is the MAIN MEAS selection in INPUT menu.
LOOP 7.20 mA	Displays the 4 to 20 mA LOOP output
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	ON prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select OFF/ON. Default = OFF.
LEVEL CAL	Shows SET LEVEL on bottom line. When user presses any key, the live value is frozen and the user edits that value. Returns either GOOD CAL or LEVEL OFFSET TOO LARGE.
RESET CAL	Resets calibration to factory default. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (ii).

INPUT Menu

	Enter 13-character string (optional). Default = LEVEL/VOLUME.
	Select between Level or Volume. Default = LVL.
	Select unit of measure for LEVEL display (FT, IN, M, CM). Default = FT
	ON = Measurement will be displayed as a percentage of full scale. OFF = Measurement will be displayed in unit of measure selected in previous setting. Default = OFF.
	If PERCENT LEVEL = ON, set the desired full scale (100%) value in units of measure. Default = 10.00.
	Select unit of measure for VOLUME display (GAL, LIT, Lb, KG, FT^3, in^3, M^3, cm^3). Default = GAL.
	Select ON = Measurement will be displayed as a percentage of full scale. OFF = Measurement will be displayed in unit of measure selected in previous setting. Default = OFF.
	If PERCENT VOLUME = ON, set the full scale value (100%) in units of measure. Default = 100.00.
	Enter the specific gravity of the fluid at normal operating temperature. This setting is required only if the level measurement is made by a pressure sensor or if kg or lb volume units are selected. Default = 1.0000 (water).
	Enter the distance from sensor location to the Zero reference point in the vessel (see discussion in Appendix). Displayed in units of measure chosen in LEVEL UNITS. Default = 0.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF (see discussion in Appendix). Default = OFF
	Select the shape of the vessel where the level sensor is located. VERT CYLINDER, HORIZ CYLINDER, RECTANGLE, or CUSTOM. (To define a custom tank shape, see Appendix page 52, Defining a Custom Tank.) Default = VERT CYLINDER.
	If VERT CYLINDER or HORIZ CYLINDER is selected, enter the diameter of the cylinder. Displayed in units of measure chosen in LEVEL UNITS. Default = 2.0000

This is the normal display and does not time out.

TEMPERATURE Setup Checklist

1. Make sure TEMPERATURE sensor type is selected (see System Setup Menu, page 25).
2. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
3. Set Units of Measurement (°C or °F).
4. Set Last Cal Date and initials.
5. If desired, set up relay functions for your own application.

VIEW Mode Menu

LOOP 4.20 mA	Displays the 4 to 20 mA LOOP output
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	ON prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select OFF/ON. Default = OFF.
SET TEMPERATURE	Provides a maximum 20 °C offset to match to a known standard (external reference).
RESET CAL	Resets Temperature Calibration to factory settings. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (ii).

INPUT Menu

NAME TEMPERATURE	Enter string up to 13 characters (optional). Default = “TEMPERATURE”.
°F TEMP UNIS	Select °C or °F. Default = °C.
AVERAGE OFF	Dampens display, output and relay response rates. Select Low, Med, High, OFF. (See discussion in Appendix.) Default = OFF.

This is the normal display and does not time out.

4 to 20 mA Setup Checklist

1. Make sure 4-20 mA INPUT sensor type is selected (see System Setup Menu, page 25).
2. Set 4 mA value (refer to your 3rd-party sensor manual).
3. Set 20 mA value (refer to your 3rd-party sensor manual).
4. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
5. Set Last Cal Date and initials.
6. If desired, set up relay functions for your own application.

VIEW Mode Menu

LOOP 720 mA	Displays the 4 to 20 mA LOOP output
INPUT ---.--mA	Diagnostic display showing raw input from 4 to 20 mA sensor.
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	ON prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select OFF/ON. Default = OFF.
SET STANDARD	Applies a linear offset to the measurement. For single point calibrations, assign the average value of your process to STANDARD. For two-point calibrations, assign the min or max value of your process to STANDARD.
SET SLOPE	Applies a slope to the measurement. The SLOPE is used for two-point calibrations along with the STANDARD above. If you assigned the min value of your process to the STANDARD, then assign the max value to the SLOPE. Else, assign the min value to the SLOPE. The slope and standard values must be at least 0.1 units apart.
RESET CAL	Resets Standard and Slope calibration to factory settings. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (ii).

INPUT Menu

	Enter string up to 13 characters (optional). Default = 4-20 mA INPUT.
	Enter up to 4 characters describing unit of measure. Default = UNIT.
	Measurement value of your sensor when its output is 4.00 mA.
	Measurement value of your sensor when its output is 20.00 mA.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF. (See discussion in Appendix.) Default = OFF.

To program the 9900 for Dissolved Oxygen measurement using the 3-2610-31 sensor:

From the 4 to 20 mA View Mode display:

1. Press and hold the ENTER key for 2 seconds.
2. Press the ▼ key to select the INPUT menu.
3. The first item is NAME. Press the ► key to change the displayed name from “4-20 mA INPUT” to a more descriptive name (e.g., DO) and press ENTER when done.
4. Press ▼ to select SENSOR UNIT menu item.
5. Press ► to change the label from UNIT to MG/L and press ENTER.
6. Press ▼ and ensure the 4 mA VALUE is set to 0.0000.
7. Press ▼ and change the 20 mA VALUE from 5.0000 to 20.000 and press ENTER.
8. Press both ▲ and ▼ simultaneously to return to the Menu.
9. Press ▼ to select the LOOP menu and press ENTER.
10. Set the 4 mA SETPOINT to your desired value. The 2610 is factory set for a 0 to 20 mg/L output. Press ENTER when done.
11. Press the ▼ key to select the 20 mA SETPOINT and set to your desired value. The 2610 is factory set for a 0 to 20 mg/L output. Press ENTER when done.
12. Press both ▲ and ▼ simultaneously to return to the Menu.
13. Press ▼ twice to select the OPTION menu and press ENTER.
14. Press ▼ twice to select SET BAR MIN. Change this option if desired. The 2610 is factory set for a 0 to 20 mg/L output. Press ENTER when done.
15. Press ▼ to select SET BAR MAX. Change this option if desired. The 2610 is factory set for a 0 to 20 mg/L output. Press ENTER when done.
16. Press both ▲ and ▼ simultaneously to return to the Menu.
17. ENTER the other menus and set the unit as desired for your application.
18. Press both ▲ and ▼ simultaneously to return to the View Menu.

This is the normal display and does not time out.

SALINITY Setup Checklist

1. Make sure SALINITY sensor type is selected (see System Setup Menu, page 25).
2. Set Cell Constant.
3. Set the Temperature Units (°C or °F).
4. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
5. Set Last Cal Date and initials.
6. Select source for Open Collector and Relay output (SAL or TEMP).
7. If desired, set up relay functions for your own application.

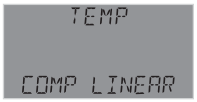
VIEW Mode Menu

TEMP 88888 °C	Displays temperature at the sensor.
LOOP 7.20 mA	Displays the 4 to 20 mA LOOP output.
COND 0.0000 mS	Displays the equivalent conductivity value in milliSiemens.
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	YES prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select YES/NO. Default = NO.
SET SALINITY	Manually set salinity value to match to a known standard (external reference).
SET TEMPERATURE	Provides a maximum 20 °C offset to match to a known standard (external reference).
RESET SAL CAL	Resets Salinity calibration to factory settings. After pressing ►, select YES/NO.
RESET TEMPCAL	Resets Temperature calibration to factory settings. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (II).

INPUT Menu

	Enter string up to 13 characters (optional). Default = SALINITY.
	Enter cell constant of sensor. Select 20.0, 10.0, 1.0 or CUSTOM. Default = 20.
	Enter the precise cell constant from the certificate provided with your sensor, or from the information label on the sensor. Shown if CELL CONSTANT = CUSTOM.
	Select °C or °F. Default = °C.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF. (See discussion in Appendix.) Default = OFF.
	Select temperature compensation (NONE, LINEAR). Default = LINEAR.
	For LINEAR temperature compensation, select a % per ºC slope. Maximum slope setting is 9.99 % per ºC. (If Temperature Compensation setting is NONE, this item will not be displayed.)

This is the normal display and does not time out.

DISSOLVED O2 Setup Checklist (3-2610-41)

2610 wiring on page 15.
3-2610-31 setup on page 44.

1. Make sure DISSOLVED O2 sensor type is selected (see System Setup Menu, page 25).
2. Set Units of Measurement (PPM, %SAT, TOR).
3. Set the Temperature Units (°C or °F).
4. Set Salinity reference value.
5. Set Barometric reference value.
6. If LOOP is used, set the minimum and maximum 4 to 20 mA setpoints.
7. Select source for Open Collector and Relay output (PPM or TEMP).
8. If desired, set up relay functions for your own application.

VIEW Mode Menu

TEMP ------°C	Displays temperature at the sensor.
LOOP 720 mA	Displays the 4 to 20 mA LOOP output.
EXP - - - - - MM-YYYY	Displays Cap Expiration Date MM-YYYY. If sensor cap is missing, - - - - - - - will be displayed.
RLYS 1 2 3 OFF OFF OFF	Bottom line shows one of three states (OFF, ON, PLS) for each of the three relays. Displays remaining time for CYC LOW or CYC HIGH mode. The relay(s) will remain ON while counting down. **NOTE:** (Reset the Timer) In the RELAY menu, select TEST RELAY function. The timer will reset to 0 if the condition no longer exists when the TEST is performed. The timer will restart if the condition still exists.

CAL Menu

NO HOLD OUTPUTS	YES prevents relays from activating while making adjustments, and relays in PULSE mode will suspend pulsing. Output is held until the user exits the CAL menu. Select YES/NO. Default = NO.
SET 100% SOLUTION	Allows user to initiate the optional calibration process. **NOTE**: Dissolved Oxygen sensors are calibrated at the factory and do not require regular calibration. Press ► to begin the calibration process (password required). User will be prompted to place sensor in 100% Solution standard. Press ENTER to save value and establish a calibration point.
SET 0% SOLUTION	Allows user to establish an optional second calibration point. **NOTE**: Dissolved Oxygen sensors are calibrated at the factory and do not require regular calibration. Press ► to begin the calibration process. User will be prompted to place sensor in 0% Solution standard. Press ENTER to save value and establish an optional second calibration point. This option is only available immediately after a successful 100% Solution calibration.
RESET DO CAL	Resets Dissolved Oxygen calibration to factory settings. After pressing ►, select YES/NO.
LAST CAL MM-DD-YYYY II	Enter date of calibration (mm-dd-yyyy) and initials of calibrator (II).

INPUT Menu

	Enter string up to 13 characters (optional). Default = DISSOLVED O2.
	Set the units of measurement: PPM = DO in mg/L; %SAT = DO % saturation; TOR = Oxygen partial pressure. Default = PPM.
	Manually set Salinity value to match application Salinity (0 - 42 PSU). Units in Practical Salinity Unit (PSU). Fresh water = 0.00 PSU. Default = 0.00
	Manually set Barometric value to match application altitude above or below sea level (506.62 - 1114.7 mBAR). Default = 1013.2 (sea level)
	Select °C or °F. Default = °C.
	Dampens display, output and relay response rates. Select Low, Med, High, OFF. (See discussion in Appendix.) Default = OFF.

Condition	Possible Causes	Suggested Solution
Wrong Sensor	Incorrect sensor installed	Connect correct sensor
	Sensor Type set incorrectly in 9900	Set correct sensor TYPE in INPUT menu (see page 25)
Wrong Code	Wrong password entered	Enter correct password (see page 26)
K-Factor Out Of Range	K-Factors cannot be set to 0	Enter K-Factor from 0.0001 to 99999
Backlight inoperative	9900 operating on loop power	Connect 9900 to 10.8 to 35.2 VDC power.
	Backlight turned OFF (**NOTE:** Backlight can turn off automatically in AUTO mode)	Set BACKLIGHT to LOW, HIGH or AUTO in OPTION menu.
Relays 2 and 3 inoperative	9900 operating on loop power	Connect 9900 to 10.8 to 35.2 VDC power.
	Relay Module installed incorrectly	Remove and reseat relay module
	Wrong settings in RELAY menu	Use test relay to verify relay operation then check relay settings.
Relay LEDs inoperative	9900 operating in Loop Power	Use DC power. Check relay states in VIEW mode for status.
Open Collector (R1) or Relay (R2 or R3) always on	Hysteresis value too large	Change the hysteresis value
	Defective Relay Module	Replace Relay Module
OVR relay state (Pulse Overrun)	Relay pulse rate exceeds maximum of 300 pulses per minute.	Increase volume pulse setting
		Reduce system flow rate
	Pulse width set too wide	Decrease pulse width
	(**NOTE:** Max pulse rate = 300; max pulse width = 100 mS.	
– – – – –	Flow rate exceeds display capability	Increase Flow units time base
		Change unit of measure

Condition	Possible Causes	Suggested Solution
Check Sensor (pH/ORP only)	9900 cannot "talk" to sensor	• Check wiring • Install or replace sensor
	Missing sensor or bad temperature element.	
No Sensor (Flow, Cond/Res, Press, Level, Temp, 4-20 mA, Sal, Batch, DO)	9900 cannot "talk" to sensor	• Check wiring • Install or replace sensor
Check Preamp	9900 cannot "talk" to the preamp	Check wiring or replace preamp
Warning LED lit	Look for error message	Correct error condition
Missing Cap	Dissolved Oxygen sensor is missing the sensor cap.	Reinstall Dissolved Oxygen sensor cap
Replace Cap	Dissolved Oxygen sensor cap has expired.	Install new Dissolved Oxygen sensor cap
Broken Glass	pH/ORP sensor glass has been damaged, causing very low impedance.	Visually inspect pH/ORP sensor for cracked and/or chipped glass.
Hi Impedance	The measured pH sensor impedance is above the high impedance level.	Visually inspect the pH electrode and clean if necessary.
	Electrode could be in air.	Ensure electrode is submersed at all times.
Check Cal (pH/ORP only)	Slope and/or Offset are out of range (possibly due to memory failure in sensor or preamp)	Perform pH EasyCal (pg. 34 & 56)
		Perform ORP EasyCal (pg. 36 & 58)
		Set pH Slope or Standard (pg. 34 & 57)
		Set ORP Slope or Standard (pg. 36 & 59)
		Reset pH CAL (pg. 34)
		Reset ORP CAL (pg. 36)

Averaging

NO AVERAGING, NO SENSITIVITY

With SENSITIVITY set to 0 (zero) and AVERAGING set to OFF (0 seconds), the 9900 responds immediately to every shift in the process. The dashed red line represents the actual output of the sensor in varying conditions.

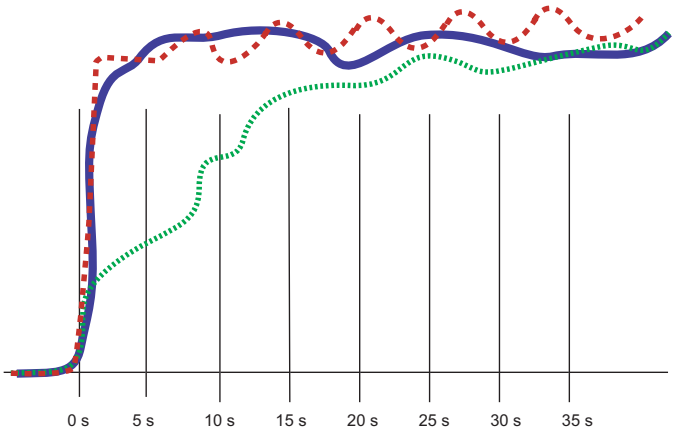
AVERAGING ONLY

With SENSITIVITY still set to zero and AVERAGING set to MED or HIGH the rate is stabilized, but a sharp change in rate is not represented for 8 to 32 seconds or longer.

AVERAGING AND SENSITIVITY

With SENSITIVITY at 50 and AVERAGING set to MED or HIGH, the rate is stabilized, while a sudden shift in flow rate exceeding 50 units of measure will be displayed immediately.

NOTE: The SENSITIVITY function applies only to FLOW.
The SENSITIVITY function has no effect if the AVERAGING function is set to OFF.



Averaging is different depending on the measurement type. Seconds to 99.5% of Final Value for Low, Med, and High are:

Sensor Type	Low	Medium	High
Flow	10	40	120
pH	2	4	12
ORP	2	4	12
Cond/Res	4	6	12
Pressure	4	10	30
Level/Volume	4	10	30
Temperature	3	10	30
4 to 20 mA	4	10	30
Salinity	4	6	12

LOG Current Loop Output

In Conductivity/Resistivity, the logarithmic (LOG) mode can be used when a very large measurement range is required, yet high resolution is needed at the low end (e.g. in a clean-in-place application where a high-resolution conductivity reading is needed at the low end, while a very high conductivity reading is needed when a cleaning cycle is in progress).

Only two parameters need to be set up, the starting or base conductivity value (4 mA SETPNT) and the ending or maximum conductivity value (20 mA SETPNT). The 4 mA setpoint may be larger than the 20 mA point (reverse span).

What equation should be put in the PLC?

$$\text{Conductivity} = 10^{n}$$

$$n = (\text{mA input} - 4.0) \times \frac{(\text{Log}_{10}\ 20\ \text{mA setpnt} - \text{Log}_{10}\ 4\ \text{mA setpnt})}{16\ \text{mA}} + \text{Log}_{10}\ 4\ \text{mA setpnt}$$

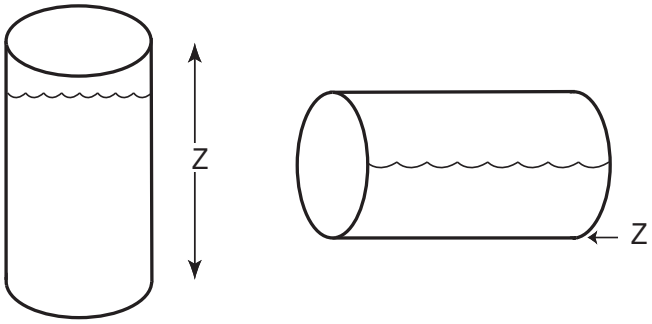
If only fixed thresholds are of required, they can be calculated in mA. Then the mA value can be checked directly.

Inside the 9900 the following equation is used:

$$\text{mA} = (\text{Log}_{10}\,\text{Conductivity} - \text{Log}_{10}\,4\ \text{mA setpnt}) \times \frac{16}{(\text{Log}_{10}\ 20\ \text{mA setpnt} - \text{Log}_{10}\ 4\ \text{mA setpnt})} + 4$$

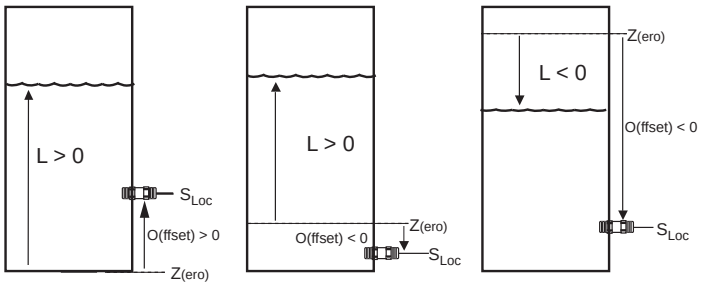
NOTE:
If ADJUST 4 mA or ADJUST 20 mA is used, the mA value can be affected. To prevent any problems the adjust function should only be used to get exactly 4.0 and 20.0 at the PLC. The 9900 is accurate and the adjust functions are only needed to compensate for an offset due to noise or a not-so-accurate PLC input card.

The error value of either 3.6 mA or 22 mA should be tested first before applying the conductivity equation.



For most vessels, the zero reference point (Z) may be designated as any height in the vessel.

For horizontal cylinders only, the zero reference point MUST be the lowest point in the vessel.



Defining a Custom Tank

1. Determine where the level measurement should start. This is the zero reference point (Z). Review the diagram to help select the best option.
2. Determine where you will mount the sensor. This is S_{LOC}. Consult the Sensor manual for information regarding the best location for the sensor.
3. Measure the distance between Z and S_{LOC}. This is O(ffset).
4. Enter the Offset into the INPUT Mode menu.

Zero reference point (Z):
The point in the vessel where you want the 9900 to display zero (0 ft, 0 gal. etc.).

- If Z is located below the fluid surface, the 9900 will display a positive level measurement.
- If Z is located above the fluid surface, the 9900 will display a negative level measurement.

Sensor Location point (S_{LOC}):
The point on the level sensor where the measurement is taken.

- The pressure sensor measures from the centerline of the diaphragm.

Offset (O):
The distance from Z to S_{LOC}.

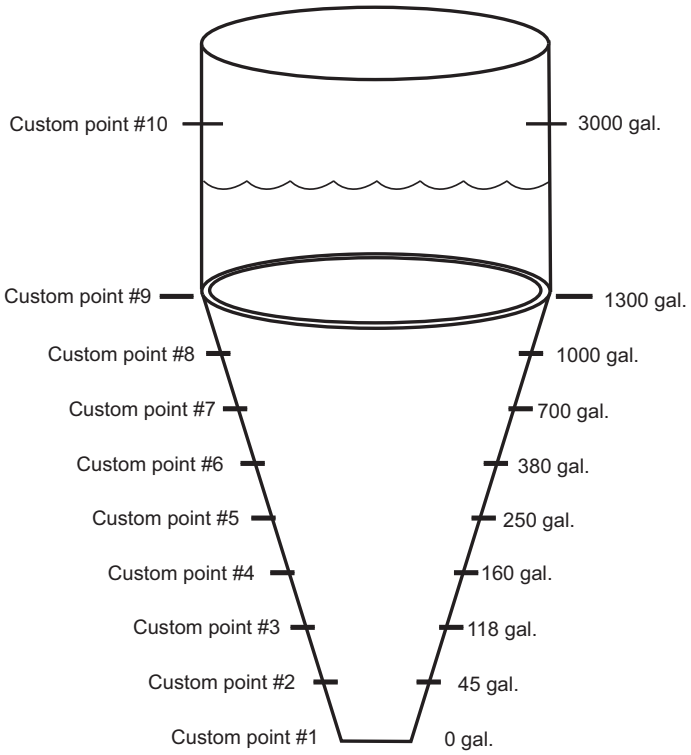
- Enter a positive value in the Calibrate menu if the sensor is located above Z.
- Enter a negative value in the Calibrate menu if the sensor is located below Z.
- Enter 0 in the Calibrate menu if the sensor is located at Z.

Level (L):
The distance from Z to surface of fluid (displayed as “Level” by 9900).

Level and Volume Calculation in Custom Shaped Vessels
In the LEVEL/VOLUME menu, if Custom Shape is selected in the INPUT menu, you can define from three to ten Custom Points to establish the relationship of level to volume in the vessel.

- Select Manual Level Measurement mode to edit both level and volume data (dry configuration).
- Select Automatic Level Measurement mode to accept the sensor measurement of the Level, while you assign a volumetric value to each custom point (wet configuration).
- Enter from 3 to 10 custom points to link level and volume values.
- The first custom point must be the lowest fluid level in the vessel. Each successive point must be greater than the preceding point.
- The last point must be equal to or greater than the highest fluid level in the vessel.
- A custom point should be located at all transition points in the vessel shape (for example, at custom point #9, where the shape changes from a cylinder to a cone).
- The more complex sections should be defined with more points.
  NOTE: The conical section of the illustration has been defined by custom points 1 through 9.
- Simpler sections require fewer defining points.
  NOTE: A cylinder requires only custom points 9 and 10.

Procedures for programming your 9900 for a custom tank shape are found on page 52.



Custom Measurements

In the LEVEL/VOLUME INPUT menu (see page 41), if SHAPE is set to HORIZ CYLINDER, RECTANGLE or CUSTOM, the tank shape can be defined with the following screens:

TANK LENGTH	If Horiz Cylinder or Rectangle shape is selected, enter the length of the vessel in LEVEL UNITS. 0.0000 to 99999.
TANK WIDTH	If Rectangle shape is selected, enter the width of the vessel in LEVEL UNITS. 0.0000 to 99999.
NUM CUST PNTS	If Custom shape is selected, enter the number of measurement points to be used to define the vessel shape (see Level and Volume Calculation in Custom Shaped Vessels discussion). Minimum 3 points, maximum 10 points. A larger number of points improves accuracy.
Auto LEVEL MEAS	Select (AUTO, MAN). Manual allows you to edit both the Level and the corresponding Volume for your custom tank. Automatic allows you to edit the Volume measurement (while displaying an automatically calculated Level value). See example below.
POINT 1 LEVEL	Enter the Level (if MAN measurement is selected) at each custom point in your vessel. If AUTO is selected, indication will read actual tank level in LEVEL UNITS at that point in your tank.
POINT 1 VOL	Set the Volume (if manual measurement is selected) at each custom point in your vessel.
POINT X LEVEL	Where (X) is number of custom points
POINT X VOL	Where (X) is number of custom points

To set AUTO LEVEL MEAS value:

1. Pour a known quantity of fluid into a tank.
2. POINT 1 LEVEL indicates actual tank level.
3. Press ▼ for POINT 1 VOL. Press ► to enter quantity of fluid (in VOLUME UNITS) you poured into the tank in step 1. Press ENTER.
4. Repeat for each point set in NUM CUST PNTS.

For example, in a 25-gallon conical tank set for three custom points:

1. Pour 10 gallons of fluid into the conical tank. POINT 1 LEVEL will indicate actual tank level.
2. In POINT 1 VOL, enter 10.
3. Pour another 10 gallons into the tank. POINT 2 LEVEL will indicate actual tank level.
4. In POINT 2 VOL, enter 10.
5. Pour the final 5 gallons into the tank. POINT 3 LEVEL will indicate actual tank level.
6. In POINT 3 VOL, enter 5.

Technical Reference for
Level, Volume, and Mass Measurement

The 9900 can automatically perform level, volume and mass calculations:

- Pressure-to-level
- Mass
- Volume

Pressure to level conversion:

$$Level = P \div (SG \times D)$$

where P = Pressure
SG = Specific Gravity of fluid
D = Density of water

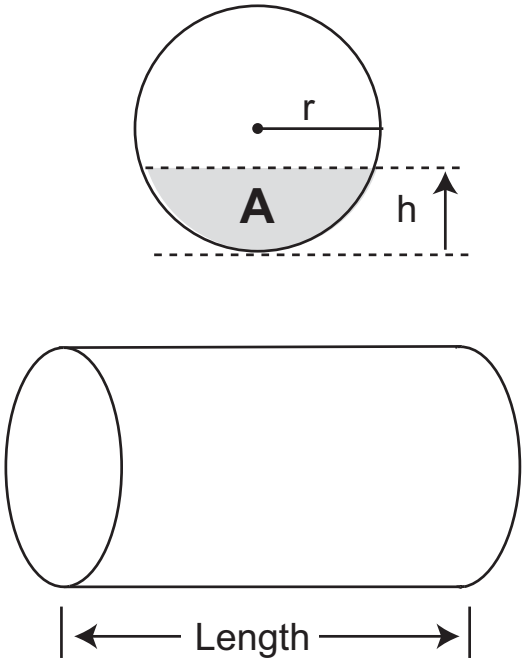
With pressure in psi:
Level (meters) = 0.703069 × (P/SG)
With pressure in bar:
Level (meters) = 1.019715 × (P/SG)

Mass Conversion

$$m = D \times SG \times V$$

where m = mass of fluid
D = density of water = 1000 kg/m^3
SG = Specific Gravity of fluid
V = Volume of fluid (m^3)

m (kg) = 1000 × SG × V



Volume Calculations

Vertical cylinder:

$$V = \pi \times r^2 \times h$$

where r = radius of cylinder
h = height of fluid

Rectangular vessel:

$$V = w \times l \times h$$

where w = width
l = length
h = height

Horizontal cylinder:

$$V = A \times L$$

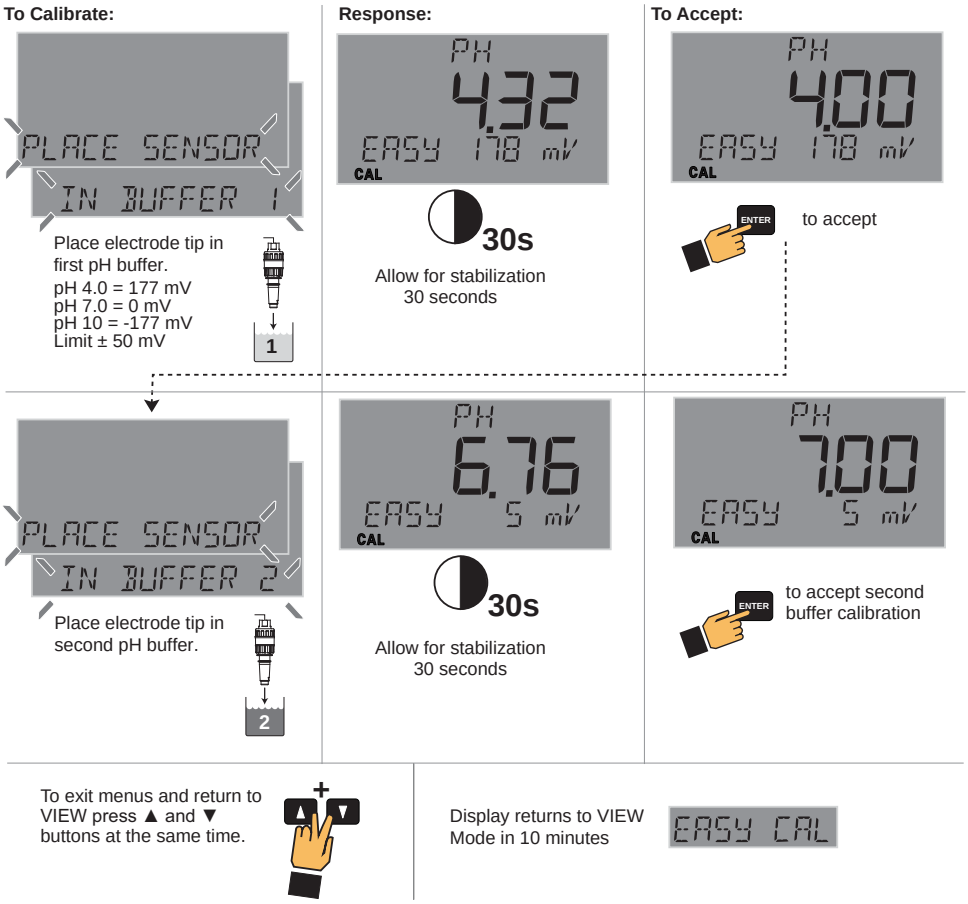
where A = area of segment
L = length of vessel

$$A = \left[\left(\left(r^2 \times \cos^{-1} \times \frac{r-h}{r}\right) - (r-h)\right) \times \sqrt{2rh - h^2}\right]$$

where r = radius of vessel
h = height of segment

EasyCal Procedure - pH

EasyCal is the fastest and simplest periodic calibration method.
Requires prepared 4, 7 or 10 pH buffers (any two).



NOTE: The solutions can be used for calibrating more than one sensor; however, the solution must remain free of debris and must not be diluted by rinse water from previous calibrations.

- This procedure simplifies pH calibration using standard 4.0, 7.0, 10.0 pH buffers only. If these pH buffers are not available, use MANUAL CAL and calibrate the system using the STANDARD and SLOPE settings.
- Set sensor temperature in the CAL Mode before performing EasyCal for new electrode installations.

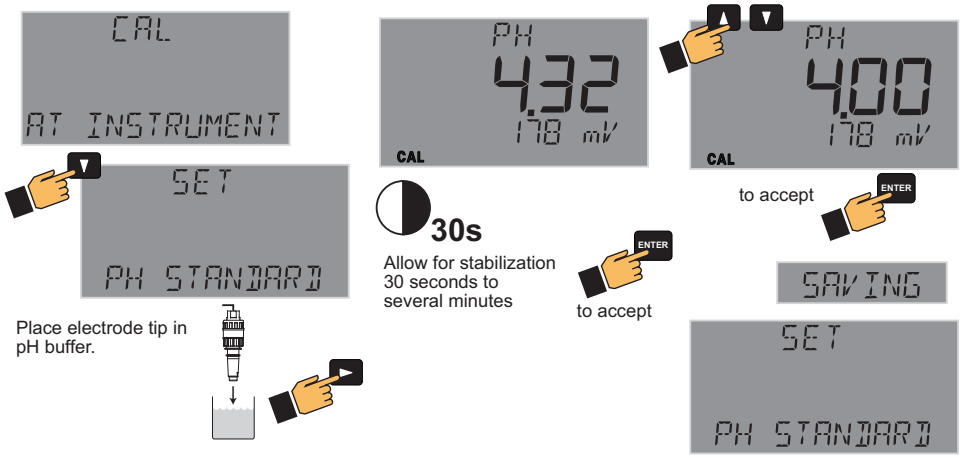
Theoretical mV values

pH @ 25 °C	mV
2	+296
3	+237
4	+177
5	+118
6	+59
7	+0
8	–59
9	–118
10	–177
11	–237
12	–296

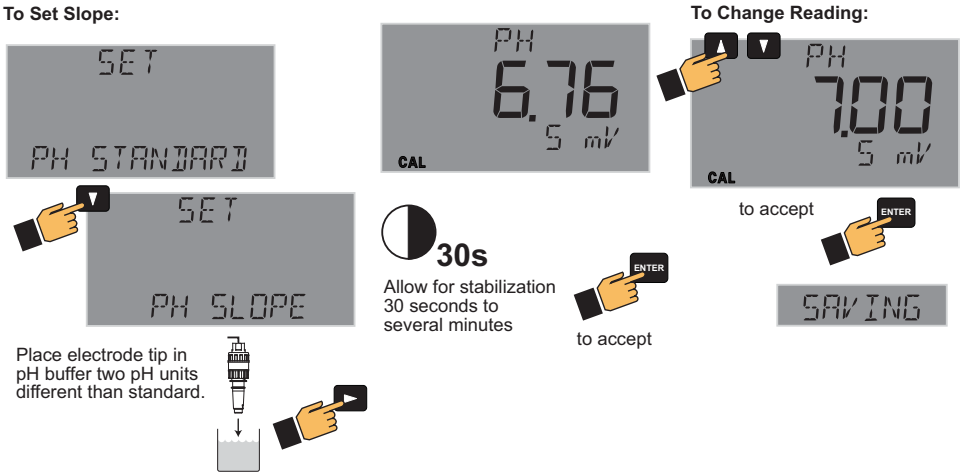
Manual Calibration Procedure - pH

Requires prepared buffers. System calibration is possible with two known pH solutions within 0 to 14 pH (buffers of pH 4.01, 7, or 10 are recommended, but use a buffer close to your own process value.)

To Calibrate:



To Set Slope:



To Set Calibration Date:

Single-point calibration sets STANDARD only; Signet recommends a two-point calibration to set SLOPE in addition to STANDARD.

Quick Manual Calibration Procedures:

1-Point Calibration:
1. Set solution standard.

2-Point Calibration (recommended):
1. Set solution standard.
2. Set solution slope.

EasyCal Procedure - ORP (one-point calibration)

EasyCal is the fastest and simplest periodic calibration method.
Requires a prepared quinhydrone solution or Light's Solution:
Saturate 50 mL of pH 4 (87 mV) or pH 7 (264 mV) buffers with 1/8 g quinhydrone.
Premixed Light's Solution (476 mV) can be used instead of pH buffers with quinhydrone.

To Calibrate:

Place electrode tip in saturated pH 7.0 buffer.
pH 7.0 = 87 mV

Response:

30s
Allow for stabilization
30 seconds

To Accept:

to accept

To exit menus and return to VIEW press ▲ and ▼ buttons at the same time.

Display returns to VIEW Mode in 10 minutes

1. Go to CAL menu.
2. Press ▼ twice to display EASY CAL setting.
3. Press ► to begin one-point EasyCal.
4. Place sensor in solution:
   - 87 mV (7 pH + quinhydrone)
   - 264 mV (4 pH + quinhydrone)
   - 476mV (Light's Solution)
5. Press **ENTER.**
6. After 30 seconds, 9900 will recognize current buffer ±80 mV.
7. Press **ENTER** to accept mV value.

NOTE: ORP solutions made with quinhydrone are very unstable and may not read properly once exposed to air for a prolonged time. These solutions must be disposed of within an hour.

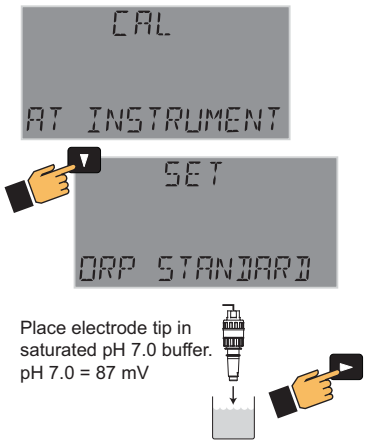
The solution can be used for calibrating more than one sensor. However, the solution must remain free of debris and must not be diluted by rinse water from previous calibrations.

Acceptable ranges for the readings are ± 80 mV (i.e., 87 ± 80 mV).

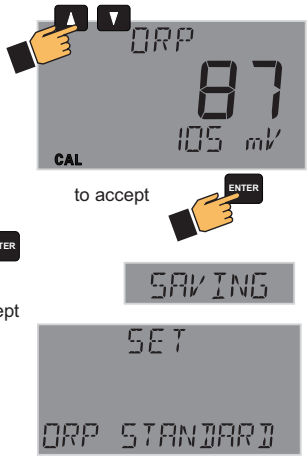
Manual Calibration Procedure - ORP

Requires prepared buffers and a prepared quinhydrone solution: Saturate 50 mL of pH 4 and 7 buffers with 1/8 g quinhydrone. (System calibration is possible with two known ORP solutions, but use a buffer close to your own process value).

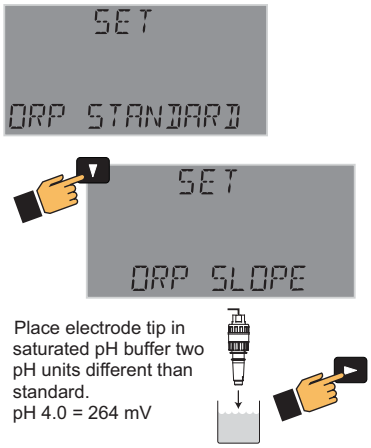
To Calibrate:

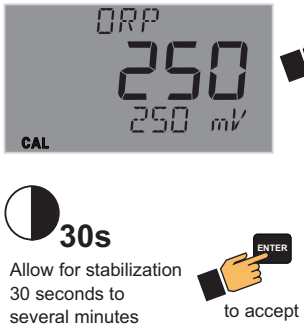


To Change Reading:

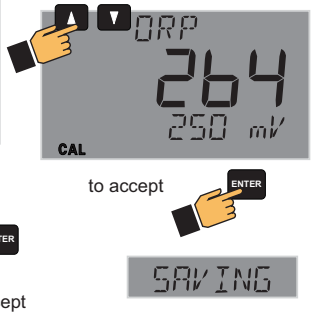


To Set Slope:





To Change Reading:



To Set Calibration Date:

NOTE: ORP solutions made with quinhydrone are very unstable and may not read properly once exposed to air for a prolonged time. These solutions must be disposed of within an hour.

The solution can be used for calibrating more than one sensor. However, the solution must remain free of debris and must not be diluted by rinse water from previous calibrations.

Acceptable ranges for the readings are ± 80 mV (i.e., 87 ± 80 mV).

Single-point calibration sets STANDARD only; Signet recommends a two-point calibration to set SLOPE in addition to STANDARD.

Quick Manual Calibration Procedures:

1-Point Calibration:
1. Set solution standard.

2-Point Calibration (recommended):
1. Set solution standard.
2. Set solution slope.

Calibration Procedure - Conductivity/Resistivity

AutoCal is the fastest and simplest periodic calibration method.
Requires prepared buffer of a value appropriate to your process.

AutoCal Procedure

AutoCal is a single-point calibration system. During this procedure, if the measured value is within ± 10% of any of the test values listed below, the 9900 will automatically recognize the test value and calibrate the output to that value.

NOTE: The first step (Reset) is recommended each time an electrode is replaced, but is NOT necessary upon initial installation or periodic calibration.

NOTE: Ensure that the buffer solution is within ± 5 °C of 25 °C.

1. Reset the sensor to factory calibration (refer to sensor manual for procedure).
2. On the 9900, select AUTO CAL from the CAL menu. Press ►.
3. Place the electrode/sensor assembly into the conductivity test solution appropriate to your operating range. Shake the electrode to dislodge any air bubbles visible on the surface of the electrode.
4. Allow at least 2 minutes for the electrode response to stabilize.
5. When the display stabilizes, press ENTER.
6. If calibration is successful, 9900 will display "SAVING". If error is too large, "OUT OF RANGE USE MANUAL CALIBRATION" will display.

Calibration is complete. Return the system to service.

Manual Cal Procedure

NOTE: The first step (Reset) is recommended each time an electrode is replaced, but is NOT necessary upon initial installation or periodic calibration.

NOTE: Ensure that the buffer solution is within ± 5 °C of 25 °C.

1. Reset the sensor to factory calibration (refer to sensor manual for procedure).
2. On the 9900, select MANUAL CAL from the CAL menu. Press ►.
3. Place the electrode/sensor assembly into the conductivity test solution appropriate to your operating range. Shake the electrode to dislodge any air bubbles visible on the surface of the electrode.
4. Allow at least 2 minutes for the electrode response to stabilize.
5. When the display stabilizes, enter the value of the buffer solution using the ▼, ▲ and ► buttons.
6. Press ENTER.
7. 9900 will display "SAVING". If error is too large, "ERR TOO LARGE TO CALIBRATE" will display.

Calibration is complete. Return the system to service.

Conductivity units are displayed as selected in the CALIBRATE menu. Resistivity displayed when KΩ or MΩ ranges are selected.

Available buffer values are:

- 10
- 100
- 146.93
- 200
- 500
- 1000
- 1408.8
- 5000
- 10,000
- 12856
- 50,000
- 100,000

(all values in µS)

Calibration Procedure - Flow

Select RATE CALIBRATION to match the dynamic flow rate to an external reference. Entering a rate will modify the existing K-Factor.

Select VOLUME CALIBRATION if the flow rate can be determined by filling a vessel of known volume. The 9900 will count the number of pulses generated as the known volume of fluid passes through the sensor, and then use the information to calculate a new K-Factor.

Rate Calibration Procedure

1. Use ▲, ▼ and ► to set the flow rate in the flashing display to match the reference meter. Press ENTER when completed.
2. The 9900 displays the newly calculated K-Factor for your reference. (If the calculated K-Factor is less than 0.0001 or greater than 999999 (out of range at either extreme), the 9900 displays "ERROR NEW KF OUT OF RANGE" and returns to RATE CAL. If flow is too low to accurately calibrate, the 9900 displays "ERROR FLOW RATE TOO LOW and returns to RATE CAL.
3. Press ENTER to accept the new K-Factor (9900 displays "SAVING") or press ▲+▼ keys simultaneously to escape without saving and return to Enter Volume.
   NOTE: You may enter your own calculated K-Factor in the INPUT menu.

Volume Calibration Procedure

1. Press ENTER to start the volumetric calibration period. The 9900 starts counting pulses from the flow sensor.
2. Press ENTER to stop the volumetric calibration period. The 9900 stops counting pulses from the flow sensor.
3. Enter the volume of fluid known to have flowed past the sensor during the volumetric calibration period. This will modify the existing Flow K-Factor.
4. The 9900 displays the newly calculated K-Factor for your reference. (If the calculated K-Factor is less than 0.0001 or greater than 999999 (out of range at either extreme), the 9900 displays "ERROR VOLUME TOO HIGH" (or LOW) and returns to VOLUME CAL.)
5. Press ENTER to accept the new K-Factor (9900 displays "SAVING") or press ▲+▼ keys simultaneously to escape without saving and return to Enter Volume.
   NOTE: You may enter your own calculated K-Factor in the INPUT menu.

Calibration Error Messages

Message	Cause	Solution
Out Of Range Use Manual Calibration	(Cond/Res) Error > 10% in AutoCal	Use manual calibration method
	(pH) Buffer not found; Error > ±1.5 pH units	Use 4, 7, 10 pH buffers (with quinhydrone for ORP calibration) Clean sensor and retry EasyCal Use manual calibration method
	(ORP) No quinhydrone in buffer Error greater than ±80 mV	
Err Too Large To Calibrate	(Cond/Res) Manual cal when error > 100%	Inspect sensor and wiring for damage Clean sensor
	(pH) Offset > 1.3 pH units; Slope error > 100%	Check reference Clean sensor Replace sensor
	(Press) Slope must be < ±50% or offset must be < 2.75 PSI or equivalent.	
	(Sal) Slope error > 1000%	
Error Volume Too Low	User-entered volume too small to calibrate	Correct volume entry Use longer calibration period
Error New KF Out Of Range	The calculated K-Factor too low or high	Verify volume or rate entered Verify flow is present
Error Flow Rate Too Low	(Rate Cal) Flow too low to accurately calibrate	Increase flow
Cal Error Out Of Range	(4 to 20 mA) Slope error > 1000%	Check input at 4 mA and 20 mA settings
	(Temp) Offset must be < ±20 °C or equivalent.	Check sensor range Check reference Replace sensor
Slope Too Close To Standard	(4 to 20 mA) Difference in calibration values must be > 0.1 units	Check sensor Use fresh buffer Use two different buffer values Clean sensor
	(pH) Difference in calibration values must be > 2 pH units	
	(ORP) Difference in calibration values must be > 30 mV	
Standard Too Close To Slope	(4 to 20 mA) Difference in calibration values must be > 0.1 units	Clean sensor Use fresh 4, 7, 10 pH buffers Use two different buffer values
	(pH) Difference in calibration values must be > 2 pH units	
	(ORP) Difference in calibration values must be > 30 mV	
Level Offset Too Large	Offset must be < 1.0 meter	Decrease offset Replace sensor
Pressure Too High	Pressure must be lower than 2.5 PSI or equivalent to do zero cal.	Decrease pressure
Pressure Too Close To Zero	Pressure must be higher than 3 PSI or equivalent to do slope calibration.	Increase pressure Check reference

USP Limits

USP (United States Pharmacopoeia) has defined a set of conductivity values (limits) to be used for pharmaceutical water. The standard requires that conductivity measurement without temperature compensation be used for these applications. The limits vary according to the temperature of the sample. The 9900 has the USP limits stored in memory. It will automatically determine the proper USP limit based on the measured temperature.

Using the USP function
USP setpoints are defined as a percentage below the USP limit, so a USP alarm is always a HIGH alarm. The 9900 can be set to warn you if the conductivity approaches within a set percentage of the USP limit.

The following settings and conditions are required for a USP relay function:

1. In the RELAY menu:
- RELAY MODE must be set to **USP**.

2. In the INPUT menu:
- COND UNITS must be set to **µS**.
- TEMP COMP must be set to **None**.

Example:
- The water temperature is 19 ºC, so the USP limit is 1.0 µS.
- The USP PERCNT is set to 40%.
- The relay will be activated when the conductivity value reaches 40% below the 1.0 USP limit, or 0.6 µS.
- If the water temperature drifts to more than 20 ºC, the 9900 will automatically adjust the USP limit to 1.1. The relay will now be activated when the conductivity value reaches 40% below 1.1 µS (0.66 µS).

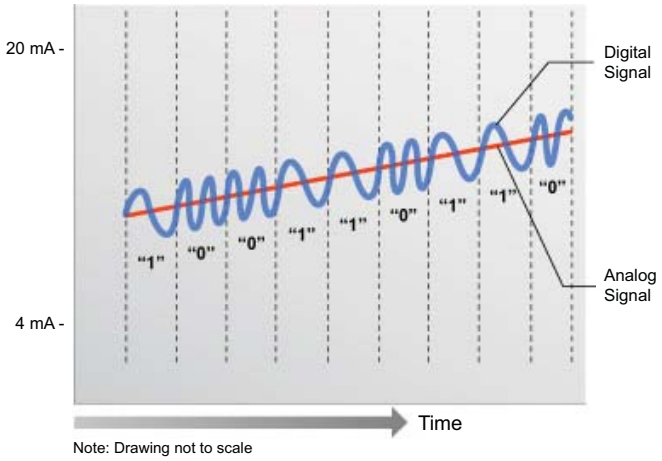
Temperature Range (ºC)	USP limit (µS)
0 to < 5	0.6
5 to < 10	0.8
10 to < 15	0.9
15 to < 20	1.0
20 to < 25	1.1
25 to < 30	1.3
30 to < 35	1.4
35 to < 40	1.5
40 to < 45	1.7
45 to < 50	1.8
50 to < 55	1.9
55 to < 60	2.1
60 to < 65	2.2
65 to < 70	2.4
70 to < 75	2.5
75 to < 80	2.7
80 to < 85	2.7
85 to < 90	2.7
90 to < 95	2.7
95 to < 100	2.9
100 to < 105	3.1

How HART® Works

The HART® (**H**ighway **A**ddressable **R**emote **T**ransducer) Protocol uses Frequency Shift Keying (FSK) to superimpose digital signals on top of the analog 4 to 20 mA current loop. This allows two-way digital communication to occur and allows additional information beyond the normal process data to be communicated to the 9900. This digital signal can contain data such as device status, diagnostics, etc.

The HART protocol provides two simultaneous communication channels: a 4 to 20 mA analog signal and a digital signal.The analog signal communicates the primary measured value using the 4 to 20 mA current loop.

Additional information is communicated using a digital signal superimposed on the 4 to 20 mA signal.



Frequency Shift Keying
Digital over Analog

Communication occurs between two HART-enabled devices, in this application a Signet 9900 Transmitter and a PLC or handheld device, using standard wiring and termination practices. The HART Protocol communicates at 1200 bits per second without interfering with the 4 to 20 mA signal and allows the PLC or handheld device to communicate two or more updates per second to and from the 9900.

The HART protocol operates according to the master-slave method. Any communication activity is initiated by the master, usually a programmable logic controller (PLC) or a data acquisition system. HART accepts two masters: the primary master - usually the control system (PLC) - and the secondary master - a PC laptop or handheld terminal used in the field.

HART field devices - the slaves - never send without being requested to do so. They respond only when they have received a command message from the master. Once a transaction (i.e., a data exchange between the control station and the field device) is complete, the master will pause for a fixed time period before sending another command, allowing the other master to break in. The two masters observe a fixed time frame when taking turns communicating with the slave devices.

As deployed in the 9900 application, HART allows remote verifying, testing, adjusting and monitoring of primary and secondary device variables. Features available in the 9900 Transmitter with H COMM Module installed:

- **Adjust 4 mA:** Allows fine-tuning to compensate for errors in other equipment connected to the 9900. Adjust the minimum and maximum current output.
- **Adjust 20 mA:** Allows fine-tuning to compensate for errors in other equipment connected to the 9900. Adjust the minimum and maximum current output.
- **Supports Multi-Drop Mode:** Allows up to four 9900 Transmitters be installed in Multidrop mode.
- **Supports all Universal HART Protocol Revision 7.2 commands**
- **Supports many Common Practice Commands**
- **Makes Primary and Secondary values available at PLC.** Secondary values are sensor-dependent and are available with pH, Conductivity, Resistivity, Salinity and Level sensors.

HART COMMUNICATION PROTOCOL

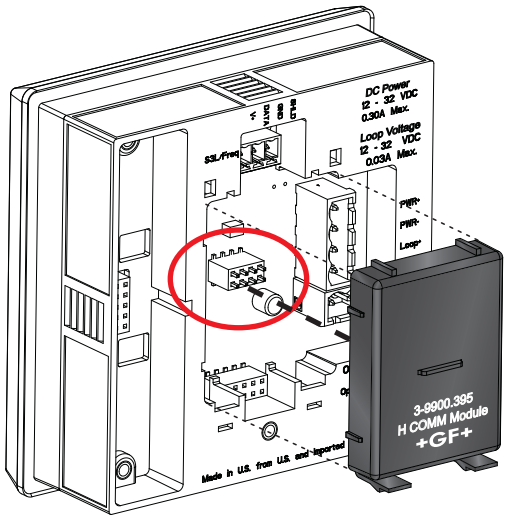
H COMM Module Installation

If the 9900 Base Unit will be mounted in a panel, plug-in modules may be installed either before or after the base unit is mounted. If the 9900 Base Unit will be mounted using the accessory wall mount kit (3-9900.392), install plug-in modules first.
If the Direct Conductivity/Resistivity Module will be included in your unit, install the H COMM module first and then install Conductivity/Resistivity Module over the H COMM Module.

To install the H COMM module, carefully align the module pins into its plug (see illustration) and push the module straight in until the tabs on the bottom edge snap into place.

To uninstall, squeeze tabs, grasp the module and pull straight out.

Be careful not to bend the pins when installing or removing the module to or from the base unit.

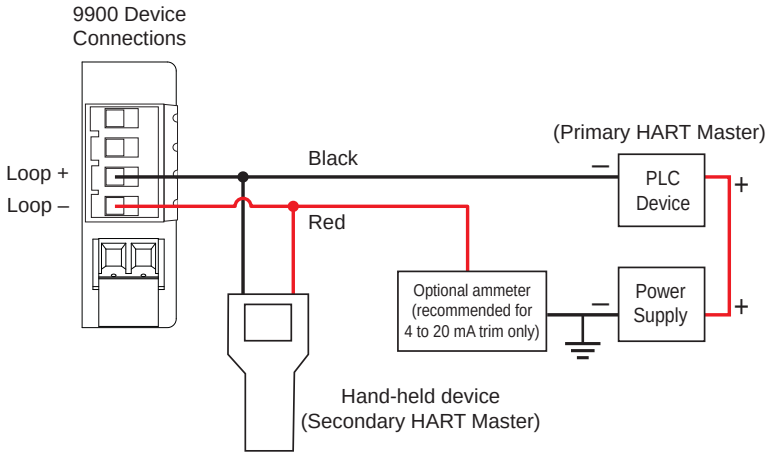


NOTE: The black rubber jumper adjacent to the power terminal should only be removed when both the H COMM Module is utilized and the required sensor cable length is over 304 m (1000 ft).

H COMM Module Wiring

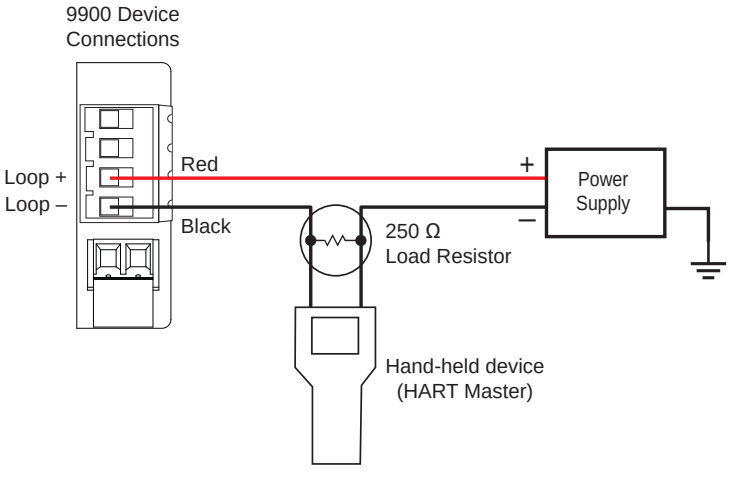
Connecting HART with a Loop-powered sensor

(Typical installation)



Connecting HART to a Hand-Held Master Device

(Typical installation)



NOTE: On pages 64-69, the term “9900 Transmitter” or “Transmitter” will assume the H COMM Module is installed unless otherwise noted.

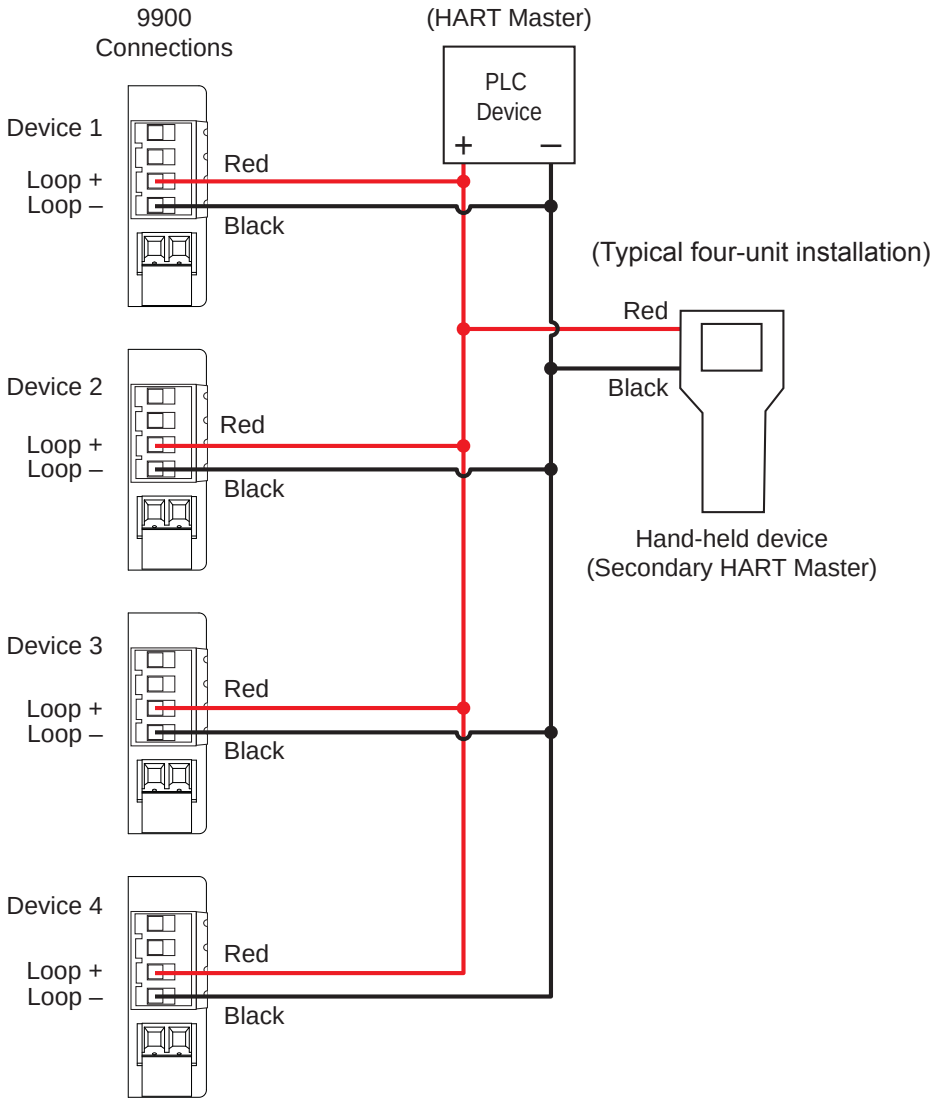
Multi-Drop Mode

Up to four 9900 Transmitters can be connected in Multi-Drop mode using the H COMM Module.

To ensure proper operation in Multi-Drop mode, configure each 9900 Transmitter with its own poll address using a configuration tool (laptop or hand-held device).

After configuring the 9900 Transmitter for multi-drop function, reset the Transmitter (remove power for five seconds then apply power) before use.

Connecting HART in Multi-Drop mode



Loop Powered systems require a minimum of 24 VDC. If connecting with DC, nominal 12 VDC is acceptable. (See Power Wiring section in the Signet 9900 Transmitter Operating Instructions manual.)

In LVL/VOL mode, the primary variable will always represent Level, the secondary variable will always represent Volume. In pH, Conductivity, Resistivity and Salinity systems the secondary variable represents the temperature.

Loop Current Trim Procedure

The Loop Current HART commands allow a Master HART device to update a loop current value in the 9900 Transmitter and to perform a two-point calibration (zero and span) of the loop current.

1. Use Command 40 (Enter/Exit Fixed Current Mode) to update the 4.00 mA current.
2. Using the measured value of your reference instrument (either a digital multimeter or the HART Master device), set the zero trim using Command 45 (Trim Loop Current Zero). The transmitter will then trim its calibration and return the loop current value in the response message. The response value may differ slightly from the value sent by the Master due to rounding.
3. Use Command 40 (Enter/Exit Fixed Current Mode) to update the 20.00 mA current.
4. Using the measured value of your reference instrument (either a digital multimeter or the HART master device), set the span trim using Command 46 (Trim Loop Current Gain). The transmitter will then trim its calibration and return the loop current value in the response message. The response value may differ slightly from the value sent by the Master due to rounding.
5. Repeat steps 1 through 4 as needed to gain the accuracy desired. Once the loop current is calibrated to your satisfaction, return the device to normal operation by issuing Command 40 (Enter/Exit Fixed Current Mode) with a value of 0.0. This will take the 9900 out of fixed current mode.

Note: With the H COMM Module installed, the following functions are not accessible via the 9900 keypad:
- Trim Loop Current
- Test Loop Current

These functions are only accessible via the HART interface.

Changes to Units of Measure in Transmitter

HART devices can be used to change the units of measure in a 9900 Transmitter. After an update, you must cycle power to the 9900 Transmitter (remove power for 5 seconds, then restore power). In a flow system, the units update automatically and it is not necessary to cycle power to the 9900 Transmitter.

Universal Commands
All HART Rev. 7.2 Universal Commands are supported:

CMD ID	Function
0	Read Unique Identifier
1	Read Primary Variable
2	Read Loop Current And Percent Of Range
3	Read Dynamic Variables And Loop Current
6	Write Polling Address
7	Read Loop Configuration
8	Read Dynamic Variable Classification
9	Read Device Variable With Status
11	Read Unique Identifier Associated With Tag
12	Read Message
13	Read Tag, Descriptor, Date
14	Read Primary Variable Transducer Information
15	Read Device Information
16	Read Final Assembly Number
17	Write Message
18	Write Tag, Descriptor, Date
19	Write Final Assembly Number
20	Read Long Tag
21	Read Unique Identifier Associated With Long Tag
22	Write Long Tag
38	Reset Configuration Changed Flag
48	Read Additional Device Status

Command 0 – Read Unique Identifier
Returns device type, device and software revision levels, device status, and codes for the manufacturer and product information.

Command 1 – Read Primary Variable
Returns the numeric value of the Primary Variable (the 4 to 20 mA current loop) and the unit code for that value (e.g. ’45.3’ and ‘Degrees Celsius’).

Command 2 – Read Loop Current and Percent of Range
Returns the loop current value of the 4 to 20 mA current loop and the percent of range (e.g. ’12.0’ and ‘50%’).

Command 3 – Read Dynamic Variables and Loop Current
Returns the loop current value of the 4 to 20 mA current loop, as well as the numeric value of the Secondary Variable (if present) and the Secondary Value’s unit code.

Command 6 – Write Polling Address
Enables (or disables) Multi-Drop mode. While in Multi-Drop mode, loop current is held at a fixed value and is no longer available for signaling. Also sets the polling address of the device for Multi-Drop mode.

Command 7 – Read Loop Configuration
Reads the polling address of the device and the loop configuration (see Command 6).

Command 8 – Read Dynamic Variable Classifications
Returns the classification code for the Primary Variable and Secondary Variable (if present).

Command 9 – Read Device Variable with Status
Returns the value, status, variable code, variable classification and unit code of up to four device variables.

Command 11 – Read Unique Identifier Associated with Tag
Returns all identity information associated with the device, i.e., the device type, device revision level and Device ID. Issued using the ‘tag’.

Command 12 – Read Message
Read back the message stored in the device. See Command 17.

Command 13 – Read Tag, Descriptor, Date
Reads the tag, descriptor and date values contained within the device. See Command 18.

Command 14 – Read Primary Variable Transducer Information
Reads transmitter serial number, unit code, upper and lower limits and minimum span for primary variable.

Command 15 – Read Device Information
Returns the alarm selection code, transfer function code, upper and lower range values, write protect code and unit code.

Hart Commands

Universal Commands - Continued

Command 16 – Read Final Assembly Number
Returns the assembly number of the device. This will be defined by the customer. See Command 19.

Command 17 – Write Message
Write a message to be stored in the device. See Command 12.

Command 18 – Write Tag, Descriptor, Date
Writes the tag, descriptor and date values into the device. See Command 13.

Command 19 – Write Final Assembly Number
Writes the final assembly number of the device. See Command 16.

Command 20 – Read Long Tag
Read the 32-byte long tag. The 'long tag' is separate from the 'tag' that is used in Commands 13 & 18.

Command 21 – Read Unique Identifier Associated with Long Tag
Returns all identity information associated with the device - the device type, device revision level and Device ID. Issued using the long tag.

Command 22 – Write Long Tag
Write the 32-byte long tag. See Command 20.

Command 38 – Reset Configuration Changed Flag
Resetting the device's configuration changes counter back to 0.

Command 48 – Read Additional Device Status
Returns extended device status information.

Supported HART Common Practice Commands
The following Common Practice Commands are supported.

CMD ID	Function
40	Enter/Exit Fixed Current Mode
45	Trim Loop Current Zero
46	Trim Loop Current Gain
54	Read Device Variable Information

Command 40 - Enter/Exit Fixed Current Mode
The loop current of the 9900 is set to the value transmitted in the command (in milliamperes). Setting a level of '0' exits Fixed Current Mode.
If the device is in Multi-Drop mode, Error Code 11 will be returned.

Command 45 – Trim Loop Current Zero
The 9900 will trim its offset of the loop current to match the loop current value sent to it. This is typically performed at 4.00 milliamperes to optimize calibration.

Command 46 – Trim Loop Current Gain
The 9900 will trim the gain of the loop current to match the loop current value sent to it.
This is typically performed at 20.00 milliamperes to optimize calibration.

Command 54 – Read Device Variable Information
Returns serial number, limits, damping value and minimum span for a selected device variable.

Unit Codes

The H COMM module uses standard HART Foundation Protocol 7.2 unit codes. The unit code allows the HART Master to interpret and display the units of measure (e.g., GPM, PPB, °F, etc.) with two exceptions.

The following Unit Codes will not be interpreted by the HART Master:

Code	Measurement Unit
240	Cubic Centimeters
244	Parts per Thousand

A HART Master will display these unit codes instead of the units of measure that the code represents.

Specifications

General
Input channels .....One

Enclosure and Display
Case Material .....PBT
Window.....Shatter-resistant glass
Keypad .....4 buttons, injection-molded silicone rubber seal
Display.....Backlit, 7- and 14-segment
Indicators .....“Dial-type” digital bar graph
Update rate.....1 s
LCD Contrast.....5 settings
Enclosure
- Size .....¼ DIN
- Color.....Black (Panel Mount), Yellow and black (Integral Mount)

Mounting
- Panel .....¼ DIN, ribbed on four sides for panel mounting clip inside panel, silicon gasket included
- Field.....Mounts to standard Signet field mount junction boxes. Optional angle adjustment adapter is available
- Wall ..... Large enclosure (sold as an accessory) that encases the panel mount transmitter

Terminal Blocks
Pluggable screw type: use minimum 105 °C rated wire
Torque ratings
- Cond/Res, Open Collector, Power/Loop.....0.33 Nm (3.0 lb-in.)
- Freq/S^{3}L.....0.24 Nm (2.2 lb-in.)
- Relay.....0.49 Nm (4.4 lb-in.)

Connector wire gauge:
- Power, Loop.....12 to 28 AWG
- Open Collector.....12 to 28 AWG
- Freq/S^{3}L.....16 to 28 AWG

Module connector wire gauge:
- Relay.....12 to 28 AWG
- Cond/Res.....16 to 28 AWG
- Batch.....up to 14 AWG
- 4-20 mA Output....up to 14 AWG

Environmental Requirements
Ambient operating temperature:
- Backlit LCD.....-10 °C to 70 °C (14 °F to 158 °F)
- Storage Temp .....-15 °C to 70 °C (5 °F to 158 °F)

Relative Humidity.....0 to 100% condensing for Field and Panel Mount (front only); 0 to 95% non-condensing for Panel Mount back side
Maximum Altitude .....4,000 m (13,123 ft); use only DC power supply to maintain UL safety standard up to this altitude
Enclosure Rating.....Designed to meet NEMA 4X/IP65 (front face only on panel mount; field mount is 100% NEMA 4X/IP65)
Installation Category Cat II
Pollution Degree 2

Shipping Weights
Base Unit.....0.63 kg (1.38 lb)
H COMM Module.....0.16 kg (0.35 lb)
Conductivity Module ...0.16 kg (0.35 lb)
Relay Module.....0.19 kg (0.41 lb)
Batch Module.....0.16 kg (0.35 lb)
Output Module .....0.16 kg (0.35 lb)

Performance Specifications
System Accuracy
- Primarily dependent upon the sensor.

System Response
- Primarily dependent upon the sensor. Controller adds a maximum of 150 ms processing delay to the sensor electronics.
- Minimum update period is 100 ms
- System response is tempered by the display rate, output averaging and sensitivity feature.

Electrical Requirements
Power to Sensors
Voltage.....+4.9 to 5.5 VDC @ 25 °C, regulated
Current.....1.5 mA max in loop power mode; 20 mA max when using DC power
Short Circuit.....Protected
Isolation .....Low voltage (< 48 V AC/DC) to loop with DC power connected
No isolation when using loop power only

Input Power Requirements
DC (preferred) .....24 VDC; input range: 10.8 to 35.2 VDC regulated
9900 w/o Relay Module .....200 mA *
9900 w/ Relay Module.....300 mA *
*The current draw of the other modules and the sensors are minimal
Loop.....10.8 to 35.2 VDC
4 to 20 mA (30 mA max.)
Overvoltage protection .....48 Volt Transient Protection Device (for DC ONLY)
Current limiting for circuit protection
Reverse-Voltage protection

Loop Characteristics
DC Powered System (preferred)
Max. loop impedance:
@ 12 V loop power .....250 Ω max.
@ 18 V loop power .....500 Ω max.
@ 24 V loop power .....750 Ω max.

Loop Powered System
Max. loop impedance:
@ 12 V loop power .....50 Ω max.
@ 18 V loop power .....325 Ω max.
@ 24 V loop power .....600 Ω max.

Standards and Approvals
- CE, UL, CUL, WEEE
- RoHS Compliant

China RoHS (Go to gfsignet.com for details)

Declaration of Conformity according to FCC Part 15
This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

- Manufactured under ISO 9001 for Quality, ISO 14001 for Environmental Management and OHSAS 18001 for Occupational Health and Safety.

Specifications

Relay Specifications

Hysteresis..... Adjustable (absolute in Engineering Units)
Latch..... Reset in test screen only
On Delay..... 9999.9 seconds (max)
Cycle Delay ..... 99999 seconds (max)
Test Mode..... Set On or Off
Maximum Pulse Rate ..... 300 pulses/minute
Proportional Pulse ..... 400 pulses/minute
Volumetric Pulse Width..... 0.1 to 3200 s
PWM period..... 0.1 to 320 s

Open Collector

Type..... NPN
Max. Voltage Rating ..... 30 VDC
Max. Current Rating ..... 50 mA

Dry-Contact Relays

Type..... SPDT
Form C
Max. Voltage Rating ..... 30 VDC or 250 VAC
Max. Current Rating ..... 5 A resistive

Input Types

- Digital (S^3L) or AC frequency
- 4 to 20 mA input via the 8058
- Open collector
- pH/ORP input via the Digital (S^3L) output from the 2750/2751 pH/ORP Sensor Electronics
- Raw Conductivity/Resistivity input directly from Signet Conductivity/Resistivity electrodes via Direct Conductivity/Resistivity Module or via the Digital (S^3L) output from the 2850 Conductivity/Resistivity Sensor Electronics

Sensor Types:

Flow, pH/ORP, Conductivity/Resistivity, Salinity, Pressure, Temperature, Level/Volume, Dissolved Oxygen, Other (4-20 mA)

Input Specifications

Digital (S^3L)..... Serial ASCII, TTL level, 9600 bps
Frequency Type Sensors:
- Sensitivity..... (for coil type sensors): 80 mV @ 5 Hz, gradually increasing with frequency to 2.5 V
- Freq. Range..... (for square wave type sensors): 0.5 Hz to 1500 Hz @ TTL level input or open collector
- Accuracy ..... ± 0.5% of reading max error @ 25 °C
- Range ..... 0.5 to 1500 Hz
- Resolution..... 1 µs
- Repeatability ..... ± 0.2% of reading

Power Supply
- Rejection..... No Effect ± 1 µA per volt
- Short Circuit ..... Protected
- Reverse Polarity..... Protected (no isolation when using loop power only)

Update Rate ..... (1/frequency) + 150 ms

Current Outputs

- One 4 to 20 mA output in base unit (additional 4 to 20 mA output available via 3-9900.398-1 Output Module)
- Linear scaling
- Logarithmic scaling for Conductivity
- Reverse span
- Selectable error mode: 3.6 mA or 22 mA
- Test Output mode: allows testing of the current output
- Adjustable 4 to 20 mA end points
- HART communication via optional H COMM Module

Display Ranges:
pH.....-1.00 to 15.00 pH
pH Temp. .....-99 °C to 350 °C (-146 °F to 662 °F)
ORP.....-1999 to +1999 mV
Flow Rate .....-9999 to 99999 units per second, minute, hour or day
Totalizer .....0.00 to 99999999 units
Conductivity.....0.0000 to 99999 µS, mS, PPM and PPB (TDS), kΩ, MΩ
Cond. Temp. .....-99 °C to 350 °C (-146 °F to 662 °F)
Temperature .....-99 °C to 350 °C (-146 °F to 662 °F)
Pressure .....-40 to 1000 psi
Level.....-9999 to 99999 m, cm, ft, in, %
Volume .....0 to 99999 cm^3, m^3, in^3, ft^3, gal, L, lb, kg, %
Salinity.....0 to 100 PPT
Dissolved O_2.....0 to 20 mg/L, 0 to 200%

Output Specifications

Current Loop Out.....ANSI-ISA 50.00.01 Class H
Span .....3.8 to 21 mA
Zero .....4.0 mA factory set; user programmable from 3.8 to 4.2 mA
Full Scale.....20.00 mA factory set; user programmable from 19.0 to 21.0 mA
Accuracy.....± 32 µA max. error @ 25 °C @ 24 VDC
Resolution.....6 µA or better
Temp. Drift .....± 1 µA per °C
Pwr Sply Rejection .....± 1 µA per V
Isolation .....Low voltage (< 48 VAC/DC)
Voltage.....10.8 to 35.2 VDC
Max. Impedance:.....250 Ω @ 12 VDC
500 Ω @ 18 VDC
750 Ω @ 24 VDC
Update Rate .....100 mS nominal

Actual update rate determined by sensor type

Short circuit and reverse polarity protected

Adjustable span, reversible

Error Condition .....Selectable error condition 3.6 or 22 mA.
Test Mode.....Increment to desired current (range 3.8 to 21.00 mA)
Open Collector Output..1
Analog Outputs.....1 passive

Maintenance

- Clean the instrument case and front panel with a soft cotton cloth dampened with a mild liquid soap solution.
- Never wipe the front window with static retentive cloths such as wool or polyester which may induce a static charge. If a static charge develops on the window, you may notice temporary blotches form on the screen. When this occurs, clean the front window with an anti-static cloth, or a soft cotton cloth and anti-static spray or a mild liquid soap solution to remove the static charge.

Ordering Informationa

9900 Transmitter Base Unit:
Single Channel, Multi-Parameter, 4 to 20 mA, Open Collector, DC Power

Mfr. Part No	Code	Description
3-9900-1P	159 001 695	9900 Base Unit, Panel Mount
3-9900-1	159 001 696	9900 Base Unit, Field Mount
3-9900-1BC	159 001 770	Batch Controller System
Optional Modules		
3-9900.393	159 001 698	Relay Module - 2 DCR (Dry Contact Relays)
3-9900.394	159 001 699	Direct Conductivity/Resistivity Module
3-9900.395	159 001 697	H COMM Module
3-9900.397	159 310 163	Batch Module
3-9900.398-1	159 001 784	4 to 20 mA Output Module
Accessories		
3-9900.090-CD	159 900 094	9900 Transmitter product manual CD
6682-0204	159 001 709	Conductivity Module Plug, 4 Pos, Right Angle
6682-1102	159 001 710	Open Collector Plug, 2 Pos, Right Angle
6682-1103	159 001 711	Relay Module Plug, 3 Pos, Right Angle
6682-1104	159 001 712	Power/Loop Plug, 4 Pos, Right Angle
6682-3104	159 001 713	Freq/S^3L Plug, 4 Pos, Right Angle
6682-3004	159 001 725	Freq/S^3L Plug, In-Line
7310-1024	159 873 004	24 VDC Power Supply, 10 W, 0.42 A
7310-2024	159 873 005	24 VDC Power Supply, 24 W, 1.0 A
7310-4024	159 873 006	24 VDC Power Supply, 40 W, 1.7 A
7310-6024	159 873 007	24 VDC Power Supply, 60 W, 2.5 A
7310-7024	159 873 008	24 VDC Power Supply, 96 W, 4.0 A
3-0251	159 001 724	PC COMM Configuration/Diagnostic tool
3-8050	159 000 184	Universal Mount Kit
3-8050.396	159 000 617	RC Filter Kit (for relay use), 2 per kit
3-8051	159 000 187	Flow Sensor Integral Mounting Kit, NPT, Valox
3-8051-1	159 001 755	Flow Sensor Integral Mounting Kit, NPT, PP
3-8051-2	159 001 756	Flow Sensor Integral Mounting Kit, NPT, PVDF
3-8052	159 000 188	¾ in. Integral Mount Kit
3-8058-1	159 000 966	i-Go™ Signal Converter, wire-mount
3-8058-2	159 000 967	i-Go™ Signal Converter, DIN rail mount
3-9900.390	159 001 714	Standard Connector Kit, Right Angle, (Included with 9900 Transmitter)
3-9900.391	159 001 715	Connector Kit, In-Line, 9900 Transmitter
3-9900.392	159 001 700	Wall Mount Accessory for 9900
3-9000.392-1	159 000 839	Liquid Tight Connector Kit, NPT (1 pc.)
3-9900.396	159 001 701	Angle Adjustment Adapter Kit (for Field Mounting)

+GF+

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For Worldwide Sales and Service, visit our website: www.gfsignet.com • or call (in the U.S.): (800) 854-4090
For the most up-to-date information, please refer to our website at www.gfsignet.com

3-9900.090 Rev. E 06/14 English

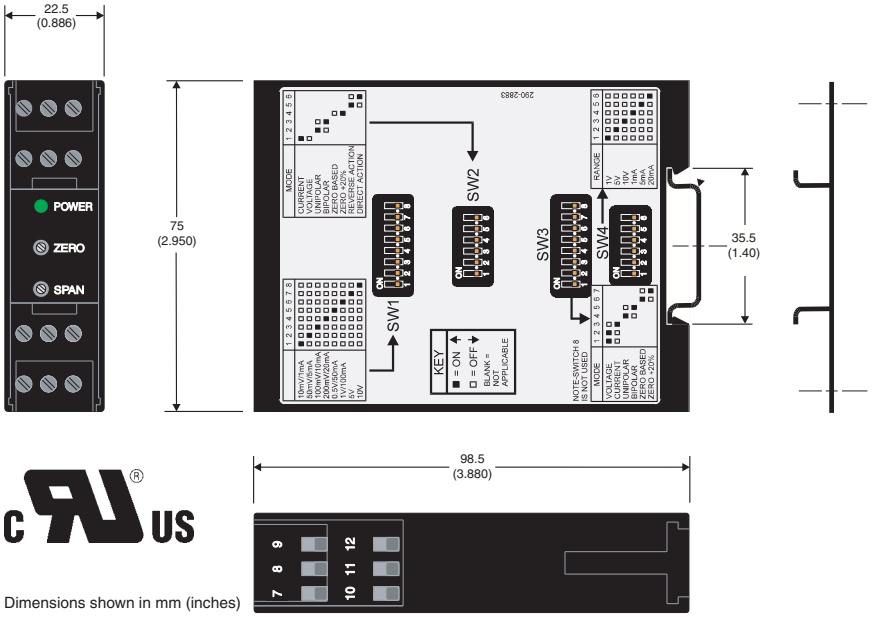
Iso Verter® II
Model SC4380/SCL4380
Installation Instructions

Getting Started

1. Using a small screwdriver, ball point pen, etc. set the four switches on the side of the unit (see Input Programming and Output Programming on page 2).
2. Mount unit into panel (see Mounting on page 3).
3. Connect unit to input signal, output signal, and power wiring (see Wiring on page 4).
4. Check calibration (see Calibration on page 4).

Specifications are on page 4.

Dimensions



Dimensions shown in mm (inches)

LOVE CONTROLS DIVISION
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P.O. BOX 373 • MICHIGAN CITY,
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Phone: 219/879-8000
www.love-controls.com
Fax: 219/872-9057
e-mail: lit@dwyer-inst.com

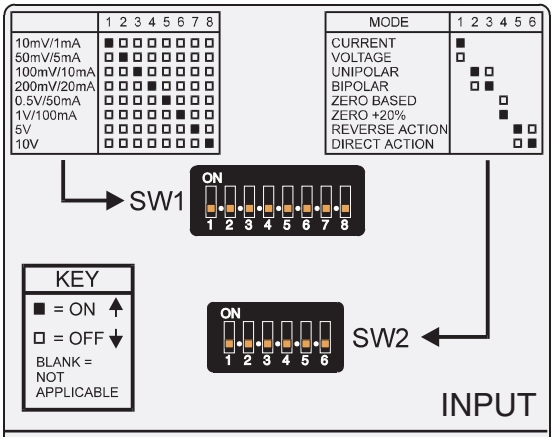
Input Programming

RANGE SELECTION SWITCH BANK (SW-1)

Turn ON the switch for the scale desired. All other switches should be OFF. If BI-POLAR INPUT is selected, the scale will be MINUS-SELECTION to PULSE-SELECTION (eg. -10 TO +10 VDC).

MODE SELECTION SWITCH BANK (SW-2)

1. For CURRENT INPUT turn switch one ON. For VOLTAGE INPUT turn switch one OFF.
2. For UNI-POLAR INPUT (low end of scale ≥ zero) turn switch two ON and turn switch three OFF.
3. For Bi-POLAR INPUT (low end of scale < zero) turn switch two OFF and turn switch three ON.
4. For ZERO BASED INPUT (eg. 0 TO 20 mA) turn switch four OFF.
5. For ZERO SUPPRESSION (eg. 4 TO 20 mA) turn switch four ON.
6. For DIRECT ACTING INPUT turn switch five OFF and switch six ON. For REVERSE ACTING INPUT turn switch five ON and switch six OFF.



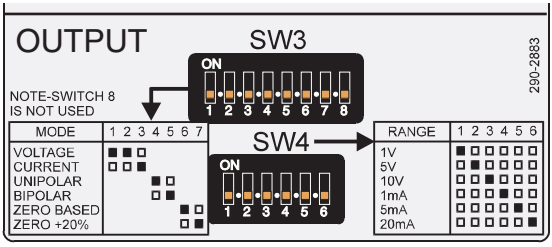
Output Programming

MODE SELECTION SWITCH BANK (SW-3)

1. For VOLTAGE OUTPUT turn switches one and two ON and switch three OFF.
2. For CURRENT OUTPUT turn switches one and two OFF and switch three ON.
3. For UNIPOLAR OUTPUT turn switch four ON and switch five OFF.
4. For BIPOLAR OUTPUT turn switch four OFF and switch five ON.
5. For ZERO BASED OUTPUT (eg. 0 TO 20 mA) turn switch six ON and switch seven OFF.
6. For ZERO SUPPRESSION (eg. 4 TO 20 mA) turn switch six OFF and switch seven ON. If BIPOLAR is selected, do not use the ZERO SUPPRESSION switch. Use the ZERO adjustment to suppress the output.
7. Switch eight is always OFF. (It is not connected to any circuitry. If switch eight is turned ON there is no effect on the operation of the device.)

RANGE SELECTION SWITCH BANK (SW-4)

Turn ON the switch for the scale desired. All other switches should be OFF. If BIPOLAR OUTPUT is selected, the scale will be from MINUS-SELECTION to PLUS-SELECTION (eg. -10 TO +10 VDC).



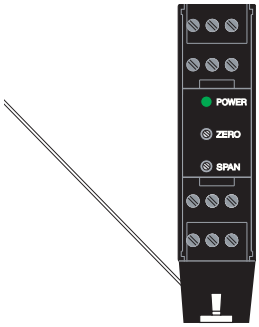
WARNING: Do not attempt to operate this device with the cover removed. Potentially lethal voltage is present on some of the internal components. Do not open the unit. There are no internal adjustments or user serviceable parts in the unit.

Mounting

Mount the unit in a panel that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting on an industry standard 35 mm DIN rail.

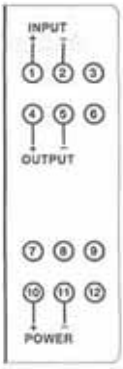
To install hold the SC4380 so that the front is higher than the rear. Place the upper slot on the rear of the SC4380 on the top edge of the DIN rail. Slowly rotate the front down until the bottom spring clip snaps over the bottom edge of the DIN rail.

To remove from the DIN rail, place a small slotted screwdriver in the slot in the spring clip under the housing. Pry the slot downward to release the SCU from the bottom of the rail.



Wiring

The wiring terminals for the SC4380 are compression type. To open the wiring terminal, turn the screw for that terminal counterclockwise. Slide the wire into the terminal space. While holding the wire in place, turn the screw clockwise to tighten. Do not overtighten. The wire should be held snugly in place.



Wire the input, output, and power as shown on the wiring label. **Do not run Class 2 signal wires adjacent to or in the same conduit as power wires.**

Calibration

1. Apply the appropriate input for the low end of the scale.
2. Adjust the ZERO screw for the appropriate low end output.
3. Apply the appropriate input for the high end of the scale.
4. Adjust the SPAN screw for the appropriate high end output.
5. Repeat as necessary.

SPECIFICATIONS

Power Supply:
SCL4380: 12 to 24 VDC/AC 40 to 400 Hz ±20%.
SC4380: 85 to 265 VDC/VAC 50 to 400 Hz.
Isolation: 1500 VAC.
Ambient Temperature Range (operating): 0 to 50°C (32 to 131°F).
Linearity: 0.1%.
Drift: ±0.02% per °C typical, ±0.05% maximum.
Maximum Current Output Load: 600 ohms.
Maximum Voltage Output Load: 20 mA (500 ohms).
Input Impedence - Current: 10 ohms.
Input Impedence - Voltage: 1 Megohm.

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SECTION 22 - ENCLOSURE EQUIPMENT - SVE COMP / CONTROL ROOM (NEC NON-CLASSIFIED)

HEATER, 1.8 KW, 120 VAC , 1 PH W/ T-STAT - DAYTON MODEL 2HAD8

EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH - DAYTON MODEL 10D964

FAN THERMOSTAT - HONEYWELL MODEL T6031A1136

FLUORESCENT LIGHT - COLUMBIA LIGHTING MODEL XEM4-232-RA-EU

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Dayton® Fan-Forced Wall Heaters

Description

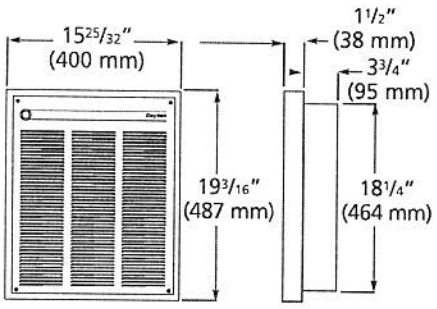
Dayton fan-forced large wall heaters provide electric heat for offices, reception rooms, game rooms, family rooms and similar light-duty commercial and residential applications. These heaters have an integral thermostat so a separate thermostat is not necessary. Heaters include a built-in power disconnect switch for added safety during maintenance and can be surface mounted using optional surface frame.

Specifications

Model Number	Volts	Phase	Watts	Amps	Wire Gauge
2HAD7	120	1	1500	12.5	12
2HAD8	120	1	1800	15.0	12
3UF59D*	277	1	3000/1500	10.8/5.4	14
3UF60D*	240/208	1	4000/3000	16.7/14.5	10
			2000/1500	8.3/7.2	12
3UF61D*	277/240	1	4000/3000	14.5/12.5	12
			2000/1500	7.2/6.3	12
3UF62D	208/240	1	3600/4800	17.3/20.0	10
3UF63D	240/277	1	3600/4800	15.0/17.3	10
3END1	208	1	4000/2000	19.3/9.7	10

(*) Factory wired for higher wattage, field convertible to half wattage.

Dimensions



General Safety Information

⚠ WARNING ***When using electric appliances, basic precautions should always be followed to reduce the risk of fire, electric shock and injury to persons, including the following:***

1. Read all instructions before installing or using this heater.
2. This heater is hot when in use. To avoid burns, do not let bare skin touch hot surfaces. Keep combustible materials, such as furniture, pillows, bedding, papers, clothes, etc. and curtains at least 3 feet (0.9 m) from the front of the heater.
3. Extreme caution is necessary when any heater is used by or near children or invalids, and whenever the heater is left operating and unattended.
4. Do not operate any heater after it malfunctions. Disconnect power at main service panel and have heater inspected by a reputable electrician before using.
5. Do not use outdoors.

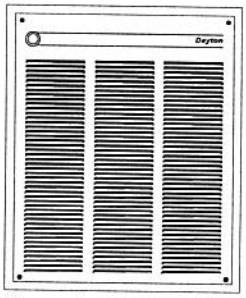


Figure 1

6. To disconnect heater, turn controls to off, and turn off power to heater circuit at main service panel.
7. Do not insert or allow foreign objects to enter any ventilation or exhaust opening as this may cause an electric shock, fire, or damage to the heater.
8. To prevent a possible fire, do not block air intake or exhaust in any manner.
9. A heater has hot and arcing or sparking parts inside. Do not use it in areas where gasoline, paint, or flammable liquids are used or stored.
10. Use this heater only as described in this manual. Any other use not recommended by the manufacturer may cause fire, electric shock, or injury to persons.
11. This heater is provided with a red alarm light that will illuminate only if the heater has turned off as a result of overheating. If you see the light on, immediately turn the heater off and inspect for any objects on or adjacent to the heater that may have blocked the airflow or otherwise caused high temperatures to have occurred. **DO NOT OPERATE THE HEATER WITH THE ALARM LIGHT ILLUMINATING.**

ENGLISH

ESPAÑOL

FRANÇAIS

Form 5S6796

Printed in China
09663
Version 1
06/2013

06/13
5200-11143-000
ISS 1.0
ECR 39433

Dayton® Fan-Forced Wall Heaters

ENGLISH

General Safety Information (Continued)

12. This heater is intended for comfort heating applications and not intended for use in special environments. Do not use in damp or wet locations such as marine or greenhouse or in areas where corrosive or chemical agents are present.
13. When installing, see INSTALLATION INSTRUCTIONS for additional warnings and precautions.
14. For safe and efficient operation, and to extend the life of your heater, keep your heater clean. See MAINTENANCE INSTRUCTIONS.
15. **FOR COMMERCIAL USE ONLY.**

SAVE THESE INSTRUCTIONS

Installation Instructions

⚠ WARNING ***To prevent a possible fire, injury to persons or damage to the heater, adhere to the following:***

1. Disconnect all power coming to heater at main service panel before wiring or servicing.
2. All wiring procedures and connections must be in accordance with the National and Local Codes having jurisdiction and the heater must be grounded.
3. Power supply must enter back box through the knockouts in the RIGHT side of box (see Figure 1). See also TOP marking on the back box for proper orientation.
4. Verify the power supply voltage coming to heater matches the ratings as shown on the heater nameplate.

⚠ CAUTION ***Energizing heater at a voltage greater than the voltage printed on the nameplate will damage the heater and void the warranty and could cause a fire.***

⚠ CAUTION ***High temperature, risk of fire; keep electrical cords, drapery, furnishings, and other combustibles at least 3 feet (0.9 m) from front of heater. Do not install heater behind doors, below towel racks, or in an area where it is subject to being blocked by furniture, curtains or storage materials. Hot air from the heater may damage certain fabrics and plastics.***

5. To reduce the risk of fire, do not store or use gasoline or other flammable vapors and liquids in the vicinity of the heater.
6. This heater is to be mounted only using back box and may be installed with the back box recessed or surface mounted as described within this manual.
7. The following minimum clearances must be maintained:

   Bottom of heater to floor - 8" (203 mm).

   Sides of heater to adjacent wall - 8" (203 mm).

   Top of heater to ceiling - 36" (915 mm).
8. Do not operate the heater without the grille installed.
9. Do not use this heater for dry out as the paint, plaster, sawdust and drywall sanding dust will permanently damage the heater and must be kept out of the heater.

NOTE: This heater has a continuous fan-only feature. See Operation Instructions, page 4 for details.

RECESSED BACK BOX IN NEW CONSTRUCTION

1. Mounting Back Box (see Figure 2).

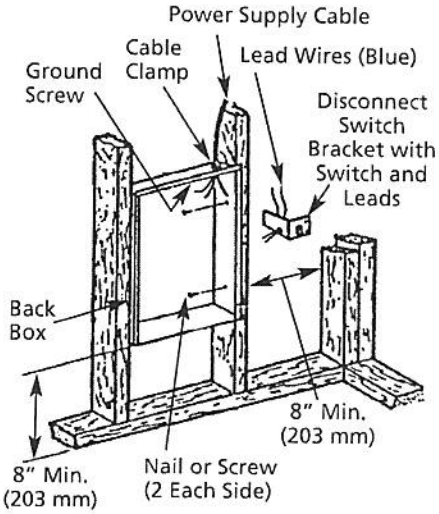


Figure 2 – Locating Recessed Back Box in New Construction

   a. Place the back box between two 16" (406 mm) center-to-center wall studs at the desired mounting height but no closer than 8" (203 mm) to adjacent wall or floor.

   b. Align back box such that the bottom and sides will be flush with finished wall surface (top flange of back box should protrude approximately 1/2" [12.7 mm] from finished wall surface).

   c. Secure the back box in position with wood screws or nails as shown in Figure 2.

2. Power Supply Wiring (see Figure 2).

NOTE: Wire compartment volume – 119 in^3 (1950 cm^3).

Models 2HAD7, 2HAD8, 3UF59D thru 3UF63D and 3END1

Installation Instructions (Continued)

a. Run a power supply cable into the knockout area in the upper right-hand corner of the back box. All wiring must be in accordance with National and Local Electrical Codes. Refer to "Specifications" for correct wire size.

b. Remove disconnect switch bracket by loosening two screws on the right side.

c. Install a cable clamp in the "knock-out" in the top of the back box.

d. Insert power supply cable through cable clamp, allowing at least 6" (152 mm) of leads to extend inside the back box. Connect the blue lead wires of disconnect switch to the supply wire leads using wire connectors (see "Wiring Diagram", shown in Figure 6, page 4).

e. Ground the back box by connecting the supply ground lead wire to the green ground screw located in the inside top of the back box.

f. Secure disconnect switch bracket in place by tightening screws.

RECESSED BACK BOX IN EXISTING CONSTRUCTION

1. Provide a wall opening 14½" (362 mm) wide by 18½" (470 mm) high at the desired mounting height, but no closer than 8" (203 mm) (see Figure 3).

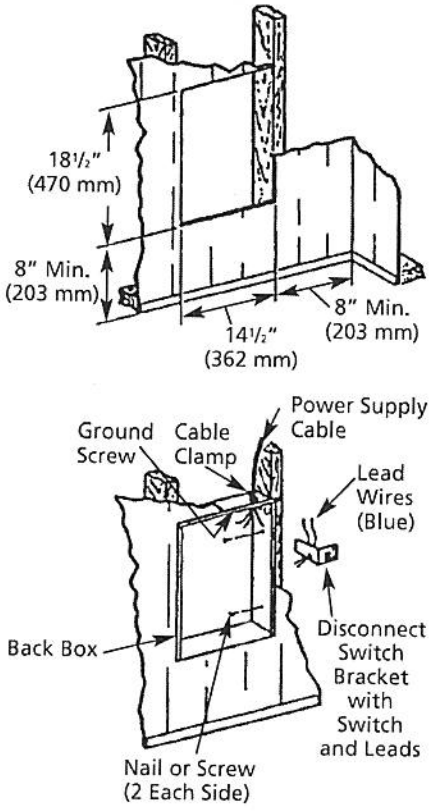


Figure 3 – Locating Recessed Back Box in Existing Construction

2. Power Supply Wiring.

NOTE: Wire compartment volume – 119 in³ (1950 cm³).

a. Run a power supply cable into the area above the top of the wall opening. All wiring must be in accordance with National and Local electrical codes. Refer to "Specifications" for correct wire size.

b. Remove disconnect switch bracket by loosening the two screws on the right side.

c. Install a cable clamp in the "knockout" in the top of wall back box.

d. Insert power supply cable through cable clamp, allowing approximately 6" (152 mm) of cable length to remain inside the back box to facilitate connections.

3. Mounting Back Box.

a. Place the back box into wall opening flush with finished wall surface on bottom and sides of box. (Top flange of back box should protrude approximately 1/2" [12.7 mm] from finished wall surface.)

b. Secure the back box in place with wood screws or nails.

4. Wiring Disconnect Switch.

a. Connect the power supply wires to the blue wires of the disconnect switch using wire connectors (see "Wiring Diagram", shown in Figure 6, page 4).

b. Ground the back box connecting the supply ground lead wire to the green ground screw located in the inside top of the back box.

c. Secure disconnect switch bracket in place by tightening screws.

MECHANICAL ACCESSORIES (SOLD SEPARATELY)

Dayton 3UG58D, 3UF64D, 3UF65D and 3UF66D accessories are intended for use with Dayton 2HAD7, 2HAD8, 3UF59D thru 3UF63D and 3END1 fan-forced electric wall heaters.

Dayton 3UG58D - Security front cover prevents unauthorized removal of the heater grille by requiring the use of a special tool (ie. Robinson type driver).

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Dayton® Fan-Forced Wall Heaters

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Installation Instructions (Continued)

Dayton 3UF64D - 1" Semi-recessed mounting sleeve allows for installation into shallow walls and provides for a finished appearance.

Dayton 3UF65D - 2" Semi-recessed mounting sleeve allows for installation into shallow walls and provides for a finished appearance.

Dayton 3UF66D - Surface-mounting frame allows for installation on solid wall and provides a finished appearance.

HEATER ASSEMBLY AND GRILLE

After back box is completely installed and no further construction dirt is expected, clean debris from back box, remove heater assembly from its carton, then refer to Figure 4 and proceed as follows:

1. Insert the heater assembly into back box, placing the four mounting holes (with key-hole slots) over the screws in the back box. Tighten all screws securely.
2. If surface-mounting frame is used, ensure that the frame is even with all four heater assembly tabs before tightening screws.
3. Connect the two disconnected switch wires to the heater control switch (thermostat) leads using wire nuts. After connection, push wires back into the opening.
4. Turn thermostat to the extreme counterclockwise position.
5. Push disconnect switch into ON position.
6. Mount the grille using the four (4) long screws provided. The screws thread into holes located in the side flanges of the back box.
7. Push thermostat knob onto thermostat shaft.

NOTE TO INSTALLER: Converting heater to half wattage:

The 3UF59D thru 3UF63D wall heaters are manufactured and shipped at the higher rated wattage (see "Specifications", page 1). Full wattage heaters can be converted to half wattage by doing the following steps:

1. Remove the red jumper wire as shown in Figure 5, and discard.
2. To permanently make the heater half wattage, cut the male terminal spade, being careful not to damage the cold pin and discard.
3. Mark the wattage of the heater on the white label inside the back box.

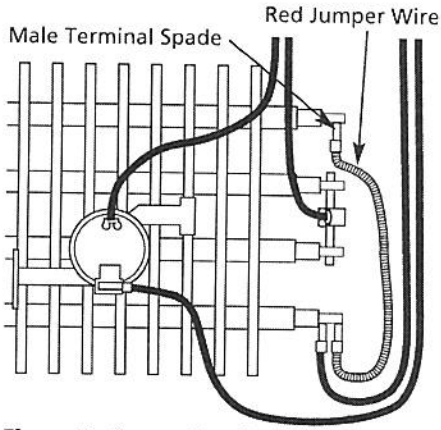


Figure 5 – Converting Heater to Half Wattage

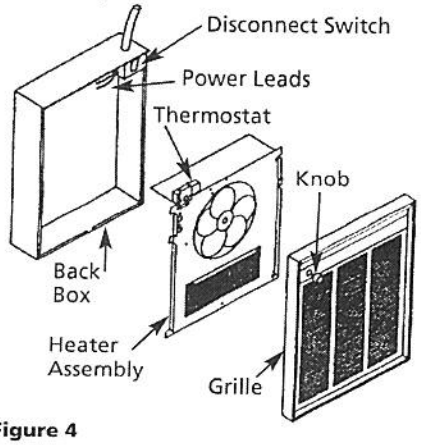
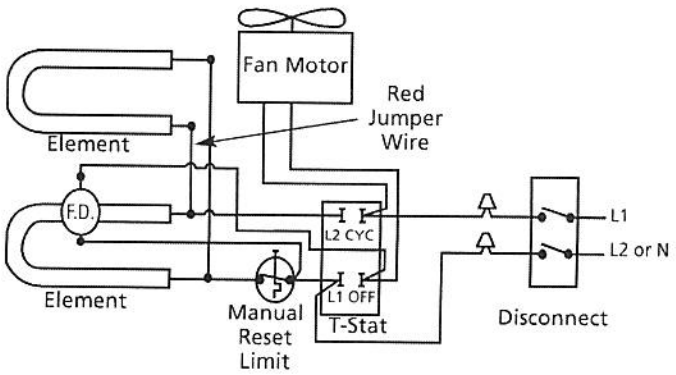


Figure 4



208V, 240V, or 277V – (Full wattage heaters can be converted to half wattage by removing the red jumper wire connecting the top and bottom element terminals.)

Figure 6 – Wiring Diagram For 1500, 1800, 4800, 3000 & 4000 Watt Heaters

Models 2HAD7, 2HAD8, 3UF59D thru 3UF63D and 3END1

Operation Instructions

1. Heater must be properly installed before operation.
2. Rotate the thermostat knob fully clockwise. This should energize the heating elements and fan causing warm air to flow from the hot air discharge at the openings in the bottom of the grille.
3. After the operation check, rotate the thermostat knob to the desired position to obtain room comfort.
4. For continuous fan-only operation (elements will not be energized) rotate thermostat knob where indicator dot on knob is aligned with FAN.
5. There will be a short delay from the time the unit is turned on until the fan engages. This is to allow the elements time to warm up. The fan will also continue to run once the unit is turned off to allow the elements time to cool.

NOTE: For best results, the heater should be left "ON" constantly during the heating season because the thermostat, when properly set, will maintain the desired temperature.

⚠ CAUTION ***Operation of the manual reset safety thermal limit control is an indication that the heater has been subjected to some abnormal condition. It is recommended that the heater be checked by a reputable electrician or repair service to ensure the heater has not been damaged.***

TO RESET MANUAL RESET LIMIT

Your heater is equipped with a manual reset safety thermal limit control that will automatically turn the heater off to prevent a fire if the heater overheats. This control is located on the fan panel assembly between the element and fan blade and marked "reset". The red reset button can be seen through the front grille when the heater is installed. To reset, allow the heater to cool, then push the red button that is visible through the hole in the fan panel. The heater should immediately return to normal operation.

⚠ WARNING ***Do not tamper with or bypass any safety limits inside heater.***

⚠ CAUTION ***Do not continue to attempt to use the heater if the safety control repeatedly operates after being reset. To do so could permanently damage the heater or create a fire or safety hazard.***

Maintenance Instructions

It is important to keep this heater clean. Your heater will give you years of service and comfort with only minimum care. To assure efficient operation follow the simple instructions below.

⚠ WARNING ***All servicing beyond simple cleaning that requires disassembly should be performed by qualified service personnel.***

⚠ WARNING ***To reduce the risk of fire and electric shock or injury, disconnect all power coming to heater at main service panel and check that the element is cool before servicing or performing maintenance.***

USER CLEANING INSTRUCTIONS

1. After the heater has cooled, a vacuum cleaner with brush attachment may be used to remove dust and lint from exterior surfaces of the heater including the grille openings.
2. With a damp cloth, wipe dust and lint from grille and exterior surfaces.
3. Return power to heater and check to make sure it is operating properly.

MAINTENANCE CLEANING INSTRUCTIONS

(To be performed only by Qualified Service Personnel)

At least annually, the heater should be cleaned and serviced by a qualified service person to assure safe and efficient operation. This should include the removal of the grille and, as necessary, the heater from the backbox to clean residue from the unit. After completing the cleaning and servicing, the heater should be fully reassembled and checked for proper operation.

Notes

For Repair Parts, call 1-800-Grainger

24 hours a day – 365 days a year

Please provide following information:
-Model number
-Serial number (if any)
-Part description and number as shown in parts list

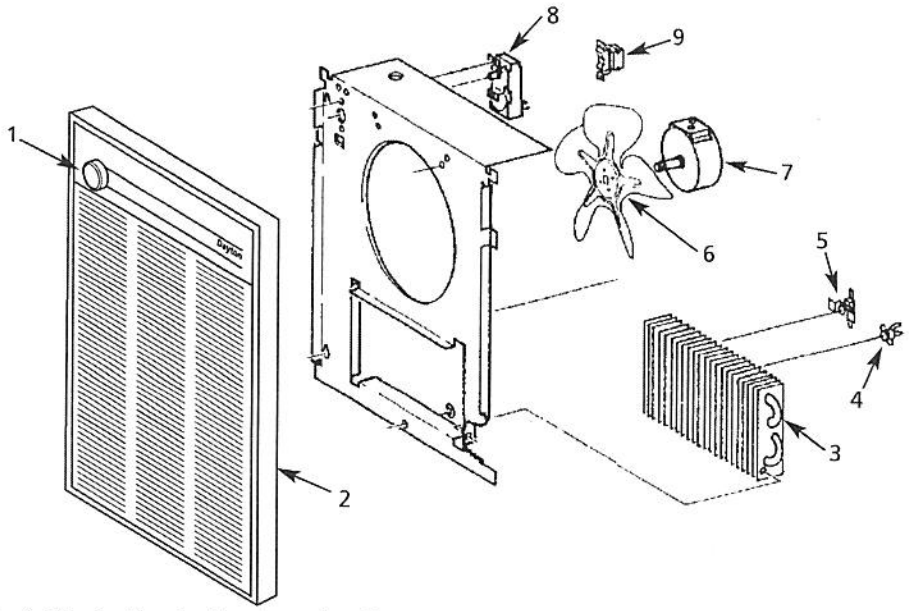


Figure 7 – Repair Parts Illustration for Fan-Forced Wall Heaters

Repair Parts List for Fan-Forced Wall Heaters

Reference Number	Description	Part Number for Models: 2HAD7	2HAD8	3UF59D	3UF60D	Quantity
1	Knob	HV33012016001G	HV33012016001G	HV33012016001G	HV33012016001G	1
2	Grille	HV25012068000G	HV25012068000G	HV25012068000G	HV25012068000G	1
3	Element	302012827	302012828	302012806	302012808	1
4	High Limit	—	—	—	—	1
	Manual Limit	4520-2027-000	4520-2027-000	4520-2027-000	4520-2027-000	1
5	Fan Delay	410074000	410074000	410074000	410074000	1
6	Fan Blade	490030103	490030103	490030103	490030103	1
7	Motor	3900-2010-003	3900-2010-003	3900-2010-001	3900-2010-000	1
8	Thermostat	5813-2059-000	5813-2059-000	5813-2059-000	5813-2059-000	1
9	Disconnect	410170001	410170001	410170001	410170001	1

Reference Number	Description	Part Number for Models: 3UF61D	3UF62D	3UF63D	3END1	Quantity
1	Knob	HV33012016001G	HV33012016001G	HV33012016001G	HV33012016001G	1
2	Grille	HV25012068000G	HV25012068000G	HV25012068000G	HV25012068000G	1
3	Element	302012809	302012810	302012811	302012807	1
4	High Limit	—	—	—	—	1
	Manual Limit	4520-2027-000	4520-2027-000	4520-2027-000	4520-2027-000	1
5	Fan Delay	410074000	410074000	410074000	410074000	1
6	Fan Blade	490030103	490030103	490030103	490030103	1
7	Motor	3900-2010-001	3900-2010-000	3900-2010-001	3900-2010-000	1
8	Thermostat	5813-2059-000	5813-2059-000	5813-2059-000	5813-2059-000	1
9	Disconnect	410170001	410170001	410170001	410170001	1

Dayton® Fan-Forced Wall Heaters

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LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *DAYTON® FAN-FORCED WALL HEATERS, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR ONE YEAR AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

LIMITATION OF LIABILITY. *TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, DAYTON'S LIABILITY FOR CONSEQUENTIAL AND INCIDENTAL DAMAGES IS EXPRESSLY DISCLAIMED. DAYTON'S LIABILITY IN ALL EVENTS IS LIMITED TO AND SHALL NOT EXCEED THE PURCHASE PRICE PAID.*

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Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 100 Grainger Parkway, Lake Forest, Illinois 60045-5201 U.S.A.

Manufactured for Dayton Electric Mfg. Co.
Lake Forest, Illinois 60045 U.S.A.

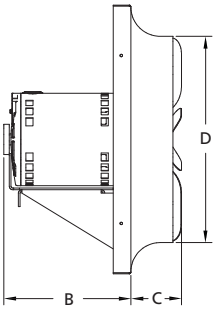
Dayton®

Please read and save these instructions. ***Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.***

Dayton® Direct-Drive Exhaust Fans

Description

Dayton exhaust fans are designed for commercial and industrial applications. Commercial units quietly exhaust high volumes of air for ventilating schools, offices, storage facilities and light manufacturing and assembly areas. Industrial units exhaust larger volumes of air at higher static pressures for ventilating factories, foundries and other industrial environments. Mount in vertical or horizontal position (vertical only for fans with intake guards). Construction includes galvanized steel frame, pre-punched mounting holes, and aluminum propeller. Motor is totally enclosed air over, with Class B insulation and ball bearings, except sleeve bearings on 10D952 thru 10D956. All fans have a maximum ambient temperature of 104°F and are UL/cUL Listed Standard 705.



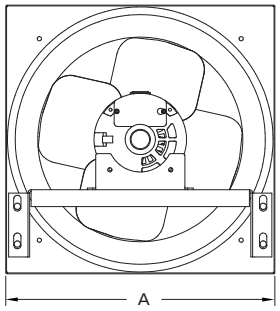


Figure 1 — Quiet-Design and Commercial Dimensions

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Optional Accessories

General or UL 705	
Description	**Model No.'s**
Aluminum Wall Shutter:	4C555-4C559, 3C308-3C310
Fan Guard:	1WBT8, 1WBT9, 1WBU1-1WBU5
Wall Collar:	3FKF3, 1WBV1-1WBV3
Wall Housing:	3FKF4-3FKF9, 3FKG1
Speed Control (For 115V):	1DGV1, 1DGV2

Dayton Electric Mfg. Co. certifies that the fans shown herein are licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

Dimensions and Specifications

Model	Prop. Dia.	Shaft Dia.	A	B	C	D	Blades	Recommended Wall Opening — Direct to Wall	Recommended Wall Opening — Wall Collar, Wall Collar & Guard, or Wall Housing
QUIET-DESIGN AND COMMERCIAL (See Figure 1)									
10E039	12"	1/2"	16"	4½"	3"	12¼"	3	14½ x 14½"	17¼ x 17¼"
10D971	12	1/2	16	4½	3	12¼	4	14½ x 14½	17¼ x 17¼
10E040, 10E041	16	1/2	20	7	3¼	16½	3	18½ x 18½	21¼ x 21¼
10D972	16	1/2	20	7	3¼	16½	4	18½ x 18½	21¼ x 21¼
10D973, 10D974	18	1/2	22	7	3⅛	18½	3	20½ x 20½	23¼ x 23¼
10E042	18	1/2	22	7	3⅛	18½	4	20½ x 20½	23¼ x 23¼
10E043	18	1/2	22	6	3⅛	18½	4	20½ x 20½	23¼ x 23¼
10D975, 10E045	20	1/2	24	7	3¾	20½	3	22½ x 22½	25⅝ x 25⅝
10D976, 10D977, 10E044	20	1/2	24	7½	3¾	20½	3	22½ x 22½	25⅝ x 25⅝
10E046	24	1/2	28	9½	3⅞	24½	3	26½ x 26½	29⅝ x 29⅝
10E047	24	5/8	28	8	3⅞	20½	3	26½ x 26½	29⅝ x 29⅝
10D978, 10D979, 10D980	24	1/2	28	8¾	3⅞	24½	3	26½ x 26½	29⅝ x 29⅝
10E048	24	5/8	28	9	3⅞	24½	3	26½ x 26½	29⅝ x 29⅝
10D981, 10D982	30	5/8	34	8¾	4¾	30½	3	32½ x 32½	35⅝ x 35⅝
10E049	30	5/8	34	9	4¾	30⅜	3	32½ x 32½	35⅝ x 35⅝

Form 5S7028

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Rev. 1, November 2011

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Dayton® Direct-Drive Exhaust Fans

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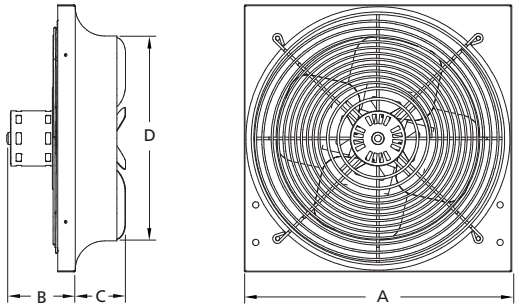

Figure 2 — Commercial With Intake Guard 8-18 Dimensions

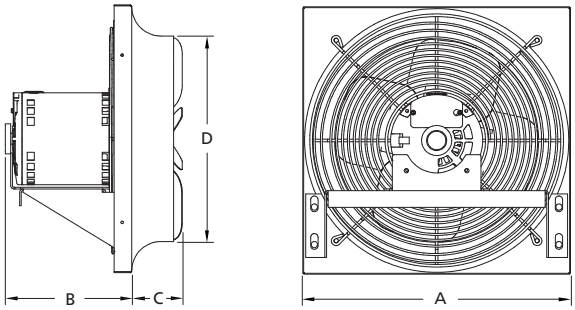

Figure 3 — Commercial With Intake Guard 20-24 Dimensions

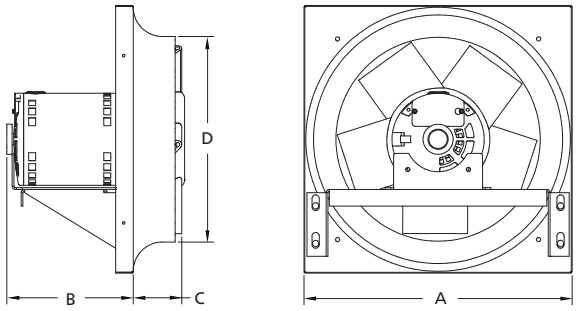

Figure 4 — Industrial Dimensions

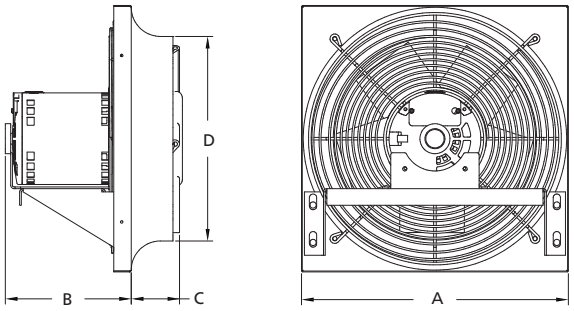

Figure 5 — Industrial With Intake Guard Dimensions

Dimensions and Specifications (Continued)

Model	Prop. Dia.	Shaft Dia.	A	B	C	D	Blades	Recommended Wall Opening: Direct to Wall	Recommended Wall Opening: Wall Collar, Wall Collar & Guard, or Wall Housing
COMMERCIAL WITH INTAKE GUARD 8-18 (See Figure 2)									
10D952	8"	5/16"	12"	4"	3"	8¼"	5	10½ x 10½"	13¼ x 13¼"
10D953	10	5/16	14	4	3½	10¼	5	12½ x 12½	15¼ x 15¼
10D954	12	5/16	16	4½	3	12¼	3	14½ x 14½	17¼ x 17¼
10D955	14	5/16	18	4	3¼	14¼	3	16½ x 16½	19¼ x 19¼
10D956	16	5/16	20	4	3¼	16½	3	18½ x 18½	21¼ x 21¼
10D957	18	1/2	22	7	3⅛	18½	3	20½ x 20½	23¼ x 23¼
10D960	18	1/2	22	7½	3⅛	18½	3	20½ x 20½	23¼ x 23¼
COMMERCIAL WITH INTAKE GUARD 20-24 (See Figure 3)									
10D958, 10D961	20	1/2	24	7	3¾	20½	3	22½ x 22½	25⅝ x 25⅝
10D959, 10D962	24	1/2	28	7	7⅞	24½	3	26½ x 26½	29⅝ x 29⅝

Models 10D952 thru 10D994, 10E039 thru 10E049

Dimensions and Specifications (Continued)

Model	Prop. Dia.	Shaft Dia.	A	B	C	D	Blades	Recommended Wall Opening: Direct to Wall	Recommended Wall Opening: Wall Collar, Wall Collar & Guard, or Wall Housing
INDUSTRIAL (See Figure 4)									
10D983, 10D984	16"	1/2"	20"	7"	3¼"	16½"	3	18½ x 18½"	21¼ x 21¼"
10D985, 10D986	18	1/2	22	7	3⅛	18½	3	20½ x 20½	23¼ x 23¼
10D987, 10D988	20	5/8	24	7	3¾	20½	4	22½ x 22½	25⅝ x 25⅝
10D989	24	1/2	28	8¾	3⅞	24½	6	26½ x 26½	29⅝ x 29⅝
10D990, 10D991	24	5/8	28	8¾	3⅞	24½	3	26½ x 26½	29⅝ x 29⅝
10D992, 10D993	30	5/8	34	9	4¾	30⅜	3	32½ x 32½	35⅝ x 35⅝
10D994	36	5/8	40	9	5¼	36⅛	3	38½ x 38½	41⅝ x 41⅝
INDUSTRIAL WITH INTAKE GUARD (See Figure 5)									
10D963	12"	1/2	16"	4½"	3"	12¼"	5	14½ x 14½"	17¼ x 17¼"
10D964	16	1/2	20	7	3¼	16½	3	18½ x 18½	21¼ x 21¼
10D965	18	1/2	22	7	3⅛	18½	3	20½ x 20½	23¼ x 23¼
10D966, 10D967	20	1/2	24	7	3¾	20½	3	22½ x 22½	25⅝ x 25⅝
10D968	20	5/8	24	7½	3¾	20½	3	22½ x 22½	25⅝ x 25⅝
10D969	24	1/2	28	7	7⅞	24½	3	26½ x 26½	29⅝ x 29⅝
10D970	24	1/2	28	7½	3⅞	24½	6	26½ x 26½	29⅝ x 29⅝

Performance

Model: 1-Phase 115/230V	Model: 3-Phase 208-230/460V	Prop. Dia.	HP	Fan RPM	Sones @ 0.000" SP @ 5Ft.	CFM Air Delivery @ Static Pressure Shown: 0.000"	0.125"	0.250"	0.375"	0.500"
QUIET-DESIGN										
10E039	**—**	12	1/4	1750	9.8	1311	1167	—	—	—
10E040	**10E041**	16	1/4	1750	14.8	2432	2212	1945	—	—
10E042	**10E043**	18	1/3	1750	19.4	2979	2810	2608	2374	—
10E044	**10E045**	20	1/2	1140	13.9	4509	4112	3590	2888	—
10E046	**—**	24	1/2	1140	17.9	5703	5293	4833	4287	—
10E047	**10E048**	24	3/4	1140	19.0	6236	5854	5390	4818	—
—	**10E049**	30	3/4	1140	24	8865	8358	7708	6970	—
COMMERCIAL										
10D971	**—**	12	1/4	1750	12.0	1590	1432	1220	1007	—
10D972	**—**	16	1/4	1725	16.6	2483	2335	2147	1913	—
10D973	**10D974**	18	1/3	1725	22	3194	3007	2805	2561	—
10D975	**—**	20	1/3	1140	14.6	3717	3319	2803	1959	—
10D976	**10D977**	20	1/2	1140	13.9	4509	4112	3590	2888	—
10D978	**—**	24	1/3	1140	16.5	4632	4196	3664	2835	—
10D979	**10D980**	24	1/2	1140	17.0	4686	4363	3953	3394	—
10D981	**10D982**	30	3/4	1140	27	9203	8505	7742	6879	—

Performance certified is for installation type A: Free inlet, Free outlet. Performance ratings do not include the effects of appurtenances (accessories). Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: Free inlet hemispherical sone levels.

Dayton® Direct-Drive Exhaust Fans

Performance (Continued)

Model 1-Phase 115/230V	Model 3-Phase 208-230/460V	Prop. Dia.	HP	Fan RPM	Sones @ 0.000" SP @ 5Ft.	CFM Air Delivery @ Static Pressure Shown 0.000"	0.125"	0.250"	0.375"	0.500"
COMMERCIAL, WITH INTAKE GUARD († 115V, * Speed Controllable)										
10D952†*	**—**	8	1/30	1725	6.9	454	319	170	—	—
10D953†*	**—**	10	1/30	1600	8.8	730	624	381	—	—
10D954†*	**—**	12	1/30	1600	6.4	889	733	509	—	—
10D955†*	**—**	14	1/20	1550	13.5	1066	878	601	—	—
10D956†*	**—**	16	1/20	1550	12.0	1201	934	594	—	—
10D957†*	**—**	18	1/4	1140	11.1	2627	2290	1818	1022	—
10D960	**—**	18	1/3	1725	19.6	3126	2953	2746	2503	—
10D958†*	**—**	20	1/4	1140	12.2	3491	3060	2502	1394	—
10D961†	**—**	20	1/4	1140	12.2	3491	3060	2502	1394	—
10D959†*	**—**	24	1/4	1160	15.8	3533	3023	2403	1722	—
10D962	**—**	24	1/3	1140	16.3	4430	3974	3417	2499	—
INDUSTRIAL										
10D983	**10D984**	16	1/4	1750	14.1	2476	2288	2061	1769	1350
10D985	**10D986**	18	1/3	1750	18.5	3354	3097	2805	2468	2003
10D987	**10D988**	20	3/4	1750	23	4557	4254	3919	3542	3101
10D989	**—**	24	1/2	1140	23	5892	5471	4961	4315	3593
10D990	**10D991**	24	3/4	1725	31	6978	6499	5905	5184	4412
10D992	**10D993**	30	3/4	1140	25	9308	8461	7556	6428	4998
—	**10D994**	36	3/4	1140	33	12,363	10,425	8453	6207	2895
INDUSTRIAL, WITH INTAKE GUARD										
10D963	**—**	12	1/4	1750	11.2	1286	1192	1022	902	666
10D964	**—**	16	1/4	1725	15.6	2847	2591	2314	1951	1265
10D965	**—**	18	1/4	1725	14.5	2989	2751	2469	2108	1555
10D966	**—**	20	1/4	1750	18.6	3198	2847	2495	2091	1579
10D967	**—**	20	1/3	1750	19.6	3745	3449	3109	2716	2195
10D968	**—**	20	3/4	1750	22	4590	4240	3843	3381	2675
10D969	**—**	24	1/3	1750	30	3984	3400	2867	2296	1706
10D970	**—**	24	1/2	1140	17.0	5438	5049	4573	3922	3242

Performance certified is for installation type A: Free inlet, Free outlet. Performance ratings do not include the effects of appurtenances (accessories). Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: Free inlet hemispherical sone levels.

Models 10D952 thru 10D994, 10E039 thru 10E049

Unpacking

1. Inspect for any damage that may have occurred during transit.
2. Shipping damage claim must be filed with carrier.
3. Check all bolts, screws, set-screws, etc. for looseness that may have occurred during transit. Retighten as required. Rotate propeller by hand to be sure it turns freely.

General Safety Information

⚠ DANGER ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the fan. Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury. Motor will restart without warning after thermal protector trips. Do not touch operating motor, it may be hot enough to cause injury.***

⚠ DANGER ***Do not place any body parts or objects in fan, motor openings or drives while motor is connected to power source.***

⚠ WARNING ***Do not use this equipment in explosive atmospheres!***

1. Read and follow all instructions and cautionary markings. Make sure electrical power source conforms to requirements of equipment and local codes.
2. Fans should be assembled, installed and serviced by a qualified technician. Have all electrical work performed by a qualified electrician.
3. Follow all local electrical and safety codes in the United States and Canada, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA) in the United States. Ground motor in accordance with NEC Article 250 (grounding). Follow the Canadian Electric Code (CEC) in Canada.

⚠ CAUTION ***To reduce the risk of injury to persons, observe the following:***

OSHA requires OSHA complying guards when fan is installed within 7 feet of floor or working level.

UL/cUL Standards require OSHA complying guards when fan is installed within 8 feet of floor or working level.

4. All moving parts should be guarded.
5. Do not kink power cable or allow it to come in contact with sharp objects, oil, grease, hot surfaces or chemicals. Replace damaged cords immediately.
6. Make certain that the power source conforms to the requirements for the equipment.
7. Motor must be securely and adequately grounded. This can be accomplished by wiring with a grounded, metal-clad race way system by using a separate ground wire connected to the bare metal of the motor frame, or other suitable means.

Installation

⚠ WARNING ***Installation, troubleshooting and parts replacement is to be performed only by qualified personnel.***

WALL MOUNTING

1. Move fan to the desired location and determine the method by which the fan is to be mounted as shown in Figures 6, 7, 8 and 9. Optional wall collar (Figure 7), wall collar and guard (Figure 8) or wall housing (Figure 9) provide a convenient means of mounting sidewall fans.

NOTE: Wall shutter must be motorized to open during fan operation in either direction.

2. Cut an appropriate sized hole in the wall using the Dimensions table.

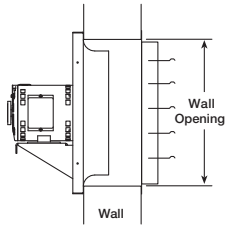

Figure 6 — Direct to Wall Installation

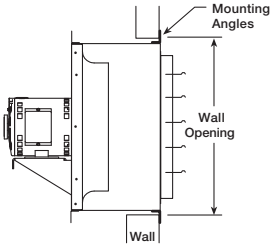

Figure 7 — Wall Collar Installation

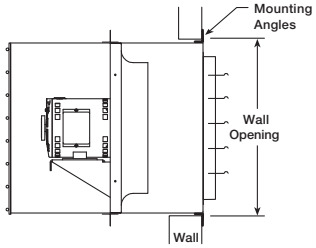

Figure 8 — Wall Collar & Guard Installation

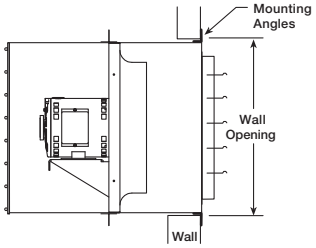

Figure 9 — Wall Housing Installation

Dayton® Direct-Drive Exhaust Fans

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Installation (Continued)

NOTE: Fans mounted to the wall require a different opening size than those mounted in collars or housings.

NOTE: Wall opening size and propeller-to-shutter distance are two important dimensions for fan installation.

3. The fan should be securely mounted within a rigid framework to prevent flexing or movement of the fan frame during operation. The fan frame should be equally supported on all sides within the framework and caution should be taken to avoid twisting of the fan frame during installation.

NOTE: Allowing the fan frame to flex or move during operation will create harmful vibrations which may damage the unit.

4. Fans should be mounted in opening with 1/4" clearance around perimeter. Framing should be secured to building structure utilizing corrosion resistant fasteners (by others). Fasteners should be used in all pre-punched mounting holes in the fan panel.
5. Install remaining components (shutter, intake guard, etc.).
6. Check all fasteners and set screws for tightness.
7. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit. For 3-phase installations, fan rotation can be reversed by interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

ELECTRICAL CONNECTION

NOTE: Refer to motor nameplate for wiring procedures.

1. Motor and fan must be securely grounded (bare metal) to a suitable electric ground, such as a grounded water pipe or ground wire system.

⚠ WARNING ***Comply with all local and national safety codes including the National Electrical Code (NEC) and National Fire Protection Act (NFPA).***

2. Wire motor for desired voltage per wiring diagram on motor.
3. Wire control switches at ground level.
4. Before activating fan, inspect to be sure that there are no obstructions or debris that would interfere with the propeller.

Operation

1. Before starting up or operating your new Dayton fan, check all fasteners for tightness. In particular, check set screws in propeller hub. While in the OFF position, or before connecting the fan to power, turn the fan propeller by hand to be sure it is not striking the orifice or any obstacle.
2. Start the fan up and shut it off immediately to check rotation of the propeller with directional arrow on the fan panel.
3. When the fan is started, observe the operation and check for any unusual noises.
4. Motor amperage should be checked to avoid overloading of the motor. With the system in full operation measure current input to the motor and compare with the nameplate rating to determine if the BHP is operating under safe load conditions.
5. Keep inlets and approaches to fan clean and free from obstruction.

Maintenance

⚠ WARNING ***Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.***

⚠ CAUTION ***Uneven cleaning of the propeller will produce an out of balance condition that will cause vibration in the fan.***

1. Depending on the usage and severity of the contaminated air, a regularly scheduled inspection for cleaning the fan propeller, housing and surrounding areas should be established.
2. Check for unusual noises when fan is running.
3. Periodically inspect and tighten set-screws.
4. Follow motor manufacturer's instructions for motor lubrication.
5. For disassembly refer to the parts illustration.
6. For critical applications, a spare motor should be available.

Models 10D952 thru 10D994, 10E039 thru 10E049

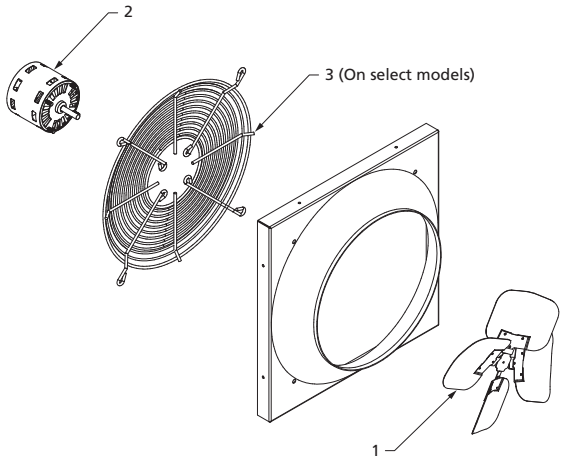

Figure 10 — Repair Parts Illustration for Quiet-Design and Commercial Fans

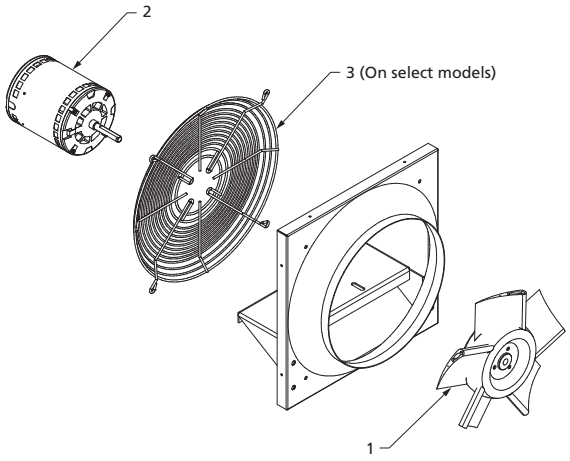

Figure 11 — Repair Parts Illustration for Industrial Fans

Repair Parts List for Direct-Drive Exhaust Fans

Reference Number	Description	Part Number For Models: 10D952	10D953	10D954	10D955	10D956	10D957	10D958	10D959	10D960	Qty.
1	Propeller	52J327	52J331	52J332	52J333	52J334	52J335	51D529	52J336	52J337	1
2	Motor	52J370	52J370	52J370	52J374	52J374	52J371	52J371	52J371	52J382	1
3	Guard	52J395	52J396	52J397	52J398	52J399	52J400	52J400	52J401	52J400	1

Reference Number	Description	Part Number For Models: 10D961	10D962	10D963	10D964	10D965	10D966	10D967	10D968	10D969	Qty.
1	Propeller	51D529	53A457	52J354	52J356	52J358	52J360	52J361	52J362	52J369	1
2	Motor	52J371	52J375	52J372	52J372	52J372	52J372	52J382	52J381	52J382	1
3	Guard	52J400	52J401	52J397	52J399	52J400	52J400	52J400	52J400	52J401	1

Reference Number	Description	Part Number For Models: 10D970	10D971	10D972	10D973	10D974	10D975	10D976	10D977	10D978	Qty.
1	Propeller	52J363	52J339	52J328	52J337	52J337	51D529	52J340	52J340	51N719	1
2	Motor	52J377	52J372	52J372	52J382	52J383	52J375	52J377	52J376	52J375	1
3	Guard	52J401	—	—	—	—	—	—	—	—	1

Reference Number	Description	Part Number For Models: 10D979	10D980	10D981	10D982	10D983	10D984	10D985	10D986	10D987	Qty.
1	Propeller	52J329	52J329	53H245	53H245	52J355	52J355	52J359	52J359	53A457	1
2	Motor	52J377	52J376	52J379	52J378	52J372	52J373	52J382	52J383	52J381	1

Reference Number	Description	Part Number For Models: 10D988	10D989	10D990	10D991	10D992	10D993	10D994	10E039	10E040	Qty.
1	Propeller	52J362	52J367	52J367	52J367	52J364	52J364	52J365	52J353	52J330	1
2	Motor	52J380	52J377	52J381	52J380	52J378	52J378	52J378	52J372	52J372	1

Reference Number	Description	Part Number For Models: 10E041	10E042	10E043	10E044	10E045	10E046	10E047	10E048	10E049	Qty.
1	Propeller	52J330	52J338	52J338	52J340	52J340	52J341	52J343	52J343	52J342	1
2	Motor	52J373	52J382	52J383	52J377	52J376	52J377	52J379	52J378	52J378	1

Dayton® Direct-Drive Exhaust Fans

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Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
Fan inoperative	1. Blown fuse or breaker	1. Replace or repair
	2. Defective motor	2. Replace or repair
	3. Incorrectly wired	3. Shut power OFF and check wiring for proper connections
	4. Electricity turned off	4. Contact local power company
Airflow - Insufficient	1. Damper (shutter) stuck shut	1. Inspect/repair damper
Airflow - Reversed air	3. Propeller rotation reversed	3. Reverse motor rotation, rewire motor
Airflow - Too much air	4. Insufficient static pressure	4. Check static pressure calculation
Excessive noise or vibration	1. Foreign material inside bearing	1. Replace bearing
	2. Loose propeller	2. Tighten set screws or taper bushing screws
	3. Crooked or damaged propeller	3. Replace propeller
	4. Fan not securely anchored	4. Secure properly
	5. Fan propeller out of balance	5. Replace propeller
Motor overloads or overheats	1. Shorted motor winding	1. Replace motor
	2. Incorrect propeller rotation	2. Check motor wiring
	3. Over/Under line voltage	3. Contact Power Company

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *DAYTON® DIRECT-DRIVE EXHAUST FANS, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR ONE YEAR AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

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Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co.

Dayton®

Honeywell

T4031A,B,P; T6031A,B
Refrigeration Temperature Controllers

PRODUCT DATA

GENERAL

The T4031A,B,P and T6031A,B are temperature controllers used in a variety of cooling applications where remote mounting of the sensing element in the controlled medium is required.

FEATURES

- **Wide control temperature range is suitable for controlling ducts, tanks, freezers, coolers, display cases. and defrost termination.**
- **Universal mounting bracket is available for easy replacement of other controllers.**
- **Models are available with various control ranges.**
- **Control setpoint is dial-knob adjustable.**
- **Models are available with fixed or adjustable temperature differentials.**
- **Capillary lengths are 5, 8, or 20 ft (1.5, 2.4, 6.1m) depending on model.**
- **Reliable snap-acting spst or spdt switch.**
- **Ambient temperature compensated.**
- **Insert supplied with TRADELINE® models replaces setpoint knob to discourage tampering.**

Contents

SPECIFICATIONS

IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, this unit may not exactly match the specifications listed. Also, this product is tested and calibrated under closely controlled conditions, and some minor differences in performance can be expected if those conditions are changed.

TRADELINE® Models

TRADELINE® models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE® model specifications are the same as those of standard models except as noted below.

TRADELINE® Model Available:

T6031A Refrigeration Temperature Controller-spdt switch, adjustable temperature differential, tamper-resistant insert.

Capillary Length:

8 ft (2.4m)

Additional Features:

TRADELINE® pack with cross reference label and special instructions

Standard Models

T4031A Refrigeration Temperature Controller-spst switch makes on temperature rise; fixed differential

T4031B Refrigeration Temperature Controller—same as T4031A but less case

T4031P Refrigeration Temperature Controller—same as T4031A but uses screw, not knob, to adjust setpoint

T6031A Refrigeration Temperature Controller-spdt switch, fixed or adjustable temperature differential

T6031B Refrigeration Temperature Controller—same as T6031A but less case

Switch Action:

T4031A,B,P spst switch makes R to W on temperature rise

T6031A,B spdt switch makes R to W on temperature rise, R to B on temperature fall

Capillary Lengths and Temperature Ranges:

Model	Copper Capillary Tube Length		Setting Range[a]		Differential	
	ft	m	°F	°C	°F	°C
T4031A,B	5	1.5	-30 to 50	-34 to 10	Fixed at 3.5	Fixed at 1.6
	20	6.1				
T4031P	8	2.4	-30 to +90	-34 to +32	3.5 to 16	1.6 to 9
T6031A,B	5	1.5	-15 to +90	-9 to +32	Fixed at 3.5 or Adjust. from 3.5 to 12	Fixed at 1.6 or Adjust. from 1.6 to 7
	20	6.1				
	5	1.5	-30 to +50	-34 to +10		
	20	6.1				
	8	2.4	-30 to +90	-34 to +32		

[a] Dial scale markings in degrees Fahrenheit

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or your distributor, refer to the TRADELINE® catalog or price sheets for complete ordering number, or specify:

1. Order number.
2. Setting range.
3. Fixed or adjustable differential (T6031).
4. Length of copper capillary tube.
5. Accessories, if desired.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Home and Building Control Sales office (check white pages of your phone directory).
2. Home and Building Control Customer Relations
   Honeywell, 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9. International Sales and Service Offices in all principal cities of the world.

Electrical Ratings:

	120 Vac		240 Vac	
	Normally Closed	Normally Open[a]	Normally Closed	Normally Open[a]
Full Load Amp	8	16	5.1	8
Locked Rotor Amp	48	80	30.6	40

[a] Makes on temperature rise.

Pilot Duty:
125 VA

Dimensions:
See Fig. 1

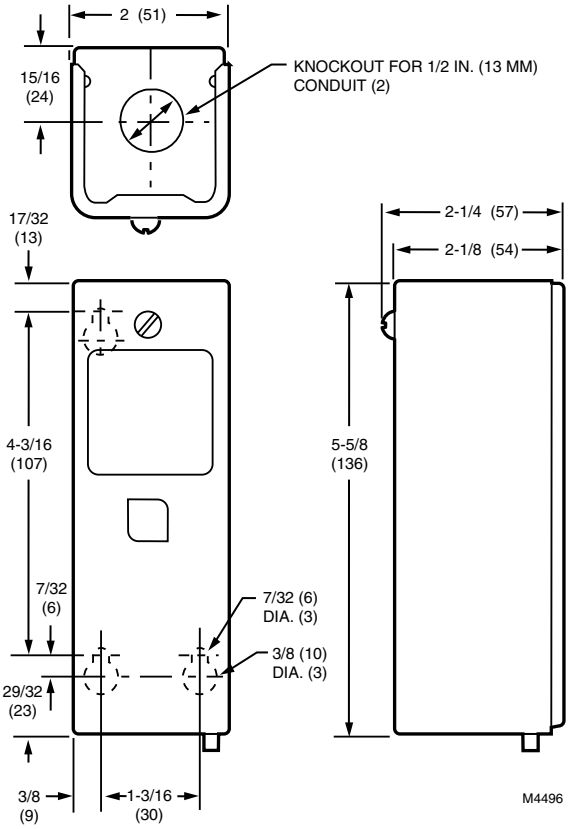


Fig. 1. Dimensions of T4031, T6031 in. (mm).

Underwriters Laboratories Inc.:
Listed

Maximum Ambient Operating Temperature:
125°F (52°C)

Accessories:
112622AA Immersion Well—short-necked, 1/2 in. NPT, copper
7617ABY Compression Fitting—50 psi water, 15 psi air
107324A Bulb Holder—for duct installation
105900 T-strap—for strapping bulb to pipe
7617ABZ Bag Assembly—for mounting controller to fan coil units
801534 Calibration Wrench
7640HY Standoff Bracket Bag Assembly—to mount controller to an insulated duct
130883 Universal Mounting Bracket
194899 Tamper-resisting Insert Button
Celsius Scaleplates:
194486 D: -15°C to +35°C replaces (0°F to 100°F) scaleplate
194486H: 15°C to 75°C replaces (55°F to 175°F)
194486F: 75°C to 125°C replaces (160°F to 260°F)

INSTALLATION

When Installing this Product…

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

⚠ CAUTION

- Disconnect power supply before installation to prevent electrical shock and equipment damage.
- Do not damage or change shape of capsule. Deformed capsule will cause calibration offset.

Mounting

Install controller in any convenient location. Make sure that the sensing bulb reaches the system to be controlled. The ambient temperature must not exceed 125°F (52°C) in the area where the controller is installed.

Install the sensing element where it can sense the average temperature. Avoid sharp bends or kinks in the capillary tubing that can affect the accuracy of the controller. Carefully coil the excess capillary tubing and leave it directly beneath the controller.

The 130883 Mounting Plate furnished with TRADELINE® models allows the control to be mounted in existing mounting holes.

Duct Installation

Position the sensing bulb in the duct to sense the average air temperature. Avoid mounting the bulb close to hot pipes, cooling coils, etc.

The 107324A Bulb Holder is available for suspending the bulb in a duct. See Fig. 2.

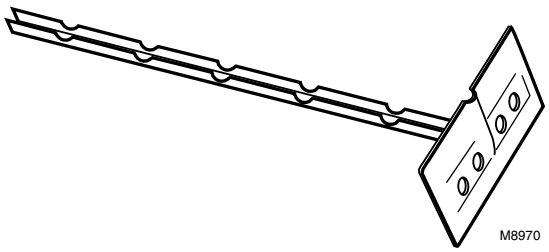


Fig. 2. 107324A bulb holder.

To install duct:

1. Make a hole in duct wall to admit sensing bulb into holder.
2. Using holder as template, mark and drill mounting holes.
3. Break off bulb holder to required length. (Be sure holder is long enough to hold sensing bulb away from duct wall and in freely circulating air.)
4. Place capillary tubing in bulb holder channel, with bulb at inner end of holder. Pinch together top edges of channel segments.
5. Insert assembled bulb and holder into duct, and fasten to duct wall with screws supplied.

Tank Installation

The sensing bulb can be inserted directly into a tank using a compression fitting; or the bulb can be inserted into an immersion well (order separately), which is screwed into a tank or boiler.

Select a location where liquid of average temperature can circulate freely around the sensing bulb.

Using Compression Fitting (Fig. 3)

1. Drain system. Screw boiler plug into properly sized and threaded boiler or pipe tapping.
2. Place packing nut on capillary tubing.
3. Slide sensing bulb completely through boiler plug.
4. Place composition disc and the four slotted brass washers on capillary tubing.
5. Slide assembly into boiler plug and tighten packing nut.
6. Refill system and check for leaks. Neatly coil excess capillary tubing.

Using Immersion Well (Fig. 4)

1. Drain system. Screw the well into threaded fitting.
2. Refill system and check for leaks.
3. Insert sensing bulb into well until it bottoms.
4. Fit bulb retaining clamp over immersion well flange and capillary tubing, and tighten screw.

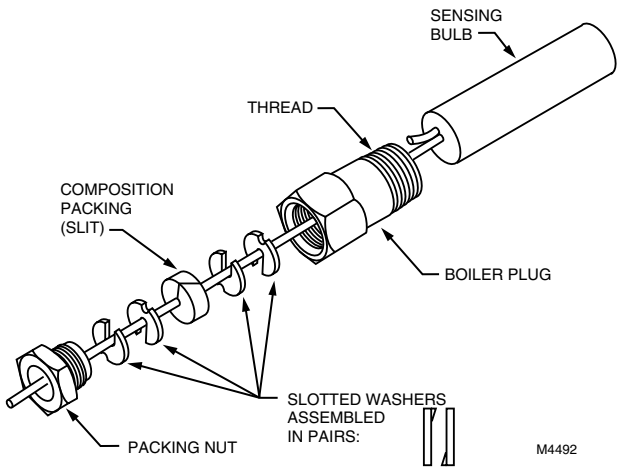


Fig. 3. Compression fitting installation.

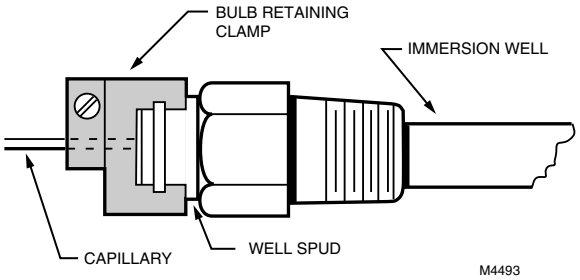


Fig. 4. Immersion well installation.

Cold Room Installation

Locate the bulb in freely circulating air in the controlled area or on the suction side of a refrigerant line, and secure the bulb in position.

Wiring (Fig. 5)

All wiring must comply with local electrical codes and ordinances.

Two knockouts are provided, one at the top and one at the bottom of the case for 1/2 in. conduit. Follow the wiring instructions furnished with the heating or cooling system. For replacement, make sure the new control is wired into the system to operate the same as the old control.

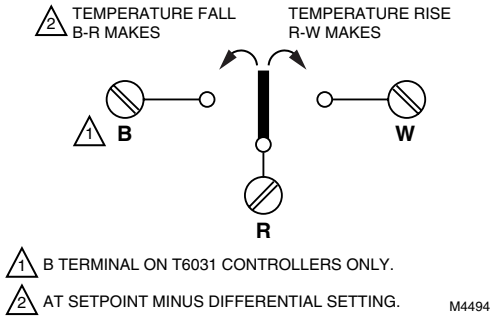


Fig. 5. Wiring terminals on T4031 and T6031 temperature controllers.

OPERATION AND CHECKOUT

When the temperature at the sensing bulb rises above the controller setpoint, a circuit is made between the R-W terminals. During a temperature fall, the R-W circuit breaks at the setpoint temperature *minus* the switch differential. Controllers with a B terminal break the B-R terminal circuit on a temperature rise to the setpoint. B-R makes again when R-W breaks on a temperature drop. See Fig. 6.

For example, if a controller with a 3°F (1.7°C) differential is set at 39°F (3.9°C), R-W makes when the bulb temperature rises to 39°F. Then during a temperature fall, R-W breaks when the temperature drops to 35°F (1.7°C) (39°F minus the 3°F differential [3.9°C minus the 1.7°C differential]).

On models with a B terminal, B-R makes when R-W breaks. Then the temperature has to climb past the control differential to the set point of 39°F (3.9°C) before the B-R circuit breaks and the R-W circuit makes.

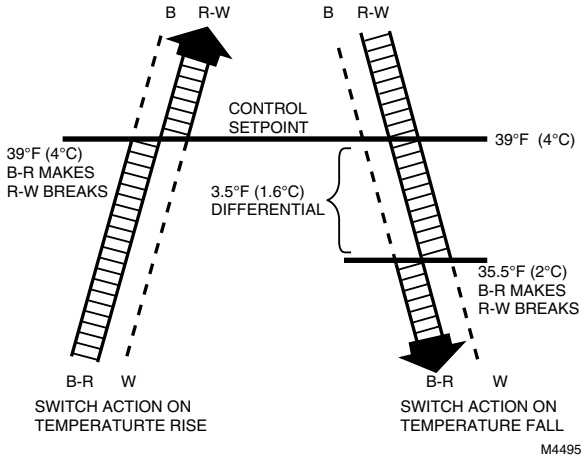


Fig. 6. Operation of switch on temperature rise and fall.

SETTING

Set the controller to the system manufacturer's recommended settings, if available.

Temperature Setpoint Knob—Turn the knob on the front of the case until the pointer indicates the temperature to be maintained in the controlled medium.

Screw—Insert a flatheaded screwdriver into the slot on the shaft, which is located in the center of the scaleplate. Turn the screwdriver clockwise ↷ to increase the temperature control point. Turn the screwdriver counterclockwise ↶ to decrease the temperature control point.

Adjustable Differential—With the cover off, turn the differential adjustment wheel (marked 3-6-9-12°F) until the desired differential is aligned with the notch in the frame. See Fig. 7.

Fixed differential models are 3.5°F at midscale.

Calibration

All controllers are carefully tested and calibrated at the factory under controlled conditions. If the controller is not operating at a temperature corresponding to the scale and differential setting, verify that the bulb senses the average temperature of the medium. If the temperature of the controlled medium is changing rapidly, the differential will appear wider than its setting.

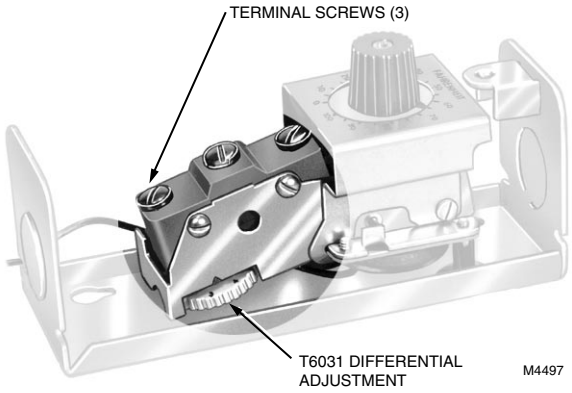


Fig. 7. Internal view showing differential adjustment wheel (applicable models).

For calibration, take an accurate temperature reading of the controlled medium. Place an accurate thermometer near the bulb of the controller, or refer to a thermometer installed as part of the system. If the bulb of the controller is installed in an inaccessible area, or if the controlled medium is unstable, remove the bulb and place in a controlled bath for accurate calibration.

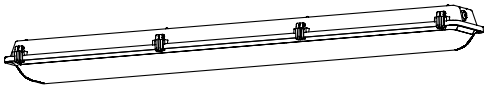
These controllers are calibrated so the dial setting is the point at which the R-W switch contacts make (B-R contacts break) on a temperature rise. Measure the temperature at the bulb. Rotate the dial counterclockwise ↶ from the top of the scale, simulating a temperature rise, until the R-W switch contacts make. Note the dial reading. If it differs from the setpoint, calibrate the dial as follows:

1. Determine the number of degrees difference between the set point and the point at which the contacts make.
2. Remove the dial knob and slip the fingers of the calibration wrench into the slots of the dial. Rotate the dial until the fingers of the wrench drop into the slots of the calibration nut under the dial. Note the dial indication at this point. Turn the dial and the calibration nut up or down scale the number of degrees that the set point differs from the point at which the contacts make (determined in step 1). For example, move the dial from 45 to 65 degrees for a 20 degree change in calibration.
3. Check the calibration adjustment by moving the dial up and down the scale while watching the contacts make and break. If dial is still out of calibration, repeat calibration procedure.
4. To install tamper-resisting insert on TRADELINE® model, remove screw from adjustment knob, remove knob, and install insert.

Columbia LIGHTING

XEM

Enclosed and Gasketed Fiberglass / 1, 2, or 3-Lamp T5 or T8



PROJECT INFORMATION

Project Name

Type

Catalog No.

Date

FEATURES

- Enclosed and Gasketed Industrial
- Available in 2', 4', or 8' lengths
- T8 or T5 fluorescent
- IP65 all sizes, IP67 4' and 8'
- Fiberglass housing with F1 weatherability rating, standard
- Smooth housing for ease of cleaning
- Gasket is non-porous to ensure seal
- Impact modified acrylic lens
- Lens selections include ribbed clear or frost, optically clear deep profile, or deep profile frost
- Lens firmly secured with tamper resistance ready polycarbonate latches
- Stainless steel latching optional
- Removable gear tray electrical access
- Includes surface mounting brackets
- Specular reflector available
- CSA c/US labeled, built to UL 1598, UL924 as appropriate
- Available with exclusive wiHUBB technology preinstalled

CONSTRUCTION
Housing is formed from UL 5VA fiberglass. F1 weatherability rating, suitable for indoor or outdoor use with respect to exposure to UV light. Pour-in-place non-porous gasketing assures seal. Fluorescent lamp sockets and ballast affixed to removable gear tray. 14 Latches per 8', 8 per 4', 6 per 2'. Latches are provided tamper resistance ready, tamper resistant screws optional. Latches are standard polycarbonate, optional in stainless steel. Knockouts are provided for electrical access and mounting.

SHIELDING
Lineal ribbed clear acrylic lens impact modified; modification adds flexibility to reduce impact breakage compared to standard acrylic formulations. Polycarbonate ribbed diffuser optional. Frosted acrylic or polycarbonate lens available for additional lamp diffusion. Deep acrylic lens in clear or frost optional (without lineal ribs).

FINISH
White painted parts are treated with a five-stage phosphate bonding process and finished with high reflectance baked enamel.

ELECTRICAL
Standard class "P", thermally protected, auto-resetting HPF ballast, sound rated A. CEE NEMA Premium compliant. All ballast leads extend a minimum of 6" through access location. NEC/CEC compliant ballast disconnect is standard.

CERTIFICATION
All luminaires are built to UL 1598 standards and bear appropriate CSA c/US labels. Ingress protection IP65 and IP67 standard. UL Sanitation certified. Wet location labeling is standard. Emergency-equipped fixtures built to UL 924.

ORDERING INFORMATION (See page 2 for Product Availability Data and Sensor Kits)

EXAMPLE **XEM4-232-RA-EU**

XEM 4 – 2 32 – RA – E U –

MODEL
- **XEM** Enclosed and Gasketed Fiberglass Industrial

NO. OF LAMPS IN CROSS SECTION
- **1** One
- **2** Two
- **3** Three

SIZE
- **2** 2'
- **4** 4'
- **8** 8'

LAMP TYPE
- **14** 2', T5 Standard: 14 Watt
- **17** 2', T8: 17 Watt
- **28** 4', T5 Standard: 28 Watt
- **32** 4', T8: 32, 30, 28, or 25 Watt
- **96T8** 8', T8: 59 Watt[1]

LENS TYPE
- **RA** Ribbed Acrylic, Impact Resistant (standard)
- **RFA** Ribbed Frosted Acrylic, Impact Resistant
- **RP** Ribbed Polycarbonate[2]
- **RFP** Ribbed Frosted Polycarbonate[2]
- **DCA** Deep Clear Acrylic[3]
- **DFA** Deep Frosted Acrylic[3]

BALLAST
- **E** Electronic, T8, Instant Start (Standard)
- **3E** 3-Lamp Electronic, Instant Start (T8)
- **4E** 4-Lamp Electronic, Instant Start (T8)
- **24E** (1) 2-Lamp and (1) 4-Lamp Electronic, Instant Start (T8)
- **EP** Electronic, Programmed Start
- **3EP** 3-Lamp Electronic, Programmed Start
- **4EP** 4-Lamp Electronic, Programmed Start
- **24EP** (1) 2-Lamp and (1) 4-Lamp Electronic, Programmed Start (T8)
- **ESD** Electronic Step Dimming for 2-Lamp 4' only[4]
- **ED** Electronic Dimming[5]
- **3ED** (1) 3-Lamp Electronic Dimming[5]
- **4ED** (1) 4-Lamp Electronic Dimming[5]
- **24ED** (1) 2-Lamp and (1) 4-Lamp Electronic T8[5]
- **11E** (2) 1-Lamp Electronic Instant Start
- **11EP** (2) 1-Lamp Electronic Programmed Start
- **11ED** (2) 1-Lamp Electronic Dimming[5]

VOLTAGE
- **U** 120V-277V
- **120** 120V
- **277** 277V
- **347** 347V

BALLAST FACTOR
- **Blank** Standard
- **LW** Low Watt
- **HL** 1.18 BF High Lumen 4' T8

OPTIONS
- **EL** Emergency Battery Pack, 350-450 Lumens, T8 only[8]
- **EL141** 900-1400 Lumen T8 Battery Pack[8]
- **EL5** 390-700 Lumen T5 Battery Pack[8]
- **EL5H** 600-1325 Lumen T5 Battery Pack[8]
- **GLR** Fast Blow Fuse
- **GMF** Slow Blow Fuse
- **TP** Tamper Proof Screws
- **SSL** Stainless Steel Latches
- **FO835** T8 Lamp Installed, 82 CRI, 3500K
- **FO841** T8 Lamp Installed, 82 CRI, 4100K
- **FO850** T8 Lamp Installed, 82 CRI, 5000K
- **F5841** T5 Lamp Installed, 82 CRI, 4100K
- **F5850** T5 Lamp Installed, 82 CRI, 5000K
- **F3C8W** 3 Wire 8' Wet Cord
- **F3C15W** 3 Wire 15' Wet Cord
- **SWH** Single Wet Hub ½" NPT Hub
- **DWH** Dual Wet Hub ½" NPT Hub
- **WIH** wiHUBB Enabled[6]
- **M4R** Specular Alum Reflector, 95% Reflectivity
- **PAF** Paint After Fabrication Reflector
- **HT** Elevated Ambient Rating 40°C[7]
- **XEDPM** Dual Pendant Brackets (pendant by others)[9]
- **XEHC** Chain Hanger

[1] Installed lamps not optional on 8' fixtures.
[2] Polycarbonate lenses available on 2' and 4' only.
[3] 4' or 8' only.
[4] Can be converted to fixed output by tying hot leads together.
[5] Not compatible with T8 25, 28, or 30 Watt energy-saving lamps.
[6] In-Fixture Module Antenna is mounted in gear tray beneath lens.
[7] HT option available on 4' 1-lamp or 2-lamp T5 and T8 only.
[8] Not available with 2'.
[9] Requires ⅜" OD threaded rod by others.

Not all configurations are compatible; for questions contact Hubbell Lighting representative.

701 Millennium Blvd. Greenville, SC 29607 / Tel **864.678.1000** / Website **www.columbialighting.com**

HUBBELL Lighting

PRODUCT AVAILABILITY DATA

PRODUCT AVAILABILITY

Size	# of Lamps in Cross Section	# of Lamps in Fixture	Lamp Type	Width	Length	Height RA, RFA	Height DCA, DFA
2'	1	2	14,17	6⅞"	27⅔"	4⅜"	N/A
	2	2	14,17	6⅞"	27⅔"	4⅜"	N/A
4'	1	1	28,32	6⅞"	51⅔"	4⅜"	5⅝"
	2	2	28,32	6⅞"	51⅔"	4⅜"	5⅝"
	3	3	28,32	6⅞"	51⅔"	4⅜"	5⅝"
8'	1	2	28,32	6⅞"	100"	4⅜"	5⅝"
	1	1	96T8	6⅞"	100"	4⅜"	5⅝"
	2	4	28,32	6⅞"	100"	4⅜"	5⅝"
	2	2	96T8	6⅞"	100"	4⅜"	5⅝"
	3	6	28,32	6⅞"	100"	4⅜"	5⅝"

SENSOR KITS (Order Separately)
All sensor kits include Occupancy & Daylight.
Daylight activation requires setting of dip-switches on site.

	Catalog #	# Relays	Lens Type	Voltage	Wet Label	Product
120V / 277V / 347V	OS1360WLK	1	360°	120/277/347	Yes	XEM
	OS2360WLK	2	360°	120/277/347	Yes	XEM
	OS1AWLK	1	Aisle	120/277/347	Yes	XEM
	OS2AWLK	2	Aisle	120/277/347	Yes	XEM
208V / 480V	OS1360480WLK	1	360°	480V	Yes	XEM
	OS1A480WLK	1	Aisle	480V	Yes	XEM
	OS1360208WLK	1	360°	208V	Yes	XEM
	OS1A208WLK	1	Aisle	208V	Yes	XEM

PHOTOMETRIC DATA

Test **7154** Test Date **09/16/13**

LUMINAIRE DATA

Luminaire	**XEM4-232-RA-EU** **XEM Enclosed and Gasketed, Industrial 6.75" x 51.5" 2-lamp with ribbed clear acrylic lens**
Ballast	**ICN-2P32-N**
Ballast Factor	**0.88**
Lamp	**F32T8**
Lumens per Lamp	**2850**
Watts	**56**
Mounting	**Surface**
Shielding Angle	**0° = 90 90° = 90**
Spacing Criterion	**0° = 1.26 90° = 1.67**
Luminous Opening in Feet	**Length: 4.27** **Width: 0.52** **Height: 0.27**

ZONAL LUMEN SUMMARY

Zone	Lumens	% Lamp	% Fixt.
0-30	803	14.1	19.0
0-40	1379	24.2	32.7
0-60	2614	45.9	62.0
0-90	3776	66.3	89.5
0-180	4218	74.0	100.0

ENERGY DATA

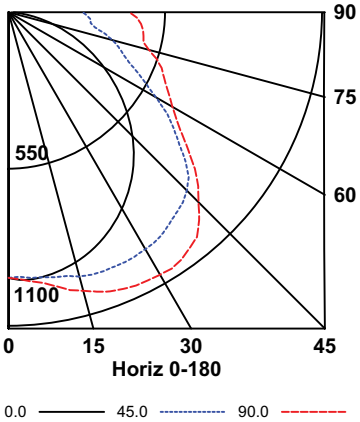
Total Luminaire Efficiency	**74.0%**
Luminaire Efficacy Rating (LER)	**66**
ANSI/IESNA RP-1-2004 Compliance	**Noncompliant**
Comparative Yearly Lighting Energy Cost per 1000 Lumens	**$3.64 based on 3000 hrs. and $0.08 per KWH**

COEFFICIENTS OF UTILIZATION (%)

RCR	RC	80				70				50			0
	RW	70	50	30	10	70	50	30	10	50	30	10	0
	1	77	72	69	65	74	70	66	63	65	62	60	51
	2	69	62	56	52	66	60	55	50	56	52	48	41
	3	63	54	47	42	60	52	46	41	49	44	39	34
	4	57	47	40	35	55	46	39	34	43	37	33	29
	5	52	42	35	30	50	41	34	29	38	33	28	24
	6	48	38	31	26	46	37	30	25	34	29	24	21
	7	44	34	27	22	43	33	27	22	31	25	21	18
	8	41	31	24	20	40	30	24	20	28	23	19	16
	9	38	28	22	18	37	27	21	17	26	21	17	14
	10	36	26	20	16	35	25	20	16	24	19	15	13

RCR = Room Cavity Ratio
RC = Effective Ceiling Cavity Reflectance **RW** = Wall Reflectance

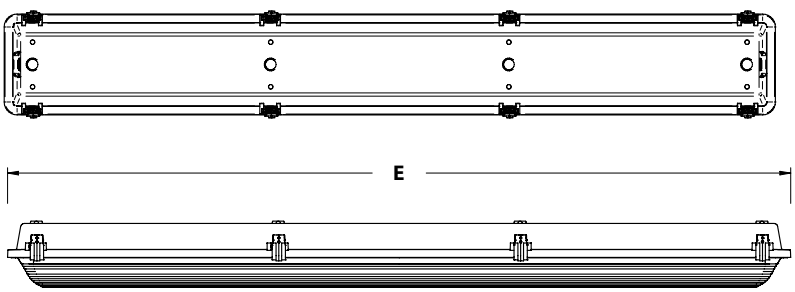
INDOOR CANDELA PLOT

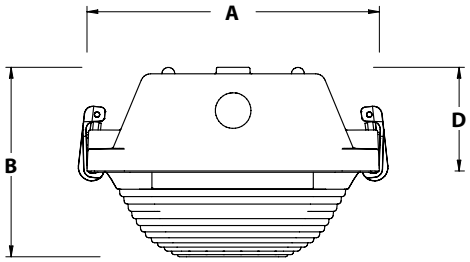


AVG. LUMINANCE (Candela/Sq. M.)

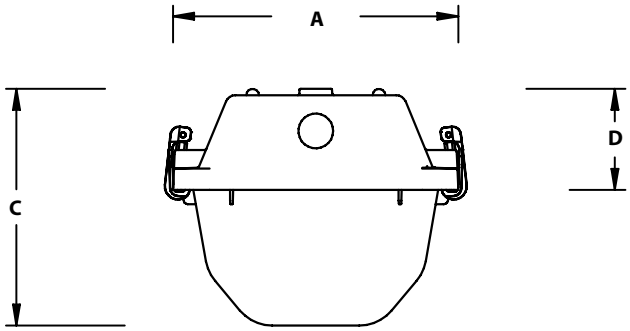
Average Luminance Angle	0.0	22.5	45.0	67.5	90.0
0	4513	4513	4513	4513	4513
30	4293	4114	4337	4497	4578
40	4104	4003	4308	4461	4531
45	3966	3905	4293	4235	4246
50	3822	3879	4093	3972	3969
55	3628	3870	3752	3593	3601
60	3364	3710	3390	3303	3384
65	3040	3202	3033	3181	3311
70	2657	2700	2846	3156	3335
75	2182	2304	2791	3115	3252
80	1582	2056	2578	3126	3397
85	969	1793	2816	3448	3738

DIMENSIONAL DATA





RA, RFA Lens



DCA, DCF Lens

PRODUCT NUMBER		WIDTH	HEIGHT		LATCH	LENGTH
			RF, RFA	DCA, DFA		
XEM	Size	A	B	C	D	E
XEM2	2'	6⅞"	4⅜"	N/A	2⅕"	27⅔"
XEM4	4'	6⅞"	4⅜"	5⅝"	2⅕"	51⅔"
XEM8	8'	6⅞"	4⅜"	5⅝"	2⅕"	100"

NOTE: All dimensions are in inches; dimensions and specifications are subject to change without notice. Please consult factory or check sample for verification.

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SECTION 23 - ENCLOSURE EQUIPMENT - SVE PROCESS ROOM (NEC CLASS 1, DIVISION 2)

HEATER, 3.6 KW, 208 VAC, 1 PH - DAYTON MODEL 2CJF2

HEATER THERMOSTAT - WHITE ROGERS MODEL 1687-9

EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH, EXP - DAYTON MODEL 10D997

FAN THERMOSTAT - HONEYWELL MODEL T6031A1136

LIGHT FIXTURES, CLASS 1 DIVISION 2 - KILLARK MODEL VUXBGG-2-100X

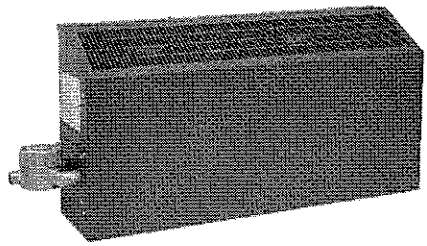
EXTERIOR LIGHT FIXTURES - LUMAPRO MODEL 4VW95

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Dayton® Hazardous Location Electric Convection Heaters

Description

These hazardous location heaters have been designed for installation in areas where potentially explosive, flammable vapors may be in the atmosphere, but a comfortable range of heat is maintained and desired.



Features

Heavy duty 16 ga. steel cabinet with epoxy textured powder coat finish.

Stainless steel cartridge element inserted into aluminum finned copper sheath.

Standard unit Is NEMA 4 rated.

Specifications

Temperature Code: Do not install in areas where vapors or gases having an ignition temperature less than 280°C (536°F) for T-2A models, and 180°C (356°F) for T-3A models.

Ratings: Class 1, Groups B, C, and D. Division 1 and 2, T-2A (280°C/536°F) or T-3A (180°C/356°F) depending on specific wattage models. NEMA 4.

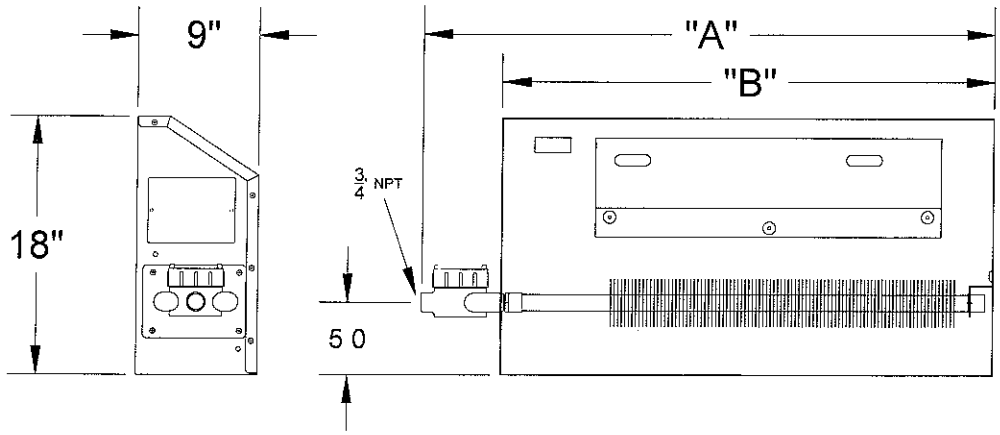
For additional information on Div., Class and Groups, refer to NEC Article 500 HAZARDOUS (CLASSIFIED) LOCATIONS

Unpacking

Remove the heater from carton and discard. Inspect heater for any damage. If it appears to be damaged, return immediately

Dimensions

MODEL	A	B
2CJE8,2CJE9,2CJF1,2CJF2,2CJF3,2CJF4	39 1/2	34
2CJF5,2CJF6	63 1/2	58



ENGLISH

ESPANOL

FRANCAIS

Form 5S5927

Printed in U S A
02966
0208/029/VCPVP

Part No.: 8994
ECO 1-5871

Dayton®

Dayton® Hazardous Location Electric Convection Heaters

ENGLISH

General Safety Information

⚠WARNING DO NOT ATTEMPT TO INSTALL, OPERATE, OR SERVICE THIS PRODUCT BEFORE READING ALL INSTRUCTIONS CAREFULLY. FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN FIRE, PERSONAL INJURY AND/OR PROPERTY DAMAGE! RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.

⚠WARNING Do not install in areas where vapors or gases have an ignition temperature less than the rating of the heater. Heater ratings are: 280°C (536° F) for T-2A models and 180°C (356°F) for T-3A models. Note: Information regarding ignition temperatures is contained in NFPA 325M "Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids" available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

⚠WARNING These heaters must not be operated in ambient temperatures exceeding 40°C (104°F). To assure heaters are not operated at temperatures exceeding the above, the heater should be controlled by a thermostat. This should be located at the same level as the heater.

1. Comply with the National Electric Code definition of Class 1, Division 1 & 2, Group B, C and D hazardous locations, including areas where the potential for explosion and fire is high. Some potentially hazardous situations include, but are not limited to, flammable gases, chemical vapors, liquified petroleum or natural gas vapor from dry cleaning solvents; and other situations as detailed by the National Electric Code.
2. Do not install one unit above another.
3. Heaters must be mounted on a wall in a horizontal position, with the terminal end at the left. Never recess the heater into the wall.
4. During normal operation, this heater will develop high surface temperatures. To avoid possible injury, do not touch the top of the heater enclosure.
5. Never place any material or object on top of the heater enclosure. Never obstruct the flow of air through the unit.
6. Make certain incoming power conforms to the requirement of the heater.
7. Disconnect power supply to heater before servicing or inspecting any part of the heater. Failure to do so may result in electrical shock.
8. SAVE THESE INSTRUCTIONS

Installation

Mounting

⚠WARNING For ample airflow, a 9" minimum space from the bottom of the heater to the floor is required. DO NOT mount directly on the floor.

1. Attach the wall bracket with the "V" at the top. Use 3/8" bolts and wall anchors supplied by installer.
2. Hang the heater onto the "V" bracket, using the horizontal slots located on the rear housing panel.
3. Secure the heater by fastening the bottom, with the 1/4-20 screws furnished, to the bottom of the bracket. This may be done through the opening in the bottom of the heater. In some cases, the front housing panel can be removed for easier access

Electrical

1. This heater must be wired in accordance with local electrical and safety codes, as well as Article 501 of the National Electric Code for Class 1 Hazardous Locations.
2. **⚠WARNING** An approved conduit seal (not included) must be provided at the entrance to the conduit box. To prevent ignition of Group B Atmospheres, conduit runs must not exceed 3/4" in size, and all conduit runs 1/2" size and larger must have a sealing fitting connected within 2" of the terminal enclosure.
3. Connect one lead from each element to L1, and connect the other lead from each element to L2 (see Figs. A and B). For 3-phase units see Fig. C. Always observe the wiring diagram on the unit.
4. Any auxiliary control equipment, such as a disconnect switch, contactor or thermostat which is located within the hazardous location, must be specifically designed and approved for that hazardous location. NOTE: It is the users' responsibility to assure that adequate controls and safety devices are installed with their electric heating equipment.

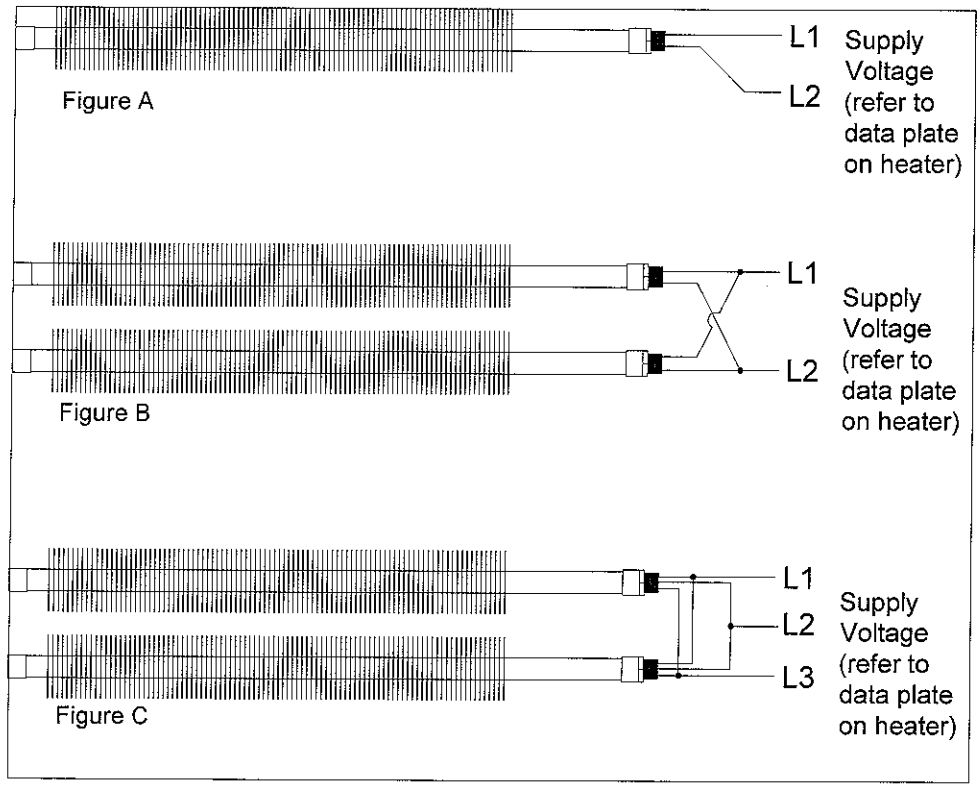
⚠WARNING If the possibility exists for the ambient temperature to exceed 40°C / 104°F, a thermostat should be installed in close promimity to the heater.

⚠WARNING This unit must be protected by either "a circuit breaker acceptable for branch circuit protection" or by "a fuse acceptable for branch circuit protection such as a Class CC, G, H, J, K, L, R or T cartridge fuse or a Type S plug fuse".

Models 2CJE8, 2CJE9 AND 2CJF1 thru 2CJF6

ENGLISH

Wiring Diagrams



Operation

This heater may be controlled by a thermostat or a contactor and thermostat. If control equipment is located in a hazardous location, it too must be approved for this location. It is essential that over-current protection be provided for the heater alone and should be of a value as near as possible to the current rating indicated on the heater data plate

Do not operate the heater at voltages in excess of that stamped on the heater, since excess voltage will shorten heater life and cause high element temperatures. These may exceed allowable temperatures of operation in a hazardous atmosphere.

⚠WARNING Never operate the heater with the front panel off. Air flow across the heating elements requires the front panel in place. Injury from hot heating elements is possible with the front panel removed.

Maintenance

Always disconnect the heater from the power source before performing any service or maintenance.

1. Keep heater clean, especially the heating elements.

2 Remove dust, lint and accumulation of other material.

3. Never allow the heater to operate with restriction to the free circulation of air through it.

4. Check that the heater has not been damaged or deformed, and that all conduit joints are secure.

Dayton®

For Repair Parts, Call 1-800-323-0620

24 Hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number shown as shown in parts list

ENGLISH

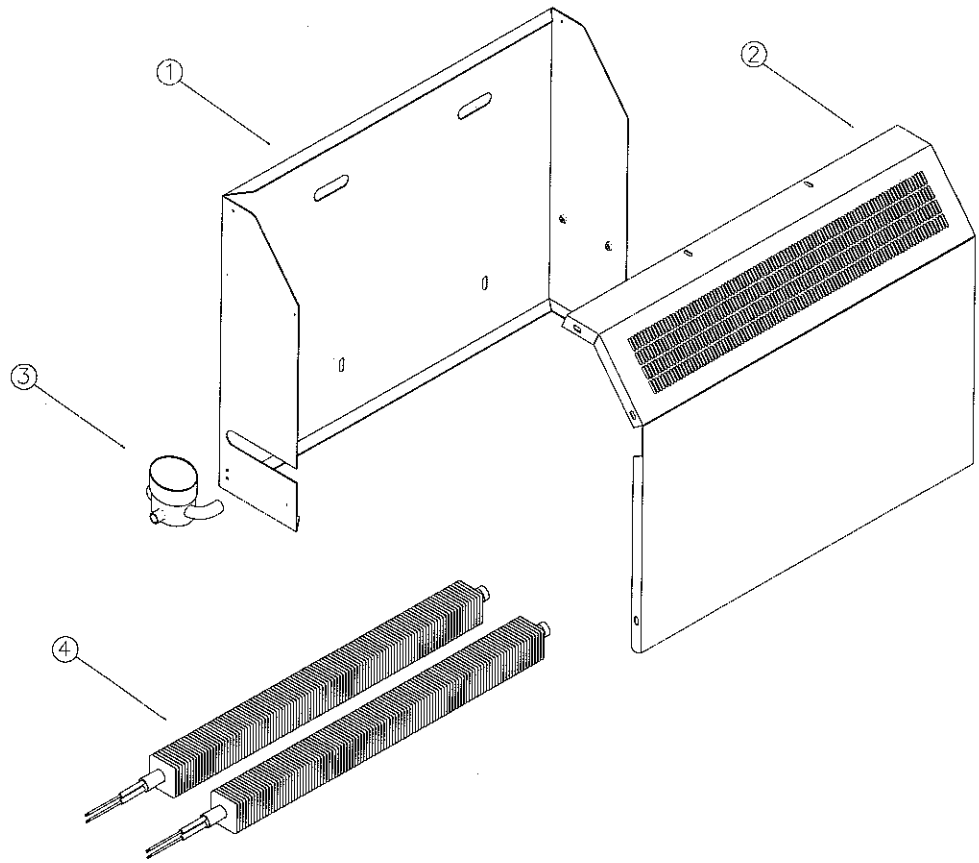


Figure 1 - Repair Parts Illustration for Hazardous Location Convection Heater

Repair Parts List for Hazardous Location Unit Heaters

Reference Number	Description	Part Number for Models 2CJE8	2CJE9	2CJF1	2CJF2	2CJF3	2CJF4	2CJF5	2CJF6
1	Rear Cabinet	63874003	63874003	63874003	63874003	63874003	63874003	63874004	63874004
2	Front Cabinet	63875003	63875003	63875003	63875003	63875003	63875003	63875004	63875004
3	Outlet Box	43416001	43416001	43416001	43416001	43416001	43416001	43416001	43416001
4	Element	53165001	53165002	53165003	53165002	53165003	53165032	53165006	53165034

Dayton® Hazardous Location Electric Convection Heaters

ENGLISH

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *DAYTON® Temperature Controls, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR ONE YEAR AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

LIMITATION OF LIABILITY. *TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, DAYTON'S LIABILITY FOR CONSEQUENTIAL AND INCIDENTAL DAMAGES IS EXPRESSLY DISCLAIMED. DAYTON'S LIABILITY IN ALL EVENTS IS LIMITED TO AND SHALL NOT EXCEED THE PURCHASE PRICE PAID.*

WARRANTY DISCLAIMER. *A DILIGENT EFFORT HAS BEEN MADE TO PROVIDE PRODUCT INFORMATION AND ILLUSTRATE THE PRODUCTS IN THIS LITERATURE ACCURATELY; HOWEVER, SUCH INFORMATION AND ILLUSTRATIONS ARE FOR THE SOLE PURPOSE OF IDENTIFICATION, AND DO NOT EXPRESS OR IMPLY A WARRANTY THAT THE PRODUCTS ARE MERCHANTABLE, OR FIT FOR A PARTICULAR PURPOSE, OR THAT THE PRODUCTS WILL NECESSARILY CONFORM TO THE ILLUSTRATIONS OR DESCRIPTIONS. EXCEPT AS PROVIDED BELOW, NO WARRANTY OR AFFIRMATION OF FACT, EXPRESSED OR IMPLIED, OTHER THAN AS STATED IN THE "LIMITED WARRANTY" ABOVE IS MADE OR AUTHORIZED BY DAYTON.*

Technical Advice and Recommendations, Disclaimer. *Notwithstanding any past practice or dealings or trade custom, sales shall not include the furnishing of technical advice or assistance or system design. Dayton assumes no obligations or liability on account of any unauthorized recommendations, opinions or advice as to the choice, installation or use of products.*

Product Suitability. *Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While attempts are made to assure that Dayton products comply with such codes, Dayton cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, review the product applications, and all applicable national and local codes and regulations, and be sure that the product, installation, and use will comply with them.*

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 U.S.A.

WHITE-RODGERS

TEMPERATURE CONTROL
SPDT Remote Bulb
INSTALLATION INSTRUCTIONS

Operator: Save these instructions for future use!

FAILURE TO READ AND FOLLOW ALL INSTRUCTIONS CAREFULLY BEFORE INSTALLING OR OPERATING THIS CONTROL COULD CAUSE PERSONAL INJURY AND/OR PROPERTY DAMAGE.

DESCRIPTION

This control is designed for use on equipment that requires a closed circuit for both rise and fall in temperature. The single pole, double throw switch action offers both open-on-rise terminals as well as close-on-rise terminals.

This control has capillary tubing between the temperature sensitive bulb and the switch mechanism, permitting the switch mechanism to be mounted at any convenient location while the temperature sensitive bulb is located in the fluid or medium being controlled.

PRECAUTIONS

THIS CONTROL MUST BE INSTALLED BY A QUALIFIED INSTALLER.

All wiring must conform to local and national electrical codes and ordinances.

This control is a precision instrument, and should be handled carefully. Rough handling or distorting components could cause the control to malfunction.

This control has been accurately calibrated at the factory. Any attempt to calibrate this control will void the White-Rodgers warranty.

⚠ WARNING

Do not use on circuits exceeding specified voltages. Higher voltages will damage control and could cause shock or fire hazard.

If in doubt about whether your wiring is millivolt, low or line voltage, have it inspected by a qualified heating and air conditioning contractor or a licensed electrician.

⚠ CAUTION

To prevent electrical shock and/or equipment damage, disconnect electric power to system at main fuse or circuit breaker box until installation is complete.

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

Following installation or replacement, follow appliance manufacturers' recommended installation/service instructions to insure proper operation.

INSTALLATION

The switch mechanism of this control may be mounted in any location, provided that the temperature and humidity of the air in which it is located do not cause a condensation on the switch parts.

The sensitive element, or "bulb", should be located in the **average temperature** of the controlled area.

Capillary tubing should be led over a path that protects it from damage from blows, cuts, etc., and should be installed without kinking or twisting. The tubing should be attached to some surface at frequent intervals along its length, and should not hang loosely. Excess tubing should be coiled and secured at a convenient protected location close to the switch mechanism.

The bulb should be handled with reasonable care, as a dent or sharp bend may change the calibration and cause the control to cycle at a temperature different from the dial setting.

EMERSON

WHITE-RODGERS DIVISION
EMERSON ELECTRIC CO.
9797 REAVIS RD., ST. LOUIS, MO. 63123-5398
(314) 577-1300, FAX (314) 577-1517
9999 HWY. 48, MARKHAM, ONT. L3P 3J3
(905) 475-4653, FAX (905) 475-4625

Printed in U.S.A.

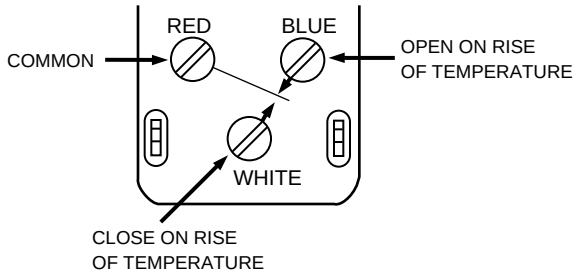
PART NO. 37-1637C
Replaces 37-1637B
9722

Wiring

All wiring must conform to local and national electrical codes and ordinances.

Connect in accordance with the wiring diagrams provided by the equipment manufacturer.

This control has a single-pole, double-throw, snap-action switch. The top left-hand terminal (red) is the common terminal. The top right-hand terminal (blue) has an open-on-rise switch action. The bottom center terminal (white) has close-on-rise switch action.

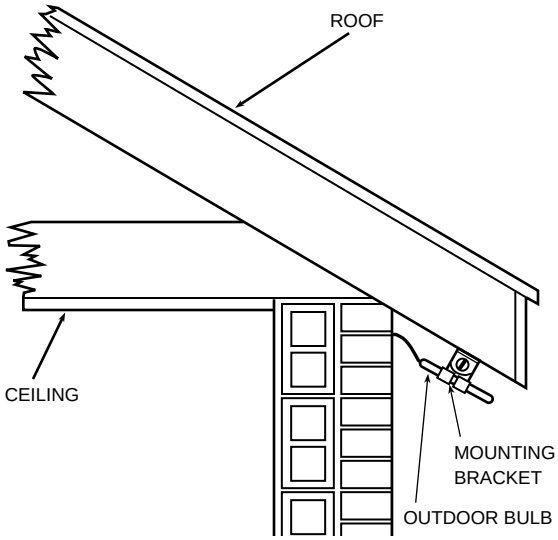


INSTALLATION AS AN OUTDOOR BULB

When used as a changeover control or outdoor thermostat, the bulb of this control should be located to measure the actual outdoor air temperature. A mounting bracket is provided for mounting the bulb.

The mounting bracket should be fastened to some convenient outside part of the building that is shielded from the direct rays of the sun, the direct fall of rain and snow, and sufficiently above ground to keep it out of snow and ice.

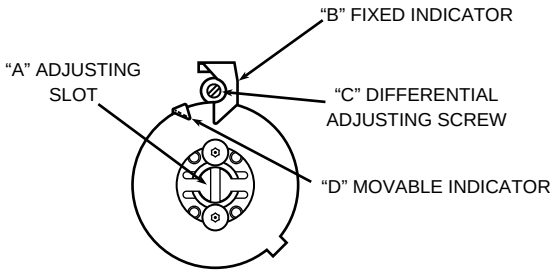
The underside of the eaves or overhang of a NORTH or NORTHEAST roof is a good location. It should be exposed to the circulation of air and wind.



SETTING THE DIAL

The fixed indicator (B) points to temperature at which the "R-B" contacts close and the "R-W" contacts open. Follow these instructions to set the dial.

1. Insert a screwdriver in the adjusting slot (A) and turn the dial until the fixed indicator (B) points to the lowest temperature of the cycle.
2. Turn the differential adjusting screw (C) until the moveable indicator (D) points to the highest temperature of the cycle.

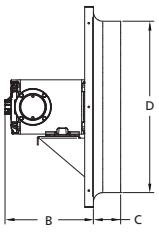


Please read and save these instructions. *Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*

Dayton® Hazardous Location Direct-Drive Exhaust Fans

Description

Dayton hazardous location exhaust fans are designed for ventilating spaces containing flammable or explosive vapors, gases, or dusts as defined under Article 500 of the National Electrical Code (NEC). Mount in vertical or horizontal position. Construction includes galvanized steel frame, pre-punched mounting holes, hazardous location ball bearings, and spark-resistant aluminum propeller. Motor is explosion-proof, fan-cooled enclosure with Class B insulation (if marked on motor). All fans have a maximum ambient temperature of 104ºF (if marked on motor) and are UL/cUL Listed Standard 1203, NEC Class I, Groups C and D; NEC Class II, Groups F and G (Model 10E020 Groups E, F and G).



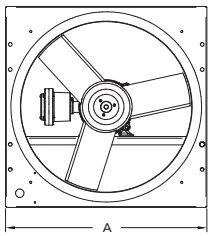
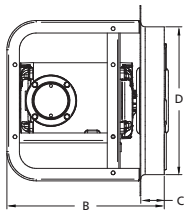


Figure 1 — Panel Fan Dimensions



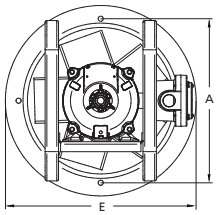


Figure 2 — Ring Fan Dimensions

Dayton Electric Mfg. Co. certifies that the fans shown herein are licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

c UL us LISTED
E197939

Unpacking

1. Inspect for any damage that may have occurred during transit.
2. Shipping damage claim must be filed with carrier.
3. Check all bolts, screws, set-screws, etc. for looseness that may have occurred during transit. Retighten as required. Rotate propeller by hand to be sure it turns freely.

Dimensions and Specifications

Model	Prop. Dia.	Shaft Dia.	A	B	C	D	E	Blades	Recommended Wall Opening — Direct to Wall	Recommended Wall Opening — Wall Collar, Wall Collar & Guard, or Wall Housing
PANEL FANS (See Figure 1)										
10D995, 10D996	12"	5/8"	16"	9½"	3"	12¼"	—	5	14½ x 14½"	17¼ x 17¼"
10D997, ~~10D998~~	16	5/8	20	9½	3¼	16½	—	3	18½ x 18½	21¼ x 21¼
10D999	18	5/8	22	9½	3⅛	18½	—	3	20½ x 20½	23¼ x 23¼
10E001	18	5/8	22	11	3⅛	18½	—	3	20½ x 20½	23¼ x 23¼
10E002, 10E003	20	5/8	24	11½	3¾	20½	—	3	22½ x 22½	25⅝ x 25⅝
10E004, 10E005, 10E006	24	5/8	28	11½	3⅞	24½	—	3	26½ x 26½	29⅝ x 29⅝
10E007	24	5/8	28	12	3⅞	24½	—	3	26½ x 26½	29⅝ x 29⅝
RING FANS (See Figure 2)										
10E008, 10E009	12"	5/8	14⅞"	13½"	2"	12½"	16¼"	5	13½" Dia.	—
10E010, 10E011	16	5/8	18⅞	13½	2	16½	20¼	3	17½	—
10E012, 10E013	18	5/8	20⅞	13½	2	18½	22¼	3	19½	—
10E014, 10E015	20	5/8	23	13½	2	20½	24¼	3	21½	—
10E016, 10E017, 10E018, 10E019	24	5/8	26⅞	13½	2	24½	28¼	3	25½	—
10E020	30	5/8	32	17½	2	30½	34¼	3	31½	—

ENGLISH

ESPAÑOL

FRANÇAIS

Form 5S7003

Printed in U.S.A.
04632
Version 0

474904
Rev. 1, November 2011

Dayton® Hazardous Location Direct-Drive Exhaust Fans

ENGLISH

Performance

Model 1-PHASE 115/208-230	Model 3-PHASE 208-230/460	Prop. Dia.	HP	Motor RPM	Sones @ 0.000" SP @ 5Ft.	CFM Air Delivery @ Static Pressure Shown 0.000"	0.125"	0.250"	0.375"	0.500"
PANEL FANS										
10D995	**10D996**	12"	1/4	1750	13.4	1347	1262	1142	947	604
10D997	~~**10D998**~~	16	1/4	1750	14.1	2476	2288	2061	1769	1350
10D999	**10E001**	18	1/3	1750	19.1	3168	2912	2612	2219	1599
10E002	**10E003**	20	1/2	1750	23	4557	4254	3919	3542	3101
10E004	**10E006**	24	1/2	1750	26	5669	4946	4010	2963	1906
10E005	**10E007**	24	3/4	1750	28	6317	5851	5314	4729	4117
RING FANS										
10E008	**10E009**	12"	1/4	1725	13.6	1147	999	803	682	—
10E010	**10E011**	16	1/4	1750	17.0	2153	1943	1713	1366	1125
10E012	**10E013**	18	1/4	1750	21	2371	2089	1756	1423	1088
10E014	**10E015**	20	1/4	1750	23	2429	2074	1744	1341	1098
10E016	**10E018**	24	1/3	1750	30	3837	3305	2637	1970	—
10E017	**10E019**	24	1/2	1750	26	5669	4946	4010	2963	1906
10E020	—	30	3/4	1140	28	8153	7515	6804	5957	4956

Performance certified is for installation type A: Free inlet, Free outlet. Performance ratings do not include the effects of appurtenances (accessories). Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: Free inlet hemispherical sone levels.

General Safety Information

⚠ DANGER ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the fan. Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury. Units with thermally protected motors, motor will restart without warning after thermal protector trips. Do not touch operating motor, it may be hot enough to cause injury.***

⚠ DANGER ***Do not place any body parts or objects in fan, motor openings or drives while motor is connected to power source.***

1. Read and follow all instructions and cautionary markings. Make sure electrical power source conforms to requirements of equipment and local codes.
2. Fans should be assembled, installed and serviced by a qualified technician. Have all electrical work performed by a qualified electrician.
3. Follow all local electrical and safety codes in the United States and Canada, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA) in the United States. Ground motor in accordance with NEC Article 250 (grounding). Follow the Canadian Electric Code (CEC) in Canada.
4. All moving parts should be guarded.

⚠ CAUTION ***To reduce the risk of injury to persons, observe the following:***

OSHA requires OSHA complying guards when fan is installed within 7 feet of floor or working level.

UL/cUL Standards require OSHA complying guards when fan is installed within 8 feet of floor or working level.

5. Make certain that the power source conforms to the requirements for the equipment.

Installation

⚠ WARNING ***Installation, troubleshooting and parts replacement is to be performed only by qualified personnel.***

⚠ CAUTION ***If gases, other than clean air, are to be exhausted using the fan, then the user bears the responsibility of determining that the fan is appropriate and safe for the application.***

Models 10D995 thru 10D999, 10E001 thru 10E020

Installation (Continued)

⚠ WARNING ***Not for use where paint residue can accumulate on motor.***

⚠ CAUTION ***To reduce the risk of ignition of hazardous atmospheres, disconnect the fan from the supply circuit before opening. Keep the motor tightly closed with in operation.***

WALL MOUNTING

1. Move fan to the desired location and determine the method by which the fan is to be mounted.

NOTE: Wall opening size and propeller-to-shutter distance are two important dimensions for fan installation.

2. Cut an appropriate sized hole in the wall using the Dimensions table on page 1.

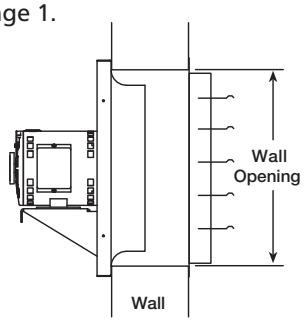


Figure 3 — Direct to Wall Installation

NOTE: Panel fans mounted to the wall require a different opening size than those mounted in collars or housings.

3. The fan should be securely mounted within a rigid framework to prevent flexing or movement of the fan frame during operation. The fan frame should be equally supported on all sides within the framework and caution should be taken to avoid twisting of the fan frame during installation.

NOTE: Allowing the fan frame to flex or move during operation will create harmful vibrations which may damage the unit.

4. Fans should be mounted in opening with 1/4" clearance around perimeter. Framing should be secured to building structure utilizing corrosion resistant fasteners (by others). Fasteners should be used in all pre-punched mounting holes.
5. Install remaining components (shutter, intake guard, etc.).
6. Check all fasteners and set screws for tightness.
7. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit. For 3-phase installations, fan rotation can be reversed by interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

ELECTRICAL CONNECTION

NOTE: Refer to motor nameplate for wiring procedures. Refer to switch manufacturer for installation and wiring procedures.

1. Motor and fan must be securely grounded (bare metal) to a suitable electric ground, such as a grounded water pipe or ground wire system.

⚠ WARNING ***Comply with all local and national safety codes including the National Electrical Code (NEC) and National Fire Protection Act (NFPA).***

NOTE: Motor and switch must be classified as hazardous for fan to be suitable for use in hazardous environments. Installation must be performed by a qualified personnel with suitable motor and disconnect for application.

2. Wire motor for desired voltage per wiring diagram on motor.
3. Wire control switches at ground level.
4. Before activating fan, inspect to be sure that there are no obstructions or debris that would interfere with the propeller.

Operation

1. Before starting up or operating your new Dayton fan, check all fasteners for tightness. In particular, check set screws in propeller hub.

   While in the OFF position, or before connecting the fan to power, turn the fan propeller by hand to be sure it is not striking the orifice or any obstacle.
2. Start the fan up and shut it off immediately to check rotation of the propeller with directional arrow in the motor compartment.
3. When the fan is started, observe the operation and check for any unusual noises.
4. Motor amperage should be checked to avoid overloading of the motor. With the system in full operation measure current input to the motor and compare with the nameplate rating to determine if the BHP is operating under safe load conditions. See performance on page 2.
5. Keep inlets and approaches to fan clean and free from obstruction.

Dayton® Hazardous Location Direct-Drive Exhaust Fans

ENGLISH

Maintenance

⚠ WARNING ***Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.***

⚠ CAUTION ***Uneven cleaning of the propeller will produce an out of balance condition that will cause vibration in the fan.***

1. Depending on the usage and severity of the contaminated air, a regularly scheduled inspection for cleaning the fan propeller, housing and surrounding areas should be established.
2. Check for unusual noises when fan is running.
3. Periodically inspect and tighten set-screws.
4. Follow motor manufacturer's instructions for motor lubrication.

Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
Fan inoperative	1. Blown fuse or breaker	1. Replace or repair
	2. Incorrectly wired	2. Shut power OFF and check wiring for proper connections
	3. Electricity turned off	3. Contact local power company
Airflow - Reversed air	1. Propeller rotation reversed	1. Reverse motor rotation, rewire motor
Airflow - Too much air	2. Insufficient static pressure	2. Check static pressure calculation
Excessive noise or vibration	1. Foreign material inside bearing	1. Replace bearing
	2. Loose propeller	2. Tighten set screws or taper bushing screws
	3. Fan not securely anchored	3. Secure properly
Motor overloads or overheats	1. Incorrect propeller rotation	1. Check motor wiring
	2. Over/Under line voltage	2. Contact Power Company

Manufactured for Dayton Electric Mfg. Co.

Dayton®

Honeywell

T4031A,B,P; T6031A,B
Refrigeration Temperature Controllers

PRODUCT DATA

GENERAL

The T4031A,B,P and T6031A,B are temperature controllers used in a variety of cooling applications where remote mounting of the sensing element in the controlled medium is required.

FEATURES

- **Wide control temperature range is suitable for controlling ducts, tanks, freezers, coolers, display cases. and defrost termination.**
- **Universal mounting bracket is available for easy replacement of other controllers.**
- **Models are available with various control ranges.**
- **Control setpoint is dial-knob adjustable.**
- **Models are available with fixed or adjustable temperature differentials.**
- **Capillary lengths are 5, 8, or 20 ft (1.5, 2.4, 6.1m) depending on model.**
- **Reliable snap-acting spst or spdt switch.**
- **Ambient temperature compensated.**
- **Insert supplied with TRADELINE® models replaces setpoint knob to discourage tampering.**

Contents

SPECIFICATIONS

IMPORTANT

The specifications given in this publication do not include normal manufacturing tolerances. Therefore, this unit may not exactly match the specifications listed. Also, this product is tested and calibrated under closely controlled conditions, and some minor differences in performance can be expected if those conditions are changed.

TRADELINE® Models

TRADELINE® models are selected and packaged to provide ease of stocking, ease of handling, and maximum replacement value. TRADELINE® model specifications are the same as those of standard models except as noted below.

TRADELINE® Model Available:

T6031A Refrigeration Temperature Controller-spdt switch, adjustable temperature differential, tamper-resistant insert.

Capillary Length:

8 ft (2.4m)

Additional Features:

TRADELINE® pack with cross reference label and special instructions

Standard Models

T4031A Refrigeration Temperature Controller-spst switch makes on temperature rise; fixed differential

T4031B Refrigeration Temperature Controller—same as T4031A but less case

T4031P Refrigeration Temperature Controller—same as T4031A but uses screw, not knob, to adjust setpoint

T6031A Refrigeration Temperature Controller-spdt switch, fixed or adjustable temperature differential

T6031B Refrigeration Temperature Controller—same as T6031A but less case

Switch Action:

T4031A,B,P spst switch makes R to W on temperature rise

T6031A,B spdt switch makes R to W on temperature rise, R to B on temperature fall

Capillary Lengths and Temperature Ranges:

Model	Copper Capillary Tube Length		Setting Range[a]		Differential	
	ft	m	°F	°C	°F	°C
T4031A,B	5	1.5	-30 to 50	-34 to 10	Fixed at 3.5	Fixed at 1.6
	20	6.1				
T4031P	8	2.4	-30 to +90	-34 to +32	3.5 to 16	1.6 to 9
T6031A,B	5	1.5	-15 to +90	-9 to +32	Fixed at 3.5 or Adjust. from 3.5 to 12	Fixed at 1.6 or Adjust. from 1.6 to 7
	20	6.1				
	5	1.5	-30 to +50	-34 to +10		
	20	6.1				
	8	2.4	-30 to +90	-34 to +32		

[a] Dial scale markings in degrees Fahrenheit

ORDERING INFORMATION

When purchasing replacement and modernization products from your TRADELINE® wholesaler or your distributor, refer to the TRADELINE® catalog or price sheets for complete ordering number, or specify:

1. Order number.
2. Setting range.
3. Fixed or adjustable differential (T6031).
4. Length of copper capillary tube.
5. Accessories, if desired.

If you have additional questions, need further information, or would like to comment on our products or services, please write or phone:

1. Your local Honeywell Home and Building Control Sales office (check white pages of your phone directory).
2. Home and Building Control Customer Relations
   Honeywell, 1885 Douglas Drive North
   Minneapolis, Minnesota 55422-4386

In Canada—Honeywell Limited/Honeywell Limitée, 35 Dynamic Drive, Scarborough, Ontario M1V 4Z9. International Sales and Service Offices in all principal cities of the world.

Electrical Ratings:

	120 Vac		240 Vac	
	Normally Closed	Normally Open[a]	Normally Closed	Normally Open[a]
Full Load Amp	8	16	5.1	8
Locked Rotor Amp	48	80	30.6	40

[a] Makes on temperature rise.

Pilot Duty:
125 VA

Dimensions:
See Fig. 1

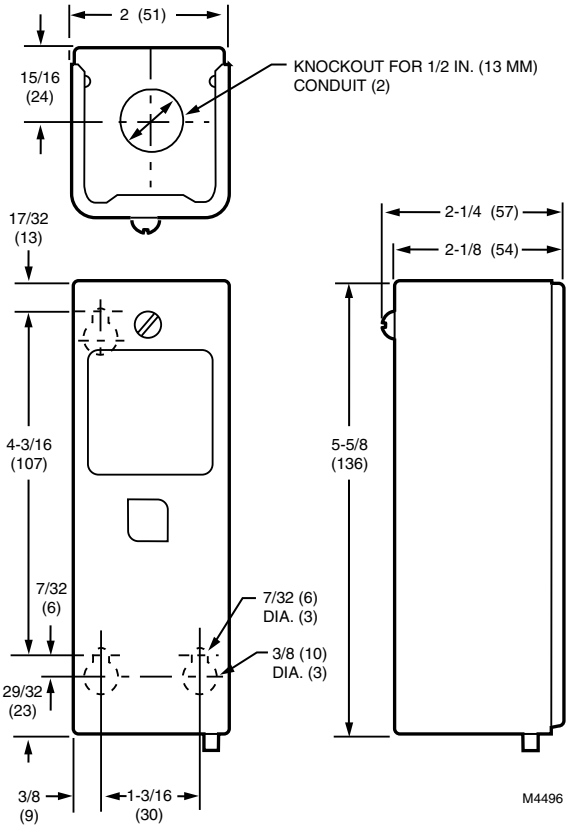


Fig. 1. Dimensions of T4031, T6031 in. (mm).

Underwriters Laboratories Inc.:
Listed

Maximum Ambient Operating Temperature:
125°F (52°C)

Accessories:
112622AA Immersion Well—short-necked, 1/2 in. NPT, copper
7617ABY Compression Fitting—50 psi water, 15 psi air
107324A Bulb Holder—for duct installation
105900 T-strap—for strapping bulb to pipe
7617ABZ Bag Assembly—for mounting controller to fan coil units
801534 Calibration Wrench
7640HY Standoff Bracket Bag Assembly—to mount controller to an insulated duct
130883 Universal Mounting Bracket
194899 Tamper-resisting Insert Button
Celsius Scaleplates:
194486 D: -15°C to +35°C replaces (0°F to 100°F) scaleplate
194486H: 15°C to 75°C replaces (55°F to 175°F)
194486F: 75°C to 125°C replaces (160°F to 260°F)

INSTALLATION

When Installing this Product…

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in these instructions.

⚠ CAUTION

- Disconnect power supply before installation to prevent electrical shock and equipment damage.
- Do not damage or change shape of capsule. Deformed capsule will cause calibration offset.

Mounting

Install controller in any convenient location. Make sure that the sensing bulb reaches the system to be controlled. The ambient temperature must not exceed 125°F (52°C) in the area where the controller is installed.

Install the sensing element where it can sense the average temperature. Avoid sharp bends or kinks in the capillary tubing that can affect the accuracy of the controller. Carefully coil the excess capillary tubing and leave it directly beneath the controller.

The 130883 Mounting Plate furnished with TRADELINE® models allows the control to be mounted in existing mounting holes.

Duct Installation

Position the sensing bulb in the duct to sense the average air temperature. Avoid mounting the bulb close to hot pipes, cooling coils, etc.

The 107324A Bulb Holder is available for suspending the bulb in a duct. See Fig. 2.

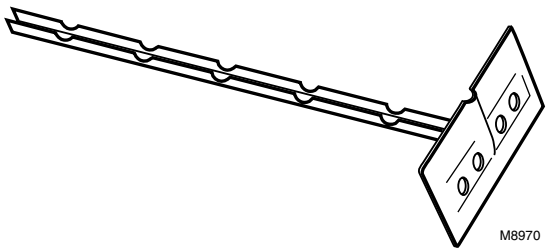


Fig. 2. 107324A bulb holder.

To install duct:

1. Make a hole in duct wall to admit sensing bulb into holder.
2. Using holder as template, mark and drill mounting holes.
3. Break off bulb holder to required length. (Be sure holder is long enough to hold sensing bulb away from duct wall and in freely circulating air.)
4. Place capillary tubing in bulb holder channel, with bulb at inner end of holder. Pinch together top edges of channel segments.
5. Insert assembled bulb and holder into duct, and fasten to duct wall with screws supplied.

Tank Installation

The sensing bulb can be inserted directly into a tank using a compression fitting; or the bulb can be inserted into an immersion well (order separately), which is screwed into a tank or boiler.

Select a location where liquid of average temperature can circulate freely around the sensing bulb.

Using Compression Fitting (Fig. 3)

1. Drain system. Screw boiler plug into properly sized and threaded boiler or pipe tapping.
2. Place packing nut on capillary tubing.
3. Slide sensing bulb completely through boiler plug.
4. Place composition disc and the four slotted brass washers on capillary tubing.
5. Slide assembly into boiler plug and tighten packing nut.
6. Refill system and check for leaks. Neatly coil excess capillary tubing.

Using Immersion Well (Fig. 4)

1. Drain system. Screw the well into threaded fitting.
2. Refill system and check for leaks.
3. Insert sensing bulb into well until it bottoms.
4. Fit bulb retaining clamp over immersion well flange and capillary tubing, and tighten screw.

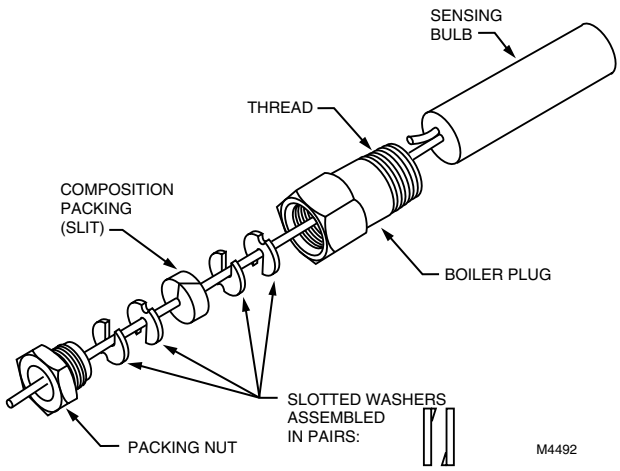


Fig. 3. Compression fitting installation.

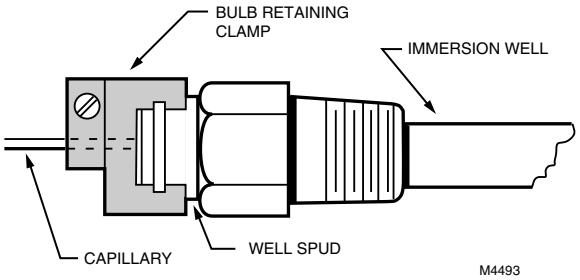


Fig. 4. Immersion well installation.

Cold Room Installation

Locate the bulb in freely circulating air in the controlled area or on the suction side of a refrigerant line, and secure the bulb in position.

Wiring (Fig. 5)

All wiring must comply with local electrical codes and ordinances.

Two knockouts are provided, one at the top and one at the bottom of the case for 1/2 in. conduit. Follow the wiring instructions furnished with the heating or cooling system. For replacement, make sure the new control is wired into the system to operate the same as the old control.

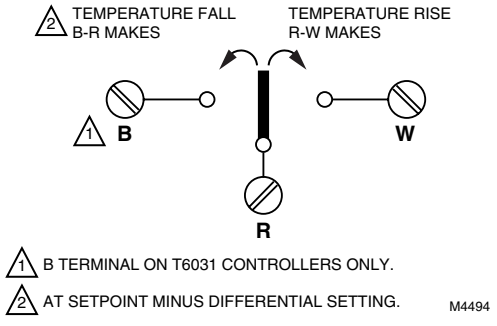


Fig. 5. Wiring terminals on T4031 and T6031 temperature controllers.

OPERATION AND CHECKOUT

When the temperature at the sensing bulb rises above the controller setpoint, a circuit is made between the R-W terminals. During a temperature fall, the R-W circuit breaks at the setpoint temperature *minus* the switch differential. Controllers with a B terminal break the B-R terminal circuit on a temperature rise to the setpoint. B-R makes again when R-W breaks on a temperature drop. See Fig. 6.

For example, if a controller with a 3°F (1.7°C) differential is set at 39°F (3.9°C), R-W makes when the bulb temperature rises to 39°F. Then during a temperature fall, R-W breaks when the temperature drops to 35°F (1.7°C) (39°F minus the 3°F differential [3.9°C minus the 1.7°C differential]).

On models with a B terminal, B-R makes when R-W breaks. Then the temperature has to climb past the control differential to the set point of 39°F (3.9°C) before the B-R circuit breaks and the R-W circuit makes.

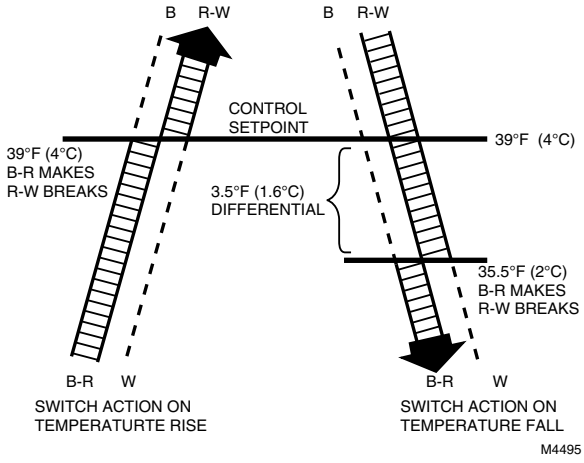


Fig. 6. Operation of switch on temperature rise and fall.

SETTING

Set the controller to the system manufacturer's recommended settings, if available.

Temperature Setpoint Knob—Turn the knob on the front of the case until the pointer indicates the temperature to be maintained in the controlled medium.

Screw—Insert a flatheaded screwdriver into the slot on the shaft, which is located in the center of the scaleplate. Turn the screwdriver clockwise ↷ to increase the temperature control point. Turn the screwdriver counterclockwise ↶ to decrease the temperature control point.

Adjustable Differential—With the cover off, turn the differential adjustment wheel (marked 3-6-9-12°F) until the desired differential is aligned with the notch in the frame. See Fig. 7.

Fixed differential models are 3.5°F at midscale.

Calibration

All controllers are carefully tested and calibrated at the factory under controlled conditions. If the controller is not operating at a temperature corresponding to the scale and differential setting, verify that the bulb senses the average temperature of the medium. If the temperature of the controlled medium is changing rapidly, the differential will appear wider than its setting.

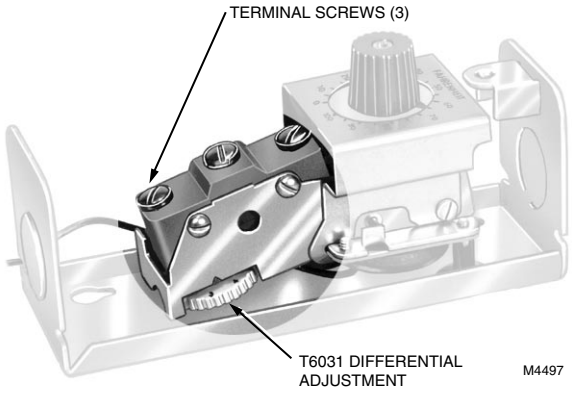


Fig. 7. Internal view showing differential adjustment wheel (applicable models).

For calibration, take an accurate temperature reading of the controlled medium. Place an accurate thermometer near the bulb of the controller, or refer to a thermometer installed as part of the system. If the bulb of the controller is installed in an inaccessible area, or if the controlled medium is unstable, remove the bulb and place in a controlled bath for accurate calibration.

These controllers are calibrated so the dial setting is the point at which the R-W switch contacts make (B-R contacts break) on a temperature rise. Measure the temperature at the bulb. Rotate the dial counterclockwise ↶ from the top of the scale, simulating a temperature rise, until the R-W switch contacts make. Note the dial reading. If it differs from the setpoint, calibrate the dial as follows:

1. Determine the number of degrees difference between the set point and the point at which the contacts make.
2. Remove the dial knob and slip the fingers of the calibration wrench into the slots of the dial. Rotate the dial until the fingers of the wrench drop into the slots of the calibration nut under the dial. Note the dial indication at this point. Turn the dial and the calibration nut up or down scale the number of degrees that the set point differs from the point at which the contacts make (determined in step 1). For example, move the dial from 45 to 65 degrees for a 20 degree change in calibration.
3. Check the calibration adjustment by moving the dial up and down the scale while watching the contacts make and break. If dial is still out of calibration, repeat calibration procedure.
4. To install tamper-resisting insert on TRADELINE® model, remove screw from adjustment knob, remove knob, and install insert.

Class I, Div. 2, Groups A,B,C,D
Class I, Zone 2, Groups IIC,IIB,IIA
NEMA 3, 4*

Listed - File E10514
UL-1571 Standard for incandescent fixtures
UL-844 Standard for hazardous location fixtures

Certified - File LR11713

Pendant

Ceiling

FEATURES-SPECIFICATIONS

Applications

Killark "V" Series Vaportight fixtures are now available Third Party Certified for use in certain hazardous as well as wet locations which require durable, protected lighting fixtures.

Wet and dirt laden industrial environments such as walkways, tunnels, loading docks, stairwells, etc. made hazardous by the presence of flammable vapors as defined by the NEC.

Fixtures intended for base-up mounting only.

Heat resistant (tempered) glass globes recommended for wet locations.

** NEMA 3, 4 when used with tempered glass.*

Features

Killark Vaportight assemblies using V**X**FC bodies & tempered glass have all the features & advantages of "V" Enclosed & Gasketed" models plus:

- Heavy-duty silicone gasketing for NEMA 4 requirements
- Third party tested & labeled for use in C1D2 areas
- Modular design permits selection of splice box, fixture body, globe, guard and reflector for specific or custom applications
- Existing V Series mounting boxes may be retrofitted to upgrade to NEMA 4; C1D2 suitability

Copper-free aluminum construction with electrostatically applied epoxy/polyester finish resists corrosion

APPLICATION DATA①

FIXTURE TYPE	LAMP SIZE	GLOBE TYPE	TEMPERATURE CODE
100	A-19 60W	colored & clear	T2C (230°C)
100	A-19 70W	colored & clear	T2D (215°C)
100	A-19 100W	colored & clear	T2A (280°C)
100	A-21 100W	colored & clear	T2B (260°C)
100	A-21 150W	colored & clear	T2 (300°C)
100	A-21 100W	clear only	T2B (260°C)
100	A-21 150W	clear only	T2C (230°C)
200	A-23 200W	colored & clear	T2 (300°C)
200	PS-25 200W	colored & clear	T2A (280°C)
200	PS-25 300W	colored & clear	(350°C)

① *Suitability based on base up installation*

See dimensions page L13.

L

HUBBELL
KILLARK®

Class I, Div. 2, Groups A,B,C,D②
Class I, Zone 2, Groups IIC,IIB,IIA
NEMA 3, 4

Listed - File E10514
UL-1571 Standard for incandescent fixtures
UL-844 Standard for hazardous location fixtures
Certified - File LR11713

ORDERING INFORMATION

PENDANT MOUNT WITH VGA SPLICE BOX

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VUAGG-1-100PX**①	VGA-1	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VUAGG-2-100PX**①	VGA-2	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VUAGG-1-200PX**①	VGA-1	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VUAGG-2-200PX**①	VGA-2	VXFC-200 N34	VCGP-200	VAG-200

CEILING FIXTURE WITH VGX SPLICE BOX

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VUXGG-1-100PX**①	VGX-1	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VUXGG-2-100PX**①	VGX-2	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VUXGG-1-200PX**①	VGX-1	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VUXGG-2-200PX**①	VGX-2	VXFC-200 N34	VCGP-200	VAG-200

CEILING FIXTURE WITH MOUNTING FEET USING VBC SPLICE BOX & VBA ADAPTER

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX/ADAPTER	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VUXBGG-1-100PX**①	VBC-1+VBA	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VUXBGG-2-100PX**①	VBC-2+VBA	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VUXBGG-1-200PX**①	VBC-1+VBA	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VUXBGG-2-200PX**①	VBC-2+VBA	VXFC-200 N34	VCGP-200	VAG-200

WALL FIXTURE WITH MOUNTING FEET USING VBC SPLICE BOX & VB ELBOW

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX/ELBOW	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VFBGG-1-100PX**①	VBC-1 + VB-1	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VFBGG-2-100PX**①	VBC-2 + VB-2	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VFBGG-1-200PX**①	VBC-1 + VB-1	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VFBGG-2-200PX**①	VBC-2 + VB-2	VXFC-200 N34	VCGP-200	VAG-200

**For other colors, order globes and mounting components separately.*
① Fixture supplied as component unit pack when ordered by this catalog number.
② See page L9 for temperature codes; NEMA 3, 4 when used with tempered glass.

GRAINGER
FOR THE ONES WHO GET IT DONE

Sensor, Motion, 500 W

LUMAPRO

Price: $141.30 / each

Typically in Stock

Add Repair & Replacement Coverage for $35.95 each.

Item # **4VW95** Mfr. Model # **4VW95** UNSPSC # **46171608**

Catalog Page # **717** Shipping Weight **7.75 lbs.**

Country of Origin **China** Country of Origin is subject to change.

click to call

close

Technical Specs

Item	**Professional Series Motion Sensor Kit**
Max. Load	**500W**
Coverage	**23,500 sq. ft.**
Viewing Angle	**270 Degrees**
Voltage	**120**
Housing Material	**All Metal**
Housing Finish	**Bronze**

Lamp Type	**Quartz Halogen**
Lamp Included	**Yes**
Sensor Type	**Passive Infrared Motion Sensor**
Standards	**UL Listed, Weatherproof**
Includes	**(2) 250 W Lamps, (2) Lamp Holders, 4" Round Box Cover, and a Motion Sensor**
Green Environmental Attribute	**Product Contributes to Reducing Energy Consumption**

Compliance and Restrictions

Green Product - This item has been designated by the manufacturer as an environmentally preferable product (EPP) because this item has one or more environmentally preferable attributes. For additional information, see the Tech Specs tab on the product description page.

This product contains a chemical that is regulated under California Proposition 65.

Warning: This product contains a chemical know n to the State of California to cause cancer.

Warning: This product contains a chemical know n to the State of California to cause birth defects or other reproductive harm.

Related Products

1 of 2 Prev | Next

Box, Weatherproof, Gray

Item # 2V567
BELL

Price:$17.14

Wire Connector, Wiretwist, Yellow, PK 100

Item # 6VG25
BUCHANAN

Price:$8.22

Plug, Closure, Gray

Item # 4A249
BELL

Price:$0.93

Electrical Tape, 3/4 x 66 ft, 7 mil, Black

Item # 2A225
SCOTCH

Price:$7.88

Customers Also Purchased

Prev | Next

SECTION 24 - ENCLOSURE EQUIPMENT - GW ENCLOSURE (NEC CLASS 1, DIVISION 2)

HEATER, 3.6 KW, 208 VAC, 1 PH - DAYTON MODEL 2CJF2

HEATER THERMOSTAT - COLUMBUS ELECTRIC MODEL EPETD8DJ

EXHAUST FAN, 16", 0.25 HP, 115 VAC, 1 PH, EXP - DAYTON MODEL 10D997

EXHAUST FAN THERMOSTAT - COLUMBUS ELECTRIC MODEL EPETD8DJ

LIGHT FIXTURES, CLASS 1 DIVISION 2 - KILLARK MODEL VUXBGG-2-100X

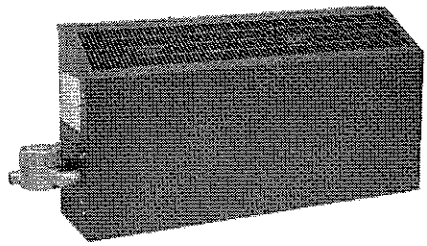
EXTERIOR LIGHT FIXTURES - LUMAPRO MODEL 4VW95

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Dayton® Hazardous Location Electric Convection Heaters

Description

These hazardous location heaters have been designed for installation in areas where potentially explosive, flammable vapors may be in the atmosphere, but a comfortable range of heat is maintained and desired.



Features

Heavy duty 16 ga. steel cabinet with epoxy textured powder coat finish.

Stainless steel cartridge element inserted into aluminum finned copper sheath.

Standard unit Is NEMA 4 rated.

Specifications

Temperature Code: Do not install in areas where vapors or gases having an ignition temperature less than 280°C (536°F) for T-2A models, and 180°C (356°F) for T-3A models.

Ratings: Class 1, Groups B, C, and D. Division 1 and 2, T-2A (280°C/536°F) or T-3A (180°C/356°F) depending on specific wattage models. NEMA 4.

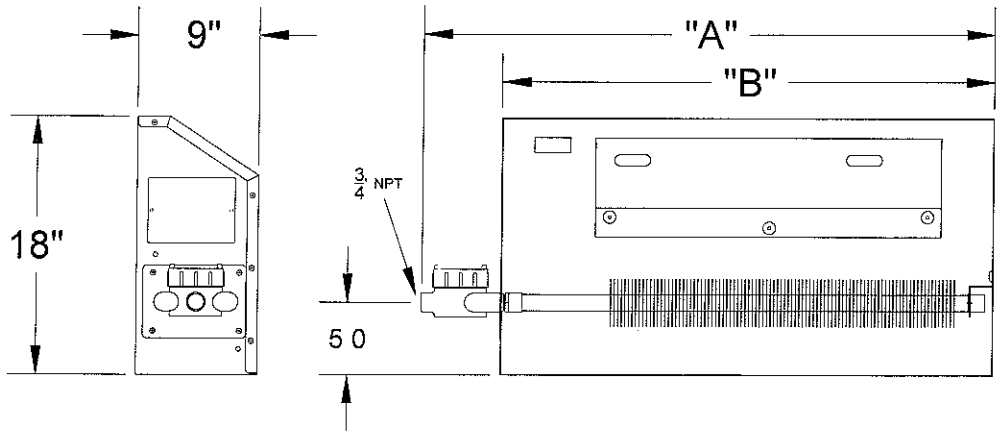
For additional information on Div., Class and Groups, refer to NEC Article 500 HAZARDOUS (CLASSIFIED) LOCATIONS

Unpacking

Remove the heater from carton and discard. Inspect heater for any damage. If it appears to be damaged, return immediately

Dimensions

MODEL	A	B
2CJE8,2CJE9,2CJF1,2CJF2,2CJF3,2CJF4	39 1/2	34
2CJF5,2CJF6	63 1/2	58



ENGLISH

ESPANOL

FRANCAIS

Printed in U S A
02966
0208/029/VCPVP

Part No.: 8994
ECO 1-5871

Dayton®

Dayton® Hazardous Location Electric Convection Heaters

ENGLISH

General Safety Information

⚠WARNING DO NOT ATTEMPT TO INSTALL, OPERATE, OR SERVICE THIS PRODUCT BEFORE READING ALL INSTRUCTIONS CAREFULLY. FAILURE TO COMPLY WITH THESE INSTRUCTIONS COULD RESULT IN FIRE, PERSONAL INJURY AND/OR PROPERTY DAMAGE! RETAIN INSTRUCTIONS FOR FUTURE REFERENCE.

⚠WARNING Do not install in areas where vapors or gases have an ignition temperature less than the rating of the heater. Heater ratings are: 280°C (536° F) for T-2A models and 180°C (356°F) for T-3A models. Note: Information regarding ignition temperatures is contained in NFPA 325M "Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids" available from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

⚠WARNING These heaters must not be operated in ambient temperatures exceeding 40°C (104°F). To assure heaters are not operated at temperatures exceeding the above, the heater should be controlled by a thermostat. This should be located at the same level as the heater.

1. Comply with the National Electric Code definition of Class 1, Division 1 & 2, Group B, C and D hazardous locations, including areas where the potential for explosion and fire is high. Some potentially hazardous situations include, but are not limited to, flammable gases, chemical vapors, liquified petroleum or natural gas vapor from dry cleaning solvents; and other situations as detailed by the National Electric Code.
2. Do not install one unit above another.
3. Heaters must be mounted on a wall in a horizontal position, with the terminal end at the left. Never recess the heater into the wall.
4. During normal operation, this heater will develop high surface temperatures. To avoid possible injury, do not touch the top of the heater enclosure.
5. Never place any material or object on top of the heater enclosure. Never obstruct the flow of air through the unit.
6. Make certain incoming power conforms to the requirement of the heater.
7. Disconnect power supply to heater before servicing or inspecting any part of the heater. Failure to do so may result in electrical shock.
8. SAVE THESE INSTRUCTIONS

Installation

Mounting

⚠WARNING For ample airflow, a 9" minimum space from the bottom of the heater to the floor is required. DO NOT mount directly on the floor.

1. Attach the wall bracket with the "V" at the top. Use 3/8" bolts and wall anchors supplied by installer.
2. Hang the heater onto the "V" bracket, using the horizontal slots located on the rear housing panel.
3. Secure the heater by fastening the bottom, with the 1/4-20 screws furnished, to the bottom of the bracket. This may be done through the opening in the bottom of the heater. In some cases, the front housing panel can be removed for easier access

Electrical

1. This heater must be wired in accordance with local electrical and safety codes, as well as Article 501 of the National Electric Code for Class 1 Hazardous Locations.
2. **⚠WARNING** An approved conduit seal (not included) must be provided at the entrance to the conduit box. To prevent ignition of Group B Atmospheres, conduit runs must not exceed 3/4" in size, and all conduit runs 1/2" size and larger must have a sealing fitting connected within 2" of the terminal enclosure.
3. Connect one lead from each element to L1, and connect the other lead from each element to L2 (see Figs. A and B). For 3-phase units see Fig. C. Always observe the wiring diagram on the unit.
4. Any auxiliary control equipment, such as a disconnect switch, contactor or thermostat which is located within the hazardous location, must be specifically designed and approved for that hazardous location. NOTE: It is the users' responsibility to assure that adequate controls and safety devices are installed with their electric heating equipment.

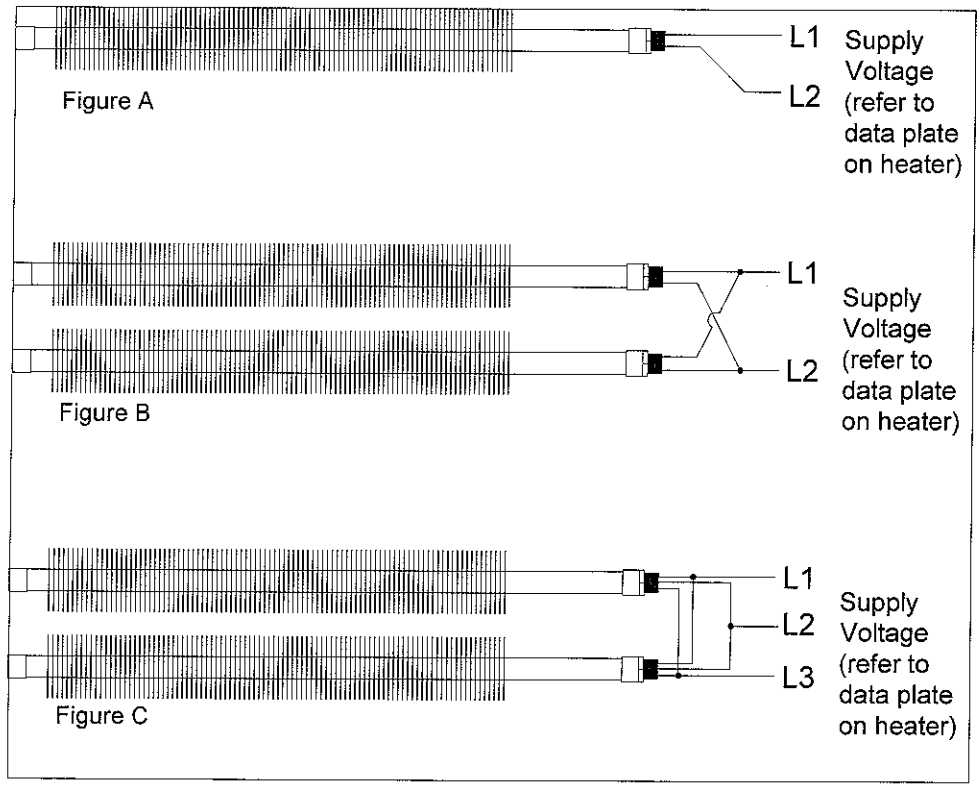
⚠WARNING If the possibility exists for the ambient temperature to exceed 40°C / 104°F, a thermostat should be installed in close promimity to the heater.

⚠WARNING This unit must be protected by either "a circuit breaker acceptable for branch circuit protection" or by "a fuse acceptable for branch circuit protection such as a Class CC, G, H, J, K, L, R or T cartridge fuse or a Type S plug fuse".

Models 2CJE8, 2CJE9 AND 2CJF1 thru 2CJF6

ENGLISH

Wiring Diagrams



Operation

This heater may be controlled by a thermostat or a contactor and thermostat. If control equipment is located in a hazardous location, it too must be approved for this location. It is essential that over-current protection be provided for the heater alone and should be of a value as near as possible to the current rating indicated on the heater data plate

Do not operate the heater at voltages in excess of that stamped on the heater, since excess voltage will shorten heater life and cause high element temperatures. These may exceed allowable temperatures of operation in a hazardous atmosphere.

⚠WARNING Never operate the heater with the front panel off. Air flow across the heating elements requires the front panel in place. Injury from hot heating elements is possible with the front panel removed.

Maintenance

Always disconnect the heater from the power source before performing any service or maintenance.

1. Keep heater clean, especially the heating elements.

2 Remove dust, lint and accumulation of other material.

3. Never allow the heater to operate with restriction to the free circulation of air through it.

4. Check that the heater has not been damaged or deformed, and that all conduit joints are secure.

Dayton®

For Repair Parts, Call 1-800-323-0620

24 Hours a day - 365 days a year

Please provide the following information:
-Model number
-Serial number (if any)
-Part description and number shown as shown in parts list

ENGLISH

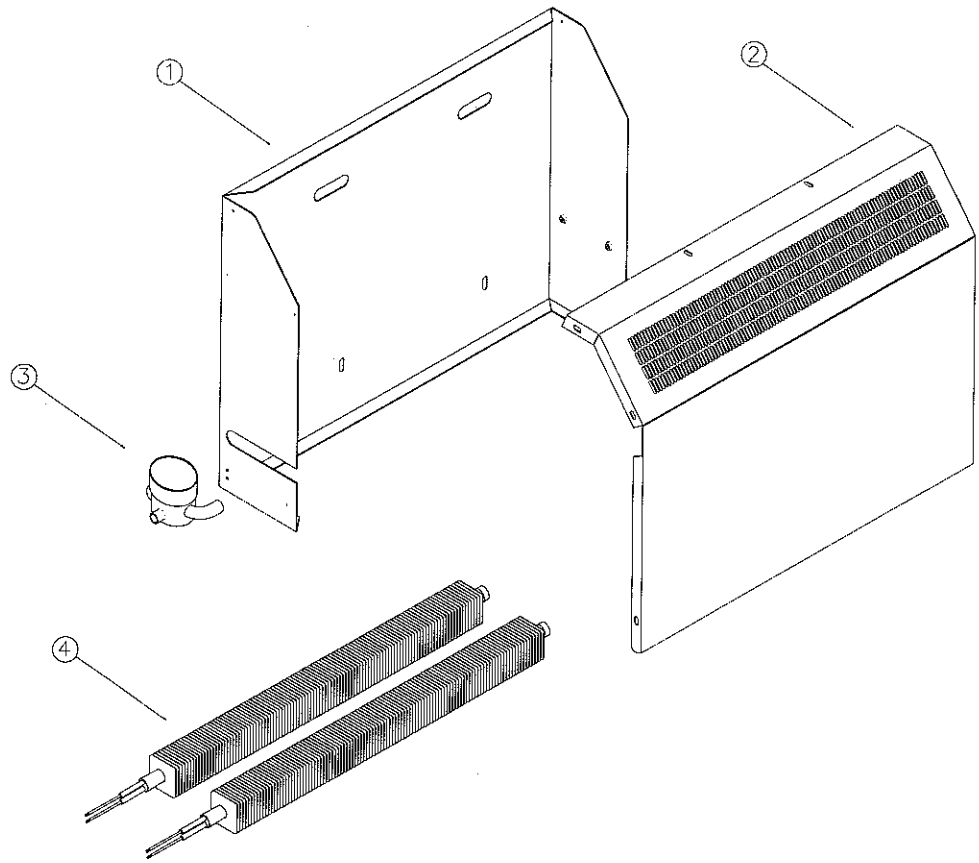


Figure 1 - Repair Parts Illustration for Hazardous Location Convection Heater

Repair Parts List for Hazardous Location Unit Heaters

Reference Number	Description	Part Number for Models 2CJE8	2CJE9	2CJF1	2CJF2	2CJF3	2CJF4	2CJF5	2CJF6
1	Rear Cabinet	63874003	63874003	63874003	63874003	63874003	63874003	63874004	63874004
2	Front Cabinet	63875003	63875003	63875003	63875003	63875003	63875003	63875004	63875004
3	Outlet Box	43416001	43416001	43416001	43416001	43416001	43416001	43416001	43416001
4	Element	53165001	53165002	53165003	53165002	53165003	53165032	53165006	53165034

Dayton® Hazardous Location Electric Convection Heaters

ENGLISH

LIMITED WARRANTY

DAYTON ONE-YEAR LIMITED WARRANTY. *DAYTON® Temperature Controls, MODELS COVERED IN THIS MANUAL, ARE WARRANTED BY DAYTON ELECTRIC MFG. CO. (DAYTON) TO THE ORIGINAL USER AGAINST DEFECTS IN WORKMANSHIP OR MATERIALS UNDER NORMAL USE FOR ONE YEAR AFTER DATE OF PURCHASE. ANY PART WHICH IS DETERMINED TO BE DEFECTIVE IN MATERIAL OR WORKMANSHIP AND RETURNED TO AN AUTHORIZED SERVICE LOCATION, AS DAYTON DESIGNATES, SHIPPING COSTS PREPAID, WILL BE, AS THE EXCLUSIVE REMEDY, REPAIRED OR REPLACED AT DAYTON'S OPTION. FOR LIMITED WARRANTY CLAIM PROCEDURES, SEE "PROMPT DISPOSITION" BELOW. THIS LIMITED WARRANTY GIVES PURCHASERS SPECIFIC LEGAL RIGHTS WHICH VARY FROM JURISDICTION TO JURISDICTION.*

LIMITATION OF LIABILITY. *TO THE EXTENT ALLOWABLE UNDER APPLICABLE LAW, DAYTON'S LIABILITY FOR CONSEQUENTIAL AND INCIDENTAL DAMAGES IS EXPRESSLY DISCLAIMED. DAYTON'S LIABILITY IN ALL EVENTS IS LIMITED TO AND SHALL NOT EXCEED THE PURCHASE PRICE PAID.*

WARRANTY DISCLAIMER. *A DILIGENT EFFORT HAS BEEN MADE TO PROVIDE PRODUCT INFORMATION AND ILLUSTRATE THE PRODUCTS IN THIS LITERATURE ACCURATELY; HOWEVER, SUCH INFORMATION AND ILLUSTRATIONS ARE FOR THE SOLE PURPOSE OF IDENTIFICATION, AND DO NOT EXPRESS OR IMPLY A WARRANTY THAT THE PRODUCTS ARE MERCHANTABLE, OR FIT FOR A PARTICULAR PURPOSE, OR THAT THE PRODUCTS WILL NECESSARILY CONFORM TO THE ILLUSTRATIONS OR DESCRIPTIONS. EXCEPT AS PROVIDED BELOW, NO WARRANTY OR AFFIRMATION OF FACT, EXPRESSED OR IMPLIED, OTHER THAN AS STATED IN THE "LIMITED WARRANTY" ABOVE IS MADE OR AUTHORIZED BY DAYTON.*

Technical Advice and Recommendations, Disclaimer. *Notwithstanding any past practice or dealings or trade custom, sales shall not include the furnishing of technical advice or assistance or system design. Dayton assumes no obligations or liability on account of any unauthorized recommendations, opinions or advice as to the choice, installation or use of products.*

Product Suitability. *Many jurisdictions have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes, which may vary from those in neighboring areas. While attempts are made to assure that Dayton products comply with such codes, Dayton cannot guarantee compliance, and cannot be responsible for how the product is installed or used. Before purchase and use of a product, review the product applications, and all applicable national and local codes and regulations, and be sure that the product, installation, and use will comply with them.*

Certain aspects of disclaimers are not applicable to consumer products; e.g., (a) some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you; (b) also, some jurisdictions do not allow a limitation on how long an implied warranty lasts, consequently the above limitation may not apply to you; and (c) by law, during the period of this Limited Warranty, any implied warranties of implied merchantability or fitness for a particular purpose applicable to consumer products purchased by consumers, may not be excluded or otherwise disclaimed.

Prompt Disposition. *A good faith effort will be made for prompt correction or other adjustment with respect to any product which proves to be defective within limited warranty. For any product believed to be defective within limited warranty, first write or call dealer from whom the product was purchased. Dealer will give additional directions. If unable to resolve satisfactorily, write to Dayton at address below, giving dealer's name, address, date, and number of dealer's invoice, and describing the nature of the defect. Title and risk of loss pass to buyer on delivery to common carrier. If product was damaged in transit to you, file claim with carrier.*

Manufactured for Dayton Electric Mfg. Co., 5959 W. Howard St., Niles, Illinois 60714-4014 U.S.A.

COLUMBUS ELECTRIC

INSTALLATION & INSTRUCTION SHEET
LINE VOLTAGE THERMOSTAT - ET SERIES

DESCRIPTION

The Columbus Electric Wall Line Voltage Thermostat is suitable for direct connection with any resistance heating elements and unit heaters.

This thermostat has a snap action switch operated by a bimetal actuator and is available in single pole, double pole with positive off, two stage heat, cooling only and heat or cool models. Other options include factory or field installed locking kits for top and for bottom setting and 6" wire leads.

WARNING

IF THIS PRODUCT IS USED TO REPLACE A DEVICE CONTAINING MERCURY, THE PURCHASER OR CONSUMER MUST ENSURE THAT THE MERCURY IS PROPERLY MANAGED TO COMPLY WITH STATE OR FEDERAL REGULATIONS. THE MERCURY MUST NOT BECOME PART OF SOLID WASTE OR WASTE WATER. ADDITIONAL GUIDANCE MAY BE OBTAINED FROM THE MANUFACTURER OF THE PRODUCT BEING REMOVED, OR BY CALLING COLUMBUS ELECTRIC MANUFACTURING COMPANY MATERIALS MANAGER.

1-800-251-7828

SPECIFICATIONS

ELECTRICAL RATING
22 AMPS @ 125/277 VAC
3/4 HP @ 125 VAC
1 1/2 HP @ 250/277 VAC

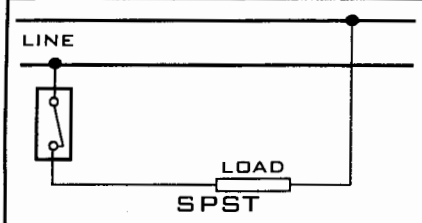
DIFFERENTIAL
HEAT APPROXIMATELY.....2°F
COOLING APPROXIMATELY....4°F
HEAT ANTICIPATOR MODEL...1/2°F

TEMPERATURE RANGE
(STANDARD MODELS)
SETTING RANGE.....50°F TO 90°
HEATING OR COOLING.50°F TO 90°
ATTIC FAN CONTROL...90°F TO 135°

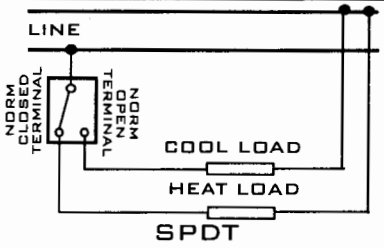
APPROVALS
U.L. APPROVED
C.S.A. CERTIFIED

DIMENSIONS
4 3/4 X 2 3/4 X 2 3/4
H W D

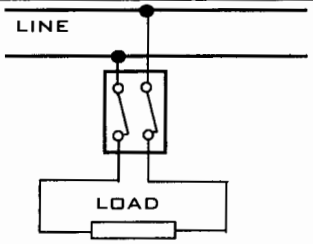
INSTALLATION / OPERATION



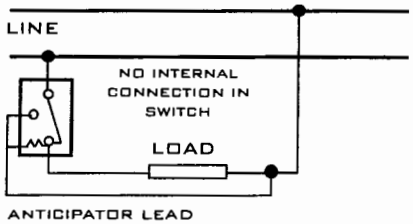
SPST
HEATING OR COOLING



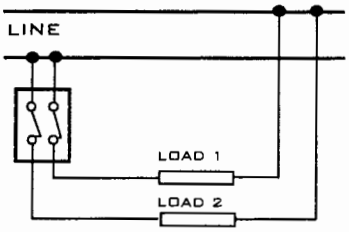
SPDT
HEATING OR COOLING



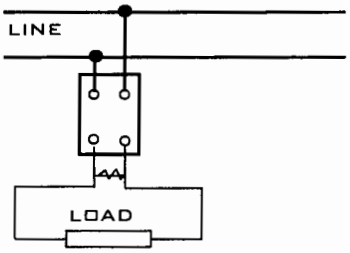
DPST HEATING



SPDT WITH
ANTICIPATION HEATING



TWO STAGE
HEATING & COOLING



DPST WITH ANTICIPATION
HEATING

8001
REV. G

P.O. BOX 4973 JOHNSON CITY, TN. 37602-4973 423-477-4131

COLUMBUS ELECTRIC MANUFACTURING

OPERATION & INSTALLATION MANUAL

EP-ETD-8D DPDT HEAT/COOL
EP-ETD-8S SPDT HEAT/COOL

EXPLOSION PROOF THERMOSTAT

The Columbus Electric Explosion Proof Thermostat is designed to control heating only, cooling only, heating and cool or ventilation systems in oil refineries, grain elevators, munition plants, hospital operating rooms and other hazardous locations.

The switch mechanism is enclosed in a 1/2" thick cast aluminum case which is dust proof and dust resistant. A reliable sensing element provides accurate response to temperature change and does not require leveling during installation.

The casing is tapped top and bottom for 3/4" conduit, a 1/2" adaptor is provided.

SPECIFICATIONS

Electrical Rating: 22 Amp 125-277 VAC
3/4 HP at 125 VAC
1 1/2 HP 250/277 VAC

Dimensions: 5.62" x 6.37" x 4.43"
Approvals: U.L. AND C.S.A.
Class I Groups C & D
Class II Groups E, F, & G

Differential: Heat: 2°F/Cool: 4°F

Temp Set Range: 50°F to 90°F

INSTALLATION

ALL WIRING MUST COMPLY WITH NFPA-70(NEC), LOCAL CODES AND ORDINANCES:

Locate the thermostat approximately five feet (5') above the floor in a location that will sense the average temperature of the area to be controlled. Do not mount the thermostat adjacent to water pipes, in drafty areas, or other locations that would adversely affect the operation of the thermostat.

1) Remove the cover of the thermostat and set it aside. Exercise care not to mar the mating surface or damage the temperature sensing/operating components. CAUTION: Marring of the mating surfaces of the enclosure could destroy the integrity of the seal causing an unsafe condition during operation of the thermostat.

2) Mount the thermostat base on the surface selected. See Fig. 1 for dimensions.

3) The base is tapped for 3/4" conduit; a 1/2" conduit adaptor and a 3/4" plug is provided. Two openings are provided. Unused openings must be properly plugged, with plugs provided, prior to applying power to the unit.

4) Connect the conduit to the mounted base and place the required wire into the base.

5) Connections are to be made to the switch terminals on the cover, see Fig. 2. The cover can then be installed to the base and securely fastened utilizing the four (4) mounting screws. Immediately prior to assembly, inspect the mating surfaces of the cover and enclosure. Do not connect if surfaces are uneven or gaps exist between the cover and enclosure. Install the four (4) cover screws to enclosure and TIGHTEN TO A MINIMUM OF 40 INCH POUNDS.

6) The installer must seal each conduit run within 18" of the thermostat enclosure. This seal must be a suitable listed hazardous location fitting.

DIAGRAMS

FIG 1

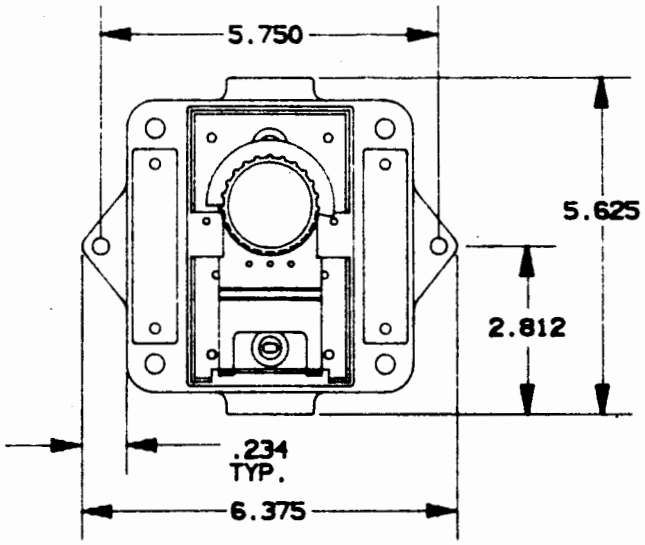
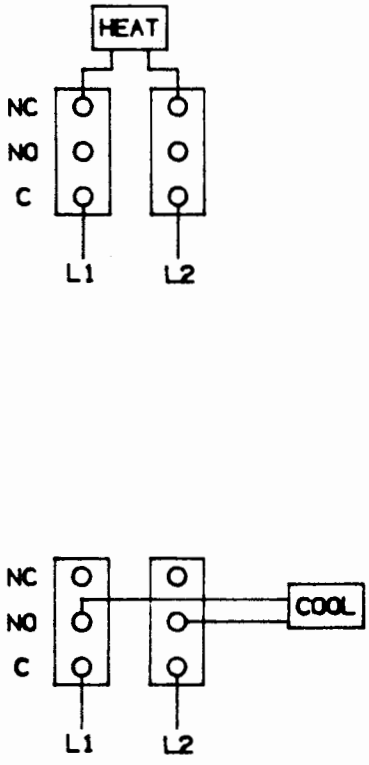


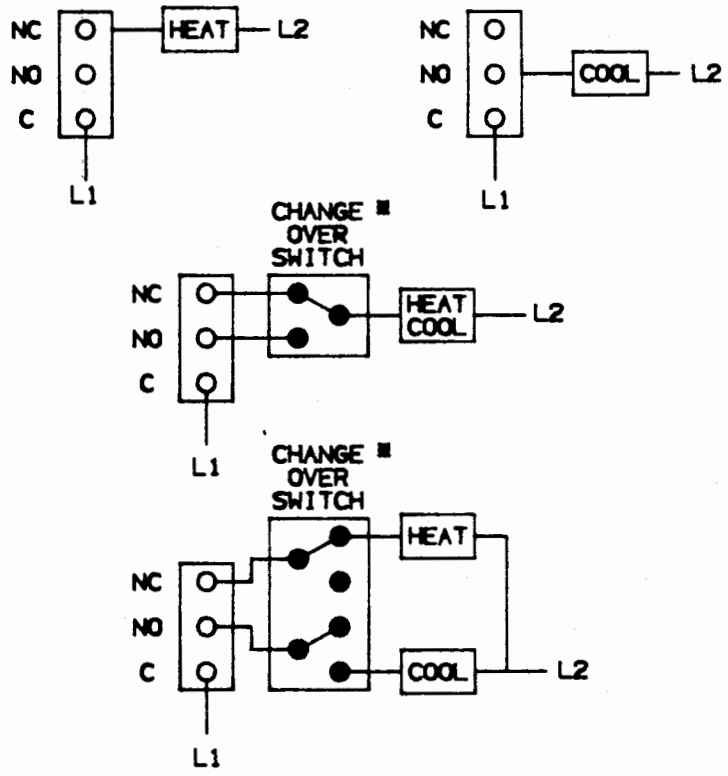
FIG 2

TYPICAL WIRING DIAGRAMS

EP-ETD-8D



EP-ETD-8S



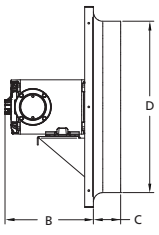
* TO BE PROVIDED BY INSTALLER

Please read and save these instructions. *Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*

Dayton® Hazardous Location Direct-Drive Exhaust Fans

Description

Dayton hazardous location exhaust fans are designed for ventilating spaces containing flammable or explosive vapors, gases, or dusts as defined under Article 500 of the National Electrical Code (NEC). Mount in vertical or horizontal position. Construction includes galvanized steel frame, pre-punched mounting holes, hazardous location ball bearings, and spark-resistant aluminum propeller. Motor is explosion-proof, fan-cooled enclosure with Class B insulation (if marked on motor). All fans have a maximum ambient temperature of 104ºF (if marked on motor) and are UL/cUL Listed Standard 1203, NEC Class I, Groups C and D; NEC Class II, Groups F and G (Model 10E020 Groups E, F and G).



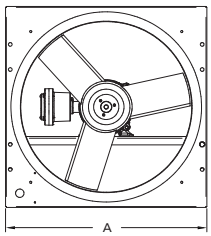
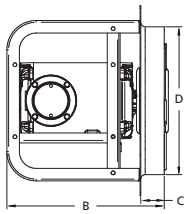


Figure 1 — Panel Fan Dimensions



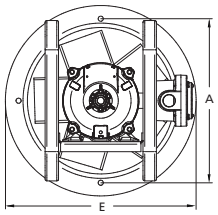


Figure 2 — Ring Fan Dimensions

Dayton Electric Mfg. Co. certifies that the fans shown herein are licensed to bear the AMCA seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and AMCA Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

c UL us LISTED
E197939

Unpacking

1. Inspect for any damage that may have occurred during transit.
2. Shipping damage claim must be filed with carrier.
3. Check all bolts, screws, set-screws, etc. for looseness that may have occurred during transit. Retighten as required. Rotate propeller by hand to be sure it turns freely.

Dimensions and Specifications

Model	Prop. Dia.	Shaft Dia.	A	B	C	D	E	Blades	Recommended Wall Opening — Direct to Wall	Recommended Wall Opening — Wall Collar, Wall Collar & Guard, or Wall Housing
PANEL FANS (See Figure 1)										
10D995, 10D996	12"	5/8"	16"	9½"	3"	12¼"	—	5	14½ x 14½"	17¼ x 17¼"
10D997, ~~10D998~~	16	5/8	20	9½	3¼	16½	—	3	18½ x 18½	21¼ x 21¼
10D999	18	5/8	22	9½	3⅛	18½	—	3	20½ x 20½	23¼ x 23¼
10E001	18	5/8	22	11	3⅛	18½	—	3	20½ x 20½	23¼ x 23¼
10E002, 10E003	20	5/8	24	11½	3¾	20½	—	3	22½ x 22½	25⅝ x 25⅝
10E004, 10E005, 10E006	24	5/8	28	11½	3⅞	24½	—	3	26½ x 26½	29⅝ x 29⅝
10E007	24	5/8	28	12	3⅞	24½	—	3	26½ x 26½	29⅝ x 29⅝
RING FANS (See Figure 2)										
10E008, 10E009	12"	5/8	14⅞"	13½"	2"	12½"	16¼"	5	13½" Dia.	—
10E010, 10E011	16	5/8	18⅞	13½	2	16½	20¼	3	17½	—
10E012, 10E013	18	5/8	20⅞	13½	2	18½	22¼	3	19½	—
10E014, 10E015	20	5/8	23	13½	2	20½	24¼	3	21½	—
10E016, 10E017, 10E018, 10E019	24	5/8	26⅞	13½	2	24½	28¼	3	25½	—
10E020	30	5/8	32	17½	2	30½	34¼	3	31½	—

ENGLISH

ESPAÑOL

FRANÇAIS

Form 5S7003

Printed in U.S.A.
04632
Version 0

474904
Rev. 1, November 2011

Dayton® Hazardous Location Direct-Drive Exhaust Fans

ENGLISH

Performance

Model 1-PHASE 115/208-230	Model 3-PHASE 208-230/460	Prop. Dia.	HP	Motor RPM	Sones @ 0.000" SP @ 5Ft.	CFM Air Delivery @ Static Pressure Shown 0.000"	0.125"	0.250"	0.375"	0.500"
PANEL FANS										
10D995	**10D996**	12"	1/4	1750	13.4	1347	1262	1142	947	604
10D997	~~**10D998**~~	16	1/4	1750	14.1	2476	2288	2061	1769	1350
10D999	**10E001**	18	1/3	1750	19.1	3168	2912	2612	2219	1599
10E002	**10E003**	20	1/2	1750	23	4557	4254	3919	3542	3101
10E004	**10E006**	24	1/2	1750	26	5669	4946	4010	2963	1906
10E005	**10E007**	24	3/4	1750	28	6317	5851	5314	4729	4117
RING FANS										
10E008	**10E009**	12"	1/4	1725	13.6	1147	999	803	682	—
10E010	**10E011**	16	1/4	1750	17.0	2153	1943	1713	1366	1125
10E012	**10E013**	18	1/4	1750	21	2371	2089	1756	1423	1088
10E014	**10E015**	20	1/4	1750	23	2429	2074	1744	1341	1098
10E016	**10E018**	24	1/3	1750	30	3837	3305	2637	1970	—
10E017	**10E019**	24	1/2	1750	26	5669	4946	4010	2963	1906
10E020	—	30	3/4	1140	28	8153	7515	6804	5957	4956

Performance certified is for installation type A: Free inlet, Free outlet. Performance ratings do not include the effects of appurtenances (accessories). Speed (RPM) shown is nominal. Performance is based on actual speed of test. The sound ratings shown are loudness values in fan sones at 5 ft. (1.5 m) in a hemispherical free field calculated per AMCA Standard 301. Values shown are for installation type A: Free inlet hemispherical sone levels.

General Safety Information

⚠ DANGER ***Do not depend on any switch as the sole means of disconnecting power when installing or servicing the fan. Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury. Units with thermally protected motors, motor will restart without warning after thermal protector trips. Do not touch operating motor, it may be hot enough to cause injury.***

⚠ DANGER ***Do not place any body parts or objects in fan, motor openings or drives while motor is connected to power source.***

1. Read and follow all instructions and cautionary markings. Make sure electrical power source conforms to requirements of equipment and local codes.
2. Fans should be assembled, installed and serviced by a qualified technician. Have all electrical work performed by a qualified electrician.
3. Follow all local electrical and safety codes in the United States and Canada, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA) in the United States. Ground motor in accordance with NEC Article 250 (grounding). Follow the Canadian Electric Code (CEC) in Canada.
4. All moving parts should be guarded.

⚠ CAUTION ***To reduce the risk of injury to persons, observe the following:***

OSHA requires OSHA complying guards when fan is installed within 7 feet of floor or working level.

UL/cUL Standards require OSHA complying guards when fan is installed within 8 feet of floor or working level.

5. Make certain that the power source conforms to the requirements for the equipment.

Installation

⚠ WARNING ***Installation, troubleshooting and parts replacement is to be performed only by qualified personnel.***

⚠ CAUTION ***If gases, other than clean air, are to be exhausted using the fan, then the user bears the responsibility of determining that the fan is appropriate and safe for the application.***

Models 10D995 thru 10D999, 10E001 thru 10E020

Installation (Continued)

⚠ WARNING ***Not for use where paint residue can accumulate on motor.***

⚠ CAUTION ***To reduce the risk of ignition of hazardous atmospheres, disconnect the fan from the supply circuit before opening. Keep the motor tightly closed with in operation.***

WALL MOUNTING

1. Move fan to the desired location and determine the method by which the fan is to be mounted.

NOTE: Wall opening size and propeller-to-shutter distance are two important dimensions for fan installation.

2. Cut an appropriate sized hole in the wall using the Dimensions table on page 1.

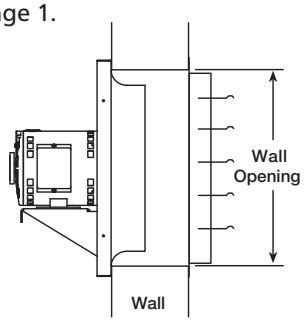


Figure 3 — Direct to Wall Installation

NOTE: Panel fans mounted to the wall require a different opening size than those mounted in collars or housings.

3. The fan should be securely mounted within a rigid framework to prevent flexing or movement of the fan frame during operation. The fan frame should be equally supported on all sides within the framework and caution should be taken to avoid twisting of the fan frame during installation.

NOTE: Allowing the fan frame to flex or move during operation will create harmful vibrations which may damage the unit.

4. Fans should be mounted in opening with 1/4" clearance around perimeter. Framing should be secured to building structure utilizing corrosion resistant fasteners (by others). Fasteners should be used in all pre-punched mounting holes.
5. Install remaining components (shutter, intake guard, etc.).
6. Check all fasteners and set screws for tightness.
7. Rotation direction of the propeller should be checked by momentarily turning the unit on. Rotation should be in the same direction as the rotation decal affixed to the unit. For 3-phase installations, fan rotation can be reversed by interchanging any two of the three electrical leads. For single phase installations follow the wiring diagram located on the motor.

ELECTRICAL CONNECTION

NOTE: Refer to motor nameplate for wiring procedures. Refer to switch manufacturer for installation and wiring procedures.

1. Motor and fan must be securely grounded (bare metal) to a suitable electric ground, such as a grounded water pipe or ground wire system.

⚠ WARNING ***Comply with all local and national safety codes including the National Electrical Code (NEC) and National Fire Protection Act (NFPA).***

NOTE: Motor and switch must be classified as hazardous for fan to be suitable for use in hazardous environments. Installation must be performed by a qualified personnel with suitable motor and disconnect for application.

2. Wire motor for desired voltage per wiring diagram on motor.
3. Wire control switches at ground level.
4. Before activating fan, inspect to be sure that there are no obstructions or debris that would interfere with the propeller.

Operation

1. Before starting up or operating your new Dayton fan, check all fasteners for tightness. In particular, check set screws in propeller hub.

   While in the OFF position, or before connecting the fan to power, turn the fan propeller by hand to be sure it is not striking the orifice or any obstacle.
2. Start the fan up and shut it off immediately to check rotation of the propeller with directional arrow in the motor compartment.
3. When the fan is started, observe the operation and check for any unusual noises.
4. Motor amperage should be checked to avoid overloading of the motor. With the system in full operation measure current input to the motor and compare with the nameplate rating to determine if the BHP is operating under safe load conditions. See performance on page 2.
5. Keep inlets and approaches to fan clean and free from obstruction.

Dayton® Hazardous Location Direct-Drive Exhaust Fans

ENGLISH

Maintenance

⚠ WARNING ***Always disconnect, lock and tag power source before installing or servicing. Failure to disconnect power source can result in fire, shock or serious injury.***

⚠ CAUTION ***Uneven cleaning of the propeller will produce an out of balance condition that will cause vibration in the fan.***

1. Depending on the usage and severity of the contaminated air, a regularly scheduled inspection for cleaning the fan propeller, housing and surrounding areas should be established.
2. Check for unusual noises when fan is running.
3. Periodically inspect and tighten set-screws.
4. Follow motor manufacturer's instructions for motor lubrication.

Troubleshooting Chart

Symptom	Possible Cause(s)	Corrective Action
Fan inoperative	1. Blown fuse or breaker	1. Replace or repair
	2. Incorrectly wired	2. Shut power OFF and check wiring for proper connections
	3. Electricity turned off	3. Contact local power company
Airflow - Reversed air	1. Propeller rotation reversed	1. Reverse motor rotation, rewire motor
Airflow - Too much air	2. Insufficient static pressure	2. Check static pressure calculation
Excessive noise or vibration	1. Foreign material inside bearing	1. Replace bearing
	2. Loose propeller	2. Tighten set screws or taper bushing screws
	3. Fan not securely anchored	3. Secure properly
Motor overloads or overheats	1. Incorrect propeller rotation	1. Check motor wiring
	2. Over/Under line voltage	2. Contact Power Company

Manufactured for Dayton Electric Mfg. Co.

Dayton®

COLUMBUS ELECTRIC

INSTALLATION & INSTRUCTION SHEET
LINE VOLTAGE THERMOSTAT - ET SERIES

DESCRIPTION

The Columbus Electric Wall Line Voltage Thermostat is suitable for direct connection with any resistance heating elements and unit heaters.

This thermostat has a snap action switch operated by a bimetal actuator and is available in single pole, double pole with positive off, two stage heat, cooling only and heat or cool models. Other options include factory or field installed locking kits for top and for bottom setting and 6" wire leads.

WARNING

IF THIS PRODUCT IS USED TO REPLACE A DEVICE CONTAINING MERCURY, THE PURCHASER OR CONSUMER MUST ENSURE THAT THE MERCURY IS PROPERLY MANAGED TO COMPLY WITH STATE OR FEDERAL REGULATIONS. THE MERCURY MUST NOT BECOME PART OF SOLID WASTE OR WASTE WATER. ADDITIONAL GUIDANCE MAY BE OBTAINED FROM THE MANUFACTURER OF THE PRODUCT BEING REMOVED, OR BY CALLING COLUMBUS ELECTRIC MANUFACTURING COMPANY MATERIALS MANAGER.

1-800-251-7828

SPECIFICATIONS

ELECTRICAL RATING
22 AMPS @ 125/277 VAC
3/4 HP @ 125 VAC
1 1/2 HP @ 250/277 VAC

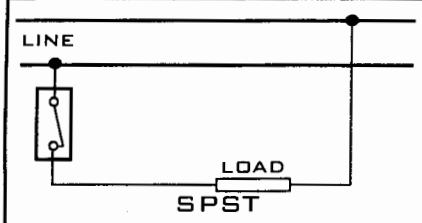
DIFFERENTIAL
HEAT APPROXIMATELY.....2°F
COOLING APPROXIMATELY....4°F
HEAT ANTICIPATOR MODEL...1/2°F

TEMPERATURE RANGE
(STANDARD MODELS)
SETTING RANGE.....50°F TO 90°
HEATING OR COOLING.50°F TO 90°
ATTIC FAN CONTROL...90°F TO 135°

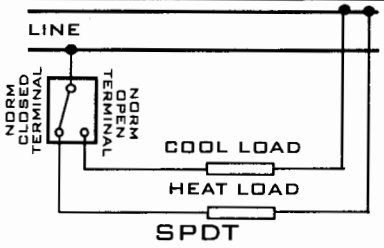
APPROVALS
U.L. APPROVED
C.S.A. CERTIFIED

DIMENSIONS
4 3/4 X 2 3/4 X 2 3/4
H W D

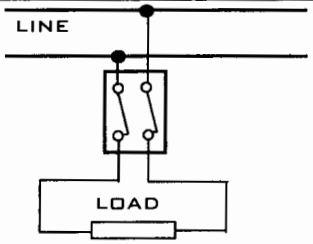
INSTALLATION / OPERATION



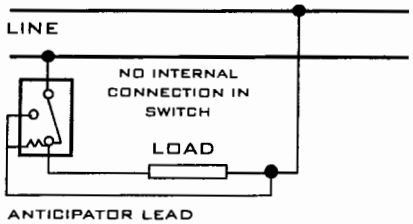
SPST
HEATING OR COOLING



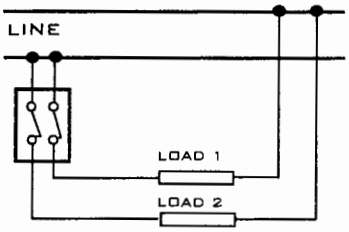
SPDT
HEATING OR COOLING



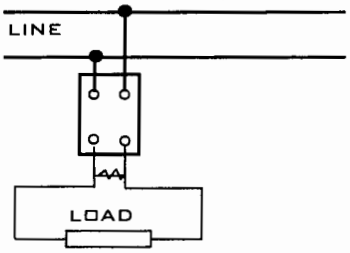
DPST HEATING



SPDT WITH
ANTICIPATION HEATING



TWO STAGE
HEATING & COOLING



DPST WITH ANTICIPATION
HEATING

8001
REV. G

P.O. BOX 4973 JOHNSON CITY, TN. 37602-4973 423-477-4131

COLUMBUS ELECTRIC MANUFACTURING

OPERATION & INSTALLATION MANUAL

EP-ETD-8D DPDT HEAT/COOL
EP-ETD-8S SPDT HEAT/COOL

EXPLOSION PROOF THERMOSTAT

The Columbus Electric Explosion Proof Thermostat is designed to control heating only, cooling only, heating and cool or ventilation systems in oil refineries, grain elevators, munition plants, hospital operating rooms and other hazardous locations.

The switch mechanism is enclosed in a 1/2" thick cast aluminum case which is dust proof and dust resistant. A reliable sensing element provides accurate response to temperature change and does not require leveling during installation.

The casing is tapped top and bottom for 3/4" conduit, a 1/2" adaptor is provided.

SPECIFICATIONS

Electrical Rating: 22 Amp 125-277 VAC
3/4 HP at 125 VAC
1 1/2 HP 250/277 VAC

Dimensions: 5.62" x 6.37" x 4.43"
Approvals: U.L. AND C.S.A.
Class I Groups C & D
Class II Groups E, F, & G

Differential: Heat: 2°F/Cool: 4°F

Temp Set Range: 50°F to 90°F

INSTALLATION

ALL WIRING MUST COMPLY WITH NFPA-70(NEC), LOCAL CODES AND ORDINANCES:

Locate the thermostat approximately five feet (5') above the floor in a location that will sense the average temperature of the area to be controlled. Do not mount the thermostat adjacent to water pipes, in drafty areas, or other locations that would adversely affect the operation of the thermostat.

1) Remove the cover of the thermostat and set it aside. Exercise care not to mar the mating surface or damage the temperature sensing/operating components. CAUTION: Marring of the mating surfaces of the enclosure could destroy the integrity of the seal causing an unsafe condition during operation of the thermostat.

2) Mount the thermostat base on the surface selected. See Fig. 1 for dimensions.

3) The base is tapped for 3/4" conduit; a 1/2" conduit adaptor and a 3/4" plug is provided. Two openings are provided. Unused openings must be properly plugged, with plugs provided, prior to applying power to the unit.

4) Connect the conduit to the mounted base and place the required wire into the base.

5) Connections are to be made to the switch terminals on the cover, see Fig. 2. The cover can then be installed to the base and securely fastened utilizing the four (4) mounting screws. Immediately prior to assembly, inspect the mating surfaces of the cover and enclosure. Do not connect if surfaces are uneven or gaps exist between the cover and enclosure. Install the four (4) cover screws to enclosure and TIGHTEN TO A MINIMUM OF 40 INCH POUNDS.

6) The installer must seal each conduit run within 18" of the thermostat enclosure. This seal must be a suitable listed hazardous location fitting.

DIAGRAMS

FIG 1

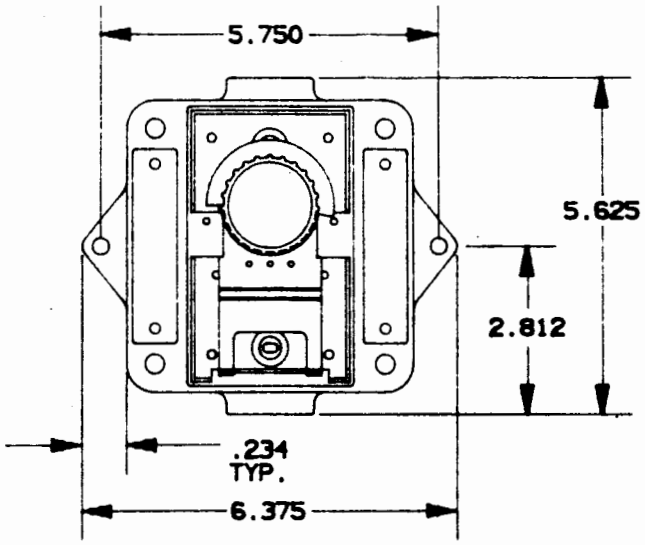
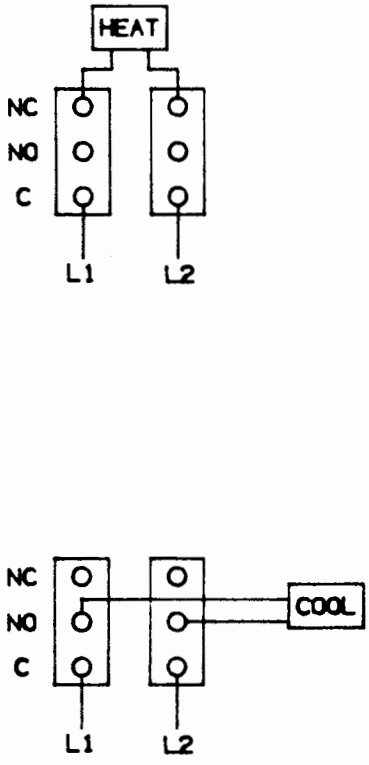


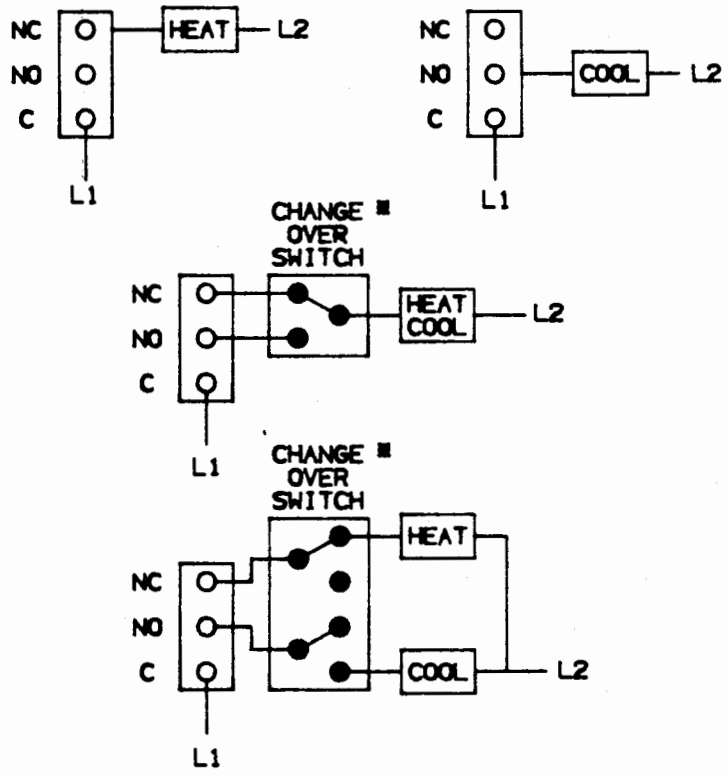
FIG 2

TYPICAL WIRING DIAGRAMS

EP-ETD-8D



EP-ETD-8S



* TO BE PROVIDED BY INSTALLER

Class I, Div. 2, Groups A,B,C,D
Class I, Zone 2, Groups IIC,IIB,IIA
NEMA 3, 4*

Listed - File E10514
UL-1571 Standard for incandescent fixtures
UL-844 Standard for hazardous location fixtures

Certified - File LR11713

Pendant

Ceiling

FEATURES-SPECIFICATIONS

Applications

Killark "V" Series Vaportight fixtures are now available Third Party Certified for use in certain hazardous as well as wet locations which require durable, protected lighting fixtures.

Wet and dirt laden industrial environments such as walkways, tunnels, loading docks, stairwells, etc. made hazardous by the presence of flammable vapors as defined by the NEC.

Fixtures intended for base-up mounting only.

Heat resistant (tempered) glass globes recommended for wet locations.

** NEMA 3, 4 when used with tempered glass.*

Features

Killark Vaportight assemblies using V**X**FC bodies & tempered glass have all the features & advantages of "V" Enclosed & Gasketed" models plus:

- Heavy-duty silicone gasketing for NEMA 4 requirements
- Third party tested & labeled for use in C1D2 areas
- Modular design permits selection of splice box, fixture body, globe, guard and reflector for specific or custom applications
- Existing V Series mounting boxes may be retrofitted to upgrade to NEMA 4; C1D2 suitability

Copper-free aluminum construction with electrostatically applied epoxy/polyester finish resists corrosion

APPLICATION DATA①

FIXTURE TYPE	LAMP SIZE	GLOBE TYPE	TEMPERATURE CODE
100	A-19 60W	colored & clear	T2C (230°C)
100	A-19 70W	colored & clear	T2D (215°C)
100	A-19 100W	colored & clear	T2A (280°C)
100	A-21 100W	colored & clear	T2B (260°C)
100	A-21 150W	colored & clear	T2 (300°C)
100	A-21 100W	clear only	T2B (260°C)
100	A-21 150W	clear only	T2C (230°C)
200	A-23 200W	colored & clear	T2 (300°C)
200	PS-25 200W	colored & clear	T2A (280°C)
200	PS-25 300W	colored & clear	(350°C)

① *Suitability based on base up installation*

See dimensions page L13.

L

HUBBELL
KILLARK®

Class I, Div. 2, Groups A,B,C,D②
Class I, Zone 2, Groups IIC,IIB,IIA
NEMA 3, 4

Listed - File E10514
UL-1571 Standard for incandescent fixtures
UL-844 Standard for hazardous location fixtures
Certified - File LR11713

ORDERING INFORMATION

PENDANT MOUNT WITH VGA SPLICE BOX

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VUAGG-1-100PX**①	VGA-1	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VUAGG-2-100PX**①	VGA-2	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VUAGG-1-200PX**①	VGA-1	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VUAGG-2-200PX**①	VGA-2	VXFC-200 N34	VCGP-200	VAG-200

CEILING FIXTURE WITH VGX SPLICE BOX

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VUXGG-1-100PX**①	VGX-1	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VUXGG-2-100PX**①	VGX-2	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VUXGG-1-200PX**①	VGX-1	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VUXGG-2-200PX**①	VGX-2	VXFC-200 N34	VCGP-200	VAG-200

CEILING FIXTURE WITH MOUNTING FEET USING VBC SPLICE BOX & VBA ADAPTER

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX/ADAPTER	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VUXBGG-1-100PX**①	VBC-1+VBA	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VUXBGG-2-100PX**①	VBC-2+VBA	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VUXBGG-1-200PX**①	VBC-1+VBA	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VUXBGG-2-200PX**①	VBC-2+VBA	VXFC-200 N34	VCGP-200	VAG-200

WALL FIXTURE WITH MOUNTING FEET USING VBC SPLICE BOX & VB ELBOW

FIXTURE TYPE	LAMP WATT	HUB SIZE	CATALOG NUMBER	CONSISTS OF			
			FIXTURE W/ GLOBE & GUARD	MOUNTING BOX/ELBOW	FIXTURE BODY	CLEAR GLOBE*	GUARD
100	150	1/2"	**VFBGG-1-100PX**①	VBC-1 + VB-1	VXFC-100 N34	VCGP-100	VAG-100
		3/4"	**VFBGG-2-100PX**①	VBC-2 + VB-2	VXFC-100 N34	VCGP-100	VAG-100
200	300	1/2"	**VFBGG-1-200PX**①	VBC-1 + VB-1	VXFC-200 N34	VCGP-200	VAG-200
		3/4"	**VFBGG-2-200PX**①	VBC-2 + VB-2	VXFC-200 N34	VCGP-200	VAG-200

**For other colors, order globes and mounting components separately.*
① Fixture supplied as component unit pack when ordered by this catalog number.
② See page L9 for temperature codes; NEMA 3, 4 when used with tempered glass.

GRAINGER
FOR THE ONES WHO GET IT DONE

Sensor, Motion, 500 W

LUMAPRO

Price: $141.30 / each

Typically in Stock

Add Repair & Replacement Coverage for $35.95 each.

Item # **4VW95** Mfr. Model # **4VW95** UNSPSC # **46171608**

Catalog Page # **717** Shipping Weight **7.75 lbs.**

Country of Origin **China** Country of Origin is subject to change.

click to call

close

Technical Specs

Item	**Professional Series Motion Sensor Kit**
Max. Load	**500W**
Coverage	**23,500 sq. ft.**
Viewing Angle	**270 Degrees**
Voltage	**120**
Housing Material	**All Metal**
Housing Finish	**Bronze**

Lamp Type	**Quartz Halogen**
Lamp Included	**Yes**
Sensor Type	**Passive Infrared Motion Sensor**
Standards	**UL Listed, Weatherproof**
Includes	**(2) 250 W Lamps, (2) Lamp Holders, 4" Round Box Cover, and a Motion Sensor**
Green Environmental Attribute	**Product Contributes to Reducing Energy Consumption**

Compliance and Restrictions

Green Product - This item has been designated by the manufacturer as an environmentally preferable product (EPP) because this item has one or more environmentally preferable attributes. For additional information, see the Tech Specs tab on the product description page.

This product contains a chemical that is regulated under California Proposition 65.

Warning: This product contains a chemical know n to the State of California to cause cancer.

Warning: This product contains a chemical know n to the State of California to cause birth defects or other reproductive harm.

Related Products

1 of 2 Prev | Next

Box, Weatherproof, Gray

Item # 2V567
BELL

Price:$17.14

Wire Connector, Wiretwist, Yellow, PK 100

Item # 6VG25
BUCHANAN

Price:$8.22

Plug, Closure, Gray

Item # 4A249
BELL

Price:$0.93

Electrical Tape, 3/4 x 66 ft, 7 mil, Black

Item # 2A225
SCOTCH

Price:$7.88

Customers Also Purchased

Prev | Next

APPENDIX F

Recovery Well Pumps and Additional Manufacturer's Information

4” SPG4 Programmable Genie®

C100M Controller

4” SPG Programmable Genie® Skimmer

The 4” SPG4 Programmable Genie® is a safe, reliable and complete system for removing free product from wells. The 4” SPG4 Programmable Genie system consists of an air-powered pumping unit with a floating inlet that tracks changes in the water level. The SPG float uses specific gravity to avoid water intake, and includes multiple inlet hole positions to allow fine-tuning of the inlet level as the floating layer thickness is reduced. The special Genie bladder pump with high suction capacity delivers proven reliability and durability. The 4” SPG4 utilizes the C100M Controller which allows the user to not only control the pump fill/discharge cycles but also to set OFF periods to match the LNAPL pumping rate to the LNAPL recovery rate of the well. A complete line of matched accessories is available to help installation and performance, including in-well tubing, well caps, LNAPL collection tank full shutoffs and other items.

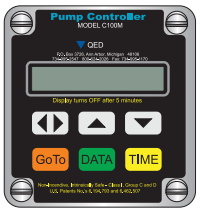
Warranty

SPG4 Programmable Genies are warranted for one (1) year.

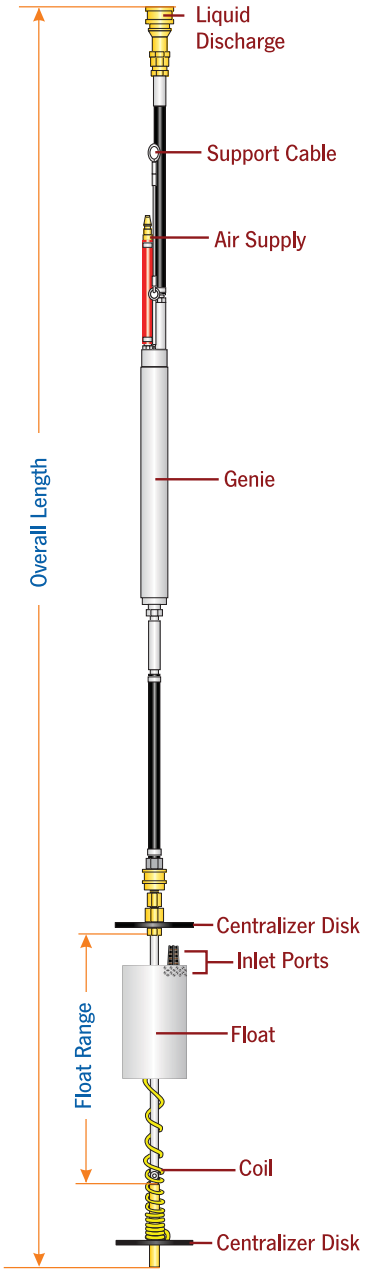
Advantages

1. **Specialized bladder pump is extremely durable, provides high suction to maintain flow, and eliminates contact of drive air with pumped fluid.**
2. **Easy-to-use digital control of pump discharge and refill cycles.**
3. **Available in a range of flow rates and float travel ranges.**
4. **Low air consumption.**

4” SPG4 Programmable Genie®



C100M Controller



Specifications

Programmable Genie Model	Maximum LNAPL Recovery Rate*	Float Travel Range	Overall Length	Minimum Liquid Column
PG2424L SPG4	160 gpd (605 Lpd)	24 in. (61 cm)	114 in. (290 cm)	31 in. (79 cm)
PG2424C SPG4	160 gpd (605 Lpd)	24 in. (61 cm)	99 in. (251 cm)	15 in. (38 cm)
PG2445 SPG4	160 gpd (605 Lpd)	45 in. (114 cm)	119 in. (302 cm)	15 in. (38 cm)
PG2460 SPG4	160 gpd (605 Lpd)	60 in. (152 cm)	136 in. (345 cm)	16 in. (41 cm)
PG4824L SPG4	320 gpd (1,211 Lpd)	24 in. (61 cm)	139 in. (353 cm)	31 in. (79 cm)
PG4824C SPG4	320 gpd (1,211 Lpd)	24 in. (61 cm)	123 in. (312 cm)	15 in. (38 cm)
PG4845 SPG4	320 gpd (1,211 Lpd)	45 in. (114 cm)	143 in. (363 cm)	15 in. (38 cm)
PG4860 SPG4	320 gpd (1,211 Lpd)	60 in. (152 cm)	160 in. (406 cm)	16 in. (41 cm)

Minimum Well ID	4 in. (10 cm)
Maximum OD	3.79 in. (9.63 cm)
Maximum Depth	150 ft. (45.7 m)
Air Supply Pressure (min/max)	40/100 psi (2.7/6.9 bar)
LNAPL Fluid Density	< .85 SG
Kinematic Viscosity	1-1000 centistokes
Recommended Initial LNAPL Layer	> 3 in. (> 7.6 cm)
Residual LNAPL Layer	≥ 0.25 in. (.64 cm)
Suitable Types of LNAPL	Gasoline, diesel, jet fuels, kerosene, #2 - #5 fuel oils, light weight motor oil and hydraulic fluid
Materials	Brass, Tygon®, stainless steel, Viton®, Teflon®
Fitting Type	Quick-connect
Hose or Tubing	Both are available

Tygon is a registered trademark of Saint Gobain - Norton. Viton is registered trademark of DuPont Dow Elastomers.
Teflon is a registered trademark of Dupont.
* gpd = gallons per day, Lpd = liters per day

C100M Pump Controller

The C100M Digital Controller is solar-powered and provides advanced operational capabilities at an economical price. Easy-to-use digital control of pump discharge and refill cycles and programmed OFF times make it convenient to optimize LNAPL recovery to match site conditions.

Tank full shutoff for the collection tank is a safe, simple and inexpensive add-on to the C100M, as an optional level control function. The C100M includes both a highly effective solar power system and a conventional AC power supply. Under solar-powered operation, the C100M is CSA rated as intrinsically safe.

P.O. Box 3726 Ann Arbor, MI 48106 USA **800-624-2026** **F 734-995-1170** info@qedenv.com www.qedenv.com

*QED Environmental Systems is the leading manufacturer of innovative environmental products. For over 30 years their expertise has included **Pumping Systems**, **Landfill Products**, and **Air Strippers**.*

Request a Quote | Local Support
info@qedenv.com
Call us: 1 (800) 624-2026

LNAPL Skimmers Specifications

Overview | How It Works | Specifications

Model No.	Max. LNAPL Recovery Rate: gpd (Lpd)	Float Range: in. (cm)	Overall Length: in. (cm)	Min. Liquid Column: in. (cm)	Min. Well ID: in. (cm)	M
2" SPG2 AutoGenie™						
AG2415 SPG2	160 (605)	15 (38)	95 (241)	6 (15)	2 (5)	1.
AG2424 SPG2	160 (605)	24 (61)	105 (267)	12 (30)	2 (5)	1.
AG2445 SPG2	160 (605)	45 (114)	130 (330)	15 (38)	2 (5)	1.
AG4815 SPG2	320 (1,211)	15 (38)	118 (300)	6 (15)	2 (5)	1.
AG4824 SPG2	320 (1,211)	24 (61)	129 (328)	12 (30)	2 (5)	1.
AG4845 SPG2	320 (1,211)	45 (114)	153 (389)	15 (38)	2 (5)	1.
4" SPG AutoGenie™						
AG2424L SPG4	160 (605)	24 (61)	124 (315)	31 (79)	4 (10)	3.
AG2424C SPG4	160 (605)	24 (61)	109 (277)	15 (38)	4 (10)	3.
AG2445 SPG4	160 (605)	45 (114)	129 (329)	15 (38)	4 (10)	3.
AG2460 SPG4	160 (605)	60 (152)	145 (368)	16 (41)	4 (10)	3.
AG4824L SPG4	320 (1,211)	24 (61)	148 (376)	31 (79)	4 (10)	3.
AG4824C SPG4	320 (1,211)	24 (61)	133 (338)	15 (38)	4 (10)	3.
AG4845 SPG4	320 (1,211)	45 (114)	153 (389)	15 (38)	4 (10)	3.
AG4860 SPG4	320 (1,211)	60 (152)	169 (429)	16 (41)	4 (10)	3.
4" SOS AutoGenie™						
AG2412 SOS4	160 (605)	12 (30)	90 (229)	5 (13)	4 (10)	3.
AG2424L SOS4	160 (605)	24 (61)	125 (318)	29 (74)	4 (10)	3.
AG2424C SOS4	160 (605)	24 (61)	108 (274)	11 (28)	4 (10)	3.
AG2448 SOS4	160 (605)	48 (122)	129 (328)	11 (28)	4 (10)	3.
AG4812 SOS4	320 (1,211)	12 (30)	115 (292)	5 (13)	4 (10)	3.
AG4824L SOS4	320 (1,211)	24 (61)	149 (378)	29 (74)	4 (10)	3.
AG4824C SOS4	320 (1,211)	24 (61)	132 (335)	11 (28)	4 (10)	3.
AG4848 SOS4	320 (1,211)	48 (122)	153 (389)	11 (28)	4 (10)	3.

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OPERATIONS MANUAL

QED
Environmental Systems

Leaders in Environmental Compliance Products

Genie®

Genie® Controllerless System

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Document No. **600258-07**

The equipment in this manual is protected under U.S. and foreign patents issued and pending:

U.S. Patents:	
Selective Oil Skimmer (SOS)	4,497,370
Specific Gravity Skimmer (SPG)	4,663,037
AutoPump (AP)	5,004,405
Specific Gravity Skimmer (SPG) Product Sensing	5,474,685
Vacuum/Pressure Hydrocarbon Recovery System	4,761,225
SPG PSR technology	5,474,685
AP-2	5,641,272
Genie System	5,704,772
Canada Patent:	
Specific Gravity Skimmer (SPG)	1,239,868

Table of Contents

Figures:

Introduction

Welcome to QED Environmental Systems' Genie® manual.

To ensure the best operator safety and system performance, it is strongly recommended that the operators read this entire manual before using the system.

This manual reflects our many years of experience and includes comments and suggestions from our sales and service personnel and most importantly from our customers. The chapters, their contents and sequence were designed with you, the user and installer, in mind. We wrote this manual so it can be easily understood by users who may not be familiar with systems of this type or are using a *QED* system for the first time.

Safety

Safety has been a cornerstone of our design which has been proven over fifteen years of building and shipping systems throughout the world. Our high level of performance is achieved by using quality components, building in redundancies or backup systems, and not compromising our commitment to quality manufacturing. The net result is the highest quality and safest pneumatic pump recovery system on the market. We feel so strongly about safety, based on years of working with the hydrocarbon industry, that it is the first chapter in all of our manuals.

How to Contact *QED*

If for any reason you are unable to find what you need in this manual please feel free to contact the *QED* Service Department at any time.

Service Department
QED Environmental Systems
www.qedenv.com

Oakland Service Center
550 Adeline Street
Oakland, California 94607

(800) 537-1767 – North America Only
(510) 891-0880 – Tele.
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info@qedenv.com — E-mail

***QED* can be reached 24 hours a day**

We welcome your comments and encourage your feedback regarding anything in this manual and the equipment you have on site.

Thank you again for specifying *QED* remediation equipment.

Chapter 1: Safety

Safety has been a prime consideration when designing the Genie System. Safety guidelines are provided in this manual, and the Genie System safety features are listed below. Please do not attempt to circumvent the safety features of this system.

We have also listed some possible hazards involved when applying this system to site remediation. Nothing will protect you as much as understanding the system, the site at which it is being used, and the careful handling of all the equipment and fluids. If you have any questions, please contact the *QED* Service Department for guidance.

As you read through this manual, you will encounter three kinds of warnings. The following examples indicate how they appear and their purpose.

Note:	Information of interest.
Caution:	Ways to avoid damaging equipment.
WARNING:	Personal safety.

A Partial List of Safety Procedures

WARNING:
The air compressor and any other electrical equipment used with this pneumatic system must be positioned outside of any area considered hazardous because of possible combustible materials.

These safety procedures should be followed at all times when operating *QED* equipment on or off site, and should be considered as warnings.

- Wear safety goggles when working with the Genie System to protect eyes from any splashing or pressure release.

- Wear chemically resistant rubber gloves, boots and coveralls when handling the Genie and fluid discharge hose to avoid skin contact with the fluid being recovered.

- Point all hoses away from personnel and equipment when connecting or disconnecting.

- Refer to **Chapter 3**: Equipment, for a list of parts and hoses supplied with the Genie System.

The Genie System minimizes the potential for accidents with the following safeguards:

Fire and Explosion Protection

Almost all of *QED* underground fluid extraction systems are pneumatic. This offers many fire and explosion protection features:

- Compressed air lines eliminate electrical wiring in hazardous areas.

- Aluminum or fiberglass enclosures help to prevent sparking.

- Standard systems use brass fittings, which help to eliminate sparking hazard.

Personal Protection

On-site, service and maintenance personnel can safely use *QED* equipment. Safety-in-use is the primary design feature in all systems. Following are some samples:

- All standard high pressure air hoses have automatic shut off quick-connects on the supply side which prevents injury due to hose whip or air blown particles.

- Metal regulators and filter bowls are rated at 150 psi. The metal air filter bowl is made of aluminum, providing greater pressure and chemical resistance than plastic bowls and it is less prone to damage if dropped.

Spill Protection

On-site spills cannot always be prevented. *QED* equipment is designed to take into consideration such unpredictable occurrences that may happen despite strict adherence to standardized safety practices.

- Static grounded wire reinforced product hoses are available. These are rated at over 5,000 psi burst pressure. The 1/4-inch hose is rated at 18,000 psi.
- The standard air hoses are rated at over 800 psi burst pressure.
- Down well quick-connects have locking features to prevent accidental disconnections.
- The controls are located underground in the Genie System to guard against freezing.
- In an optional TFSO System, two independent product tank-full sensors inform the Genie System when the product recovery tank is full, halting operation of the pumping system, and preventing overflow of the product recovery tank. The system shuts down if connections or hoses are vandalized. In addition, should all sensors fail, a fail-safe overflow option directs the product to an overflow vessel or secondary containment.

Chapter 2: Overview

The Genie® is a versatile downwell remediation pump. It can be used on a number of different applications: product only, dual pump, or total fluids recovery.

Therefore, the equipment will vary by application and site specifications. **(See Chapter 3)** Although this manual contains operating information for the three applications, the product only application is the more typical, and therefore will be mentioned primarily. In any case, be sure to look for the correct heading for your specific application.

Method of Operation

The Genie System (when coupled with any one of *QED's* floating intake skimmers) recovers free floating hydrocarbon from the surface of groundwater, without producing any water, in wells two inches (2 in.) or larger and depths down to one hundred and fifty feet (150 ft.).

A skimmer attaches below the pneumatic Genie pump. An adjustable, automatic pulser unit in the Genie cycles the pump section. The pump draws oil into the skimmer floating intake and drives it out of the well.

Hydrocarbon can be recovered from one well or the system can easily be expanded to capture free phase fuels from multiple wells. Product can be recovered from more than one well by incorporating a common pump air line and a common pump discharge line.

A Genie pump and floating intake skimmer go in each well, and the air and product hoses tee off to each well. This gives you a low-cost, expandable option when responding to fuel spills and specific site needs.

Genie System Configurations

Depending on site specifics and the resulting intake configuration, the Genie can be used in the following applications:

- Product Only
- Dual Pump Recovery
- Total Fluids

Major Genie System Features

- **Versatile**. Can be used in any one of the different applications (as previously listed), and many intake types including the different floating intake skimmers.

- **Low Air Consumption**. Consumes less than 0.109 CF per cycle. It can be cycled as seldom as once per hour.

- **Safe Pneumatic Construction**. The entire system is pneumatically powered with no electrical components, thus avoiding sparks in control power and sensing devices.

- **Small Well Operation**. The Genie System can operate in a 2-inch well and larger.

- **Rugged Construction**. Stainless steel casing and durable internal parts ensure long system life, even under harsh conditions.

- **Small and Lightweight**. Weighs only 6 pounds and is as short as 24 inches by 1.875 inches in diameter.

Figure 1 on the next page illustrates a SPG AutoGenie System (Genie coupled with SPG-2 skimmer).

The Genie System provides everything required for pumping fluid from the well except the air source.

The system is designed to perform for years. *An automatic drain on the compressor (available from QED) is highly recommended* since it dramatically decreases air filter maintenance.

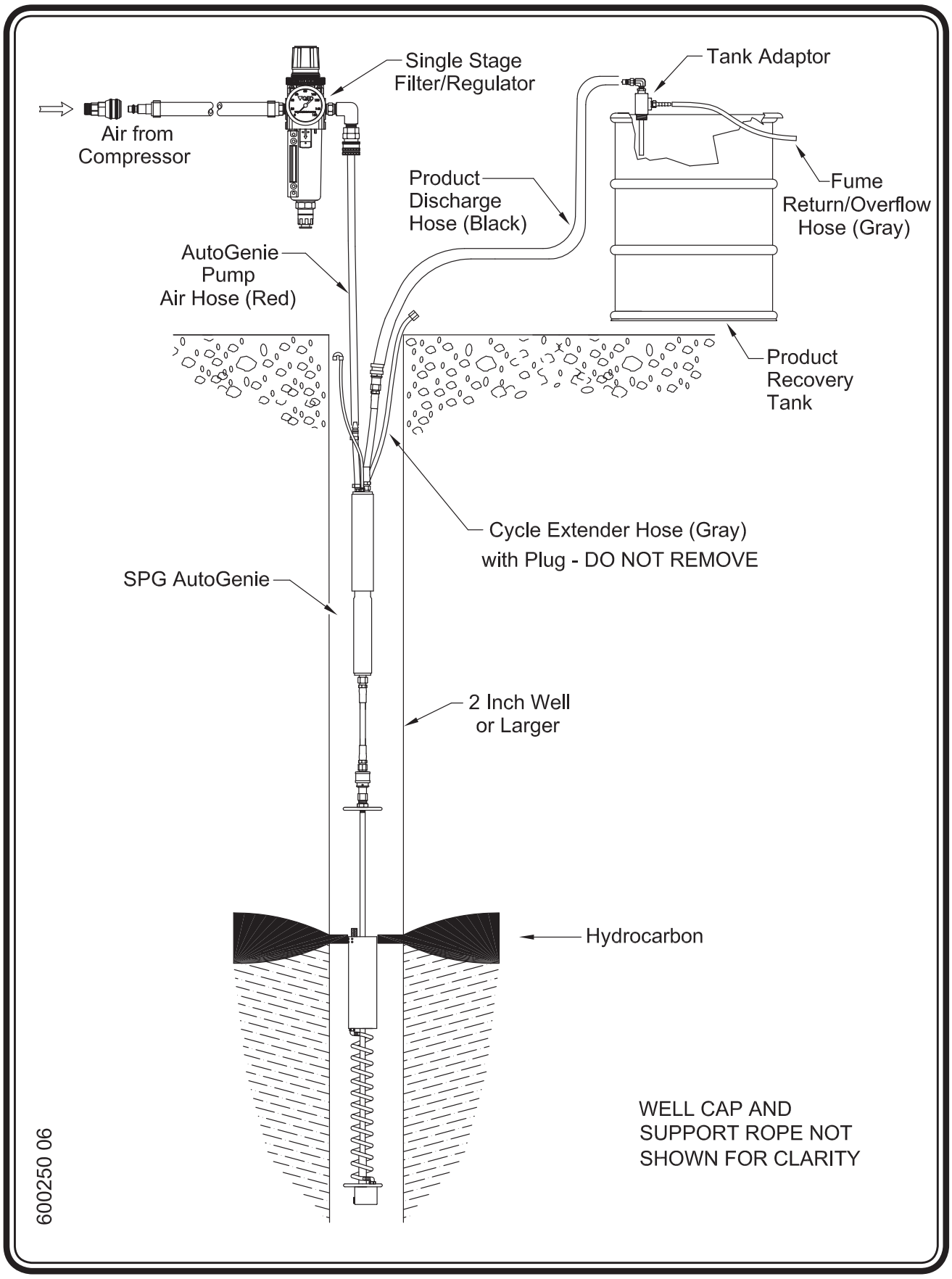

Figure 1 - Overview of a Typical Configuration (SPG AutoGenie)

Alteration of the System

Do not change or modify the system without the express written approval of *QED*. To meet the many different needs of users, additional sensors can only be added to the system by *QED*.

Optional Systems/Accessories

The following options are available from *QED*. Contact your regional office for more information.

- **Tank-Full Shut-Off (TFSO) – (See Appendix A)**
- **High-Water Shut-Off (HWSO) – (See Appendix A)**

Chapter 3: Equipment

Equipment List

The equipment list will vary depending on application type, but the following list is a *base* Genie configuration:

1. Genie Controllerless Pump consisting of:
- Automatic pulser unit
- Bladder pump located below pulser unit

2. Single stage filter/regulator consisting of:
- 5 micron filter with auto drain trap
- Pressure regulator with gauge

3. Tank adapter

4. Hoses:
- Product discharge hose (black)
- Genie pump air hose (red)
- Air exhaust tubing (black)
- Fume return/overflow hose (gray)
- System air supply hose (blue)
- Cycle extender hose (gray)

5. Well support system:
- Well cap

6. Intake Configurations: In addition to the *base* configuration, there are two other intake configurations. Based on the application type one of the following equipment are used with the noted configurations.

a. Floating intake skimmer:
- Product only
- Dual Pump Recovery

b. Top-loading cup:
- Total fluids

c. Inlet screen:
- Dissolved fluids

Specifications

Equipment	L (Inches)	O.D. (Inches)	Weight (Pounds)	Max GPD	Max Depth (Feet)	Min Well ID Req (Inches)	Min Air Pressure (Psi)	Max Air Pressure (Psi)*
Genie:								
12-inch	52	1.875	6	80	150	2	40	100
24-inch	64	1.875	11	160	150	2	40	100
48-inch	88	1.875	13	320	150	2	40	100
Filter/Reg	13.4	5.4	NA	NA	NA	NA	NA	120
Hoses	**See Page 20**							
Skimmers	**See Appendix C**							

*** Higher pressure systems available.**

The following sections describe each of the basic components and the applications used to operate them.

Genie Controllerless Pump

Automatic Pulser Unit

The pulser combines timers and an air valve and is mounted above the bladder pump. The timer located inside the pulser governs how often and for how long the pump is pressurized. **(See Figure 3 and Figure 4)**

The pulser supplies air to the pump and exhausts the pump using an internal pneumatic circuitry. This is done with one adjustment on the unit when setting the cycle on the pump.

With a flathead screwdriver, turn the cycle adjustment screw **(See Figure 2)** inside the pulser unit clockwise to increase the cycle time, and counterclockwise to decrease the cycle time.

The Genie is preset at the factory to a 30 second cycle time using 80 psi air pressure. This means the pump is pressurized (fluid pushed out) and exhausted (fluid drawn in) within 30 seconds. If the cycle rate is adjusted to another time, ensure ample time for desired fill and discharge is allowed. The cycle time is apportioned with 30% to 35% to the pressurization phase and 65% to 70% to the exhaust phase. The shortest cycle time used is about 10 seconds, but this is rarely needed. If the pump is cycled more times than necessary, compressed air is wasted and the time life of the bladder (about 3 million cycles) will be shortened. The Product Recovery Rate chart in Chapter 5 shows cycle times, pump sizes, and the resulting flow rates.

Cycle times can be increased or decreased by adjusting the timing adjustment screw in the Genie driver, changing the volume of the Cycle Extender Hose and by varying the air pressure. All of these are discussed later in **chapter 5**.

The approximate volume per cycle of the Genie pumps are as follows:

12-inch pump = 45 cc
24-inch pump = 110 cc
48-inch pump = 280 cc

Bladder Pump

The bladder pump attached to the automatic pulser unit removes fluids from as deep as 150 feet. The pump is designed to draw product from a skimmer and push it up and out of the well.
(See Figure 2 and Figure 3)

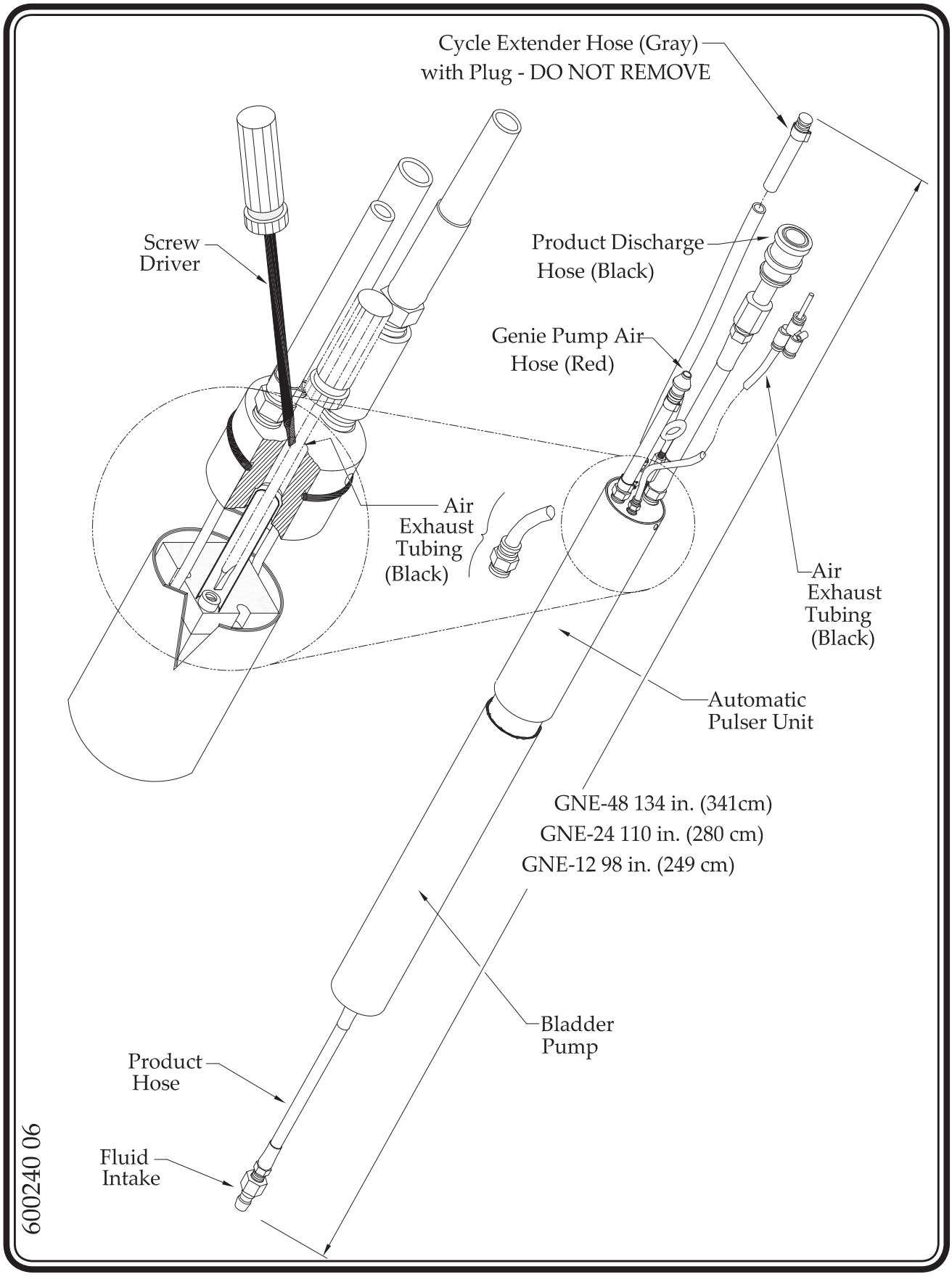

Figure 2 - Genie Controllerless Pump

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Discharge Quick-Connect	1
2	302764	GNE/Blad Disch. Swaged Hose	1
3	301285	Cycle Ext. Gray Hose Assy.	1
4	300723	Discharge Viton Check Valve	1
5	301286	GNE Air Exhaust Tube Assy.	1
6	301276	GNE Air Hose Assy.	1
7	200724	1/8" MPT X 1/4" HB	2
8	200884	GNE Eyebolt and Hardware	1
9	200682	1/4" Nipple S.S.	1
10	202605	Exhaust Tube Connector	1
11	201055	GNE Bladder Disch. End	1
12	201258	10-32 Plug	1
13	301635	GNE-12 Bladder Tube w/Clamps and Bladder Casing O-Rings	1
	301636	GNE-24 Bladder Tube w/Clamps and Bladder Casing O-Rings	
	301637	GNE-48 Bladder Tube w/Clamps and Bladder Casing O-Rings	
14	201336	GNE-12 Bladder Casing	1
	201337	GNE-24 Bladder Casing	
	201462	GNE-48 Bladder Casing	
15	202195	Bladder Casing Screw	8
16	201054	GNE Intake End	1
17	201258	10-32 Drain Plug	1
18	204998	1/4" S.S. Hex Nipple	1
19	300722	IntakeTeflon Check Valve	1
20	302763	GNE/Blad Int. Swaged Hose	1
21	200878	Intake Quick-Connect	1

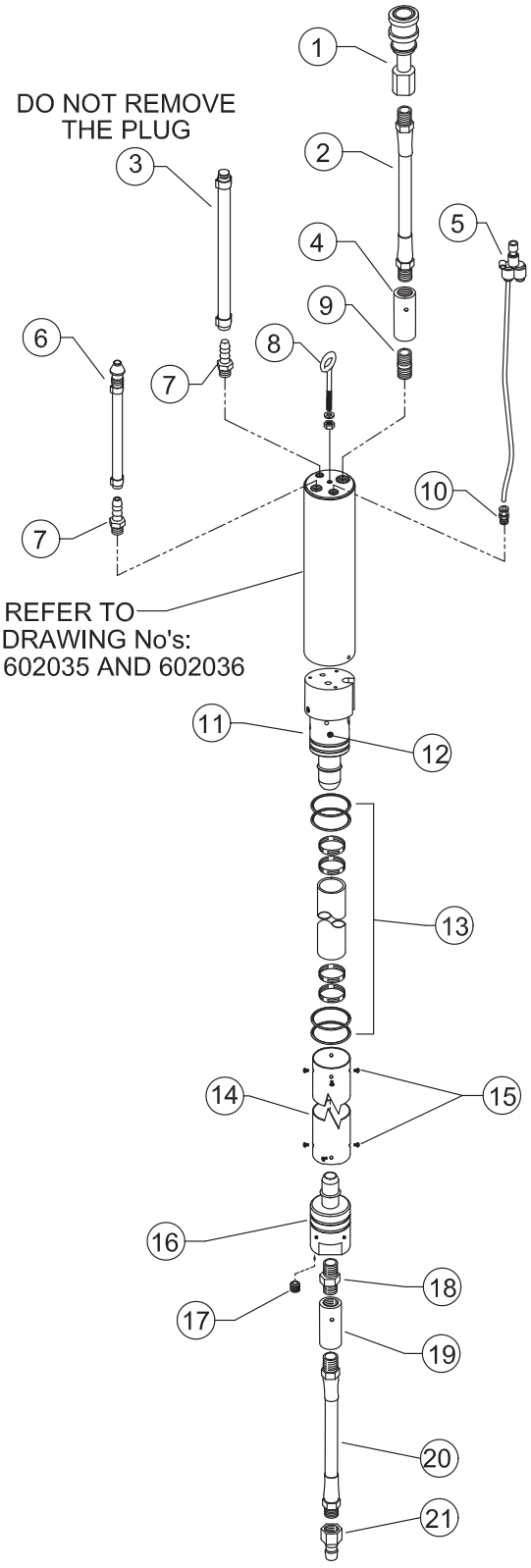

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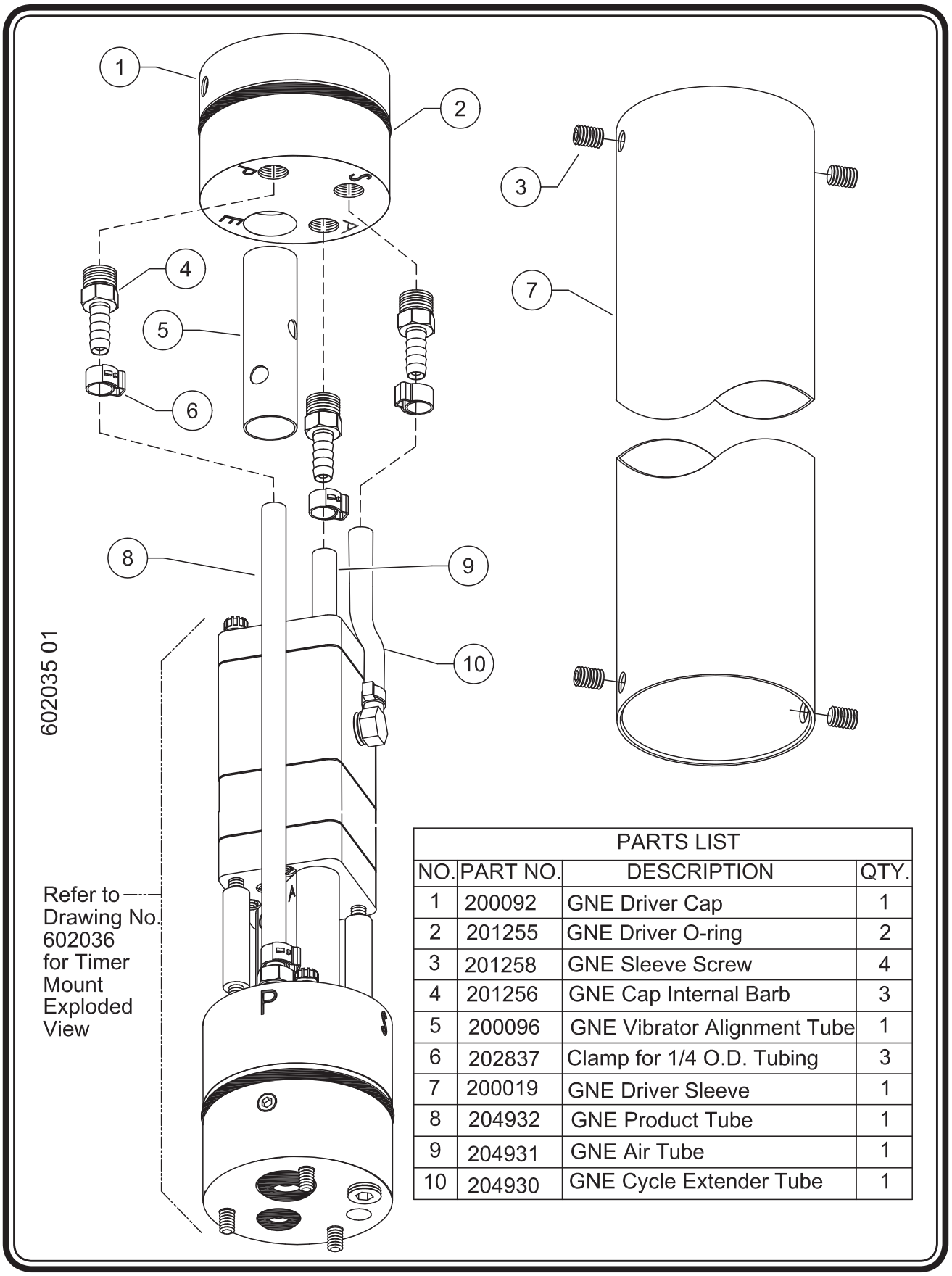
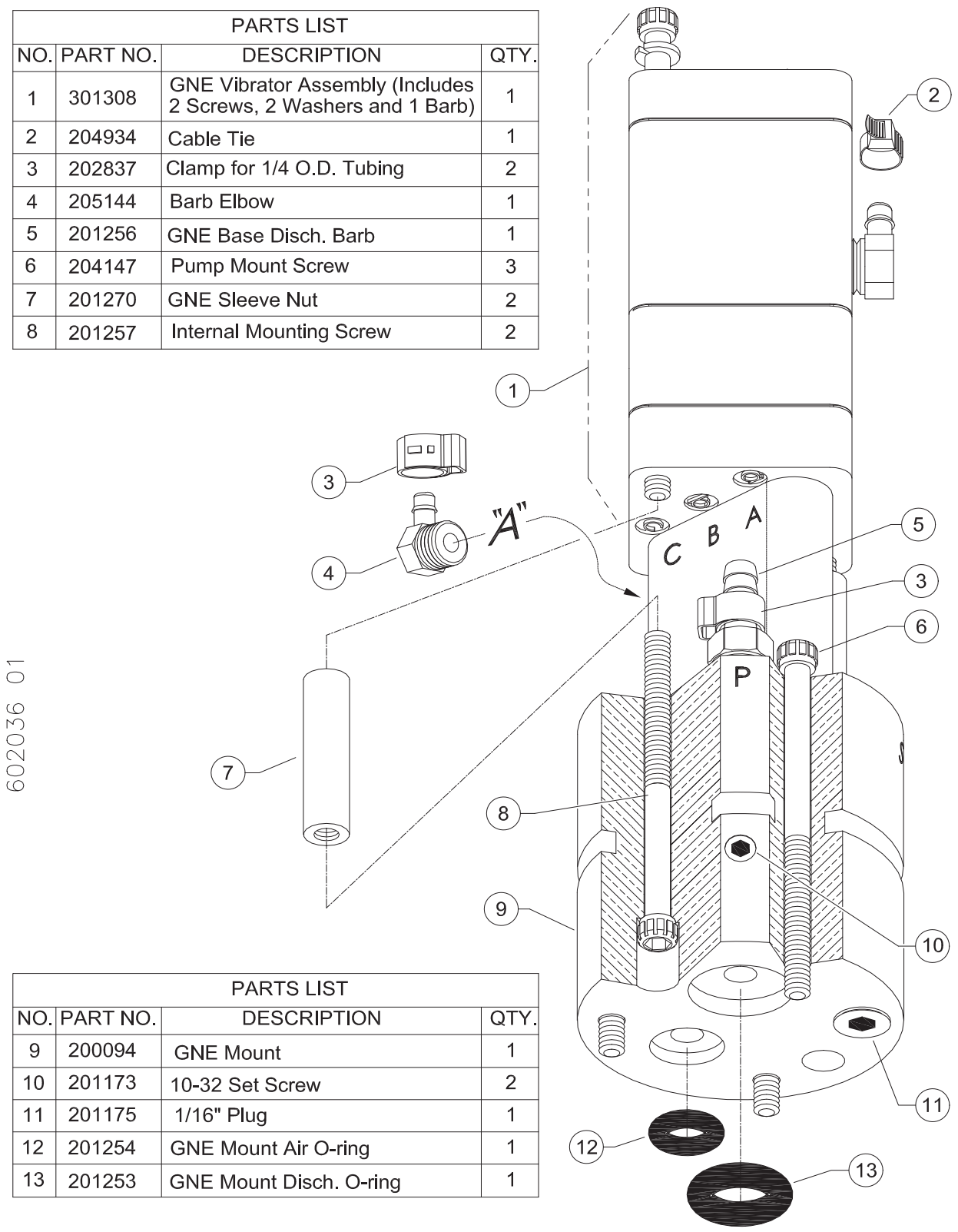
Figure 3 - Genie Controllerless Pump – Exploded View



PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200092	GNE Driver Cap	1
2	201255	GNE Driver O-ring	2
3	201258	GNE Sleeve Screw	4
4	201256	GNE Cap Internal Barb	3
5	200096	GNE Vibrator Alignment Tube	1
6	202837	Clamp for 1/4 O.D. Tubing	3
7	200019	GNE Driver Sleeve	1
8	204932	GNE Product Tube	1
9	204931	GNE Air Tube	1
10	204930	GNE Cycle Extender Tube	1

Figure 4 - Genie Pulser Unit

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	301308	GNE Vibrator Assembly (Includes 2 Screws, 2 Washers and 1 Barb)	1
2	204934	Cable Tie	1
3	202837	Clamp for 1/4 O.D. Tubing	2
4	205144	Barb Elbow	1
5	201256	GNE Base Disch. Barb	1
6	204147	Pump Mount Screw	3
7	201270	GNE Sleeve Nut	2
8	201257	Internal Mounting Screw	2



PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
9	200094	GNE Mount	1
10	201173	10-32 Set Screw	2
11	201175	1/16" Plug	1
12	201254	GNE Mount Air O-ring	1
13	201253	GNE Mount Disch. O-ring	1

Figure 5 - Genie Timer and Base– Exploded View

Single Stage Filter/Regulator

The single stage 5 micron air filter/regulator has an automatic drain and is mounted outside of the well. The filter/regulator removes particles, water droplets, and some oil mist from the air passing to the Genie pump. The regulator should produce at least as much pressure as required to move the fluid from the depth at which the pump is installed. **(See Figure 6)**

Note:
Too much air pressure can result in low pump efficiency.

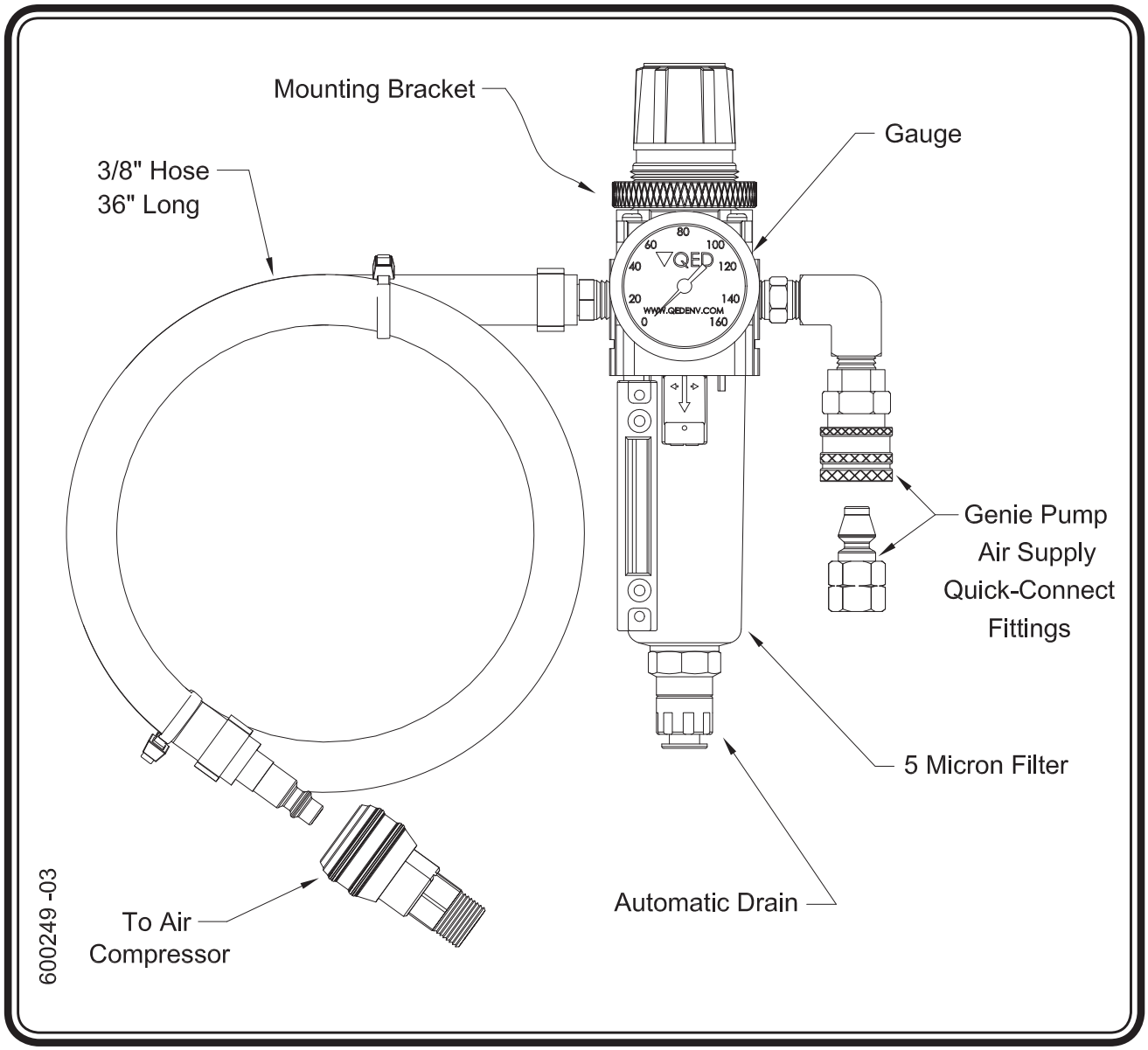


Figure 6 - Single Stage Filter/Regulator

Tank Adapter

The tank adapter threads into the product recovery tank to act as an intake and vent/overflow fitting. It has 3/4 inch NPT threads made of brass to reduce spark hazard. **(See Figure 7)**

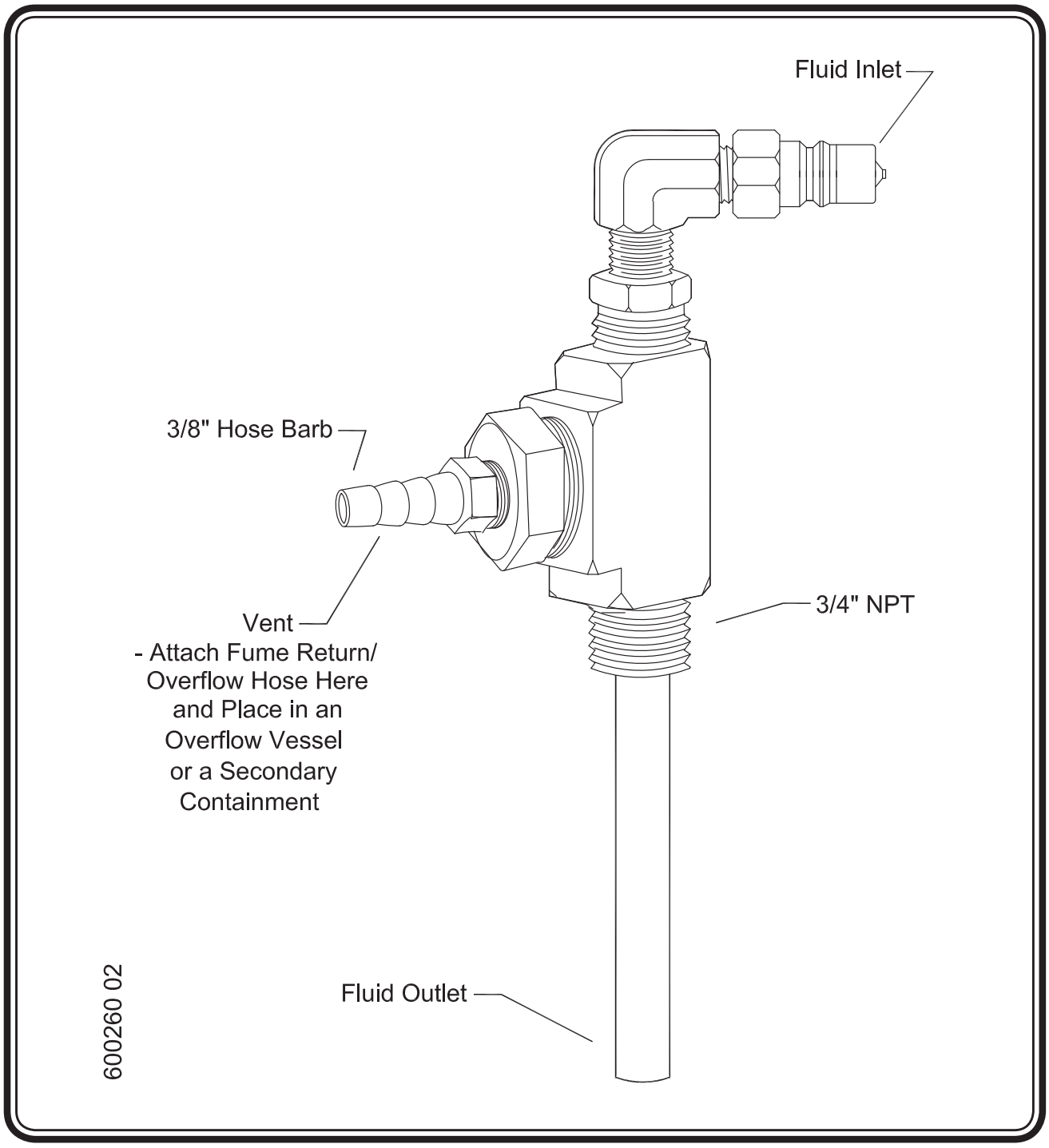


Figure 7 - Tank Adapter

Hoses and Fittings

Hose is usually supplied with the Genie System. The table below shows the normal hose colors and sizes, and, the air exhaust tube. These may change due to application or need.

Hose Color Code Table

Color/Material/Size	Name	Function	Fittings
Hose: Black/Wire-Reinforced Hydrolic hose with Nylon core **Size:** 1/4" I.D.	Product Discharge	Transport product from the Genie pump to the discharge point	Hose barb and clamp or straight-through quick-connects
Hose: Red/Nitrile, PVC **Size:** 1/4" I.D.	Genie Pump Air	Supplies air from the single stage filter/regulators to the Genie pump	Hose barb and clamp or one-way quick-connect fitting
Tubing: Black/Nylon **Size:** 1/4" O.D.	Air Exhaust Tube	Exhausts air from the Genie pump	Hose barb and clamp or straight-through quick-connect
Hose: Blue/Nitrile **Size:** 3/8" to 1/2" I.D.	System Air Supply	Supplies air from the compressor to the single stage filter/regulator	Hose barb and clamp or one-way quick-connect fitting
Hose: Gray/Nitrile **Size:** 3/8" I.D.	Fume Return/Overflow	Returns product overflow from the product recovery tank to overflow vessel or secondary containment	Hose barb and clamp or straight-through quick-connect fitting
Hose: Gray/Nitrile **Tubing:** Gray/Nylon **Size:** 1/4" I.D.	Cycle Extender	Increases the cycle time of the GNE driver timer	Hose barb

The cycle extender hose's upper end is sealed by a brass barb plug. The hose should not be removed from the driver, nor the plug from the end of the hose, unless the operator wishes to a add a length of the hose to further extend the cycle time. If a longer cycle time is desired, pleased contact the factory.

If optional quick-connects are used, the flow of air and fluid in the hoses runs *into* the male plug and *out* of the female socket.

The quick-connect fittings will not interchange, so one cannot connect a hose to an incorrect fitting.

Note:
The down well hose fittings normally have locking quick-connects. On sites with water depths over 50 feet, special consideration may be required to support the hoses. Consult with QED regarding such applications.

Well Support System

To safely support the product discharge hose, Genie pump, and floating intake skimmer, a well support system is provided.

Included in the system are a well cap (holes drilled through the cap without fittings), hose clamp, cable ties and eyebolts that secure the hose, Genie pump and skimmer in the well.

See page 47 for a description of how to connect the well support system.

Intake Configurations

Skimmers
QED Environmental Services manufactures two types of floating intake product skimmers. The floating intake allows the skimmer to move freely up and down within the well bore following groundwater level fluctuations. The two skimmer types are: the Selective Oil Skimmer (SOS) and the Specific Gravity Skimmer (SPG).

Selective Oil Skimmer (SOS)

- The SOS uses a hydrophobic-oleophilic (selective) screen which repels water but allows the passage of fuels. Product that enters though the selective screen is drawn out by the Genie pump and removed from the well. **(See figures 9, 10, 11 and 12)**

- The SOS can remove the product layer down to a sheen (≤ 0.01 inch) if the product is not too thick or viscous. The product should be about SAE 20 weight or less for good performance.

- There is a shorter tube section at one end of the selective screen and a longer section at the other end. When the shorter tube section is placed on the bottom, the product is removed to a sheen. When the longer section is down, the skimmer leaves a little more oil in the well. This can enhance oil movement into the well.

- There are two screen sizes available (55 and 110 mesh). The 110 mesh is standard and shipped with the SOS unless the 55 mesh is requested. The 55 mesh screen is used when more viscous oils (e.g. No. 2 fuel oil) must be recovered.

- The SOS will resist water intrusion up to several inches of water column. If the SOS is submerged, the hydrostatic water pressure will overcome the water repulsion ability of the screen and water will enter the skimmer. If this happens, rinse the green screen in the recovered hydrocarbon to wash off the water and reinstall the screen into the skimmer.

- If the product contains a lot of very small suspended solids or biological growth, the outer debris screen and perhaps the selective screen on the skimmer may required periodic service or cleaning.

Caution:
Do not scrub the screen, this could destroy its selective properties.
(See Chapter 6: Maintenance, page 54)

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	300062	SOS-4 Disk/Patent Assembly	1
3	200865	1/4" X 1/8" Brass Nipple	1
4	201153	1/8" Brass Tee	1
5	201203	Modified Barb	1
6	200446	1/4" O.D. Tube Clamp	2
7	200097	Quick Connect Shield	1
8	200668	1-ST S.S. Socket	1
9	200859	1-ST S.S. Plug	1
10	205954	SOS4 Bott. Skr. Guide Rod	1
11	205958	Coiled Tubing for SOS-4 Bottom Skimmer 12" Travel	1
12	200089	SOS-4/SPG-4 Disk	1
13	202361	Brass Cap	1

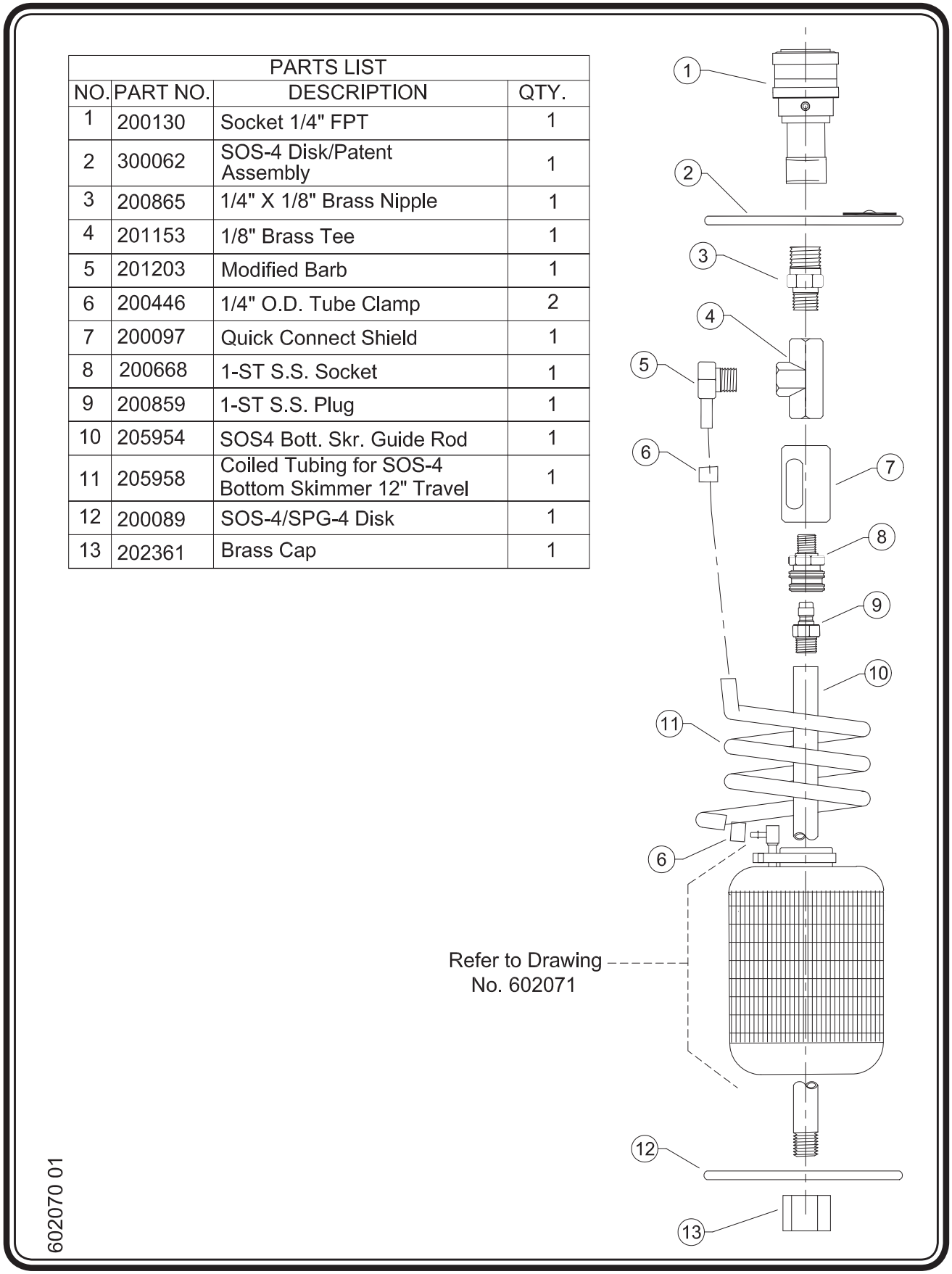
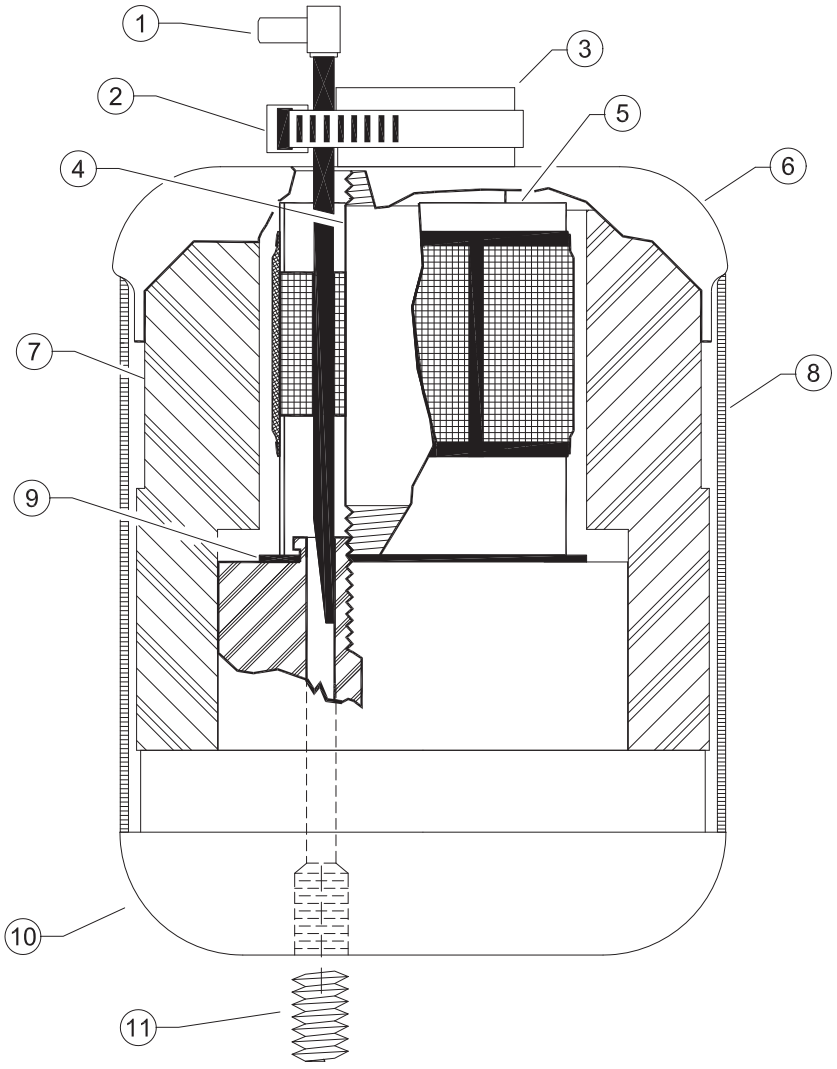


Figure 8 - Four-Inch Selective Oil Bottom Skimmer 12″ Travel (P/N 302524)

PARTS LIST							
NO.	PART NO.	DESCRIPTION	QTY.	NO.	PART NO.	DESCRIPTION	QTY.
1	300655	SOS4 Bott. Skr. Int. Assy.	1	7	200103	SOS4 Float Collar	1
2	200657	Cable Tie	1	8	200106	SOS4 Debris Screen	1
3	200100	SOS4 Nut	1		200758	Large-Hole Debris Screen	
4	200098	SOS4 Post	1	9	201657	SOS4 Float Gasket	1
5	204254	100-mesh Selective Screen	1	10	200099	SOS4 Float Base	1
	204256	55-mesh Selective Screen		11	200954	SOS4 Float Plug	1
6	201672	SOS4 Dome Cover	1				



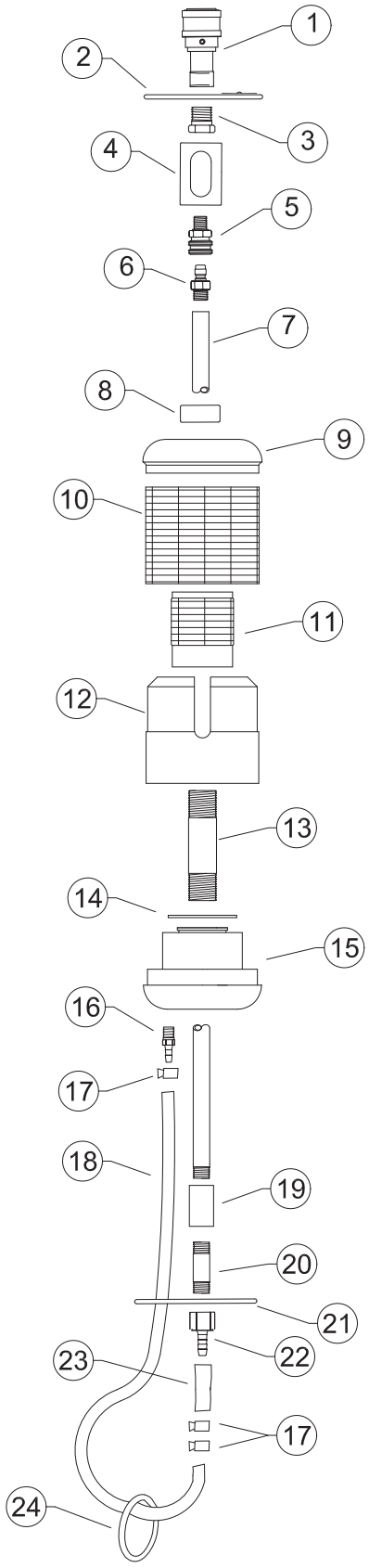
FLOAT / INTAKE ASSEMBLY DETAIL

NOTE:
-ENSURE THAT THE ANGLE TIP OF THE INTAKE ASSEMBLY (ITEM #1) GOES INTO THE HOLE ON THE FLOAT BASE

602071 01

Figure 9 - Four-Inch Selective Oil Bottom Skimmer Float Assembly

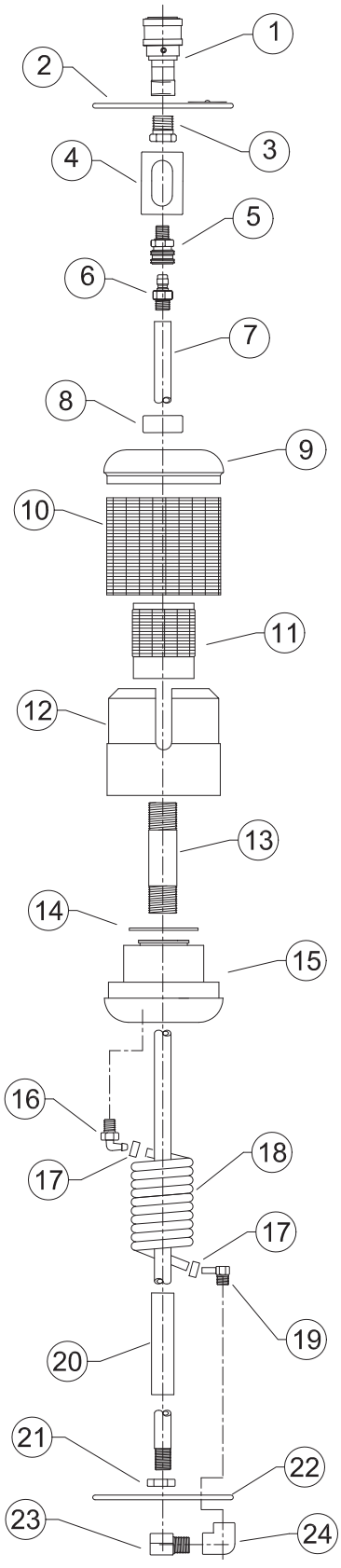
PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	300062	SOS-4 Disk/Patent Assembly	1
3	200660	1/4" X 1/8" Brass Reducer	1
4	200097	Quick Connect Shield	1
5	200668	1-ST S.S. Socket	1
6	200859	1-ST S.S. Plug	1
7	200111	STD. SOS-4 Guide Rod	1
8	200100	SOS-4 Float Nut	1
9	201672	SOS-4 Dome Cover	1
10	200106	SOS-4 Debris Screen	1
	200758	SOS-4 Large-Hole Debris Screen	
11	204254	100-Mesh Selective Screen	1
	204256	55-Mesh Selective Screen	
12	200103	SOS-4 Float Collar	1
13	200098	SOS-4 Post	1
14	201657	SOS-4 Gasket	1
15	200099	SOS-4 Base	1
16	200655	1/4" X 1/8" Black Barb	1
17	200657	Cable Tie	3
18	201134	SOS4 Loop 24" Travel-Tubing	3.75 Ft
19	200863	1/4" S.S. Coupling	1
20	200864	2" S.S. Nipple	1
21	200089	SOS-4/SPG-4 Disk	1
22	201098	1/4" X 1/4" FPT Barb	1
23	200658	5/16" X 7/16" X 2" Tube	0.13 Ft
24	200107	SOS4 Ring Weight	1



600254 -04

Figure 10- Four-Inch Selective Oil Skimmer Looped Tube (P/N 300028)

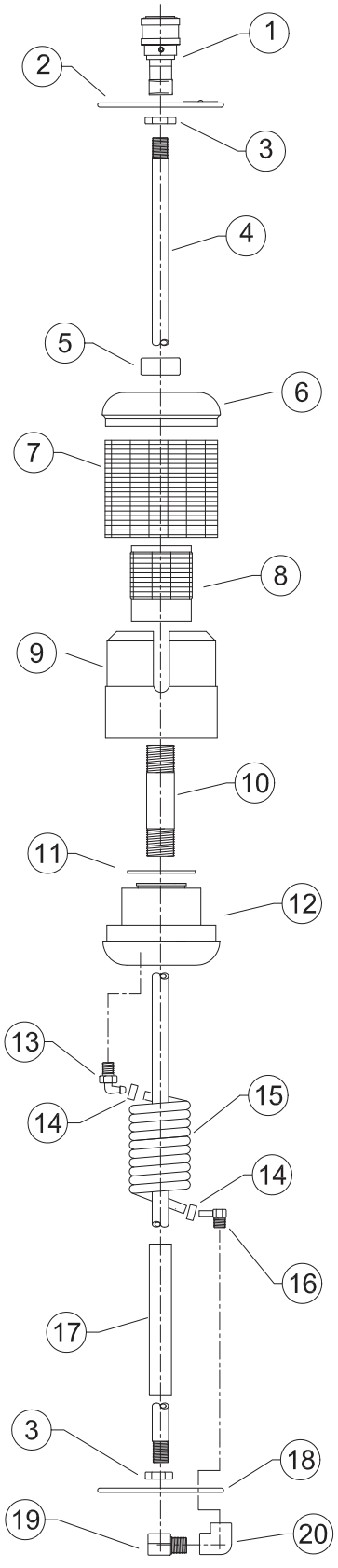
PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	300062	SOS-4 Disk/Patent Assembly	1
3	200660	1/4" X 1/8" Brass Reducer	1
4	200097	Quick Connect Shield	1
5	200668	1-ST S.S. Socket	1
6	200859	1-ST S.S. Plug	1
7	205953	SOS-4 24" Travel Guide Rod	1
8	200100	SOS-4 Float Nut	1
9	201672	SOS-4 Dome Cover	1
10	200106	SOS-4 Debris Screen	1
	200758	SOS-4 Large-Hole Debris Screen	
11	204254	100-Mesh Selective Screen	1
	204256	55-Mesh Selective Screen	
12	200103	SOS-4 Float Collar	1
13	200098	SOS-4 Post	1
14	201657	SOS-4 Gasket	1
15	200099	SOS-4 Base	1
16	200872	1/8" X 1/8" White Barb	1
17	200446	Tube Clamp	2
18	205531	Coiled Tubing for 24" Travel	1
19	202023	Modified Barb Elbow	1
20	205954	Standoff	1
21	200669	Brass Nut	1
22	200089	SOS-4/SPG-4 DISK	1
23	205369	Brass Street Elbow	1
24	203219	Brass Elbow	1



602072 -01

Figure 11- Four-Inch Selective Oil Skimmer - 24″ Travel (P/N 302525)

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	300062	SOS-4 Disk/Patent Assembly	1
3	200669	Brass Nut	2
4	200219	SOS-4 45" Travel Guide Rod	1
5	200100	SOS-4 Float Nut	1
6	201672	SOS-4 Dome Cover	1
7	200106	SOS-4 Debris Screen	1
	200758	SOS-4 Large-Hole Debris Screen	
8	204254	100-Mesh Selective Screen	1
	204256	55-Mesh Selective Screen	
9	200103	SOS-4 Float Collar	1
10	200098	SOS-4 Post	1
11	201657	SOS-4 Gasket	1
12	200099	SOS-4 Base	1
13	200872	1/8" X 1/8" White Barb	1
14	200446	Tube Clamp	2
15	205533	Coiled Tubing for 45" Travel	1
16	202023	Modified Barb Elbow	1
17	202636	Standoff	1
18	200089	SOS-4/SPG-4 DISK	1
19	205369	Brass Street Elbow	1
20	203219	Brass Elbow	1



602073 -01

Figure 12 - Four-Inch Selective Oil Skimmer Coiled 45″ Travel (P/N 300776)

Specific Gravity Skimmer (SPG)

- The SPG uses the difference in density to distinguish between water and product. The floating intake has a specific gravity of about 0.94. So, it floats in water, but sinks in most products. Because the product intake is on the top of the float, it recovers only product.

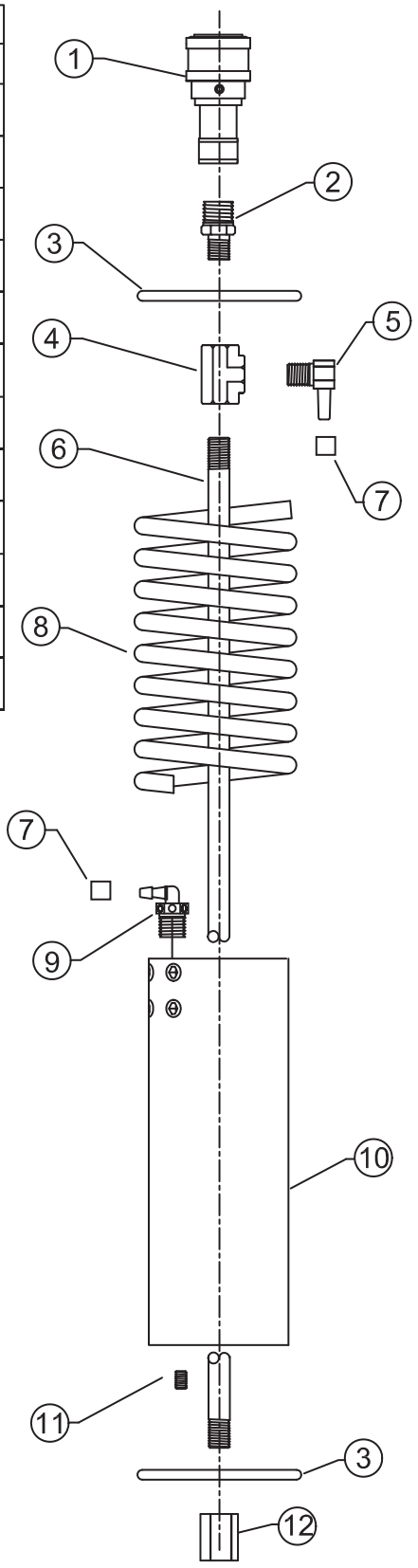
- By design, the SPG does not usually remove all of the product on the surface of the water. It typically leaves about 1.5 to 2 inches of product in the well at all times. The amount of fuel or oil left in the well depends mainly on the specific gravity of the product. This residual product can enhance the influx of additional product into the well.

- As the specific gravity of the product increases or approaches the specific gravity of the skimmer float, more product is left in the well. The skimmer has variable inlet holes on the side of the float that allow the user to adjust the intake level of the skimmer. This is usually done when the specific gravity of the product is greater than 0.85 or when there is an emulsion.

- The SPG will perform better that the SOS when the product is emulsifed, viscous, or dirty.

- The SPG is available in two diameters to fit 2-inch and 4-inch wells. The SPG usually requires 1.5 to 2 inches of fuel in the well to begin recovering. If it is submerged by a high-water condition in the well, and is not controlled by the HWSO system, water will pass to the Genie pump.

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	200865	1/4" X 1/8" Hex Reducing Nipple	1
3	200318	SPG-2 Upper Disk	2
4	201153	SPG-2 Bottom Skimmer Tee	1
5	201203	Modified 1/8" Brass Barb Elbow	1
6	200322	SPG-2 Guide Rod	1
7	200446	1/4" O.D. Tube Clamp	2
8	205537	Coiled Tub. for 2" Skr. 12"-14" Trav.	1
9	201850	Modified 1/8" Nylon Barb Elbow	1
10	302549	SPG-2 Float V.I. with Screws	1
11	201258	SPG2 Bottom Skimmer Plug	1
12	200978	1/8" Brass Cap	1



602068 -01

Figure 13 - Two-Inch Specific Gravity Bottom Skimmer - 12″Travel (P/N 300440)

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	200660	1/4" X 1/8" Bushing	1
3	200318	SPG-2 Upper Disk	1
4	202047	SPG-2 24" Travel Guide Rod	1
	200274	SPG-2 45" Travel Guide Rod	
5	300854	SPG-2 Float Assembly	1
6	200867	1/8" Nylon Barb Elbow	1
7	200446	1/4" O.D. Tube Clamp	2
8	205538	24" Travel SPG-2 Coiled Tube	1
	205540	45" Travel SPG-2 Coiled Tube	
9	204026	24" Travel SPG-2 Coiled T. Standoff	1
	204027	45" Travel SPG-2 Coiled T. Standoff	
10	200872	1/8" X 1/8" Barb Elbow	1
11	200124	SPG-2 Lower Disk	1
12	203538	SPG-2 Coiled Tubing "U" Ftg	1
13	200954	1/8" Brass Plug	1

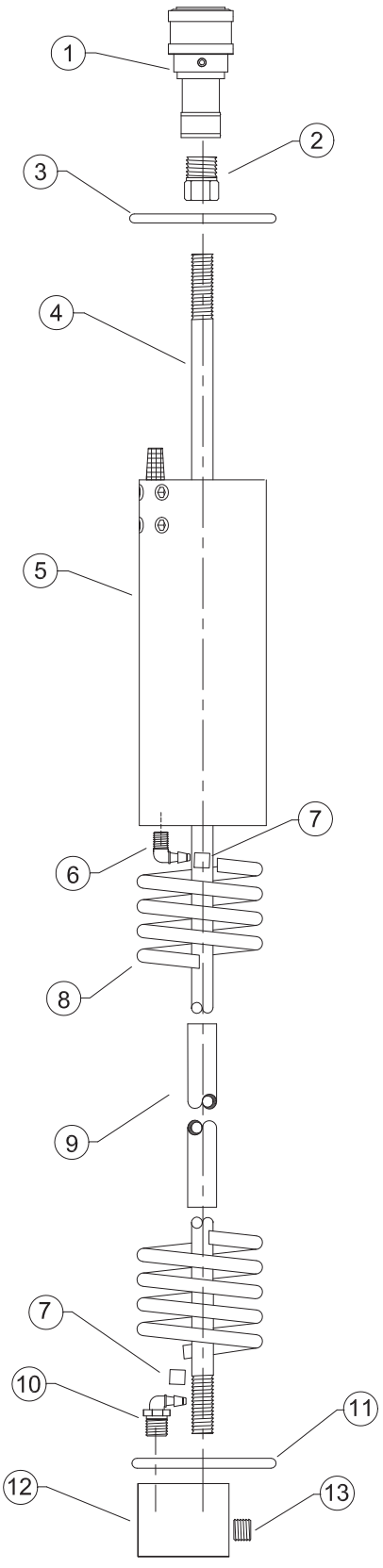


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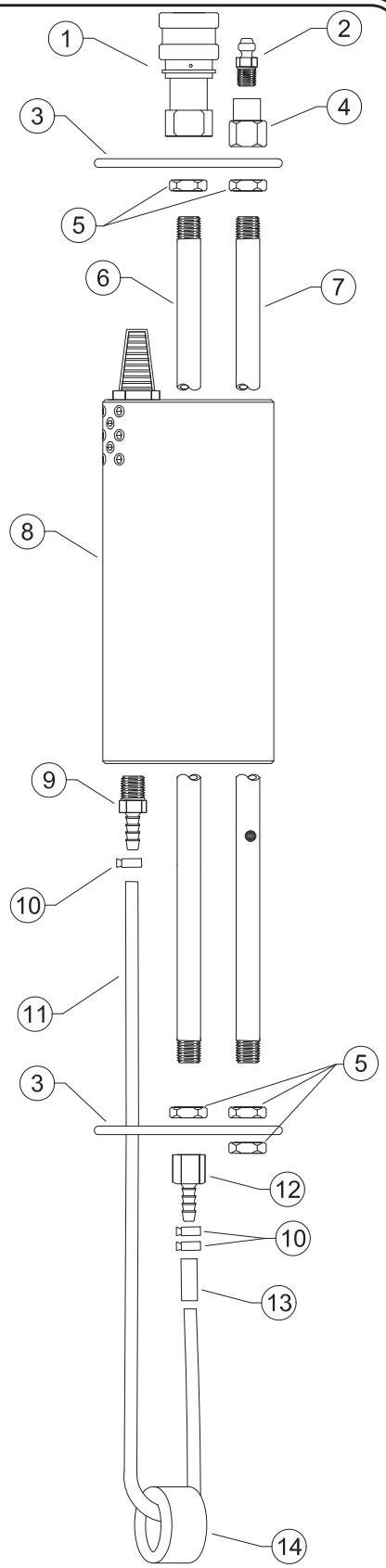
Figure 14 - Two-Inch Specific Gravity Skimmer with Coiled Tubing 24″ Travel (P/N. 300592) and 45″ Travel (P/N 300747)

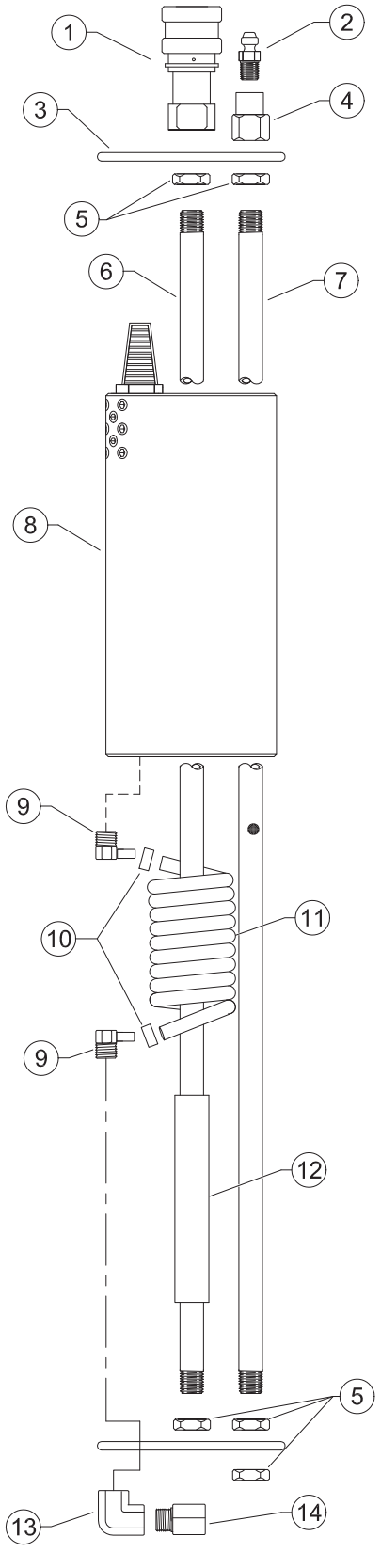
PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	200671	Plug 1/8" MPT	1
3	200671	SPG-4 Disk	2
4	204846	1/4" X 1/8" Brass Reducer	1
5	200669	Brass Nut	5
6	205950	SPG-4 Loop 24" Travel Guide Rod	1
7	205949	SPG-4 Loop 24" Travel Guide Rod with HWSO Bubbler Hole	1
8	301391	SPG-4 V. I. Float	1
9	202355	Barb X 1/4" MPT	1
10	200657	Cable Tie	3
11	205955	SPG-4 Looped 24" Travel Tube	1
12	202363	Barb X 1/4" FPT	1
13	200678	3/8" X 1/2" X 2" Tube Sleeve	.17 ft
14	200245	SPG-4 Weight	1



600257 -03

Figure 15 - Four-Inch Specific Gravity Skimmer with Looped Tubing (P/N 302522)

PARTS LIST			
NO.	PART NO.	DESCRIPTION	QTY.
1	200130	Socket 1/4" FPT	1
2	200671	Plug 1/8" MPT	1
3	200671	SPG-4 Disk	2
4	204846	1/4" X 1/8" Brass Reducer	1
5	200669	Brass Nut	5
6	204260	SPG-4 Coiled 24" Travel Guide Rod	1
	200580	SPG-4 Coiled 45" Travel Guide Rod	
	302562	SPG-4 Coiled 60" Travel Guide Rod	
7	202461	SPG-4 Coiled 24" Travel Guide Rod with HWSO Bubbler Hole	1
	200579	SPG-4 Coiled 45" Travel Guide Rod with HWSO Bubbler Hole	
	302563	SPG-4 Coiled 60" Travel Guide Rod with HWSO Bubbler Hole	
8	301391	SPG-4 V. I. Float	1
9	202355	Barb X 1/4" MPT	1
10	200657	Cable Tie	3
11	205531	Coiled Tube for 4" Skr. w/24" Travel	1
	205533	Coiled Tube for 4" Skr. w/45" Travel	
	205956	Coiled Tube for 4" Skr. w/60" Travel	
12	205954	Standoff for 4" Skr. w/24" Travel	1
		Standoff for 4" Skr. w/45" Travel	
	205957	Standoff for 4" Skr. w/60" Travel	
13	203219	1/4" Elbow	1
14	205369	1/4" Street Elbow	1



602074 -01

Figure 16 - Four-Inch Specific Gravity Skimmer with Coiled Tubing and HWSO 14″ Travel (P/N 301226), 45″ Travel (P/N 300728) and 60″ Travel (P/N 302523)

Inlet Screen

An intake screen may be attached to the inlet of a Genie Pump for Total Fluids Recovery. **(See figures 17 and 20)**

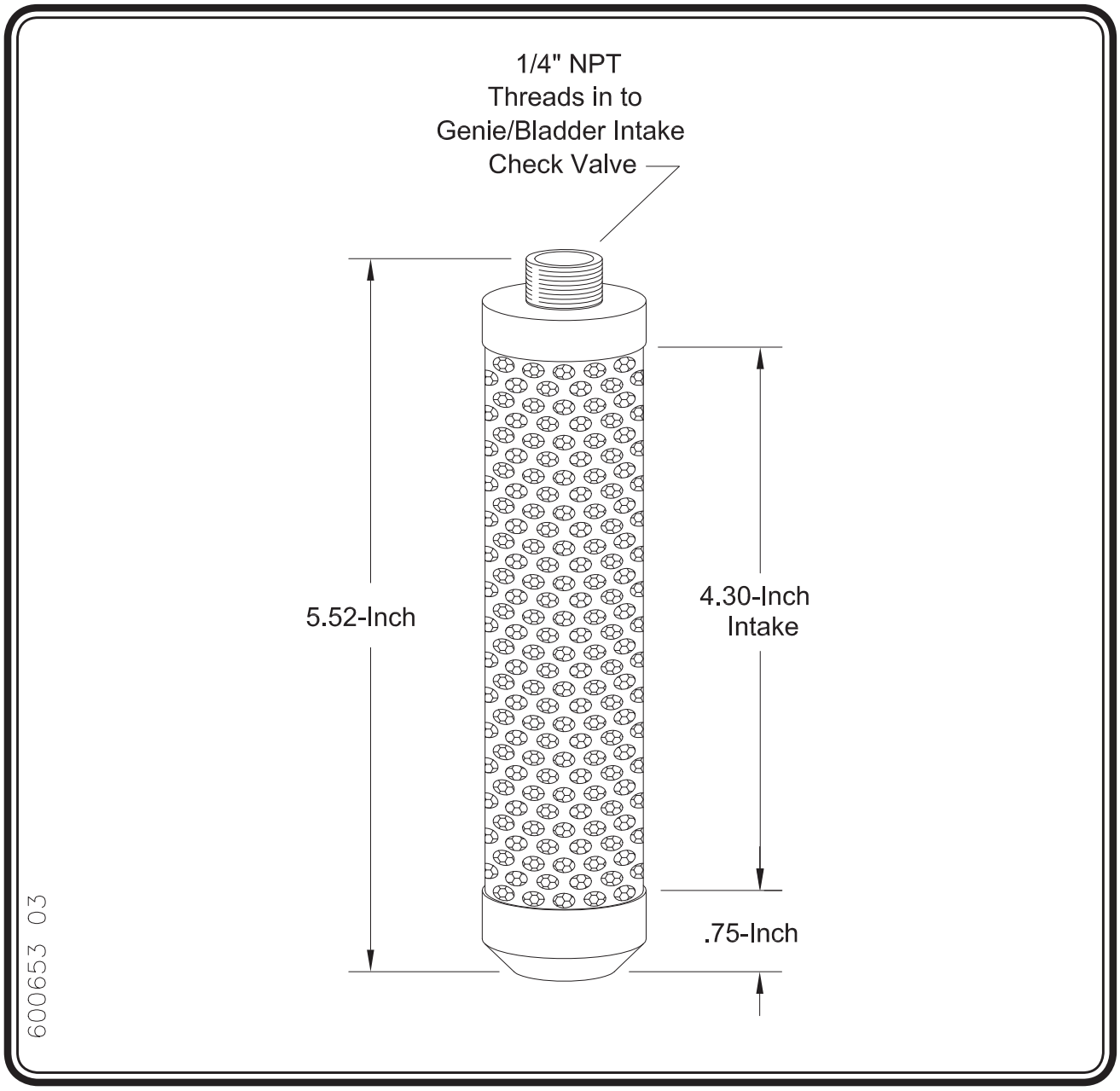


Figure 17 - Stainless Steel Inlet Screen

Chapter 4: Assembly & Installation

Cautions

Note:
Follow the instructions on **Figure 18** (following page) for properly securing the locking quick-connects.

- Do not use PVC pipe for compressed air conduit. It is not considered a safe use of the material.

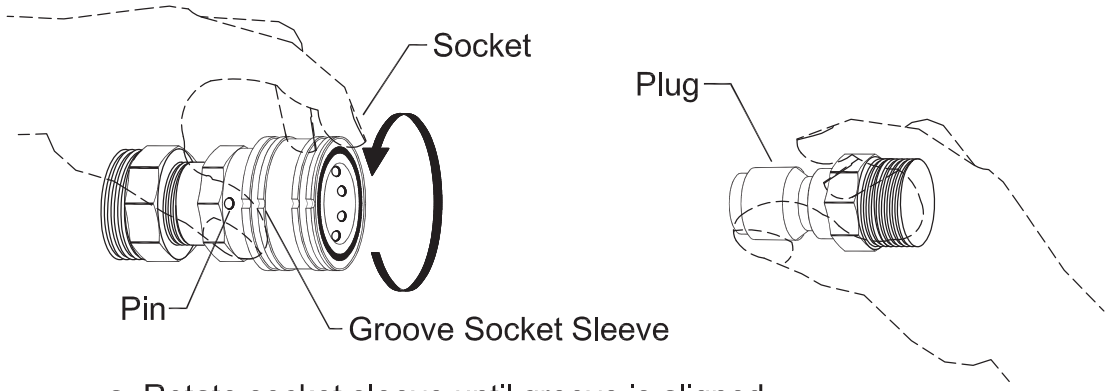
- Cover the hose ends with tape if they are being pulled through trenches. Be sure the ends of the hoses that connect to the air compressor and fluid discharge have the correct fitting leading out of the well. If you are unsure, look at the respective fittings on the pump.

- Blow out all compressed air conduits (trunk lines, sensor hoses, air supply hoses etc.) and fluid lines for at least 10 seconds before connecting them to the system.

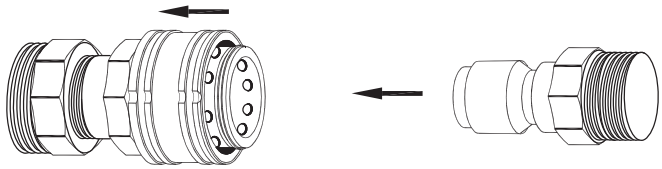
- When running hoses in conduit, include a rope to pull additional hoses in case they are needed at a later date.

- Protect the Genie from freezing conditions. If possible, maintain the temperature above 45° F. This is usually accomplished because the system is positioned inside the well, which is warmed by the groundwater. Other adverse conditions such as rain, dust and vibration usually have little or no effect on the system.

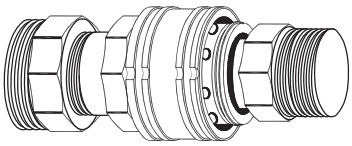
- If solid metal piping is used for compressed air conduit, it is advised that an air filter or a "Y" strainer with a fine mesh screen (80 mesh or finer) be placed at the downstream end of the piping. Metal flakes, rust, galvanizing material, dirt, etc. can be dislodged from such metal piping and travel to the pump or controls.



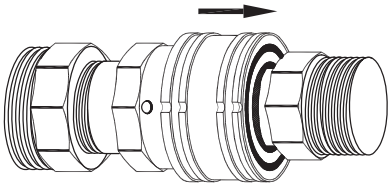
a. Rotate socket sleeve until groove is aligned with the pin close to the hex.



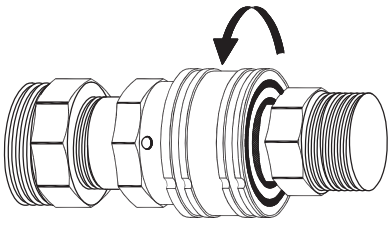
b. Pull socket sleeve against the hex (the pin will be totally covered). Hold in this position for plug insertion.



c. Push plug into socket until the plug is almost covered.



d. Let the socket sleeve go in. It must slide all the way until the pin is visible again.



e. Rotate the socket sleeve so the groove does not align with the pin. To test, gently pull hexes of both fittings in opposite directions. Fittings must remain attached.

600259 02

Figure 18 - Locking Quick-Connect Instructions

- Cut the tie-wrap that holds the ring weight to the bottom of the skimmer.

- Cut the tie-wrap that prevents the skimmer float from moving on the guide rod during shipping.

Compressed Air Supply

The Genie System includes two air lines—one from the compressor to the air regulator and the other from the air regulator to the GNE system. Both have quick disconnect fittings, unless hose barbs were specified by the client.

There is a distinct air inlet on the Genie. This fitting has a female counterpart on the air inlet hose. The air inlet must be connected for the Genie System to function. Do not lubricate the compressed air coming out of the compressor. The Genie does not require lubrication and excess oil may foul the filter/regulator.

The filter and regulator accepts a maximum of 150 psi air pressure from the compressor. The maximum outlet air pressure setting on the regulator is 125 psi. The maximum pressure rating for the GNE, however, is 100 psi.

Cold Weather

Freezing conditions may cause problems that could require assistance from QED.

The Genie System was designed to solve freezing of the pump controls in cold (<40° F) weather. Since the controls are in the well with the pump, usually freezing does not occur because the ground water maintains the temperature in the well above freezing. The compressed air traveling to the well casing may need protection from freezing.

If you are operating the system in freezing weather, take precautions so that moisture does not freeze in the pneumatic lines.

Actions To Take

- Use water traps and automatic compressor tank drains. These are available at industrial distributing companies (e.g., Grainger®).

- Bury air hoses below the frost line. Insulate and heat with heat tape or run through a PVC pipe with warm air being blown through it.

- Remove all the moisture you can from the air by using drains on the compressor, filter, and low points in the air line. Use an electrical or desiccant air dryer, and pull only cold, dry air into the compressor.

- During freezing conditions regulators may fail "open", allowing high pressure (e.g. 150 psi from the compressor) to enter components (e.g. gauges, hoses, fluid receptacles) that may be damaged, cause a safety problem, or release contaminating material. Be sure the regulator is protected from freezing.

- A pneumatic or electric air drier can be installed between the air compressor and control box. This unit reduces the water content of the air so condensation and freezing is reduced significantly. If an electric air drier is used, it must be outfitted with explosion-proof controls or placed away from the Genie pump and product recovery tank.

Base Configuration Component Assembly

STEP 1 - Install Genie Pump Air Hose (red)

a. Attach the male fitting of the Genie pump air hose to the single stage filter/regulator. **(See Figure 19)**

b. Attach the female fitting of the Genie pump air hose to the air supply fitting on the Genie pump.

STEP 2 - Install Air Exhaust Tubing (black)

a. Push the air exhaust tubing into the red-collared tubing fitting on the pump. **(See Figure 19)**

b. Secure the exhaust tubing to the air hose and the cycle extender hose with a cable tie so it does not wander freely in the well.

STEP 3 - Install Tank Adapter

a. Thread the tank adapter into a 3/4 inch NPT fitting on the top of the product recovery tank. **(See Figure 19)**

STEP 4 - Install Fume Return/Overflow Hose (gray)

a. Attach the fume return/overflow hose to the tank adapter via hose barb and clamp. **(See Figure 19**)

STEP 5 - Install Product Discharge Hose (black)

a. Attach the female fitting of the product discharge hose to the tank adapter in the product recovery tank. **(See Figure 19)**

b. Attach the male fitting of the product discharge hose to the Genie pump.

STEP 7 - Install System Air Supply Hose (blue)

a. Thread the air hose socket with 3/8 inch MPT to the compressor. Use teflon tape or sealant on the threads.

b. Attach the air hose plug end of the system air supply hose to the socket now attached to the compressor.

c. Attach the socket on the discharge end of the hose to the single stage filter. **(See Figure 19**)

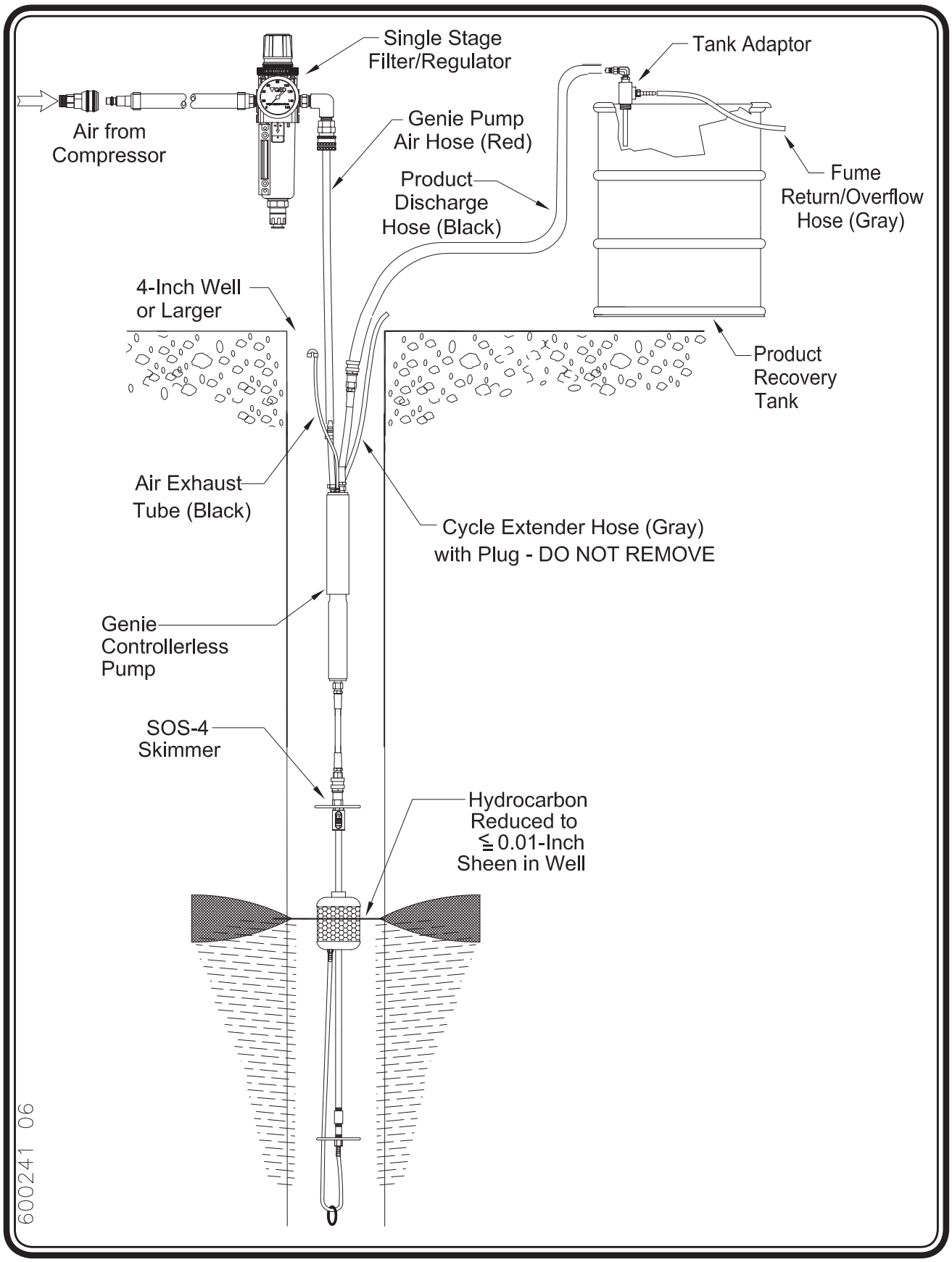


Figure 19 - Genie System with Floating Intake Skimmer (for Product Only)

In addition to the *base* configuration, there are six intake configurations depending on site specifics and application. First assemble the base configuration. Next, find the appropriate heading below, and then follow its instructions.

Product Only

- Attach the Skimmer to the inlet of the Genie pump. **(See Figure 19)**

Total Fluids

- Connect the male fitting on the end of the Genie bladder pump intake hose to the female fitting on the intake screen. **(See Figure 20)**

Dual Pump Recovery

- Attach the skimmer to the male product hose quick connect fitting beneath the Genie pump. **(See Figure 21)**

- Water is removed with an AutoPump (AP). The skimmer is used to attach the water draw down sensor or it is strapped alongside the bottom loading AutoPump (AP/BL) with the trigger level of AP at 4 inches above the lowest level of the skimmer intake. **(See Figure 21**)

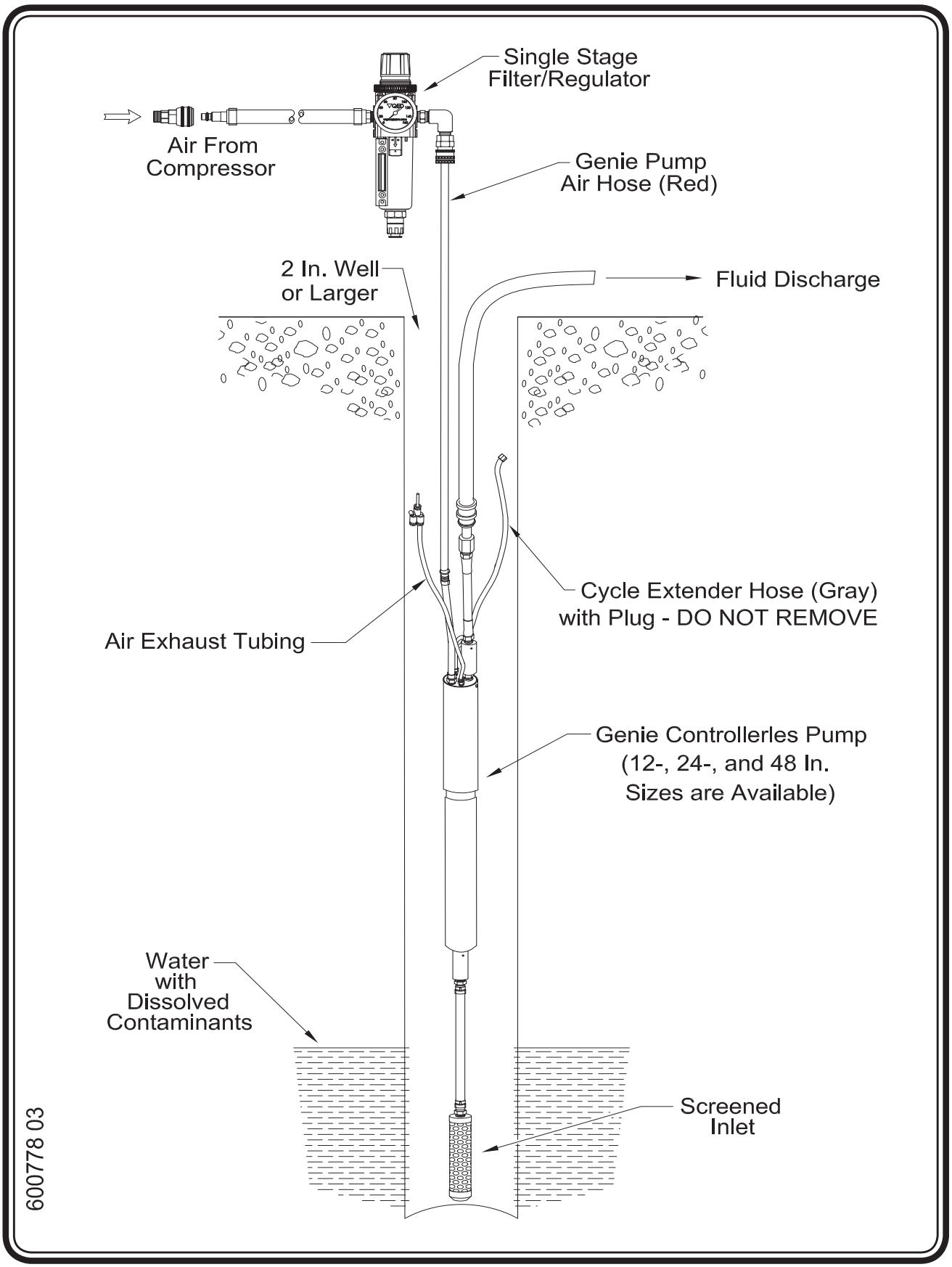


Figure 20 - Genie System with Inlet Screen

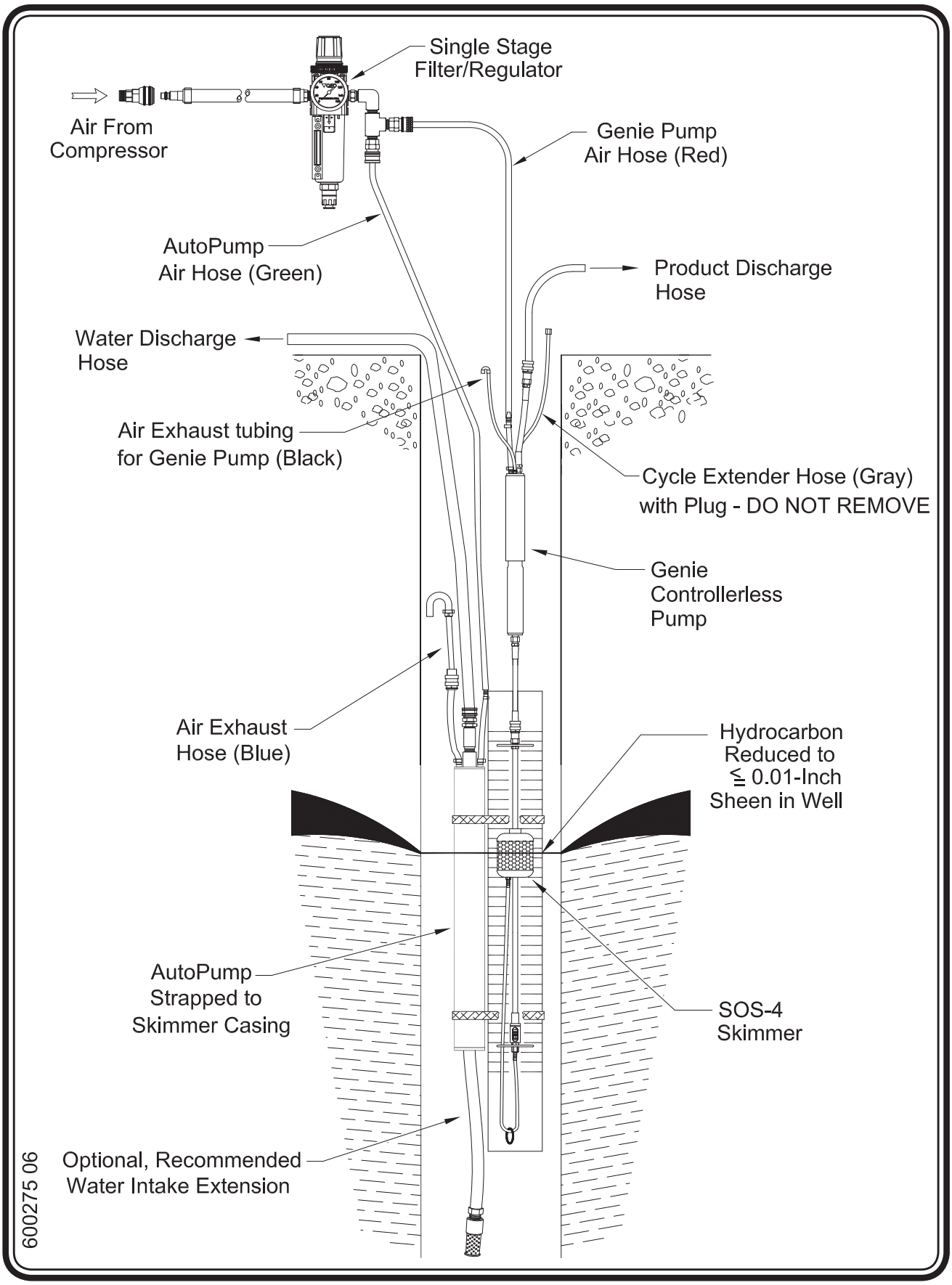


Figure 21 - Genie System with Dual Pump Recovery: (AP-4)

- The following hoses are included with the dual pump recovery configuration:
  - Water discharge hose
  - Water pump air hose

Dry Test

Before installing the skimmer and Genie pump assembly in the recovery well, it is important to test the Genie System for proper operation. Before beginning this test, make sure that all hoses are properly connected as described in the previous section.

STEP 1 - Turn on the Air Compressor

- Turn on the air compressor. Allow it to charge the reservoir tank and automatically turn off.

STEP 2 - Connect the Air Hose to the Genie

- Connect the system air supply hose to the Genie pump.
- Ensure that there is at least 40 psi to the Genie System.

STEP 3 - Test the Automatic Pulser Unit

- Allow the pulser unit to pressurize and exhaust itself.

STEP 4 - Check the Cycle Rate

- The cycle rate has been factory set at 30 seconds for the complete pressure/exhaust cycle at 80 psi.

STEP 5 - Test the Suction and Discharge

- Test for suction and discharge pressure at intake and discharge of Genie. Remove the skimmer from the intake end of the pump and the discharge hose from the discharge end. Because the quick-connect fittings have internal valves, they must have their mating fittings be attached or be removed before a suction or pressure can be felt or measured. Pressure can be felt by closing off the inlet with a thumb, or a vacuum gauge can be attached.

- The discharge pressure can be felt in the same manner, or by attaching a pressure gauge to the discharge. Which ever end is being tested, the other end should be open so there is no resistance to building up pressure or discharge. To measure the maximum pressure, the pump should be filled with water.

If the Genie System does not pass this test, check all fittings and hoses to make sure they are not twisted and that all connections are correct.

Adjust the pulser to desired rate and allow it to cycle several times.

Hose Bundling Assembly

In addition to supporting the down-well equipment with a support rope, it is important to support the down-well hoses. In many cases the down-well hoses weigh more than the equipment itself, particularly in wells over 50 feet deep with fluid inside the discharge hose. Hose support is necessary to avoid the following problems:

- Hoses may kink at the pump
- Hoses could coil and get caught in the well
- In some cases the hoses are supporting the down-well equipment leaving the support rope hanging free in the well, placing tension on the hoses.
- Tension on the hoses may exceed its design limits

Hose bundling reduces equipment entanglement at the well surface, and aids the removal of the pump from the well. Bundling also assists in positioning the pump and down-well hose assembly against one side of the well casing. Maximum space is created for other items, such as probes, to be periodically placed inside the well.

For well caps without barbs or compression fittings (e.g. holes through which the hoses or tubing pass), a support rope needs to be used to prevent kinking of the hoses as they pass up and out of the well cap. Bundle the hoses with the support line. **(See figure 22**)

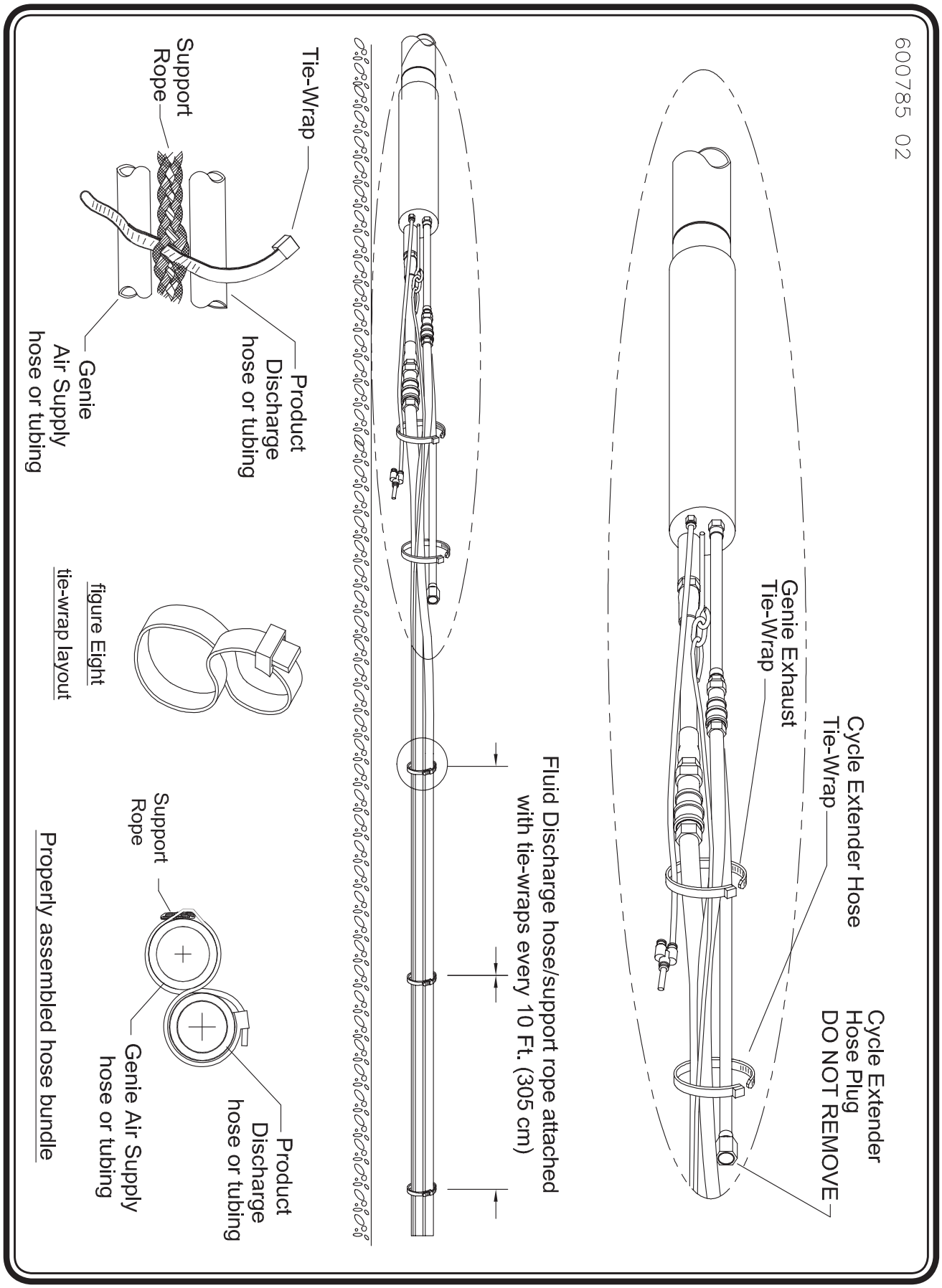


Figure 22 - Hose Bundling

Genie Installation

This section describes the installation of the Genie pump, skimmer, and well support system.

Once the assembly and hose bundling of the Genie pump and skimmer are completed, you may begin to install them in the recovery well. If the recovery well is much larger than the skimmer, we strongly suggest that a well screen casing be used. This protects the skimmer from hanging up on the other hoses in the well. A 2-inch skimmer will need a 2-inch casing an a 4-inch skimmer will need a 4-inch casing. (PVC well casing can be used. Perforated stainless steel tubing can be used if the PVC well casing will not fit).

STEP 1 - Lower Genie Controllerless Pump and Skimmer into Well

- Lower the skimmer and Genie pump down the recovery well until the midpoint of the skimmer's guide tube(s) is located at the fluid level in the well. This provides the skimmer with ample rise and fall travel to accommodate reasonable fluctuation in the water table.

  For product thickness of 6 to 12 inches, the midpoint of the guide tube(s) can be positioned halfway into the product. For thicker layers, the position can be calculated using the specific gravity of the product.

  i. Multiply the specific gravity of the product times the product thickness.

  ii Subtract the above results from the depth-to-water. Place the midpoint of the guide tube at this point.

Example:

- Gasoline with a specific gravity of 0.75 is in a 5 foot thick lens. The water level (below the product) is 10 feet below ground level. The midpoint of the Selective Oil Skimmer guide tube should be positioned [10-(.75 x 5)] or 6.25 feet below ground level.

- When the specific gravity of a product is not known, use 0.8. Gasoline will generally be in the range 0.70 to 0.75, while diesel oil is 0.8 to 0.85. The specific gravity of a leaked product will increase over time due to the loss of the lighter weight hydrocarbons to the soil, water and evaporation.

STEP 2 - Install Well Cap

Note
If wire-reinforced discharge hose is ordered from QED, it will not stretch or kink from the weight of the skimmer and Genie Pump.

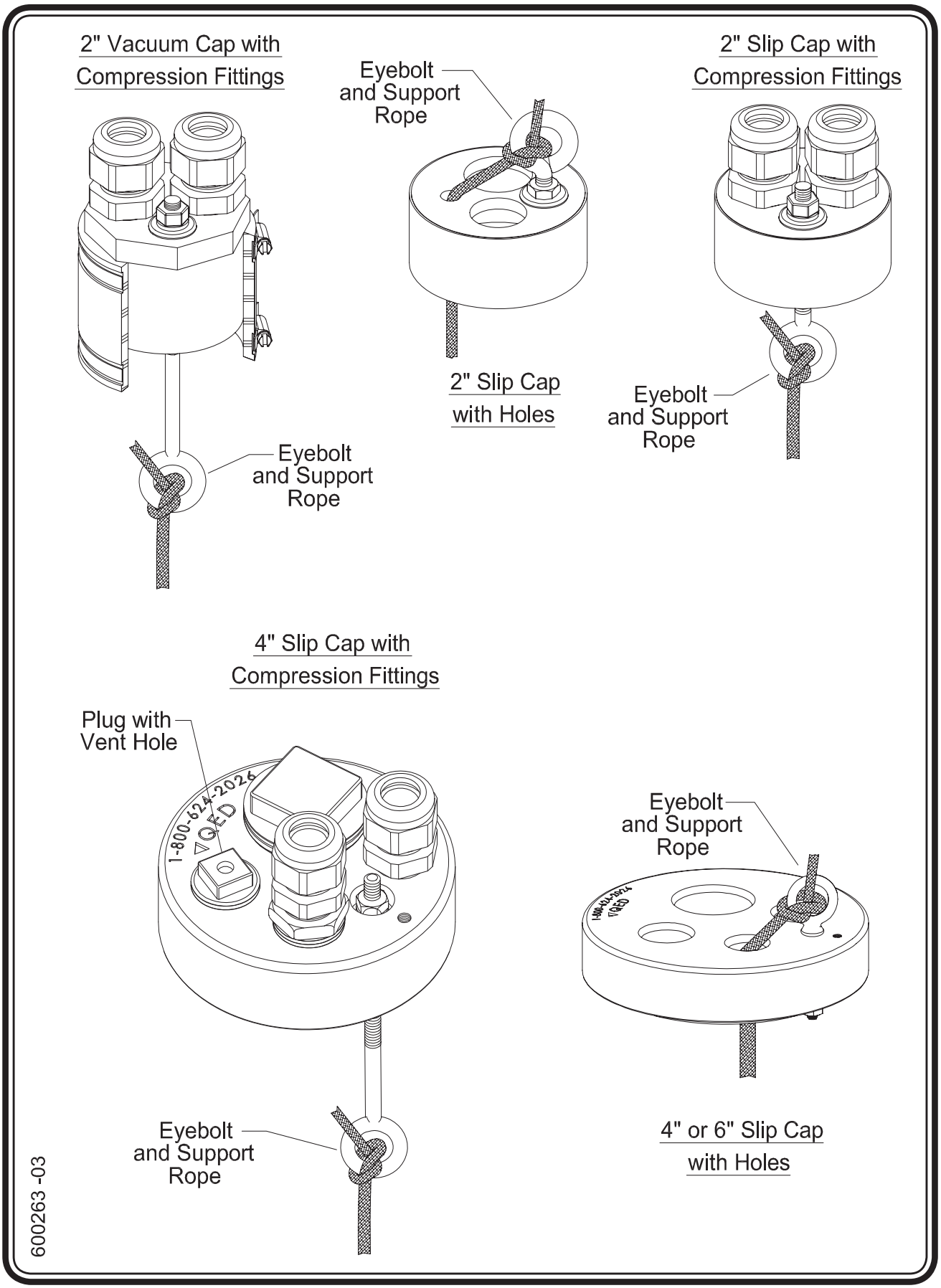


Figure 23 - Well Caps

Chapter 5: Start Up and Operation

Start Up Checklist

In normal operation, the Genie System requires little attention. Conduct a routine inspection of the product recovery tank to record the rate of product recovery and to ensure that the water is not entering the skimmer.

Before regulating the air pressure to the desired operating pressure, ensure that the following conditions exist:

1. Personal Protective Equipment (PPE) is being used by all personnel.

2. All hoses are connected.

3. The air filter is mounted verically to allow the filter to operate properly.

4. All out-of-well air and fluid valves are in their correct positions.

A method of rapid disconnect and exhaust (or at least a shut off) of compressed air to the pump is available in case of an unexpected occurence.

Only the automatic pulser unit potentially needs to be adjusted to fit the site conditions. Everything else is automatic.

Adjusting Genie Cycling

Fist determine what cycle rate is needed to obtain the desired flow rate by using the chart below. The effects of using the adjustment screw in the Genie pulser, the addition of hose and changes in pressure are discussed below.

Adjusting Cycle Rate by using the Adjustment Screw

The cycle adjustment screw has about 5-1/2 turns from full open to full closed. All settings are measured from full open (where the screw stops when turning counterclockwise). Beyond 4 turns from full open, the opening in the air passage becomes very small and timing may be shut off entirely.

Once the cycle time is set, an increase of 20 psi in the air supply pressure will increase the cycle time about 8 to 9%. A decrease of 20 psi will decrease the cycle time the same amount.

STEP 1 - Remove the exhaust tubing from the head of the pump by pushing on the red collar and pulling on the tubing

STEP 2 - **Slower or Faster:** Insert a small flathead screwdriver (0.13-inch wide, 6-inch long - included with the system) through the exhaust fitting on top of the pulser unit and into the cycle adjustment screw in the automatic pulser unit. To slow down the cycling rate (decrease the pump rate), turn the cycle adjustment screw clockwise. To speed up the cycle rate (increase the pump rate), turn the screw counterclockwise. **(See Figure 2 on page 13)**

WARNING:
See the table below for examples of settings.

STEP 3 - Time the cycle rate for two complete cycles to ensure it is what you want and the replace the exhaust tubing into the push-lock fitting in the head of the pump.

Note:
It is recommended that the cycle time is set between 15 and 60 seconds.
The further closed the adjustment screw is turned the smaller the timing air passage will be. Too small of an opening can result in debris being trapped in the opening and severely changing the cycling rate. On the other hand, if the cycle time is too short, the pump bladder will not have enough time to fill or empty completely.

With the standard five foot 1/4-inch Cycle Extender Hose and an air supply of 80 psi, the following are the approximate cycle times to be expected at the respective adjustment screw setting:

Turns From Full Open	Cycle Time in Seconds
2.5	9
3	13
3.5	26
4	114

Note:
All cycle times given here are approximate due to the variations in adjustment screw, adjustment screw seat and air passage construction in the pulser unit. Humidity and temperature will also affect cycle timing.

Additional hose added to the Cycle Extender Hose will result in longer cycle times without changing the adjustment screw setting.

Formulas for Hose Extensions	
Hose Extension I.D.	C = Original cycle time F = Feet of additional hose N = New cycle time
1/4"	N = C (0.176) F + C
3/8"	N = C (0.34) F + C
1/2"	N = C (0.58) F + C

Example: With an air supply pressure of 80 psi and the cycle time set at 30 seconds:

- For every ten feet of 1/4-inch I.D. hose, the cycle time increases by about 53 seconds.
- For every ten feet of 3/8-inch I.D. hose, the cycle time increases by about 1.7 minutes.
- For every ten feet of 1/2-inch I.D. hose, the cycle time increases by about 2.9 minutes.

Maximum Product Recovery Rates at various cycle times

Cycle Time	Gallons Per Day (GPD) 12-inch Pump	Gallons Per Day (GPD) 24-inch Pump	Gallons Per Day (GPD) 48-inch Pump
15 Seconds	68	168	375*
30 Seconds	34	84	212
60 Seconds	17	42	106
90 Seconds	11	28	70
30 Minutes	0.5	1.4	3.5

* At this cycle rate, this pump could not fill and empty completely. A Genie using a four-inch skimmer (SOS-4 or SPG-4) may be needed to obtain this value.

All flow rates depend upon the availability and viscosity of the product, the depth to the water table, the air pressure to the system, flow resistance and the pressure in the receiving piping. When pumping gasoline, all QED skimmers are capable of delivering the flow rates in the tables. If greater flow rates are desired, consult the factory.

The Genie System cannot remove product faster than the soil will give it up. Most spills are recovered at less than 30 gallons per day.

Air Use

Using a standard Genie Cycle Extender Hose of 1/4 inch I.D. and 5 feet long, the average air used per cycle in standard cubic feet is:

Pump Size	12-inch	24-inch	48-inch
Pressure			
60 psi	0.05	0.09	0.17
80 psi	0.06	0.11	0.22
100 psi	0.07	0.13	0.26

For larger Cycle Extender Hoses add the additional volume of the hose multiplied by the compression ratio of the air pressure (i.e. air supply psi ÷ 14.7) to obtain the additional air use for each cycle.

Observation of System Operation

After installing the system in the well, listen for the cycling of the pulser unit. By listening near the well, the exhaust cycle should be audible. Monitor the output of the fluid hose by removing the tank adapter and holding the output over the opening in the tank. If the product is flowing easily into the skimmer, a 1/4-inch I.D. product hose will fill at the rate of about 10 feet per cycle (using a 24-inch bladder pump). Thus a 100 feet hose may require 10 cycles before any fluid exits the hose.

It may be advisable to leave the tank adapter in a bucket until product appears. The time required for product to be first discharge depends on the pump size, hose size and length, cycle rate, and the amount of product available.

After the entire site is operating, return to each well to ensure that the pump is functioning properly. The addition of other pumps and possible system back pressure may necessitate air pressure readjustment.

Special Operating Conditions

Conditions may exist that require adjustment or adaptations to the equipment. Below is a list for some of these conditions, possible effects and a brief description of an adjustment which may solve the problem.

Since every site is different, please contact *QED* for detailed assistance if needed.

1. **The well is under vacuum:** The pump will operate normally if the air exhaust is *in the well*. If the exhaust is ducted *outside the well* to atmospheric pressure, and if the vacuum in the well is 4 inches Hg (About 5 ft. W.C.) or less, the pump will function.

2. **Abrasive particles in the well:** These may cause excessive wear on the check valves and other parts of the pump. Material changes to resist abrasion can be made. A filter "sock" can be placed over the pump intake to filter out the particles. This does not apply to skimmers. A finer mesh inlet or debris screen may be used on skimmers.

3. **Aggressive chemicals and/or corrosive environments:** These may cause pump parts to deteriorate.

4. **Hard pipe connections to the pump:** These can cause debris and scale to travel down the pump. Blow out all of the hard pipe before connecting to pump.

Other site conditions such as highly viscous material, deep (>150 feet) applications, high flow rates for LNAPL application, intermittent air supply high dissolved solids and high temperature can be addressed also. Please contact QED for guidance.

Genie Shutdown and Removal

If the Genie is to be shut down and left in the well, raise the pump above the highest fluid level and shut off the air to the pump. Also close the fluid discharge valve if one is present.

Chapter 6: Maintenance

General Maintenance

The Genie System should be relatively free of maintenance. The frequency of maintenance depends upon the nature of the fluids being pumped. Following are some general maintenance checks that can be done periodically.

- Periodically inspect all hoses and connections for damage. Make sure that the hoses are not split or cracked and listen for leaks in the system.

- Soapy water can be sprayed (using a squirt bottle) on the components and fittings to locate leaks. Dish detergent in water will not damage the system.

Caution:
Do not get soapy water on a skimmer's selective screen. Soap causes the screen to lose its hydrophobic properties. Rinse the screen, and then soak it in clean product to return its hydrophobic properties.

- If water enters the Genie pump via the compressed air (from the compressor), it can cause the pulser unit to malfunction. The unit can stall in the pressurizing mode. Most of the time this does not cause a problem, but if it does, use a clean, dry air source to blow out the system. Remove the small drain plug from the intake end of the Genie pump and blow out any oil and moisture that may have accumulated in the pump. Once the controls begin functioning, check the pulser and allow the system to operate for an hour before returning it to service.

- Even if a little oil and water enters the air hose, the Genie System should perform reliably for years.

- Check the air filter and filter bowl drain on the single stage filter/regulator for saturation and operation every few weeks.

- Drain the air filters on the air hose to the pumps of collected particles, water and oil periodically to prevent the filter from clogging up or being otherwise damaged. Check the regulator to ensure the pressure setting has not drifted appreciably.

- An automatic drain on the compressor is highly recommended, since such an addition can dramatically increase air filter life and decrease maintenance. Automatic drains are available from *QED.*

Maintenance Table

Maintenance is recommended at least once every two weeks, but some site environments may demand more frequent service. The following table outlines the recommended minimum maintenance schedule for the Genie System.

Maintenance	Weekly	Biweekly
Air Quality Check **-** Single Stage Filter/Regulator		**X**
Check Genie Pump		**X**
Check Skimmers **-** SPG Skimmer **-** SOS Skimmer	 **X**	 **X**

The following sections describe each of these maintenance activities in detail.

Air Quality Check

Single Stage Filter/Regulator Maintenance

If the incoming air is clean and dry, the AutoPump System should operate trouble-free for years. The air filter is normally a 5 micron filter with a replaceable element.

To replace the element in the air filter on the single stage filter/regulator use the following procedure:

STEP 1 - Disconnect Air Source

- Valve off the air supply and drain the downstream air to the air filter. Or disconnect the blue system air supply hose from the single stage filter/regulator. The air filters will depressurize, allowing them to be safely serviced.

WARNING:
Do not remove a filter bowl that is pressurized.

STEP 2 - Remove Filter Bowl

- Remove the bowl of the air filter by sliding the silver button downward and twisting the bowl about 1/8 of a turn. The bowl should slide downward from the upper portion of the filter revealing the filter element. Unscrew the element as you would unscrew a light bulb. Hand tighten the element after replacing it.

STEP 3 - Bowl Drain

Standard Float Drain

- Wash out any deposits and oil buildup from the filter bowl with warm water and soap. To make sure the float drain is operating freely, shake it; the drain should rattle. Test the float drain by filling the bowl with water, assembling the bowl to the filter and reconnecting it to the air supply. The water should drain from the bowl. When under pressure, the drain should not leak.

Optional Manual Drain

- With water in the bowl, open the drain and ensure the liquid drains easily. When under pressure and closed, the drain should not leak.

Check Genie Pump

Check the Genie pump to ensure it is cycling properly and moving material. Check the suction vacuum and discharge pressure by connecting a vacuum gauge to the intake of the Genie pump and opening the discharge to atmosphere. Afterwards, open the intake and place a pressure gauge on the outlet. These gauges and fittings are available from *QED*.

With the discharge open, the pump should produce at least 15 inches Hg vacuum. Connect a pressure gauge to the discharge with the intake open and in water and the Genie pump full of water. The generated discharge pressure should be within 30 psi of the air pressure to the Genie pump.

With only air in the pump, the Genie should be able to produce over 60 psi using 100 psi air pressure.

If the pump does not perform correctly, follow the procedures in **chapter 7:** Troubleshooting.

Cleaning Skimmers

Specific Gravity Skimmer (SPG)

- The Specific Gravity Skimmer can be hosed off, scrubbed, or steam cleaned without damage.
- This skimmer can be left for weeks without servicing depending on the water iron content.
- Normal service includes ensuring the skimmer travels freely, passes fluid easily through itself and its flexible tubing, and that no leaks exist.

Selective Oil Skimmer (SOS)

- The Selective Oil Skimmer requires care in cleaning and should be checked about once per week. The selective screen should **not** be scrubbed because the water-repulsive coating may be damaged.
- If the selective screen is passing water, the skimmer can easily be taken apart. The recommended way to clean the screen avoids brushing, rubbing or abrasion.

STEP 1 - Soak the screen and gently shake it in the hydrocarbon product being recovered.

If the hydrocarbon is viscous and the screen is still not adequately clean, an additional soaking and shaking in a lighter hydrocarbon, such as gasoline, is recommended.

STEP 2 - Use soft rubber gloves to avoid accidental screen abrasion by finger nails.

STEP 3 - Direct a brief low pressure air blast around 15 psi from the inside of the screen out.

Caution:
Be careful to blow fluids away from you and others around you and do not breath the fumes.

STEP 4 - Wash off any biological growth from the skimmer.

Caution:
Do not use soap on the selective screen.

On rare occasions, even with using the cleaning procedure, the screen may contain some difficult to remove debris. Follow these instructions:

STEP 1 - Use soft gloves or some other gentle nonabrasive material to very gently rub both the inside and outside of the screen. This removes the excess debris.

STEP 2 - Soak the screen and gently shake it in the hydrocarbon product being recovered.

Caution:
Replace the selective screen making sure it rests on the gasket and that the wide end of the screen faces up.

Replace the float and outer debris screen on the skimmer making sure the open end of the float's fluid slot faces up.
(See Figures 9, 10, 11 and 12)

STEP 3 - It is imperative that the doughnut shaped black gasket be positioned in the skimmer base prior to reassembling the skimmer.

Also, the cap nut should be threaded hand tight, putting pressure on the selective screen below, but not to the point where the dome cap is being crushed or indented.
(See Figures 9, 10, 11 and 12)

Chapter 7: Troubleshooting

Problems may usually be resolved by following these instructions. If you need assistance, please do not hesitate to call the *QED Environmental Systems (QED)* Service Department at (800) 537-1767.

Troubleshooting

I. Problem: System Not Cycling

Steps to take:

STEP 1 - Check that the air pressure reaching the Genie system is greater than any system back pressure by 30 psi.

STEP 2 - Check the timing adjustment by backing it out (counterclockwise) several turns and then turning it in to set the cycle time.

STEP 3 - Put the plugged end of the cycle extender hose under water. If bubbles are coming from the plug, tighten it or remove it and replug the hose. The hose must not leak if the driver is to cycle.

STEP 4 - There may be water or oil in the pulser unit. Pull the system out of the well.

a. Unscrew the small 10-32 drain plug at the fluid intake end of the Genie pump.

b. Let the system blow air and fluids out of the drain hole for a minute.

c. Disconnect the system air supply from the single stage filter/ regulator.

d. Return the plug and reconnect the air supply.

END OF SECTION I.

II. Problem: Genie Is Pumping Water With The Product

Steps to take:

STEP 1 - Check if the floating intake head of the skimmer is free to move vertically in the well.

STEP 2 - Check for kinks in the flexible tube below the skimmer, obstructions on the skimmer tubes, and excess weight on the skimmer. Check for leaks in the following locations:

- the seal between the selective screen (on SOS only) and the gasket
- between the flexible tube and its hose barbs
- in the flexible tubing
- the check valve and fittings

STEP 3 - Hand tighten the Selective Oil Skimmer nut to ensure screen is sealing on the gasket. In addition, tighten all fittings and replace flexible tube if a hole is found. Do not overtighten skimmer nut! **(See Figures 9, 10, 11 and 12)**

STEP 4 - Replace or clean the Selective Screen. **(See page 59)**

END OF SECTION II.

III. Problem: System Is Cycling, But Not Pumping Fluid

Steps to take:

STEP 1 - Check if air is getting to the pump:

Listen to the cycling of the system. If the exhaust is at least 1 second long, air is reaching the pump.

By holding the bladder pump in your bare hand, the vibration caused by the passage of air can be felt and heard.

STEP 2 - Check if the pump is drawing a suction by listening to the skimmer while the pump is cycling. The sound of drawing the last bit of liquid through a straw should be heard.

OR

Open the inlet to the bladder pump by inserting a female fitting into the male fitting. Ensure that the discharge is open.

Feel the intake suction by putting your finger over the intake. The suction can be measured by attaching a vacuum gauge on the intake fitting.

STEP 3 - Check if the Genie pump is pushing anything out:

a. **First** - Disconnect the male quick-connect on the product hose from the Genie pump's female quick-connect. Ensure the pump inlet is open and clear.

b. **Second** - Insert a male plug into the female end to open it up and attach a pressure gauge.

Pressure should build up over two or three cycles. Note there may be a closed valve, crushed hose or obstruction downstream of the pump. Ensure all discharge conduits on the site are open.

STEP 4 - Inspect the pump check valve for malfunctions:

a. Open the inlet to the bladder pump and clean the check ball and seat.

b. Clean the upper check valve on the top of the Genie System by removing it and blowing out the debris with compressed air.

STEP 5 - Inspect the bladder.

a. Remove the eight screws from the pump casing and remove the casing.

b. Check for a hole or a tear in the bladder, or, if it is completely collapsed.

It is rare that the bladder requires service, but if it must be replaced, the necessary parts and a clamp tool are available.

BLADDER REPLACEMENT KIT WITH BLADDER, CLAMPS, AND O-RINGS	
Part No.	Description
301635	GNE-12 Bladder Kit
301636	GNE-24 Bladder Kit
301637	GNE-48 Bladder Kit
205650	Bladder Clamp Tool

END OF SECTION III.

Returning Equipment for Service

If the equipment needs to be returned to *QED* for servicing, please follow these steps:

STEP 1 - Call the *QED* Service Department and obtain a Return Material Authorization (RMA) number. Please have available the customers contact person's name, company name and address, phone number, fax number, reason for the return, and the names of the chemicals to which the equipment has been exposed.

STEP 2 - Clean all equipment before shipping. See **Equipment Cleaning Requirements** at the end of this section.

If the equipment must be cleaned after it arrives at *QED*, the customer will be charged for the cleaning and disposal of material, if necessary. (Cost can be $200.00 per piece of equipment cleaned.) Drain and dry all equipment after cleaning.

STEP 3 - Package the equipment so that it will not be damaged in shipment. Use bubble pack rather than styrofoam flakes as packing material.

STEP 4 - Ship the equipment via a carrier and service level (i.e., one-day, two-day shipping) in consideration of probable service time and return shipment time.

STEP 5 - It is recommended that such shipments be insured so if the shipment is badly damaged or lost, the customer can replace the equipment at little or no cost.

STEP 6 - Include the contact's name, company, phone number and RMA number given by *QED* .

STEP 7 - Write the RMA number on the outside of the packaging so it will be directed immediately to the *QED* Service Department.

Equipment Cleaning Requirements

If the equipment is to be shipped to another site or to the factory for service, it needs to be thoroughly cleaned before leaving the site. Cleaning the equipment protects the user (sender), the shipper, and the receiver from dirt and/or contaminants. If the equipment is not cleaned prior to shipping for servicing, it may be severely delayed, refused or the shipper may be charged a cleaning fee. Before packing and shipping, ensure that the equipment is dry inside and out.

The following is a list of equipment and how it should be cleaned prior to shipment.

Skimmers

Note:
With a Selective Oil Skimmer (SOS), remove the selective screen from the skimmer before using soap on the skimmer.

STEP 1 - Pump clean water or water with a gentle soap solution through the skimmers to remove free product and particles.

STEP 2 - Rinse all soap off of the equipment.

STEP 3 - Soak and rinse the outside of the unit with water to remove loose debris and dirt.

STEP 4 - Steam clean inside and out to remove difficult dirt and contaminants.

Caution:
Use low pressure (less than 40 psi) when steam cleaning.

Bladder Pumps

STEP 1 - Pump clean water or water with a gentle soap solution (e.g. Dish Soap) through the pump to remove free product and particles.

STEP 2 - Rinse all soap off of the equipment.

STEP 3 - Soak and rinse the outside of the unit with water to remove loose debris and dirt.

STEP 4 - Steam clean inside and out to remove difficult dirt and contaminants.

Caution:
Do not steam clean the inside of the pump, as it may damage the bladder.

Hoses and Fittings

STEP 1 - Pump clean water or water with a gentle soap solution (e.g. Dish Soap) through the pump to remove free product and particles.

STEP 2 - Rinse all soap off of the equipment.

STEP 3 - Soak and rinse the outside of the unit with water to remove loose debris and dirt.

STEP 4 - Steam clean inside and out to remove difficult dirt and contaminants.

Caution:
Use low pressure (less than 40 psi) when steam cleaning.

Appendix A: Optional Systems/Accesories

The following Options may be added to the Genie System at any time. Contact your regional *QED* office for more information.

Wall Mount Tank-Full Shut-Off (TFSO-WM)

The TFSO System shuts down the Genie System in the event of a liquid level rise or a pressure increase in the product recovery tank. This system guards against contaminants in the compressed air supply, vandalism, inexperienced operators and accidental damage to the equipment. If any of the quick-connects are removed, the system will shut down.

- Included in the TFSO option is a TFSO control box with tank-full indicator and tank-full reset button.

- Also included are the dual TFSO sensor hose and TFSO tank unit. The hose runs from the control box to the tank unit on the product recovery tank.

- A fume return/overflow hose directs overflow, if it occurs, from the tank to an overflow vessel or secondary containment.

- Please see the Tank-Full Shut-Off (TFSO) manual for additional information.

Tank-Mount Tank-Full Shut-Off (TFSO-TM)

This control is similar to the TFSO-WM except that the unit screws directly into the top of the tank, and there is no dual sensor line. **(See Figure 24)**

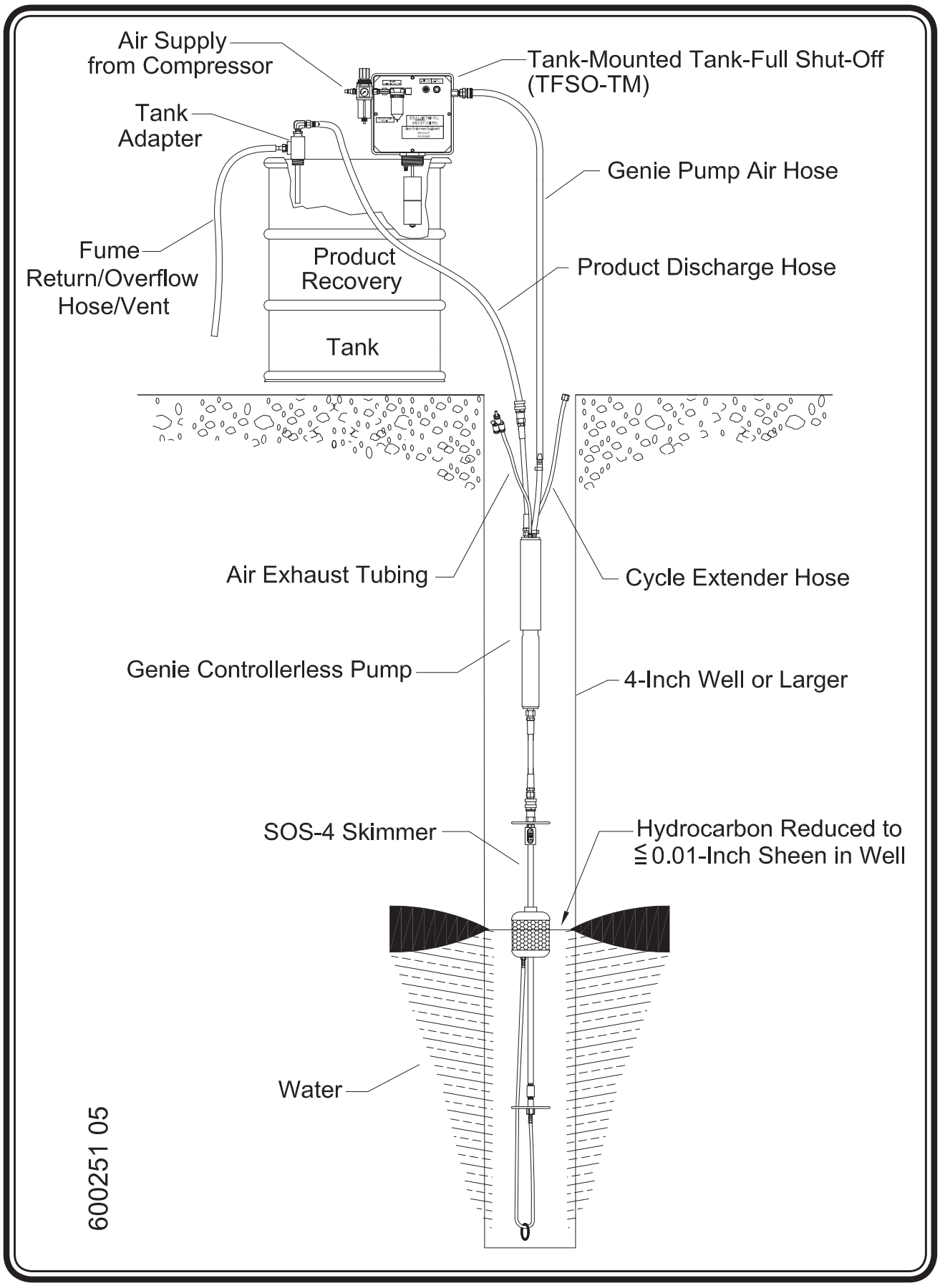


Figure 24 - Genie Systems with Optional Tank-Full Shut-Off (TFSO) Systems

High-Water Shut-Off (HWSO)

A High-Water Shut-Off (HWSO) option may be added to the Genie System. If a High-Water condition exists that causes the skimmer float to rise to its upper range of travel, air is turned off to the Genie pump. This prevents water from entering the product line. When the water level drops back to the normal range, the skimmer float starts dropping with the lower water level and the air is turned back on to the Genie pump.

- Included with the HWSO option is a well level sensor hose (yellow). This hose runs from the control box to the skimmer to sense the fluid level in the well.

- Also included is a High-Water Shut-Off (HWSO) indicator. This indicator is located on the outside of the control box. When the indicator is green, the system is ON; when the indicator is red, the fluid in the well has risen 11 inches above the level sensor bubbler hole on the skimmer, and the automatic cycling of the pump has been stopped. If more that one skimmer is being used, the operator must select the one to have the well level sensor hose. Unless the controls are modified, only one skimmer can be monitored.

Appendix B: Air Compressor

Installation

The air compressor provides the air necessary to drive the system. The compressed air normally passes through a single stage filter/regulator and then into the Genie. If the system receives clean, oil-free air from the compressor, maintenance will be significantly reduced.

Warning:
The air compressor and any other electrical equipment used with this pneumatic system must be positioned outside of any area considered hazardous because of the possibility of the presence of combustible materials.

Compressors start and stop automatically. Do not place hands or objects on or near any part of the compressor.

Follow the instructions that accompany your compressor. This appendix is only a general guide, not an in-depth manual for your compressor.

Warning:
When compressing air, parts of a compressor can get very hot. Do not touch the motor, compressor or piping until it has cooled down.

Caution:
The air compressor should be located outside and away from any area which may contain flammable fumes.

Note:
An automatic drain on the compressor receiver tank significantly reduces the load on the air filters, extends the life of the filter elements, and reduces system maintenance. If your air compressor is not equipped with an automatic drain, you can obtain one from QED.

Note:
The information on compressors is for reciprocating piston compressors. A centrifugal compressor produces about twice the air of a piston compressor for the same horsepower.

- As a general rule, a piston-type compressor should not start more than six times per hour. Also, a piston compressor should not operate more than 50% of the time.

- At a minimum, the air compressor should be in the 1 to 1-1/2 HP range with a 20 gallon holding tank.

- At sea level a 1 HP air compressor provides approximately 3.5 cubic feet per minute (SCFM) of free air.

- For compressor sizing, all down well and surface hosing and other resistance must be known.

- The 2 and 3 HP compressors should have 60 to 80 gallon tanks.

- A 5 HP compressor should have at least an 80 gallon tank, and the 7-1/2 HP and 10 HP compressors should have at least a 120 gallon tank.

- Storage tanks and automatic pressure shut-off switches provide a buffer so the compressor motor can cool between each time the tank is pressurized.

- Compressors are generally equipped with a pressure activated start/stop switch. This switch senses the pressure of the air in the holding tank (reservoir) of the compressor. The pressure difference between when the compressor starts and when it stops may need to be adjusted to maintain compressor starts to six times per hour. Refer to the compressor manufacturer for guidance.

Electrical Wiring for the Compressor

- All electrical connections should be made by a licensed electrician and in accordance with the electrical code for particular areas. The wiring should provide full motor nameplate voltage and current at the motor terminals during start-up.

- Wiring hookup must be made so that the compressor flywheel turns in the proper direction. There is usually an arrow on the flywheel to indicate the proper rotation direction.

Motor Overload Protection

- To prevent motor damage, provide all compressor motors with overload protection. Some motors are furnished with built-in thermal overload protection.

- To prevent motor damage due to low voltage or undue load imposed on the motor, use larger motors in conjunction with starters that include thermal overload units.

- To determine the proper thermal protection (thermal element), consider the load to be carried, the starting current, the running current, and the ambient temperature. Recheck electric current characteristics against nameplate characteristics before connecting wiring.

Caution:
Fuses are for circuit protection only and are not to be considered motor protection devices. Consult your local power company regarding proper fuse size.

Air Quality and Pressure

- In compressors requiring lubricating oil, do not use synthetic oil. Synthetic oil can adversely affect some materials. Non-detergent 30 Weight oil is recommended for compressor lubrication.

- Install an automatic drain on the compressor holding tank to periodically drain the water and oil which collects in the tank. This will help to extend air filter cartridge life.

- Do not lubricate the compressed air coming out of the compressor. QED equipment is designed to run without the aid of lubricated air.

- The compressor should provide between 70 and 150 pounds per square inch (psi) of air pressure to the system. The filter (with metal bowl) and regulator will accept a maximum of 150 psi air pressure. Air filters with plastic bowls will accept a maximum of 125 psi. Maximum output air pressure setting on the regulator is 125 psi.

Maintenance

Inspection - Check for possible damage in transit. Almost all compressors are shipped with the flywheel unmounted. Do not force the flywheel on the crankshaft. Use a wedge-in "slot" provided for easy assembly. Checked belt alignment and tension carefully.

Placement - A compressor is a source of sparking. Place it out of what is considered a hazardous area by local and national fire and electric codes.

Mounting - Install in a clean, dry, well-ventilated location away from any source of heat such as a boiler or radiator. If the unit is to be fastened to a foundation, support and shim all four feet firmly to remove all stress from the unit. The compressor flywheel should be mounted towards a wall with a minimum clearance of 18 inches to allow for circulation of air and additional clearance if required for servicing.

Lubrication - Fill the crankcase to the level mark on the oil gauge with an industrial compressor oil having a minimum of 95 V.I. or SAE No. 30 non-detergent, single grade motor oil. Do not use synthetic oil, as these can damage the product pump.

Pressure and Speed - Never operate the compressor at pressures or speeds in excess of those recommended by the factory. Every compressor assembly must have a safety valve installed and should be set at either the maximum tank working pressure or 25 psi over the actual pressure of the pump, whichever is less.

Daily - Check for unusual noise, failure to compress, overheating, oil leaks, and vibration. Correct before serious damage can develop. Drain all condensate from receiver and traps.

Weekly - Examine intake filter elements and if they are dirty, remove and clean or replace them. Check oil level and add oil if necessary. Do not fill over level mark on sight glass. Keep compressor clean for efficient operation and appearance.

Monthly - Check and tighten all bolts and nuts as required. Check air connections for air leaks and tighten as required. Check belt tension.

Note:
These are standard maintenance procedures which the QED Environmental Systems "warranty" does not cover. QED does not manufacture compressors. Always use the manufacturer's instructions and recommendations when installing, using and servicing the compressor. These notes are included as a general guide only.

Troubleshooting

I. Problem: Slow Pumping or Insufficient Pressure

Solutions:

A. Clogged filter element: clean or replace.

B. Leaks in air lines: retighten or replace.

C. Insufficient air capacity: add compressor capacity, consult dealer.

D. Head valves: clean or replace.

E. Slipping belts: adjust or replace.

F. Power cord is too long for the power needed, causing a voltage drop: use a short cord with large wires. Do not coil the power cord.

II. Problem: Excessive Oil Consumption

Solutions:

A. Too much oil: drain out excess to level mark on sight glass.

B. Worn rings: replace rings.

C. Clogged air intake filters: clean or replace.

D. Improper Oil: consult oil chart.

E. Oil leaks: check and tighten all bolts and nuts to manufacturer's specifications. Replace gaskets if necessary.

F. See "Overheating."

III. Problem: Overheating
Solutions:

A. Pump running backwards: reverse rotation.

B. Inadequate ventilation or high ambient temperature: move intakes to outside and install filters to protect against weather and foreign objects. Force air through enclosure if necessary.

C. Restricted air intakes: clean or replace.

D. Loose or restricted valves: retighten, clean, or replace.

E. Incorrect installation: allow 18 inches minimum between wall and flywheel.

F. Insufficient air capacity: consult dealer. Seal all air leaks.

G. Insufficient oil: check level and consult dealer.

IV. Problem: Oil or Water in Air
Solutions:

A. Drain tank more often: use an automatic drain.

B. Reposition intake to take in cooler, drier air.

C. Install water dropouts with automatic drains in the air lines.

D. Install an after cooler prior to the air storage tanks.

Appendix C: Skimmers

The Genie System can use any of the skimmers listed below (one or more with each system). **(See Figure 25, 26, 27, 28 and 29)**

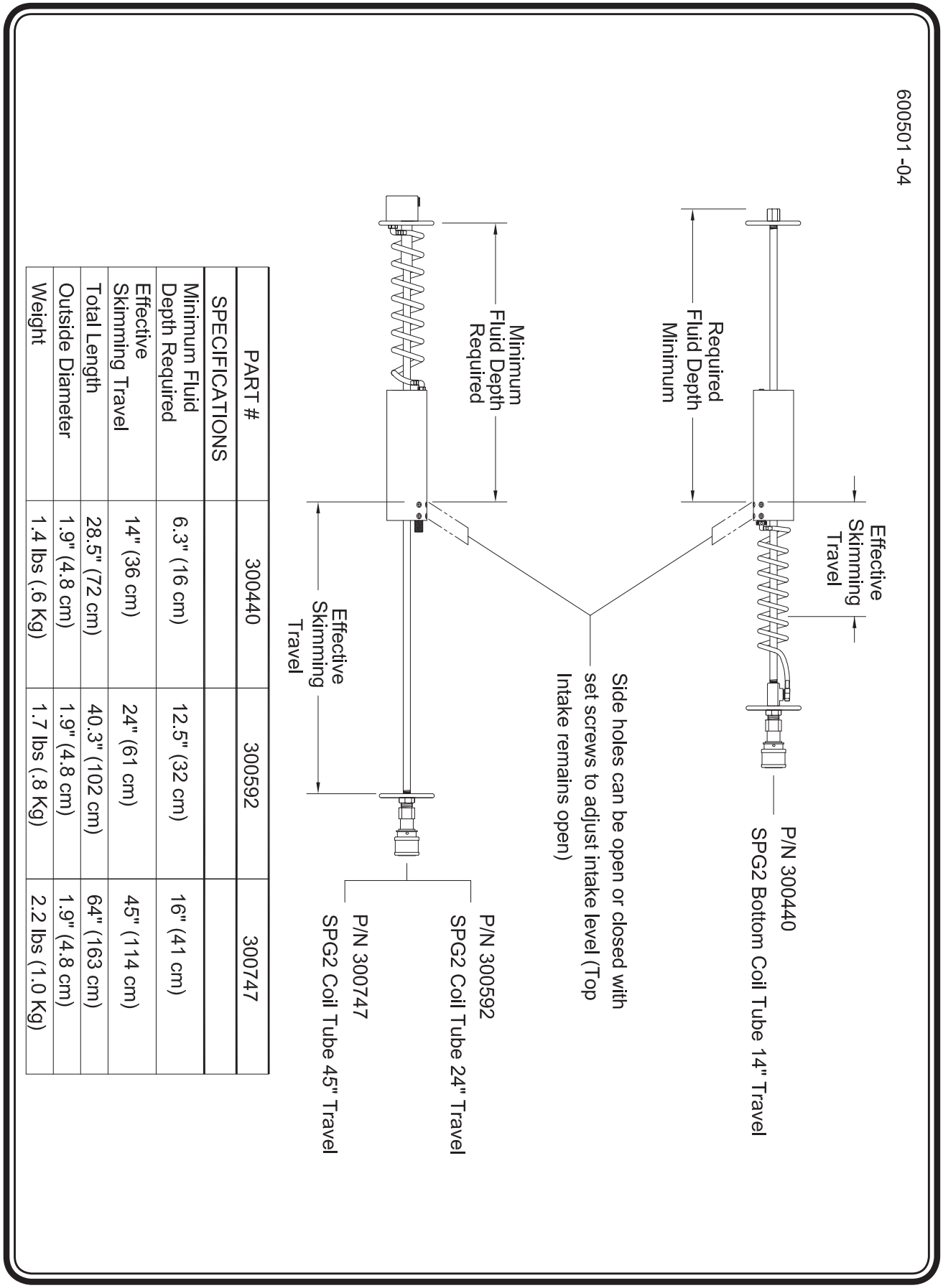
Description

- **SOS –** Selective Oil Skimmer skims oil to 0.01 inches.
- **SPG –** Specific Gravity Skimmer skims oil to 2 inches.
- **Bottom –** Allows intake as close as possible to the bottom of the well.
- **Passive –** Does not require a pump to collect oil.

Note:
A High-Water Shut-Off sensor can be built into most skimmers.

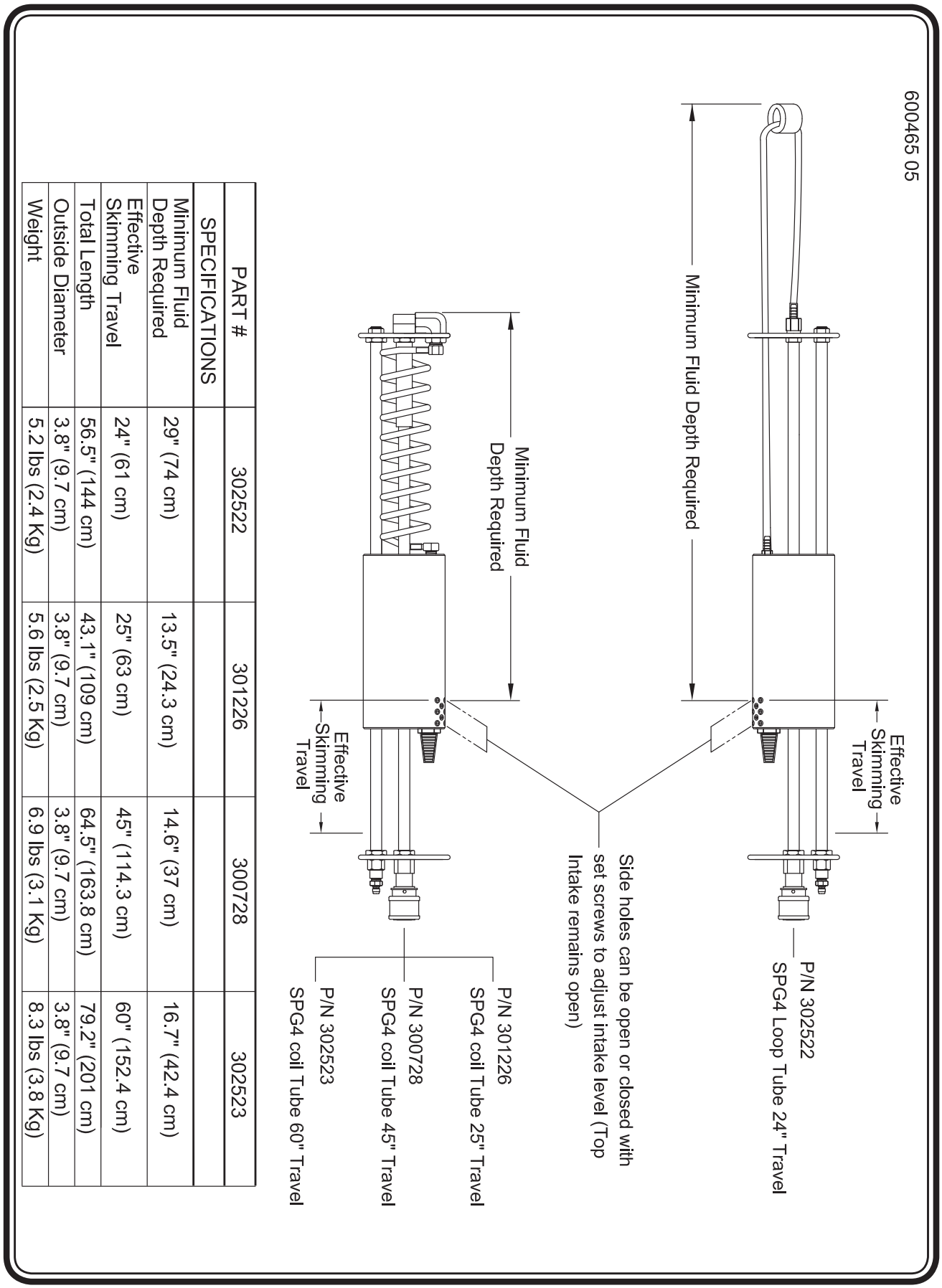
PART #	302524	300028	302525	300776
SPECIFICATIONS				
Minimum Fluid Depth Required	6" (15 cm)	28.5" (72 cm)	10.3" (26 cm)	10.9" (28 cm)
Effective Skimming Travel	12" (30 cm)	24" (61 cm)	24" (61 cm)	47" (119 cm)
Total Length	28.5" (72 cm)	58.8" (149 cm)	42.7" (108 cm)	63.3" (161 cm)
Outside Diameter	3.8" (9.7 cm)	3.8" (9.7 cm)	3.8" (9.7 cm)	3.8" (9.7 cm)
Weight	3.2 lbs (1.5 kg)	2.8 lbs (1.3 kg)	3.4 lbs (1.5 kg)	3.7 lbs (1.7 kg)

Figure 25 - 4-inch Selective Oil Skimmers (SOS-4)



PART #	300440	300592	300747
SPECIFICATIONS			
Minimum Fluid Depth Required	6.3" (16 cm)	12.5" (32 cm)	16" (41 cm)
Effective Skimming Travel	14" (36 cm)	24" (61 cm)	45" (114 cm)
Total Length	28.5" (72 cm)	40.3" (102 cm)	64" (163 cm)
Outside Diameter	1.9" (4.8 cm)	1.9" (4.8 cm)	1.9" (4.8 cm)
Weight	1.4 lbs (.6 Kg)	1.7 lbs (.8 Kg)	2.2 lbs (1.0 Kg)

Figure 26- 2-inch Specific Gravity Skimmers (SPG-2)



PART #	302522	301226	300728	302523
SPECIFICATIONS				
Minimum Fluid Depth Required	29" (74 cm)	13.5" (24.3 cm)	14.6" (37 cm)	16.7" (42.4 cm)
Effective Skimming Travel	24" (61 cm)	25" (63 cm)	45" (114.3 cm)	60" (152.4 cm)
Total Length	56.5" (144 cm)	43.1" (109 cm)	64.5" (163.8 cm)	79.2" (201 cm)
Outside Diameter	3.8" (9.7 cm)	3.8" (9.7 cm)	3.8" (9.7 cm)	3.8" (9.7 cm)
Weight	5.2 lbs (2.4 Kg)	5.6 lbs (2.5 Kg)	6.9 lbs (3.1 Kg)	8.3 lbs (3.8 Kg)

Figure 27- 4-inch Specific Gravity Skimmers (SPG-4)

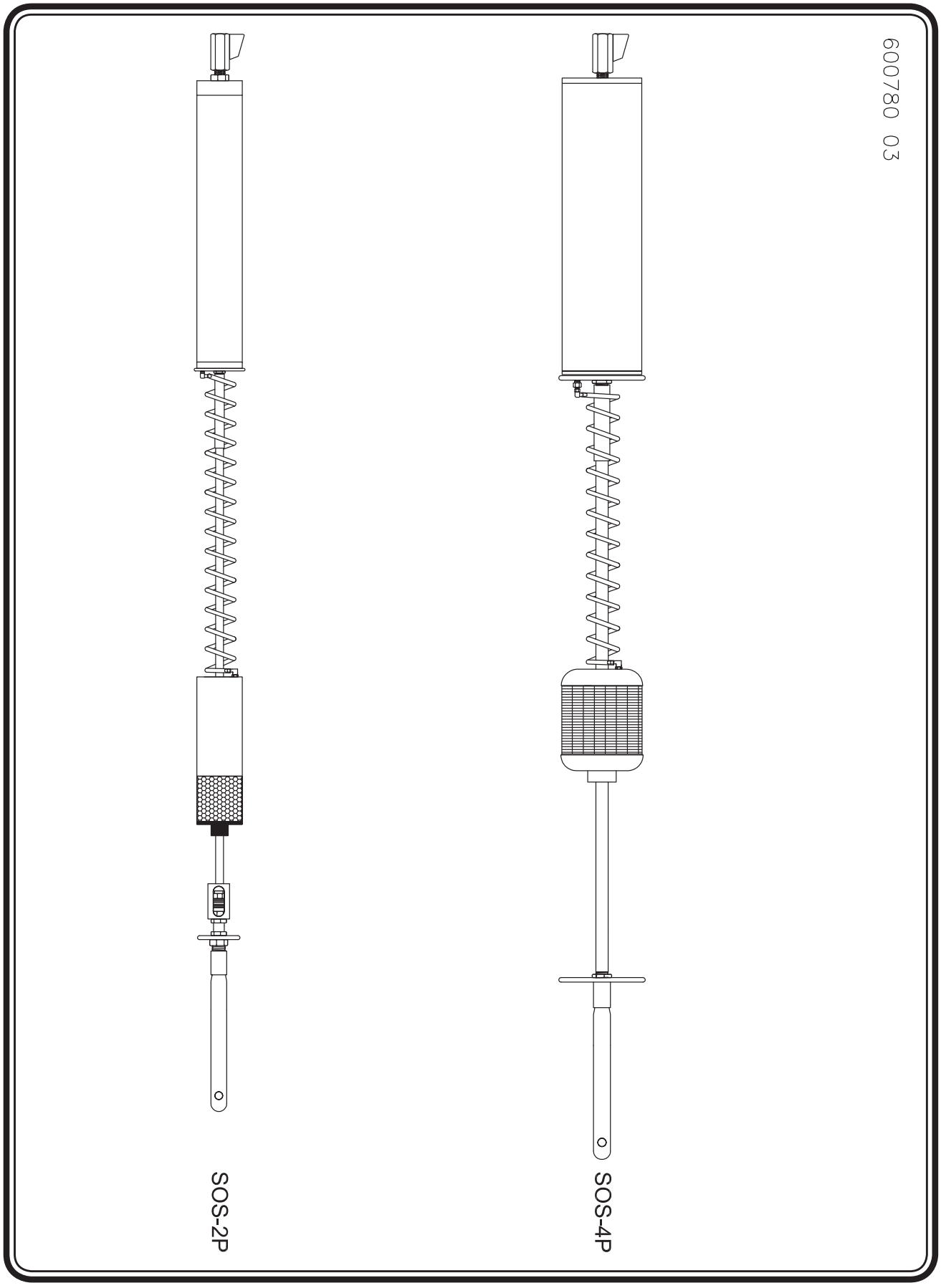


Figure 28- Passive Skimmers

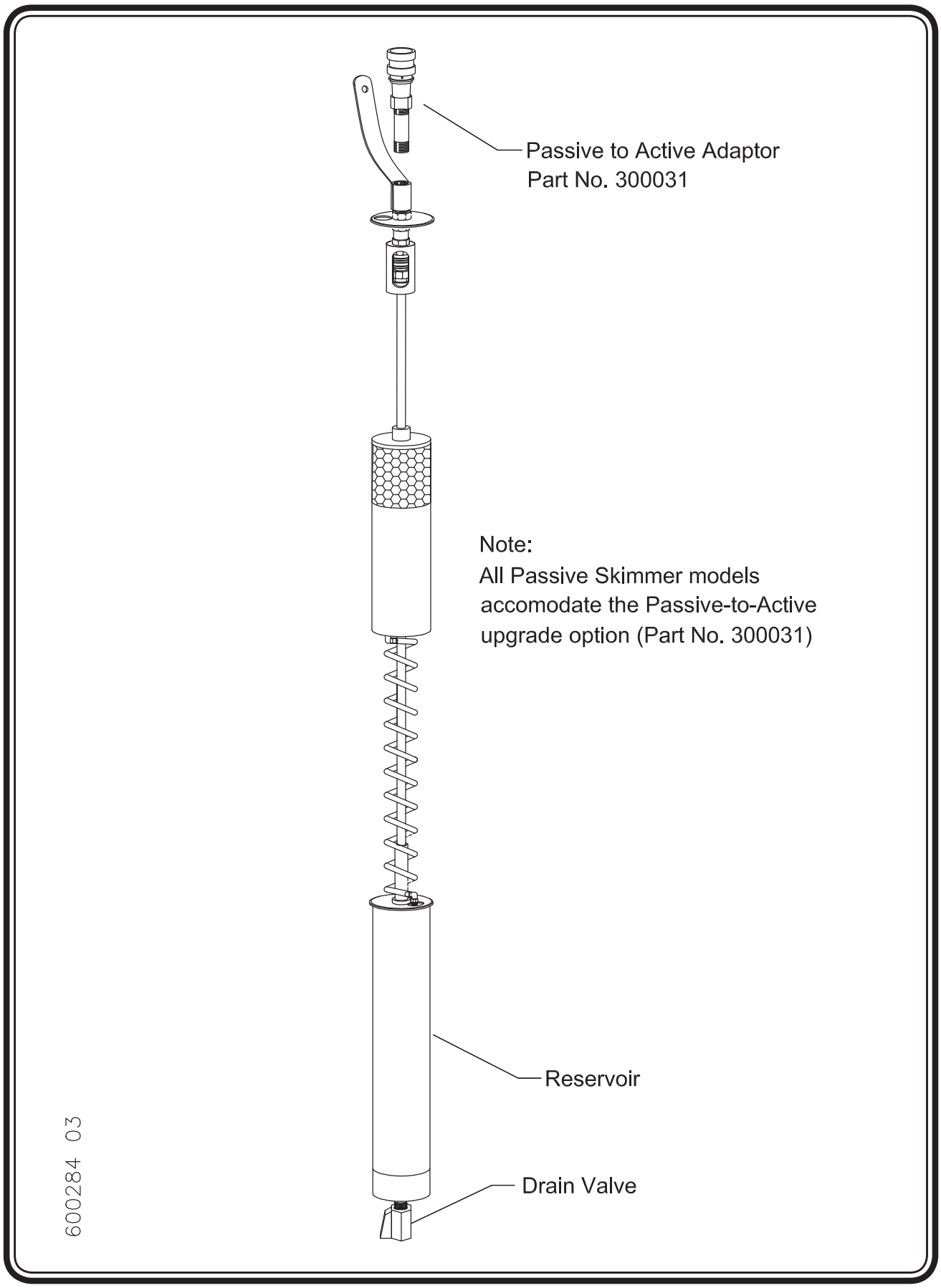


Figure 29 - Fully Automatic Product Recovery Upgrade Assembly Kit

Terms, Conditions, and Warranty

This limited warranty is in lieu of and excludes all other representations made by advertisements, distributors, agents, or manufacturers sales representatives, and all other warranties, both express and implied. There are no implied warranties of merchantability or of fitness for a particular purpose for goods covered hereunder.

QED Environmental Systems warrants to the purchaser of its products that, subject to the limitations and conditions provided within the Terms & Conditions of Sale, products, materials and/or workmanship shall reasonably conform to descriptions of the products and shall be free of defects in material and workmanship.

All warranty durations are calculated from the original date of purchase-determined as beginning the date of shipment from QED facilities and the date QED is notified of a warranty claim. This warranty shall be limited to the duration and conditions set forth below.

1. **Pumps (other than AutoPumps), Skimmers, hose, tubing, fittings, heater, condensers and air filtration housings** - warranted for one (1) year: 100% material and 100% workmanship. There will be no warranty for application or material compatibility. The materials used vary depending upon application, and the customer is responsible for knowing the environment in which the equipment will be operating and informing QED of this.

2. **Pneumatic Data Modules / Logic Control Panels** - warranted for one (1) year: 100% material and 100% workmanship.

3. **Parts and Repairs** - warranted for ninety (90) days: 100% material and 100% workmanship; when repairs are performed by QED or its appointed agent; from date of repair or for the full term of the original warranty, whichever is longer. Separately sold parts are warranted for ninety (90) days: 100% materials and 100% workmanship.

This warranty will be void in the event of unauthorized disassembly of component assemblies, other than maintenance and conversion procedures detailed in the operations and maintenance manual. Defects in any equipment that result from abuse, operation in any manner outside the recommended procedures, or use and applications other than for intended use will also void the warranty.

Chemical attack by liquids and/or abrasive substances contacting equipment and accessories shall not be covered by this warranty. A range of materials of construction is available from QED and it is the Buyer's responsibility to inform QED of the contaminants and their concentrations, including the presence of abrasives. QED will recommend materials of construction. QED will only warrant that the component materials will conform to published QED specifications and generally accepted standards for that particular material.

QED Environmental Systems shall be released from all obligations under all warranties if any product covered hereby is repaired or modified by persons other than QED service personnel (unless such repair by others is made with the written consent of QED, or as stated in QED manuals or directions); resold to other parties; and/or moved to or used on a remediation site other than originally specified.

It is understood and agreed that QED Environmental Systems shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of this agreement, nor for special damages, nor for improper selection of any product described or referred to for a particular application. Liability under this warranty is limited to repair or replacement F.O.B. QED's factory, or its appointed agent's shop, of any parts which prove to be defective within the duration and conditions set forth herein, or repayment of the purchase price at the option of QED, provided the products have been returned in accordance with the duration and conditions set forth herein.

Subassemblies and Other Equipment Manufactured by Others

The foregoing warranty does not apply to major subassemblies, other equipment, accessories, or parts manufactured by others, and such other parts, accessories, and equipment are subject only to the warranties, if any, supplied by their respective manufacturers. QED makes no warranty concerning products or accessories not manufactured by QED. In the event of failure of any such product or accessory, QED will give reasonable assistance to Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

Illustrations and Drawings

Reasonable Effort has been made to have all illustrations and drawings accurately represent the product(s) as it actually was at the time the illustrations and drawings were created.

However, products may change to meet user requirements and therefore may not be reflected in the literature. In addition, literature may be updated to reflect the most recent equipment revision(s). Changes to either or both equipment and/or literature can be made without notice.

Buyer's Remedies

The buyer's exclusive and sole remedy on account of or in respect to the furnishing of defective material or workmanship shall be to secure replacement thereof as aforesaid. QED shall not in any event be liable for the cost of any labor expended on any such product or material or for any special, direct, indirect or consequential damages to any one by reason of the fact that it shall have been deemed defective or a breach of said warranty.

Changes without Notice

Prices and Specifications are subject to change without notice.

Shipping Dates

Shipping dates are approximate and are subject to delays beyond our control.

F.O.B. Point and Title

All material is sold F.O.B. factory, unless otherwise agreed on writing. Title to all merchandise sold shall pass to Buyer upon delivery by Seller to carrier at factory. All freight insurance is the responsibility of the Buyer and shall be charged to the Buyer on the invoice unless directed otherwise in writing. All Freight claims are the Buyer's responsibility.

Terms

Payment terms are net 30 days; 1.5% per month past due.

State and Local Taxes

Any taxes, duties or fees which the seller may be required to pay or collect upon or with respect to the sale, purchase, delivery, use or consumption of any of the material covered hereby shall be for the account of the Buyer and shall be added to the purchase price.

Acceptance

All orders shall be subject to the terms and conditions contained or referred to in the Seller's quotation, acknowledgments, and to those listed here and to no others whatsoever. No waiver, alteration or modification of these terms and conditions shall be binding unless in writing and signed by an executive officer of the Seller. All orders subject to written acceptance by QED Environmental Systems, Ann Arbor, MI, U.S.A.

Warranty Claims Procedure (Responsibility of purchaser)

The original purchaser's sole responsibility in the instance of a warranty claim shall be to notify QED or its appointed agent, of the defect, malfunction, or other manner in which the terms of this warranty are believed to be violated. The purchaser may secure performance of obligations hereunder by contacting the Customer Service Department of QED or its appointed agent, and:

1. Identifying the product involved by model or serial number, or other sufficient description, that will allow QED, or its appointed agent, to determine which product is defective.

2. Specifying where, when, and from whom the product was purchased.

3. Describing the nature of the defect or malfunction covered by this warranty.

4. After obtaining authorization from QED, sending the malfunctioning component via a RMA# (Return Material Authorization number) to the address below or to its appointed agent:

QED Environmental Systems
550 Adeline Street
Oakland, CA 94607 USA

(800) 537-1767 Toll-Free in North America
(510) 891-0880 International
(510) 444-6789 FAX

e-mail: info@qedenv.com
website: www.qedenv.com

5. Equipment must be cleaned before shipment or it will be cleaned by QED before any work is performed. The customer will be charged for such cleaning.

If any product covered hereby is actually defective within the terms of this warranty, purchaser must contact QED, or its appointed agent, for determination of warranty coverage. If the return of a component is determined to be necessary, QED, or its appointed agent, will authorize the return of the component at Purchasers expense. If the product proves not to be defective within the terms of this warranty, then all costs and expenses in connection with the processing of the Purchaser's claim and all costs for repair, parts, labor, and shipping and handling, as authorized by owner hereunder, shall be borne by the Purchaser. In no event shall such allegedly defective products be returned to QED, or its appointed agent, without its consent, and QED's, or its appointed agent's, obligations of repair, replacement or refund are conditional upon the buyer's return of the defective product to QED, or its appointed agent.

The Next Generation AutoPump® AP4+

- Easier to Disassemble and Clean
- Same Proven AutoPump® Air Control Mechanism
- Upgraded Materials
- Expanded 5-year Warranty

QED™
Innovative Environmental Products

AutoPump®

The New AP4+

Same proven internal design, improved user features and value

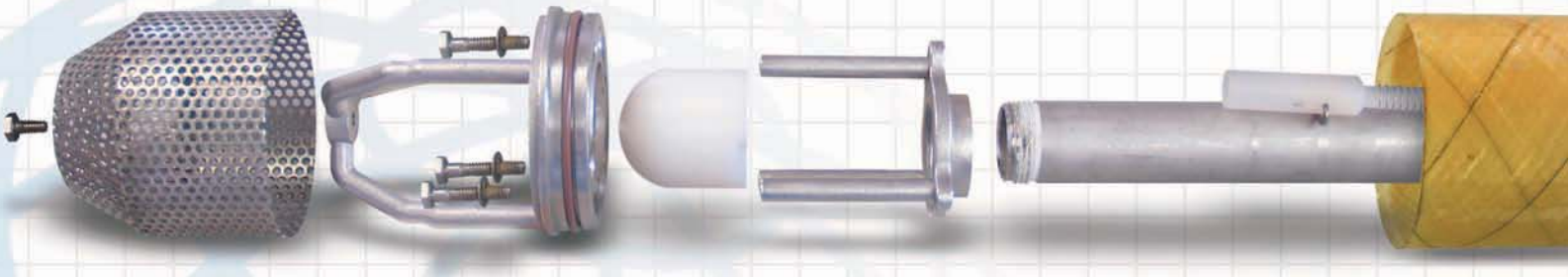
The AutoPump® AP4 has been the gold standard for landfill and remediation pumping for over 20 years, proving itself #1 in reliability, long service life and the longest warranty in the industry. Although the original design has proven superior over time, QED has continued to refine it to make it even more reliable. The new AP4+ (Patent Pending) model now builds on the world's #1 choice for landfill and remediation pumping and makes it even better, to deliver more value to our customers. At the same time, the new AP4+ keeps the same internal mechanism design that AP4 users have depended on for over 20 years, along with the industry's leading pumping rates and low air consumption.

What makes the AP4+ even better?

- Easier to disassemble and clean
- Upgraded materials
- Expanded 5-year warranty terms

Removing the spring clip allows for easy disassembly of the float.

Smooth ID helps reduce the rate of solid buildup inside the casing.



AP4+ Bottom Inlet Disassembly

Easier to Disassemble and Clean

The AP4+ was made easier to clean by borrowing from our HammerHead® pump design, using 3 bolts to attach the pump inlet and open up the pump. This is easier than having to rotate the inlet multiple turns to unthread it from the center tube inside the pump, especially under field conditions of silt, deposits and coatings. Removing the inlet is also aided by the new, precision ID pump casing, ensuring a more controlled fit. The new pump casing's smoother internal surface has the added benefit of reducing the rate of buildup of solids and coatings inside in some cases. The Easy Fittings make it a snap to remove the tubing from the pump without cutting, and the float is now easily removed by pulling a clip.

Upgraded Materials

The new AP4+ features upgraded materials for many parts to further extend the service life of the pump and to broaden the range of conditions each model can be used in. All nonmetallic internal parts are now made of PVDF*; this is a high-grade engineering plastic with higher strength at elevated temperatures and extremely broad chemical resistance, including to acidic and oxidizing cleaning agents sometimes used for pump maintenance. All stainless steel parts have been upgraded to 304 grade or higher for improved corrosion resistance.

Expanded 5-year Warranty

The new and improved warranty, a straight 5-year warranty with no pro-rating, is proof of the AP4+'s successful history and continued improvements.

Of course, the new AP4+ is compatible with the AutoPump Family of Accessories, including:

- Sheathed nylon pump tubing sets for maximum chemical resistance, reduced weight, less tangling and easier handling, another innovation lead by QED.
- QED's Easy Fittings for affordable, quick connection and removal of the pump from its tubing set, built to function easily even under high solids well conditions. These are now available pre-installed to pump and tubing so pump system installation just snaps together!
- QED's Easy Bolts for rapid access to flanged wellheads.
- The industry's widest range of wellhead completions to match your site so that pump installation goes smoothly. Custom options are available to fit your specific wellhead requirements.

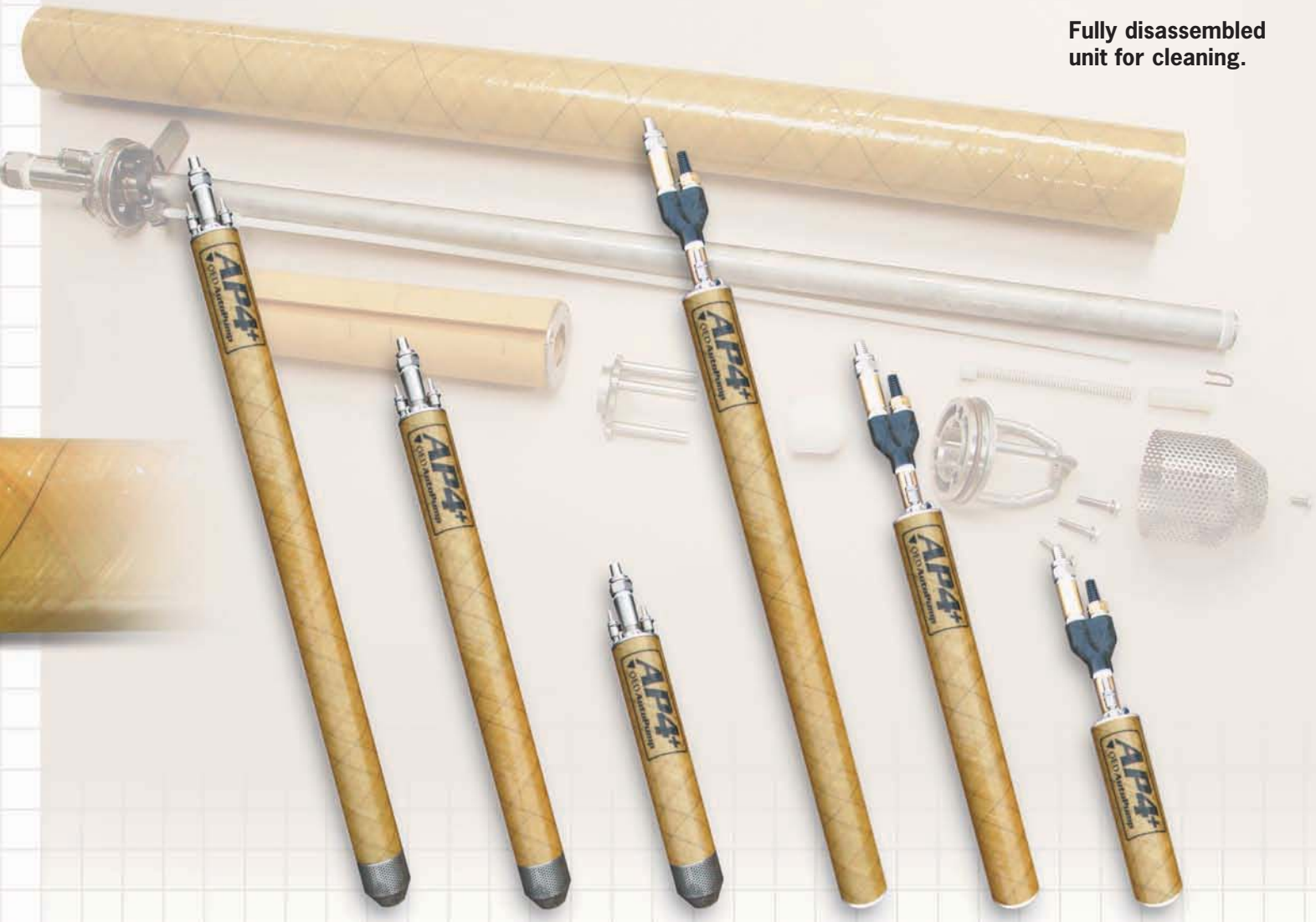
* Except for the standard top-filling wye, which is made of acetal.

Pull out the release clips.

Once the clips are removed, simply pull the connections apart.

See the AP4+ disassembled in two minutes with this video online: http://www.qedenv.com/AP4plus

Builds On A Tradition Of Success



Fully disassembled unit for cleaning.

AP4+ Series Pumps

	4" Pump Long AP4+B	4" Pump Short AP4+B	4" Pump LD AP4+B	4" Pump Long AP4+T	4" Pump Short AP4+T	4" Pump LD AP4+T
Fluid Inlet	Bottom	Bottom	Bottom	Top	Top	Top
Diameter	3.6 in. (9.1 cm) OD	3.6 in. (9.1 cm) OD	3.6 in. (9.1 cm) OD	3.6 in. (9.1 cm) OD	3.6 in. (9.1 cm) OD	3.6 in. (9.1 cm) OD
Length	51.4 in. (131 cm)	39.3 in. (100 cm)	27.5 in. (70 cm)	56.7 in. (144 cm)	45 in. (110 cm)	30.75 in. (78 cm)
Maximum Flow	14 gpm (53 Lpm)	13 gpm (49 Lpm)	7 gpm (26.5 Lpm)	10 gpm (38 Lpm)	9 gpm (34 Lpm)	6.4 gpm (24 Lpm)
Maximum Depth	250 ft. (76 m)	250 ft. (76 m)	250 ft. (76 m)	250 ft. (76 m)	250 ft. (76 m)	250 ft. (76 m)
Actuation Level	38.4 in. (98 cm)	26.7 in. (68 cm)	15.3 in. (39 cm)	53.3 in. (135 cm)	41.6 in. (106 cm)	27.4 in. (70 cm)

All pumps can handle temperatures of 180° F. Special models available for severe applications, including high temperatures, high viscosity and corrosive conditions. Visit our website at www.qedenv.com for specifications, flow rates and operating conditions, or contact QED directly at 1-800-624-2026.

Products Designed for Easy Field Operation

QED utilizes over 20 years of experience in air-powered pumping to find ways to improve the value we offer our customers, including helping reduce the total cost of pump installation, service and ownership.

Precision Wellheads with Stabilizer™ LFG Well Caps

- Precision Wellheads include the Precision Fine Tune™ Control Valve (U.S. Patent Number 8,800,597).
- Stabilizer™ LFG Well Caps (patent pending) feature a unique support ring molded directly into the Cap.

Easy Tubing with Easy Fittings

- Pump is easy to snap onto and off of the tubing with Easy Fittings without cutting the tubing.
- Our sheathed tubing is available cut-to-length and individually labeled, with Easy Fittings factory-installed.

Easy Bolt

Easy bolts make flanges easy to access with no wrenches or tools.

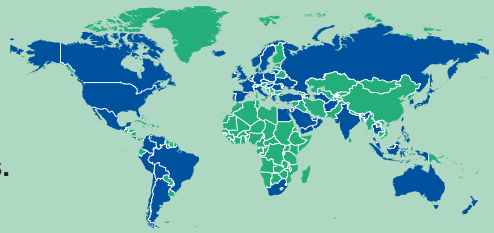
5-year Warranty

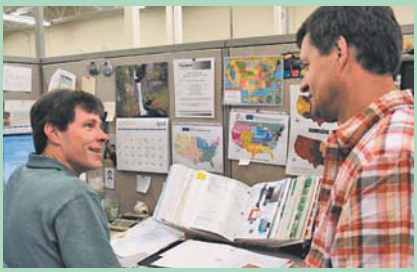
Expanded 5-year warranty for ease of mind.

Visit our website at www.qedenv.com for complete pump specifications and flow rates, or call us

800-624-2026

for prompt, expert assistance on your pumping project needs.





Every QED AutoPump® system is backed by QED's unequaled reputation and dedication to quality and service. QED leads the industry in customer service, from our worldwide sales representation and our large services staffs in both Dexter, Michigan and San Leandro, California, to our 24-hour, toll-free service hotline. Call or e-mail QED for prompt assistance with your unique project needs.

The World Leader in Air-Powered Pumps

For Remediation, Landfills and Groundwater Sampling

QED™

2355 Bishop Circle West
Dexter, MI 48130
USA

800-624-2026
T: 734-995-2547
F: 734-995-1170
info@qedenv.com
www.qedenv.com

1565 Alvarado Street
San Leandro, CA 94577
USA

800-624-2026
T: 510-346-0400
F: 510-346-0414
info@qedenv.com
www.qedenv.com

CODE 2345 09/14

QED Environmental Systems

AutoPump

Leaders in Environmental Compliance Products

OPERATIONS MANUAL

D602277-03 (doc # 602277) (Rev 5/16/14)

AP4+

AutoPump Controllerless System

(For 4 inch wells or larger)

DURABLE,
DEPENDABLE,
& DELIVERS

QED Environmental Systems - 2355 Bishop Circle West Dexter, MI 48130
1-800-624-2026 (North America Only) (734) 995-2547 - Tele (734) 995-1170 - Fax info@qedenv.com - E-mail www.qedenv.com
QED Environmental Systems (West) - 1565 Alvarado Street San Leandro, California 94577-2640
1-800-537-1767 (North America Only) (510) 346-0400 - Tele (510) 346-0414 - Fax

The equipment in this manual is protected under U.S. and foreign patents issued and pending:

U.S. Patents:

AutoPump (AP) 5,004,405

QED
Environmental Systems

Figures:

Welcome to QED Environmental Systems' AutoPump® (AP4+) manual.

To ensure the best operator safety and system performance, it is strongly recommended that the operators read this entire manual before using the system.

This manual reflects our many years of experience and includes comments and suggestions from our sales and service personnel and most importantly from our customers. The chapters, their contents and sequence were designed with you, the user and installer, in mind. We wrote this manual so it can be easily understood by users who may not be familiar with systems of this type or are using a QED system for the first time.

Safety

Safety has been a cornerstone of our design which has been proven out in building and shipping systems throughout the world. Our high level of performance is achieved by using quality components, building in redundancies or backup systems, and not compromising our commitment to quality manufacturing. The net result is the highest quality and safest pneumatic pump recovery system on the market. We feel so strongly about safety, based on years of working with the hydrocarbon industry, that it is the first section of all our manuals

How to Contact QED

If for any reason you are unable to find what you need in this manual feel free to contact the QED Service Department at any time. We encourage you to use following communication methods to reach us at any time:

Service Department
QED Environmental Systems
www.qedenv.com

San Leandro Service Center
1565 Alvarado Street
San Leandro, California 94577-2640

(800) 537-1767 — North America Only
(510) 346-0400 — Tele.
(510) 346-0414 — Fax

Ann Arbor Service Center
2355 Bishop Circle West
Dexter, Michigan 48130

(800) 624-2026 — North America Only
(734) 995-2547 — Tele.
(734) 995-1170 — Fax
info@qedenv.com — E-mail

QED can be reached 24 hours a day

We welcome your comments and encourage your feedback regarding anything in this manual and the equipment you have on-site.

Thank you again for specifying QED equipment.

Safety has been a prime consideration when designing the AutoPump System. Safety guidelines are provided in this manual, and the AutoPump System safety features are listed below. Please do not attempt to circumvent the safety features of this system.

We have also listed some possible hazards involved when applying this system to site remediation. Nothing will protect you as much as understanding the system, the site at which it is being used, and the careful handling of all equipment and fluids. If you have any questions, please contact the QED Service Department for guidance.

As you read through this manual, you will encounter three kinds of warnings. The following examples indicate how they appear and lists their respective purposes.

Note: Highlights information of interest.
Caution: Highlights ways to avoid damaging equipment.
Warning: Highlights personal safety issues.

A Partial List of Safety Procedures

WARNING:The air compressor and any other electrical equipment used with this pneumatic system must be positioned outside of any area considered hazardous because of possible combustible materials.

These safety procedures should be followed at all times when operating QED equipment on or off site, and should be considered as warnings:

- Wear safety goggles when working with the AutoPump System to protect eyes from any splashing or pressure release.
- Wear chemically resistant rubber gloves, boots, and coveralls when handling the AutoPump and fluid discharge hose to avoid skin contact with the fluid being removed
- Point tubing/hoses away from personnel and equipment when connecting or disconnecting.
- Always ensure that the fluid discharge line is connected before the air line to prevent accidental discharge.

The AutoPump System minimizes the potential for accidents with the following safeguards:

Fire and Explosion Protection

Almost all of QED underground fluid extraction systems are pneumatic. This offers many inherent fire and explosion protection features.

The AutoPump® fills and empties automatically, and is very easy to install, use, and maintain.

The AutoPump is a pneumatic fluid extraction pump that pumps in pulses. It handles any liquid which flows freely into the pump and is compatible with the component materials and with the connecting hoses. The AP4+ is intended for vertical operation in well casings with a 3.75-inch or greater internal diameter. It can pump particles up to 1/8-inch in diameter.

The AutoPump is very versatile and available in a wide range of lengths, valve arrangements, and materials of construction to meet particular site specifications.

Equipment will vary by application and site specifications. (See Chapter 3)

General Specifications

Pump Diameter:	3.6 inch (91 mm)
Pressure Range:	5 - 120 psi (0.4 - 8.5 Kg/cm²)
High Pressure Option:	5 - 200 psi (0.4 - 14.1 Kg/cm²)
Flow Ranges:	0-14 gallons per minute (0-53 liters per minute)

This is How it Works

The AutoPump is a submersible compressed air-driven pump which fills and empties automatically. It also controls the fluid level in a well automatically. The pump fills (***See Figure 1***) when fluids enter either the top or bottom check valve. Air in the pump chamber exits through the exhaust valve as the fluid fills the pump. The float inside the pump is carried upwards by the fluids rising in the casing until it pushes against a stop on the control rod, forcing the valve mechanism to switch to the discharge mode.

The switching of the valve causes the exhaust valve to close and the air inlet valve to open. This causes the pump to empty (***see Figure 1***) by allowing compressed air to enter the pump. This pressure on the fluid closes the inlet check valve and forces the fluids up the discharge line and out of the pump through the outlet check valve. As the fluid level falls in the pump, the float moves downward until it pushes against the lower stop on the control rod, forcing the valve mechanism to switch to the fill mode. The outlet check valve closes and prevents discharged fluids from re-entering the pump. The filling and discharging of the pump continues automatically.

NOTE: The figures shown here are simplified schematics.

Figure 1 - How it Works

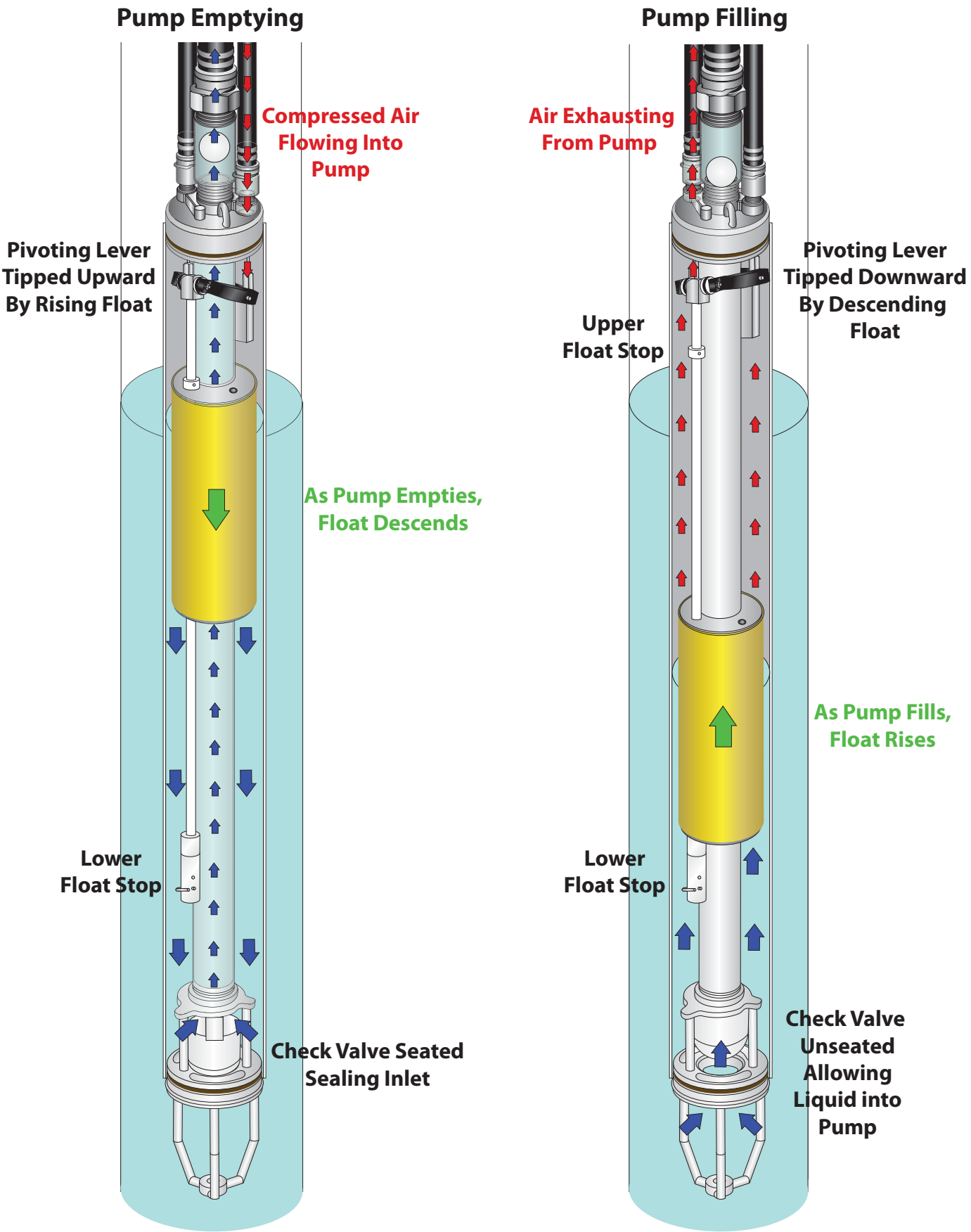
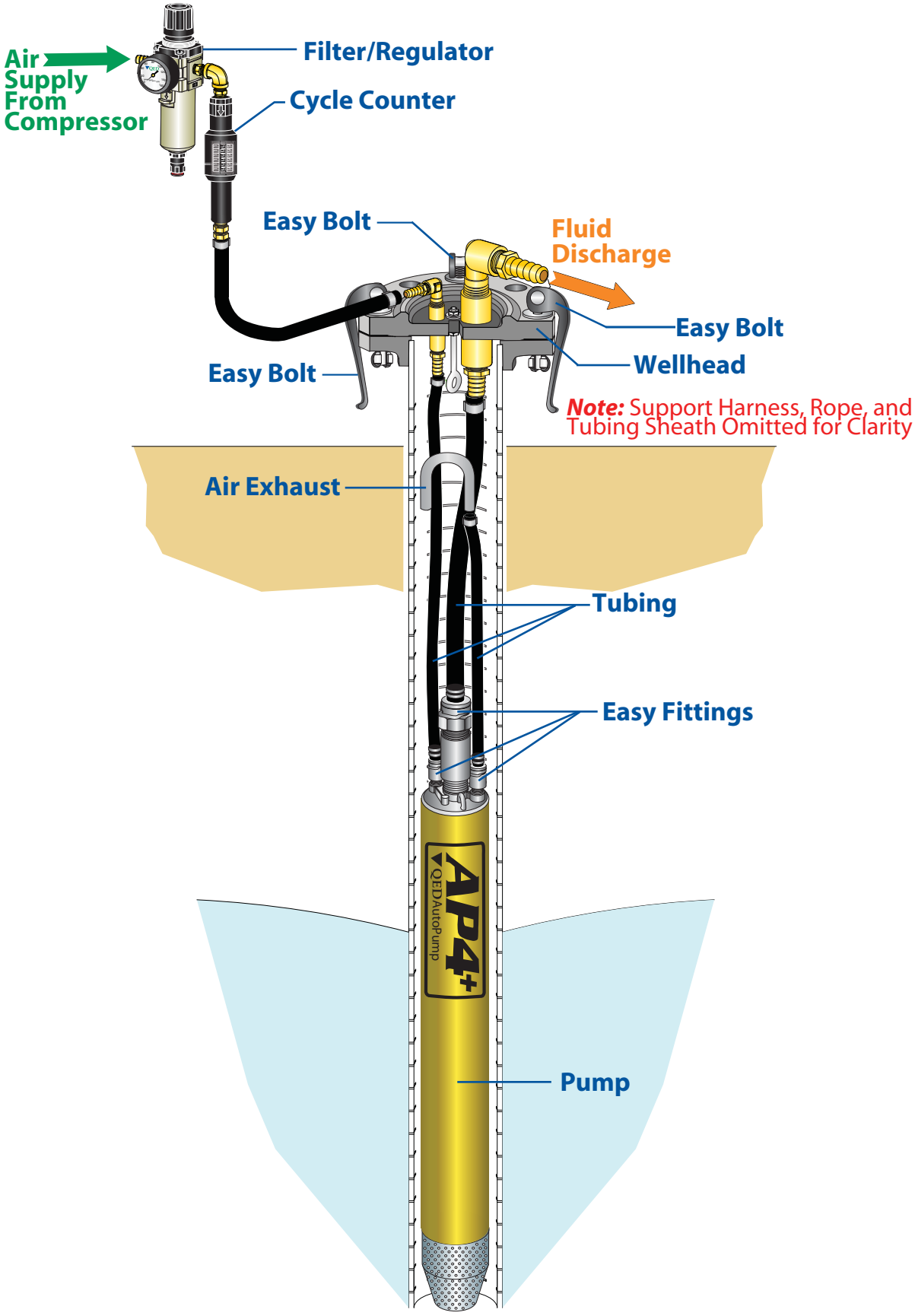


Figure 2 - Overview of the AP4+ System

AP4+ System provides everything required for pumping fluid from a well.



Unpacking

During the unpacking procedure, check for the following:

- All parts on the packing list have been included in the box
- All fitting openings are unobstructed
- The equipment has not been damaged in shipment

Equipment List

The equipment list will vary depending on site specifications, but the following list is a typical configuration

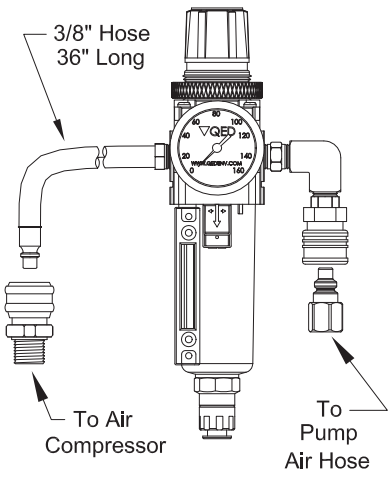
1. Top-Loading or Bottom-Loading AP-4 with support harness
2. Single stage filter/regulator with:
   - 5 Micron filter with auto drain tap
   - Pressure regulator with gauge
   - Maximum operating pressure 120 P.S.I. (8.4 Kg/cm²)
3. Pump Cycle Counter (PCC)
4. Pump support system:
   - Well cap
   - Polypropylene support rope with quick-link assembly or SS wire rope (Alternate materials as required)

Single Stage Filter/Regulator

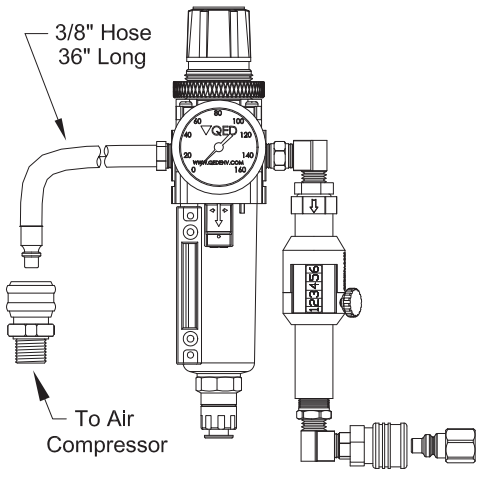
A single stage 5 Micron particulate air filter/regulator has a manual or an optional automatic drain and is installed on the system air supply line. The filter/regulator removes particles and water droplets from the air passing to the AP4+.

NOTE: Too much air pressure can result in low pump efficiency

Figure 3 - Single Stage Filter/Regulator with Quick-Connects



Part # 302468
For Standard Systems



Part # 302470
For Systems with Pump Cycle Counter

Maximum operating pressure 120 P.S.I. (8.4 Kg/cm²)

1. Cover the pump tubing/hose ends with tape if they are to be pulled through trenches or laid on the ground. This is to prevent debris from entering the lines.
2. Blow out all water and particles from compressed air conduits (including downwell pump air supply lines) and fluid lines for at least 10 seconds after the water and particles exit before connecting them to the system.
3. Slip clamps over appropriate tubing/hose prior to connecting the tubing/hose to the pump barbs.
4. Push tubing/hose down flush with the fitting's nut (hex) if possible; cover at least three barbs if three or more are present (**Note:** when installing tubing in freezing weather, tubing can be dipped in warm water for a few seconds to soften the nylon).
5. Attach pump support rope/cable to the pump.
6. Attach pump air supply and liquid discharge lines to the well cap. Attach the air exhaust line to the well cap if the pump air is to exhaust outside the well (Note: the liquid discharge line is always the largest diameter of the three lines, and the air supply line is always the smallest diameter).
7. Connect the pump air supply and liquid discharge lines to the appropriate surface lines/headers.
8. Turn on the air pressure to the pump (minimum of 0.5 psi per foot of vertical static head).

Caution: Submerging the pump before supplying it with air will result in fluid entering the exhaust tubing/hose. Those fluids will be discharged from the exhaust tubing/hose during the first few cycles of the pump. If this discharge will not be confined to the well; i.e., if the air exhaust line is routed outside the well*, it is important to make sure that the air exhaust line is not directed such that equipment/ personnel could be splashed by the discharged fluid when air is turned on to the pump.

Note: Submerging the pump before supplying it with air can also result in fluid entering the air supply line.This fluid from the well can contain particles, which could interfere with operation of the pump's air valve.

9. Lower the pump to the desired depth in the well.
10. Secure the pump by tying off the pump support line or by placing the well cap (or flange) on the well.
11. Increase the air pressure to the pump until the pump is pushing the fluid out at the desired rate. With sufficient air pressure (at least 10 to 15 psi higher than the vertical static head), the pump will gradually draw down the fluid level in the well to the level of the pump. The time required for this draw down varies with the yield of the well as compared to the flow rate of the pump. The maximum recommended pump operating pressure is 120 psi.

Note: If the well environment is such that deposition occurs on stainless steel parts, the operator may wish to raise the pump above the water level during a shutdown of the system.

*** Routing the air exhaust in vacuum wells:**

QED controllerless pumps automatically control the liquid level in the well. Under normal conditions, the liquid level will be maintained at a point approximately one foot below the top of a bottom load pump (this is the pump's actuation point). The pump will automatically start and stop as needed to maintain the level at this actuation point.

When QED controllerless pumps are used in wells that are under vacuum, and the exhaust air is routed into the well, the well level will be maintained at this normal actuation point. If, however, the well is under vacuum and the exhaust air is routed outside of the well (to atmospheric pressure), the actuation point of the pump will be higher than the normal actuation point by a distance equal to the amount of vacuum applied to the well (expressed in "inches of water column"). Please note that the pump will still function normally and maintain the liquid level, albeit a higher level.

Hose Bundles

Hose bundling or the use of jacketed tubing reduces equipment entanglement at the well surface, and aids the removal of the pump from the well. Bundling also assists in positioning the pump and down-well hose assembly against one side of the well casing. Maximum space is created for other items, such as probes, to be periodically placed inside the well.

Follow these instructions to create a hose bundle:

1. Lay the equipment on the ground and make all of the necessary hose connections. (**See Figure 5**).

2. If a well cap is supplied, install it on the hoses. (**See Figure 4**).

3. Connect the quick-link assembly on the support rope to the eyebolt on the AP4+ and lay the support rope out along with the hoses. Make sure that none of the hoses or support ropes are crossing over each other (**See Figure 5**).

   Note: To make the next step easier, pull the support rope and the hoses taut.

4. Starting at the AutoPump end of the hose, put a tie-wrap through the center of the braided support rope just above the uppermost quick-connect or barb on the AutoPump (**See Figure 5**).

5. Pulling the rope taut, put the tie-wrap around the fluid discharge hose with the rough surface outwards. Cross the ends and complete the connect the tie-wrap make sure it is straight and is not kinking the hoses (**See Figure 5**).

   Note: After completing this step, the fluid discharge hose will be attached to the support rope and the exhaust hose. At this point the air supply hose is still lying free.

6. Place the next tie-wrap two feet towards the well cap from the first. Secure the air supply hose rather than the exhaust hose.

   Note: It is important to put the tie-wraps approximately two feet apart to keep a proper discharge hose/support rope bundle. Experience has shown that spreading the tie-wraps further apart than two feet increases the probability for hose kinking.

7. Continue to alternate the air exhaust and the air supply tie-wraps every two feet, stopping about five feet from the wellhead.

8. Being careful not to leave any sharp edges, cut the excess from the tie-wraps.

You now have a down-well bundled hose assembly that supports both the hoses and the down-well equipment.

Figure 4 - Examples of Well Caps

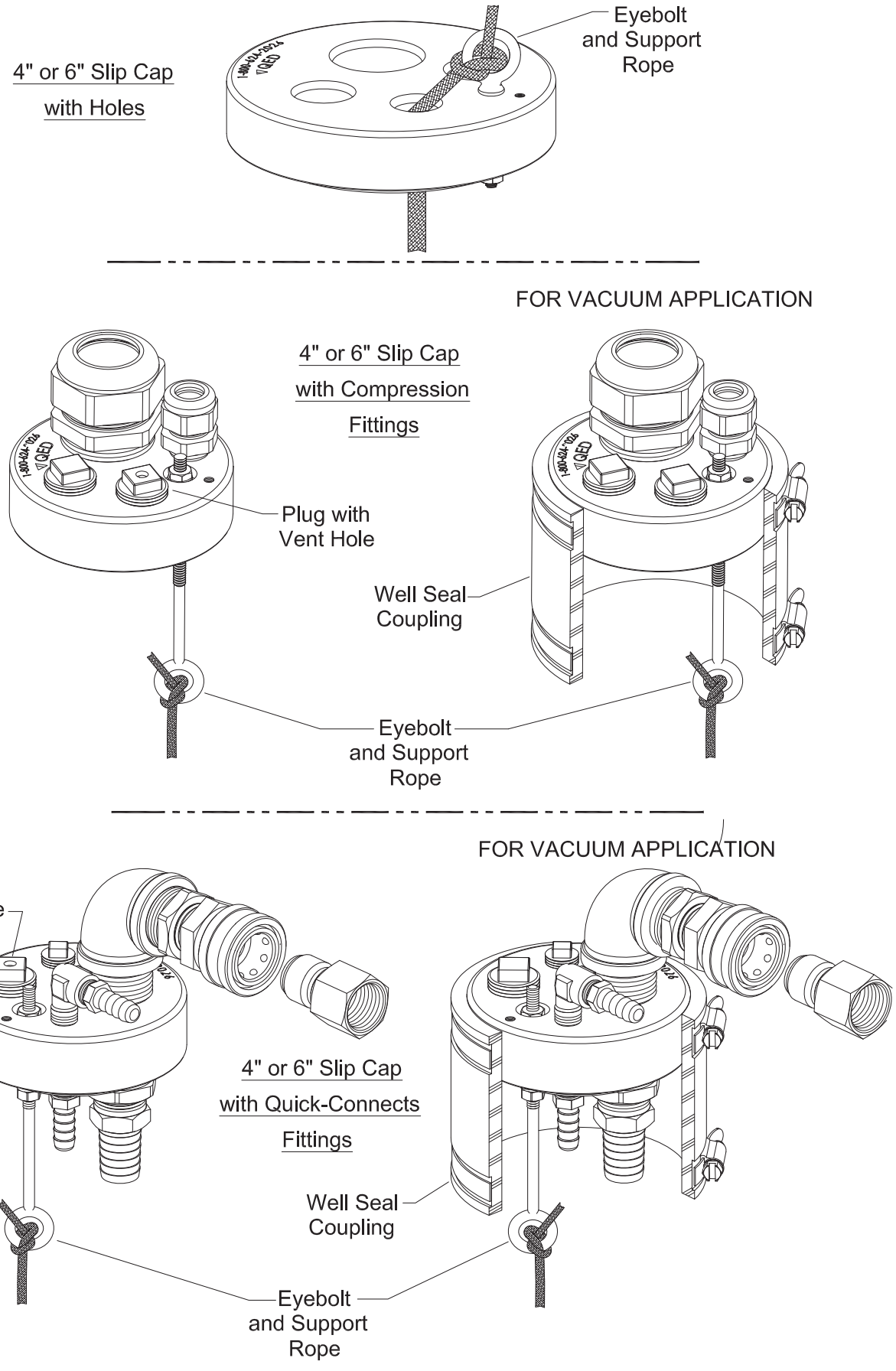
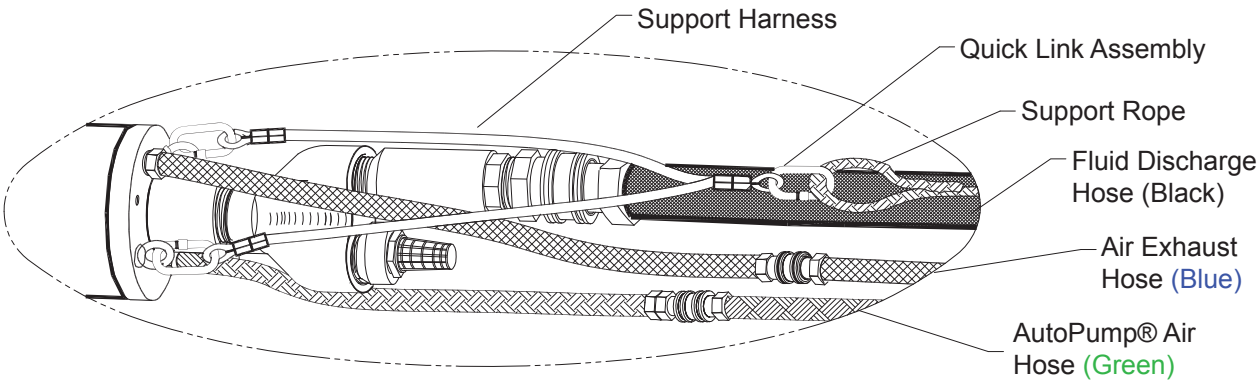
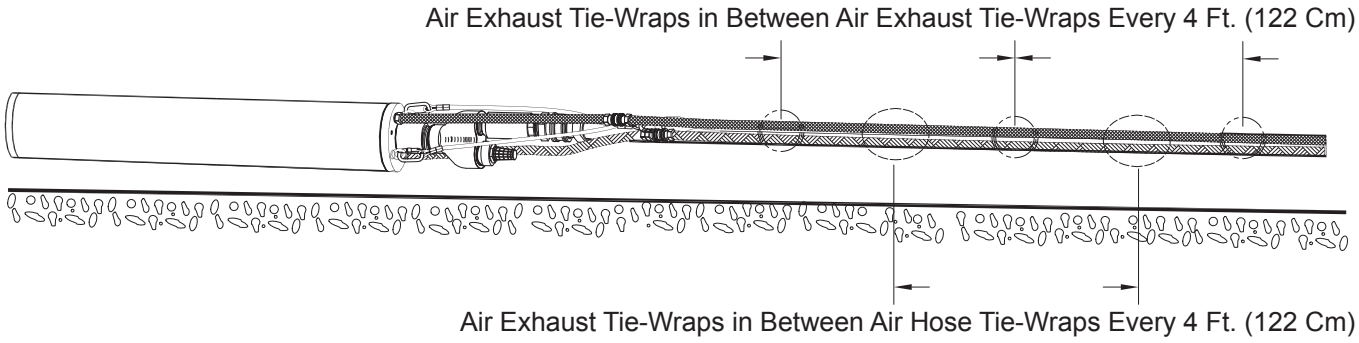
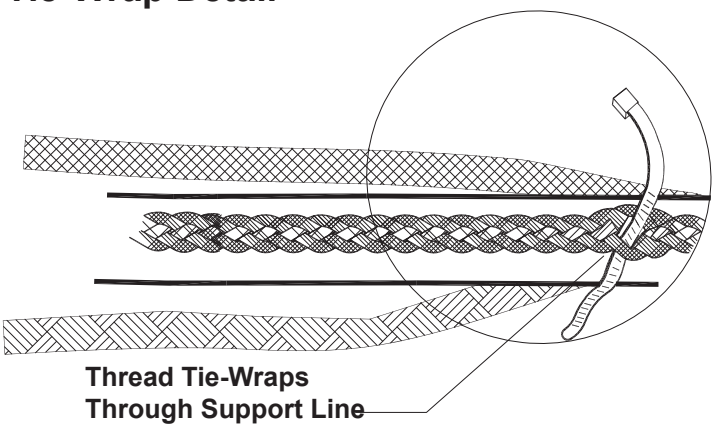


Figure 5 - Hose Bundling





Tie-Wrap Detail



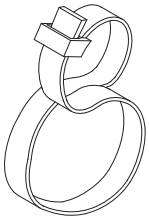
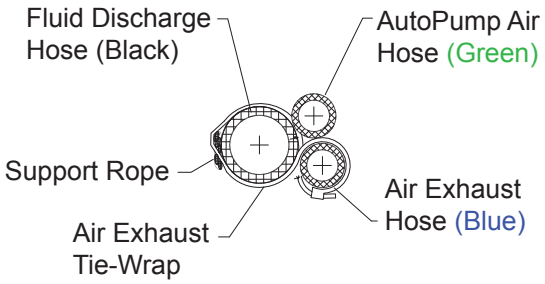
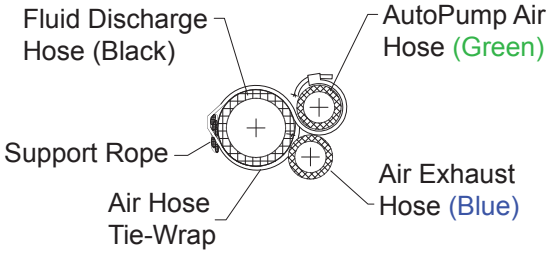


Figure 8 Tie-Wrap Layout

Air Exhaust Tie-Wrap



Air Hose Tie-Wrap



Removing the Pump's Casing

1. Remove the bolt at the bottom of the pump which holds the inlet screen in place (bottom loading pumps only).

2. Remove the three bolts at the bottom of the pump which hold the inlet in place. (***See Figures 6,7,8,and 9)***

3. Remove. the inlet from the pump's casing by pulling it out.

4. Twist and slide the casing down off the pump's frame.

Cleaning Pump Interior

The inner workings of the pump should now be exposed for inspection and cleaning. (***See Figures 6 Through 11)***
Note: A Scotch Brite® abrasive pad is useful for cleaning debris from the pump components.

1. Gently brush off built-up solids from the float, the discharge tube, the pump casing and the control rod.

2. The pump can be steam cleaned without damage.

3. Remove thick deposits of hardened scale on the discharge tube by using a handbrush or by lightly tapping the discharge tube with a small hammer. Be careful not to strike any pins or other components, since they may be damaged.

Iron Build-up Cleaning Procedure

After the casing has been removed from the AutoPump please follow the procedure below:

1. The bottom "spider" should be removed by unthreading it from the pump's discharge pipe. (***See Figures 6,7,8,and 9)***

2. Visually inspect the 1 inch stainless steel fluid discharge pipe for scale build-up or debris. Also, do the same with the float that rides up and down on the SS discharge pipe.

3. Should there be scale deposits on either or both the discharge pipe or float, then remove the float from the SS fluid discharge pipe as follows . (***See Figures 6,7,8,and 9)***

Remove the small SS hairpin from the bottom spring cup. Removing the hairpin and spring cup will allow you to remove the spring, sliding stop and float from the SS discharge pipe.

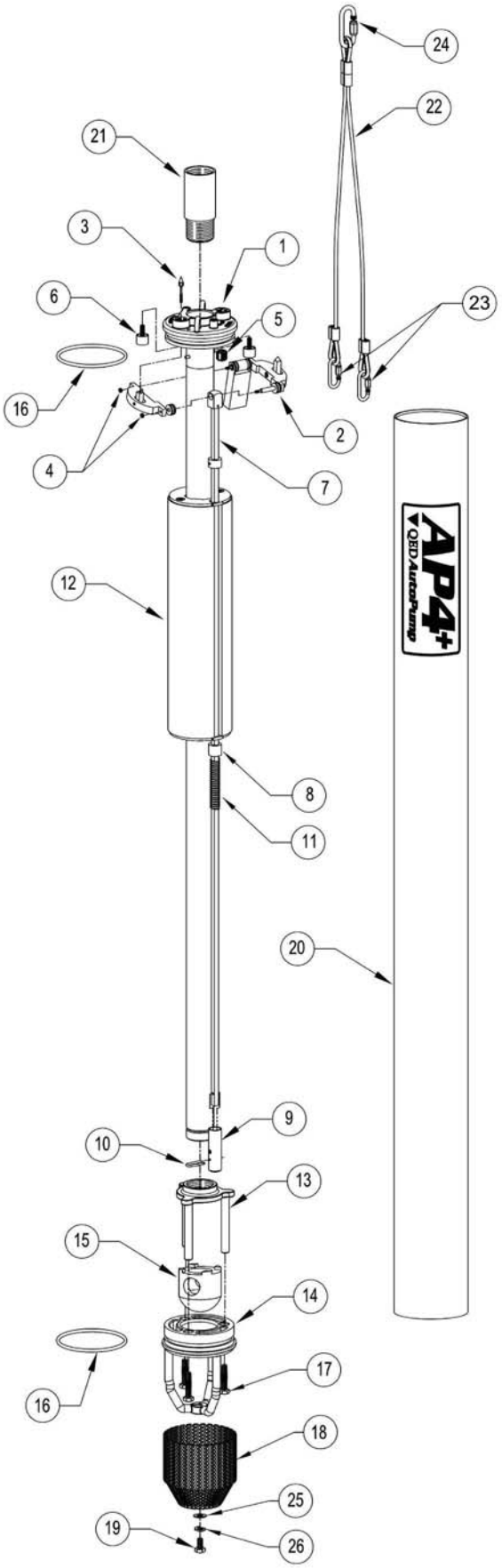
4. The 1 inch stainless steel fluid discharge pipe can now be cleaned using either a ScotchBrite pad, a wire brush or a wire wheel on either a drill or a grinding machine. After removing the scale/debris, it is recommended the pipe be water rinsed.
Both the internal and external surfaces of the float will generally require cleaning. The cleaning material choices include a Scotch Brite pad, and a light grade 150 sandpaper.
The plates are removed to ease cleaning, they should be replaced on the same float end from which they came. That is, the plates should maintain their original top and bottom positions.

5. The white plastic square Control Rod is the next component to be cleaned. The control rod is the item that fits through the smaller hole in the float and is adjacent to the SS discharge pipe in the assembled pump. To Clean use the Scotch Brite pad or a razor or Exacto knife (not sandpaper).

6. The final component to be cleaned is the outer AP4+ casing. The fastest and most effective way to clean out the inside surface of the pump casing is to use a three-stone honing tool. The technique is to move the hone in-and-out, a half dozen times or so through, each end of the casing. The time for the casing cleaning should take no longer than 5 minutes.

The AutoPump is now ready for re-assembly by following the steps above in reverse order.
Note: Before threading the bottom "spider" onto the pump's discharge pipe, be sure to wrap the discharge pipe's threads completely with Teflon tape.
Note: Before inserting the two end assemblies back into the pump's casing, apply PTFE grease to the two o-rings (#16 on the next page) to make the next disassembly easier.

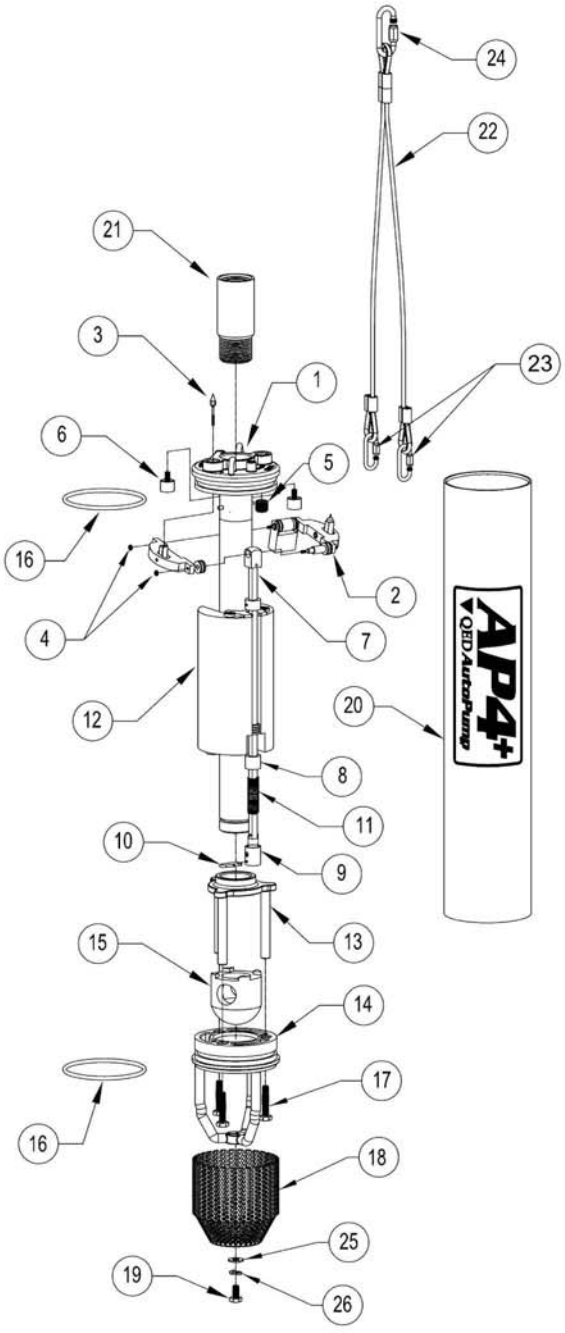
Figure 6 - Exploded View of Bottom Loading AP4+ (Long & Short)



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	303082	FRAME AP4+ LONG 304SS W/120 PSI SEAT AND PIVOT PIN	1
	303083	FRAME AP4+ SHORT 304SS W/120 PSI SEAT AND PIVOT PIN	
2	303203	AP4 LEVERS ASSY PVDF	1
3	200343	POPPET INTAKE 120 PSI AP4 303SS	1
4	200495	NUT SMALL PATTERN, 4-40, LEVER CONNECTOR	2
5	200332	SEAT EXHAUST 120 PSI AP4 303SS	1
6	301083	AP4 212 DEG 316 SS MAGNET W/EPOXY	2
7	303031	CTRL ROD ASSY LONG AP4+	1
	303030	CTRL ROD ASSY SHORT AP4+	
8	201210	AP-4 CONTROL ROD SLIDING STOP PVDF	1
9	201211	AP4 PVDF (KYNAR) SPRING CUP	1
10	206247	HAIRPIN, AP4 CTRL ROD/SPRING CUP PIN HASTELLOY C276	1
11	200351	SPRING AP4 CTRL ROD HASTELLOY C-276	1
12	300721	FLOAT ASSY AP-4	1
13	206189	SPIDER, CASTING - AP4+ MACHINED 304LS	1
14	206193	INLET, CASTING-AP4+ MACHINED 304L SS	3
15	206417	PLUG BCV INTAKE AP4 BL UHMW-PE	1
16	206273	O-RING PARKER VITON 2-235 V747-75	2
17	206362	SCREW, 1/4"-20 X 1-1/4" FL/THR HEX CAP, W/VIT, W/VIBRA-TITE	3
18	206198	SCREEN ANGLE, AP4+ 316LS	1
19	206253	SCREW, 1/4-20 X 1/2" LONG HEX HD CAP - 18-8 SS	1
20	206283	CASING, FRP AP4+ LONG LABELED	1
	206284	CASING, FRP AP4+ SHORT LABELED	
21	205599	HOUSING CHECK DISCHARGE BRASS	1
22	300585	HARNESS SUPP W/CU SLEEVE 304SS	1
23	206090	QUICK LINK 3/16" 18-8 SS	2
24	206091	QUICK LINK 1/4" 18-8 SS	1
25	206437	FLAT WASHER 1/4" 316 SS	1
26	201783	WASHER SPLIT LOCK 1/4" 18-8 SS	1

NOTE: Some Parts are available in alternate materials based on site specific applications

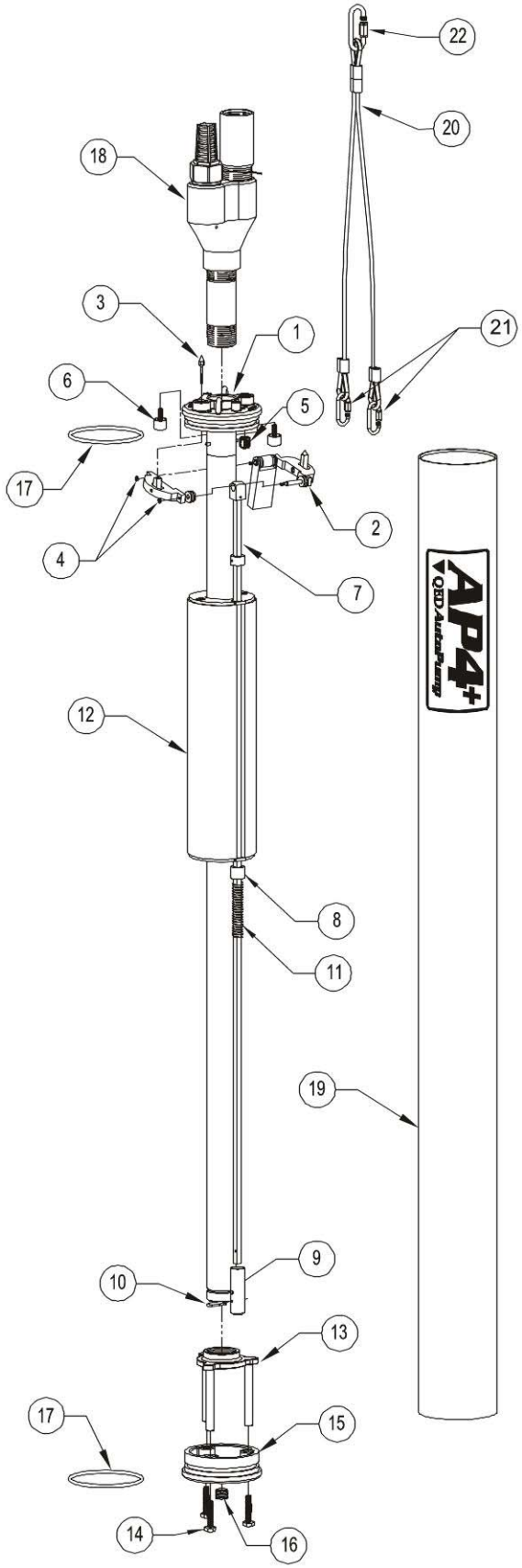
Figure 7 - Exploded View of Bottom Loading AP4+ Low Drawdown



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	303084	FRAME AP4+ LDD 304SS W/200 PSI SEAT AND PIVOT PIN	1
2	303205	LEVERS ASSY, PVDF AP4 LOW DRAW DOWN	1
3	200664	POPPET INTAKE 200 PSI AP4 303SS	1
4	200495	NUT SMALL PATTERN, 4-40, LEVER CONNECTOR	2
5	203037	SEAT EXHAUST AP4 LDD 303SS	1
6	303001	AP4 150 DEG 316 SS MAGNET W/EPOXY	2
7	303053	CTRL ROD ASSY LDD AP4+	1
8	201210	AP-4 CONTROL ROD SLIDING STOP PVDF	1
9	201664	AP4D CONTROL SPRING CUP PVDF	1
10	206247	HAIRPIN, AP4 CTRL ROD/SPRING CUP PIN HASTELLOY C276	1
11	201628	SPRING CTRL ROD AP4 LDD 316SS	1
12	302598	FLOAT, AP4LD A-1	1
13	206189	SPIDER, CASTING - AP4+ MACHINED 304LS	1
14	206193	INLET, CASTING-AP4+ MACHINED 304L SS	3
15	206417	PLUG BCV INTAKE AP4 BL UHMW-PE	1
16	206273	O-RING PARKER VITON 2-235 V747-75	2
17	206252	SCREW, 1/4"-20 X 1-1/4" FL/THR HEX CAP, W/VIT, W/VIBRA-TITE	3
18	206198	SCREEN ANGLE, AP4+ 316LS	1
19	206253	SCREW, 1/4-20 X 1/2" LONG HEX HD CAP - 18-8 SS	1
20	206285	CASING, FRP AP+ LDD LABELED	1
21	205599	HOUSING CHECK DISCHARGE BRASS	1
22	300585	HARNESS SUPP W/CU SLEEVE 304SS	1
23	206090	QUICK LINK 3/16" 18-8 SS	2
24	206091	QUICK LINK 1/4" 18-8 SS	1
25	206437	FLAT WASHER 1/4" 316 SS	1
26	201783	WASHER SPLIT LOCK 1/4" 18-8 SS	1

NOTE: Some Parts are available in alternate materials based on site specific applications

Figure 8 - Exploded View of Top Loading AP4+ (Long & Short)



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	303082	FRAME AP4+ LONG 304SS W/120 PSI SEAT AND PIVOT PIN	1
	303083	FRAME AP4+ SHORT 304SS W/120 PSI SEAT AND PIVOT PIN	
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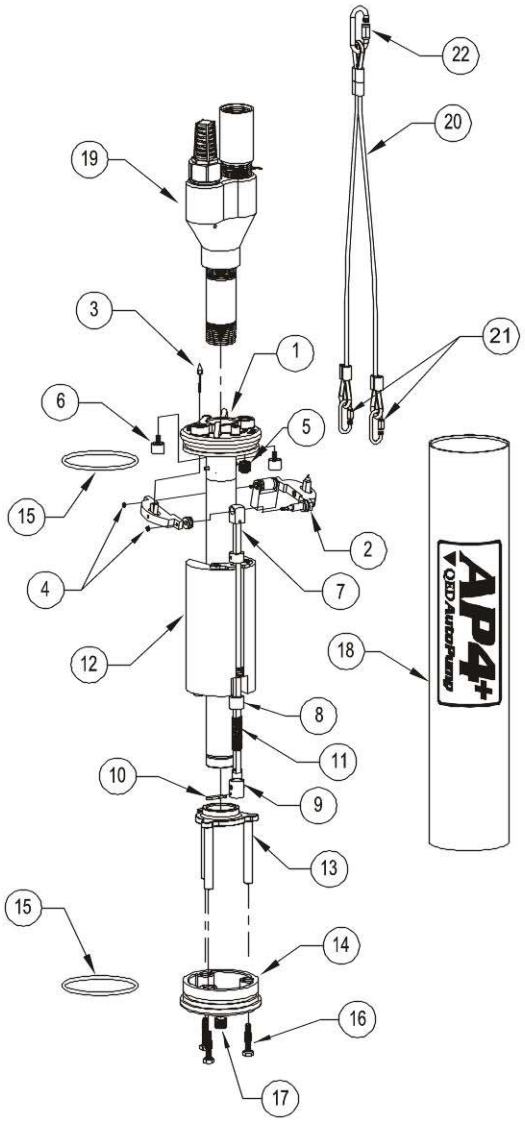
3	200343	POPPET INTAKE 120 PSI AP4 303SS	1
4	200495	NUT SMALL PATTERN, 4-40, LEVER CONNECTOR	2
5	200332	SEAT EXHAUST 120 PSI AP4 303SS	1
6	301083	AP4 212 DEG 316 SS MAGNET W/EPOXY	2
7	303031	CTRL ROD ASSY LONG AP4+	1
	303030	CTRL ROD ASSY SHORT AP4+	
8	201210	AP-4 CONTROL ROD SLIDING STOP PVDF	1
9	201211	AP4 PVDF (KYNAR) SPRING CUP	1
10	206247	HAIRPIN, AP4 CTRL ROD/SPRING CUP PIN HASTELLOY C276	1
11	200351	SPRING AP4 CTRL ROD HASTELLOY C-276	1
12	300721	FLOAT ASSY AP-4	1
13	206189	SPIDER, CASTING - AP4+ MACHINED 304LS	1
14	206362	SCREW, 1/4"-20 X 1-1/4" FL/THR HEX CAP, W/VIT, W/VIBRA-TITE	3
15	206263	INLET, CASTING-MACHINED AP4+ TOP FILL 304LSS	1
16	206290	PLUG, 1/4" 316SS COUNTERSUNK HEX	1
17	206273	O-RING PARKER VITON 2-235 V747-75	2
18	303056	AP4+TL WYE ASSY W/BRASS DCV, HDPE SCREEN	1
19	206283	CASING, FRP AP4+ LONG LABELED	1
	206284	CASING, FRP AP4+ SHORT LABELED	
20	300585	HARNESS SUPP W/CU SLEEVE 304SS	1
21	206090	QUICK LINK 3/16" 18-8 SS	2
22	206091	QUICK LINK 1/4" 18-8 SS	1

NOTE: Some Parts are available in alternate materials based on site specific applications

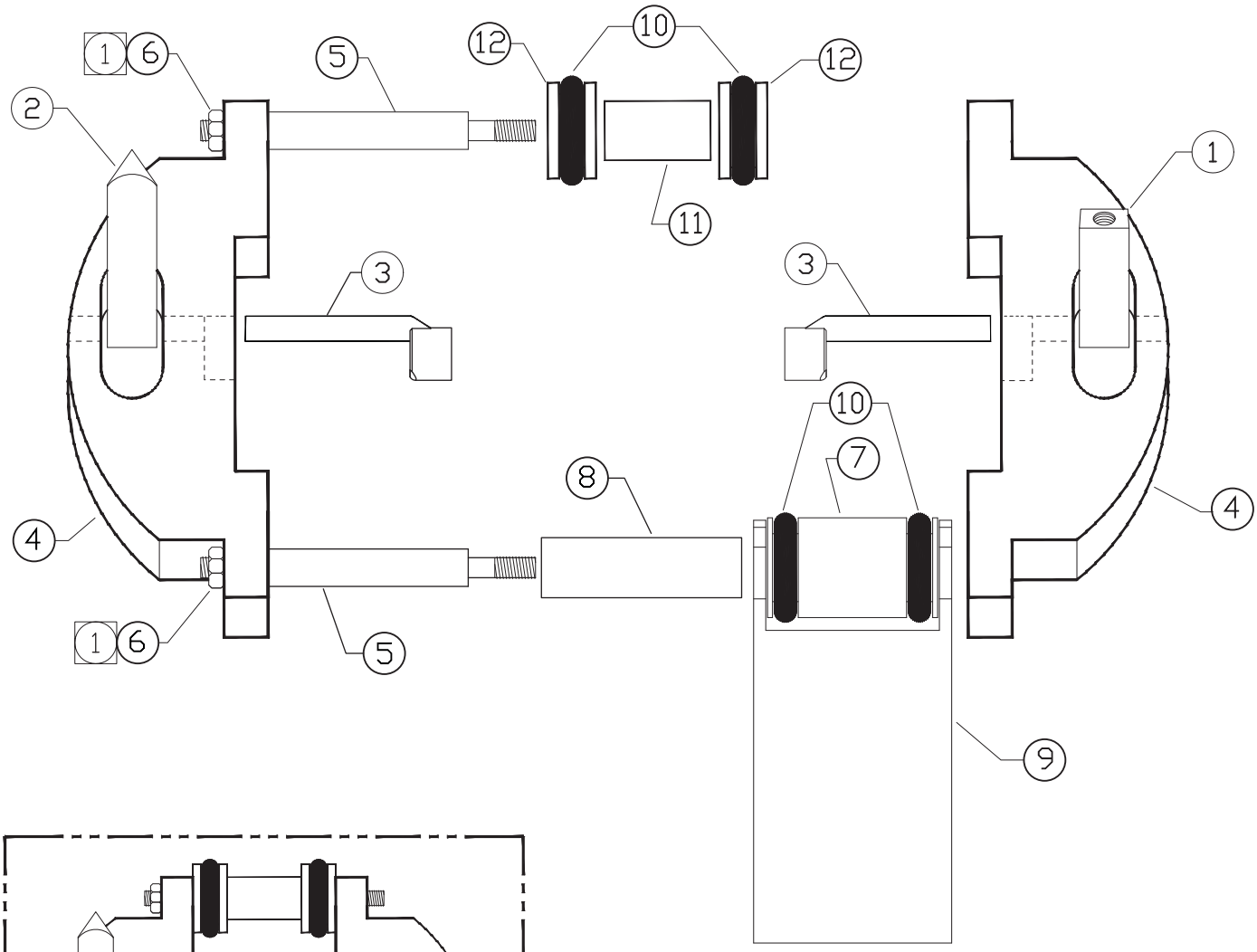
Figure 9 - Exploded View of Top Loading AP4+ Low Drawdown

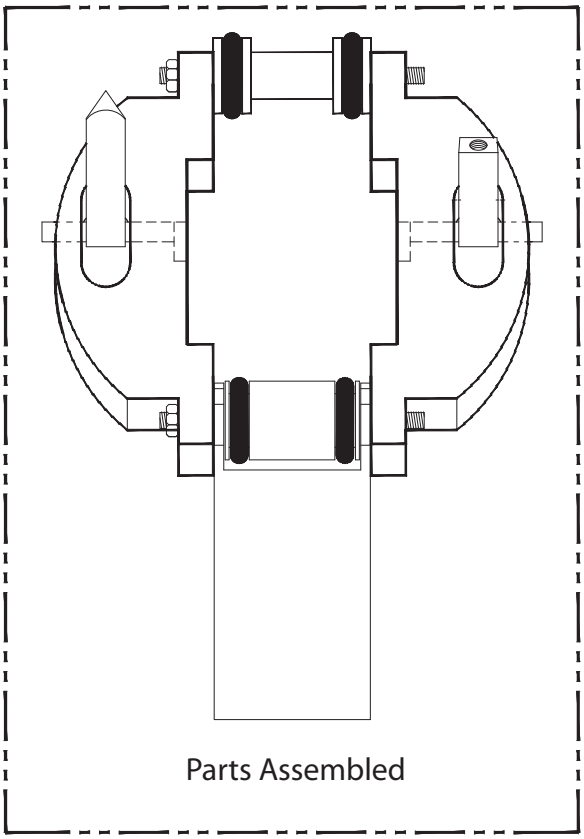


ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	303084	FRAME AP4+ LDD 304SS W/200 PSI SEAT AND PIVOT PIN	1
2	303205	LEVERS ASSY, PVDF AP4 LOW DRAW DOWN	1
3	200664	POPPET INTAKE 200 PSI AP4 303SS	1
4	200495	NUT SMALL PATTERN, 4-40, LEVER CONNECTOR	2
5	203037	SEAT EXHAUST AP4 LDD 303SS	1
6	303001	AP4 150 DEG 316 SS MAGNET W/EPOXY	2
7	303053	CTRL ROD ASSY LDD AP4+	1
8	201210	AP-4 CONTROL ROD SLIDING STOP PVDF	1
9	201664	AP4D CONTROL SPRING CUP PVDF	1
10	206247	HAIRPIN, AP4 CTRL ROD/SPRING CUP PIN HASTELLOY C276	1
11	201628	SPRING CTRL ROD AP4 LDD 316SS	1
12	302598	FLOAT, AP4LD A-1	1
13	206189	SPIDER, CASTING - AP4+ MACHINED 304LS	1
14	206362	INLET, CASTING-MACHINED AP4+ TOP FILL 304L SS	1
15	206273	O-RING PARKER VITON 2-235 V747-75	2
16	206252	SCREW, 1/4"-20 X 1-1/4" FL/THR HEX CAP, W/VIT, W/VIBRA-TITE	3
17	206290	SCREEN ANGLE, AP4+ 316LS	1
18	206285	CASING, FRP AP+ LDD LABELED	1
19	303056	AP4+TL WYE ASSY W/BRASS DCV, HDPE SCREEN	1
20	300585	HARNESS SUPP W/CU SLEEVE 304SS	1
21	206090	QUICK LINK 3/16" 18-8 SS	2
22	206091	QUICK LINK 1/4" 18-8 SS	1

NOTE: Some Parts are available in alternate materials based on site specific applications

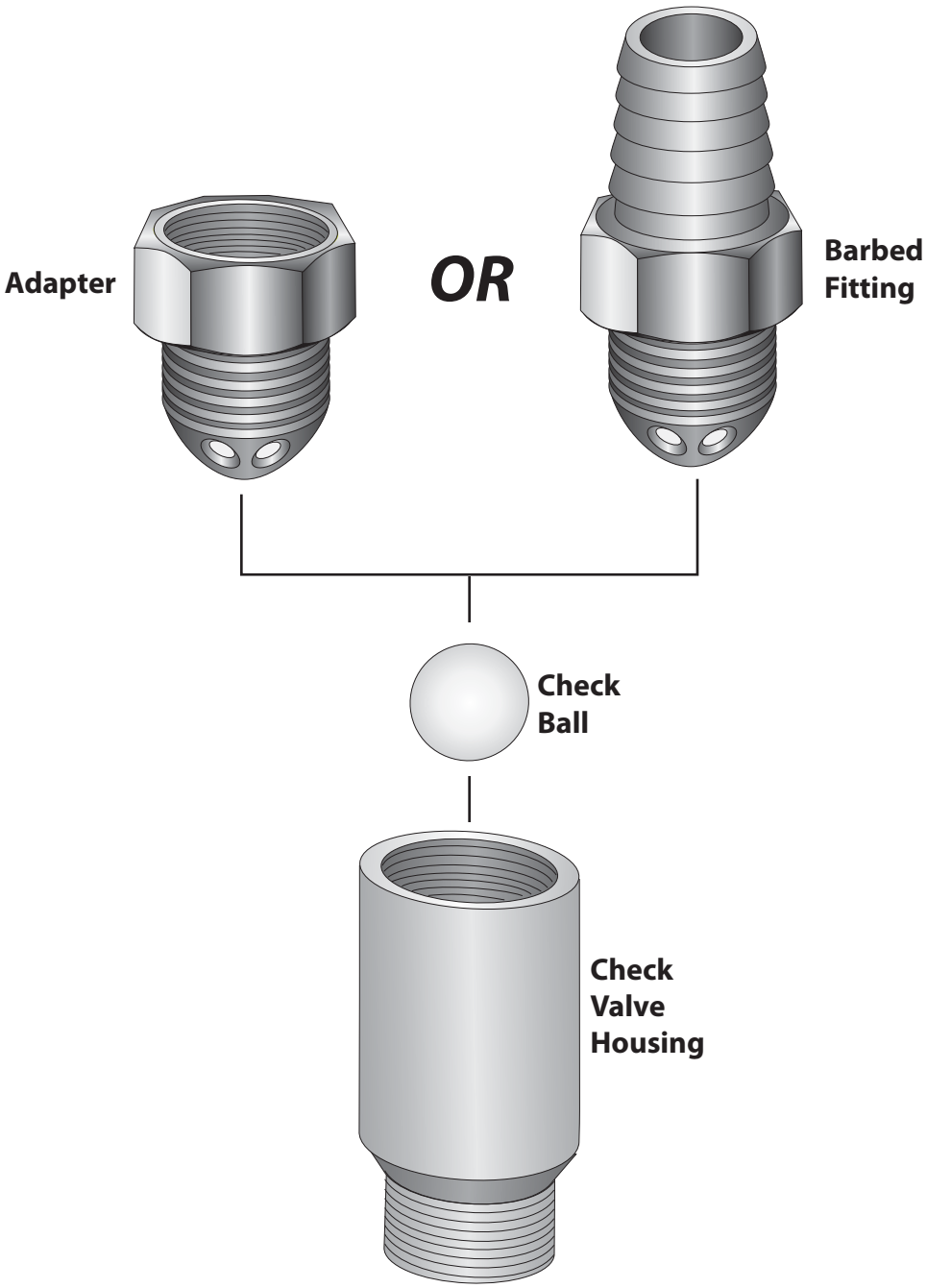
Figure 10 - Exploded View of AP4+ Lever Assembly





Parts Assembled

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	200359	120 P.SI INTAKE POPPET CONNECTOR-LONG	1
1	200359	120 P.SI INTAKE POPPET CONNECTOR-SHORT	1
1	200665	120 P.SI INTAKE POPPET CONNECTOR-LDD	1
2	200337	303 SS 120 P.SI EXHAUST POPPET-LONG	1
2	200337	303 SS 120 P.SI EXHAUST POPPET-SHORT	1
2	200336	303 SS 120 P.SI EXHAUST POPPET-LDD	1
3	206445	NITRONIC 60 POPPET PIN-BUSHING	2
4	201033	LEVER HALF	2
5	200328	303 SS LEVER CONNECTING PIN	2
6	200495	4-40 SS SMALL PATTERN NUT LEVER CONNECTING	4
7	200330	17-7 COUNTERWEIGHT ROLLER	1
8	201053	316 SS COUNTERWEIGHT BUSHING	1
9	200327	303 SS COUNTERWEIGHT-LONG	1
9	200327	303 SS COUNTERWEIGHT-SHORT	1
9	206008	303 SS COUNTERWEIGHT-LDD	1
10	200496	VITON BUMPER O-RING	4
11	201052	316 SS CONTROL ROD ADAPTER BUSHING	1
12	201458	PVDF CONTROL ROD ROLLER	2


Adapter
OR
Barbed
Fitting
Check
Ball
Check
Valve
Housing

Problems may occur and usually can be easily resolved by following these instructions. If, after careful reading and service, you cannot resolve the problem, please contact the QED Environmental Systems (QED) Service Department at **(800) 537-1767**.

Caution: Wear goggles, gloves, and coveralls when servicing this system.After troubleshooting is completed and before assembling the pump, slowly move the float through its range to ensure that the lever will trip even if the pump fills and empties slowly.

Note: Maintenance for disassembly and cleaning instructions.

Possible Causes	Symptoms		
Detailed Instructions Follow this Chart	Pump not cycling	Pump cycles, but volume is reduced or there is no discharge	Air in fluid discharge
1. Air supply	X		X
2. Fluid level	X		
3. Air exhaust restricted	X		X
4. Fluid inlet clogged	X		
5. Debris, scale or very viscous fluid	X	X	X
6. Lever pivot wear	X		X
7. Debris in air inlet valve	X		
8. Fluid check valve		X	
9. Valve timing	X		

Troubleshooting

1. Air Supply

- If the air pressure is too low, or if the flow is severely restricted, the pump will not cycle. The minimum air pressure requirement for pump operation is 0.5 psi per foot of vertical static head.
- If the air pressure exceeds the design limitations of the pump, the pump may fail to cycle, or the exhaust may have locked up and caused air to enter the fluid discharge.

2. Fluid Level

- The fluid level must be above the fluid inlet on a Top-Loading pump. On a Bottom-Loading pump, the fluid must be no lower than 9 inches below the head of the pump

3. Air Exhaust Restricted

- The exhaust line must not be kinked, plugged, or too small in diameter.
- The air exhaust outlet must be above the fluid level
- If the air exhausts in the well, the well must be vented to the atmosphere or a functioning vapor recovery line.

- If the air exhausts to the atmosphere (outside the well) and a vacuum is drawn on the well, the pump may fail to fill. In order for the pump to fill under these conditions, the pump must be submerged to make up for the pressure difference between the atmosphere and the partial vacuum in the well.

  The pressure difference, expressed as feet of water column (FT. W. C.), is the distance the fluid must be above the pump before it can fill.

4. Fluid Inlet Clogged

- If the fluid inlet screen is clogged with debris water cannot enter the pump.

5.Debris, Scale, or very Viscous Fluid

- If debris, scale or a very viscous fluid has accumulated inside the pump, the float may not move freely up and down, or the control rod may not slide easily through the float.
- Clean the float, control rod, and the casing. (***See Chapter 5 for cleaning instructions***).

6. Lever Pivot Wear

- Grasp the center of the lever with thumb and forefinger. Rotate the lever to horizontal.
- Push up and down, toward and away from the head. Confirm that there is less than 1/32 inch of movement.
- Replace the levers if the pivot hole is worn

7. Debris in Air Inlet Valve (***First check #6-Lever Pivot Wear***)

- Open the pump. Connect the air supply. Pull the control rod down. Listen to determine if air leaks through. If air still leaks through the valve with the control rod down, the air tubing must be removed to access the valve inlet to check for debris in the valve. Clean the valve by blowing air or water through it from both ends.
- Push the rod upwards. If little or no air passes through, remove the tubing to access the valve inlet. Blow air through the valve from the poppet side to clear debris from the poppet.

8. Fluid Check Valves

- Open the pump. Hold the pump vertically and pour water into the discharge check valve. If water flows through, clean the valve.
- Remove the valve and use emery cloth or a very fine sand paper to polish the surface where the ball seats.
- If the pump is a Bottom-Loading design, inspect the seat of the bottom check valve for debris and wear. Clean or replace if necessary.
- If the pump is a Top-Loading design, remove the fluid inlet check valve and inspect the seating surface and the ball for debris and wear.

9. Air Inlet Valve Timing

- (First check lever pivot wear per #6 above)
- Call the QED Service Department for correct air valve timing for your pump.

Returning Equipment for Service

If the equipment needs to be returned to QED for servicing, please follow these steps:

1. Call the QED Service Department and obtain a Return Material Authorization (RMA) number. Please have available the contact person's name, company name and address, phone number, fax number, reason for the return, and the names of the chemicals to which the equipment has been exposed.

2. Clean all equipment before shipping. (***See Equipment Cleaning Requirements at the end of this section***). If the equipment must be cleaned after it arrives at QED, the customer will be charged for the cleaning and disposal of material, if necessary. (Cost can be $500.00 per piece of equipment cleaned.) It is also important to note that shipping equipment with a known hazardous waste is a *violation of federal law*. Drain and dry all equipment after cleaning.

3. Package the equipment so that it will not be damaged in shipment. Use bubble pack rather than styrofoam flakes as packing material.

4. Ship the equipment via a carrier and service level (i.e., one-day, two-day shipping) in consideration of probable service time and return shipment time.

5. It is recommended that such shipments be insured so, if the shipment is badly damaged or lost, the customer can replace the equipment at little or no cost.

6. Include the contact's name, company, phone number and RMA number given by QED.

7. Write the RMA number on the outside of the packaging so it will be directed immediately to the QED Service Department.

Equipment Cleaning Requirements

If the equipment is to be shipped to another site or to the factory for service, it needs to be thoroughly cleaned before leaving the site. Cleaning the equipment protects the user (sender), the shipper, and the receiver from dirt and/or contaminants. If the equipment is not cleaned prior to shipping for servicing, it may be severely delayed, refused or the shipper may be charged a cleaning fee. Before packing and shipping, ensure that the equipment is dry inside and out.

To Clean the AP4+:

1. Pump clean water or water with a gentle soap solution (e.g. Dove Dish Soap) through the pump to remove free product and particles.

2. Rinse all soap off of the equipment.

3. Soak and rinse the outside of the unit with water to remove loose debris and dirt.

4. Steam clean inside and out to remove difficult dirt and contaminants.

Caution: Use low pressure (less than 40 psi) when steam cleaning.

AP4+B

Max. Flow 14 gpm (53 lpm)

O.D. 3.6 in (91 mm)

Length 51.4 in. (131cm)

Description

The AP4+ Bottom Inlet Long AutoPump provides maximum capabilities and flow in a bottom inlet pump for 4" (100 mm) diameter and larger wells with shorter water columns and/or the need to pump down to lower water levels, compared to full-length pumps. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 14 gpm (49 lpm)*. The AP4+ Long Bottom Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Bottom Inlet Long AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

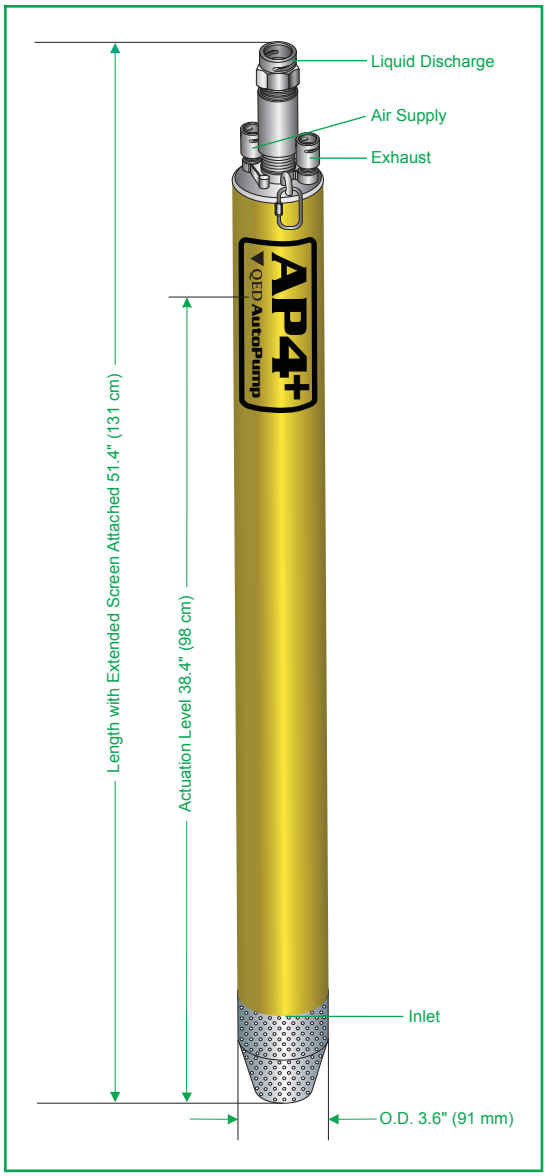
Advantages

1. **The original automatic air-powered well pump, proven worldwide over 23 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

QED Environmental Systems

AP4 +B

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Long AP4+ Bottom Inlet**
Liquid Inlet Location	Bottom
O.D.	3.6 in. (91 mm)
Overall Length With Extended Screen	51.4 in. (131 cm)
Weight	16.7 lbs. (7.6 kg)
Maximum Flow Rate	14 gpm (53 lpm)* - See Flow Rate Chart
Pump Volume/Cycle	0.58 - 0.78 gal (2.2 - 3L)
Minimum Accuation Level	38.4 in. (98 cm)
Standard Pump	
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.4 - 1.1 scf / gal. (3.0 - 8.5 liter of air / fluid liter) - See air usage chart
High Pressure Pump	
Maximum Depth	425 ft. (130 m)
Air Pressure	5 - 200 psi (0.4 - 14.1 kg/cm2)
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF, Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[2]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Material upgrades available
[2] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

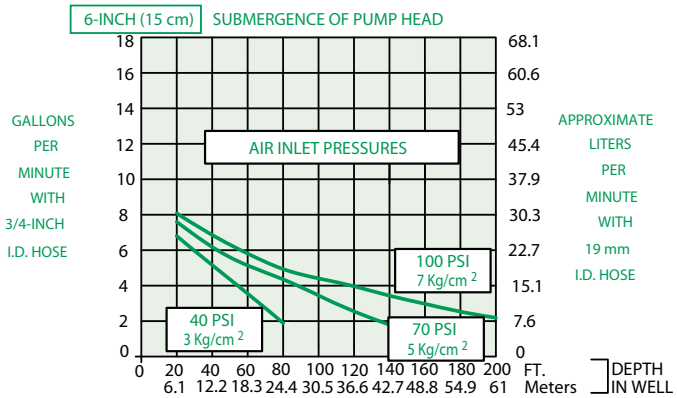
***Consult QED for higher flow requirements**

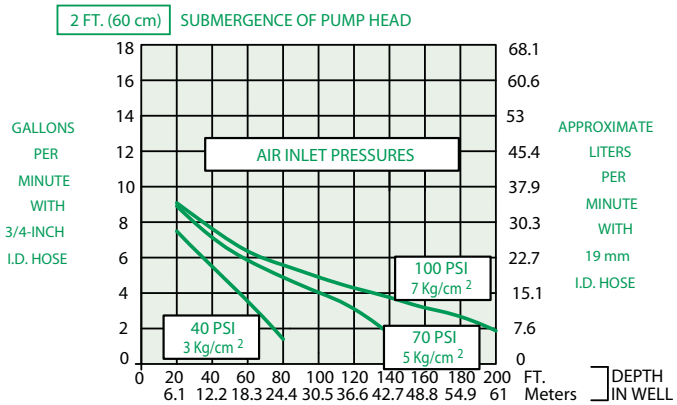
Long and short AP4+ AutoPumps are warranted for five(5) years: Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

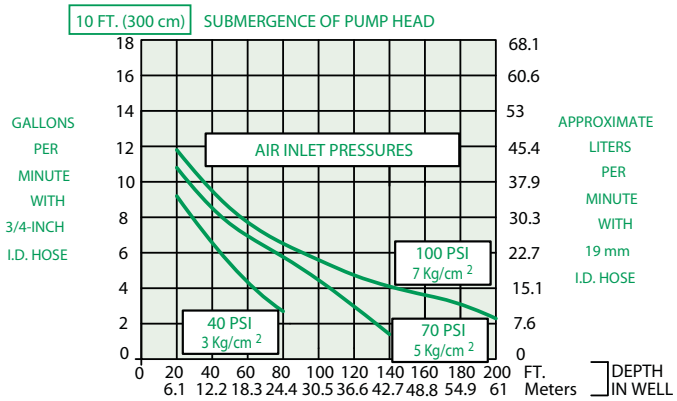
AP4 +B

Flow Rates[1]

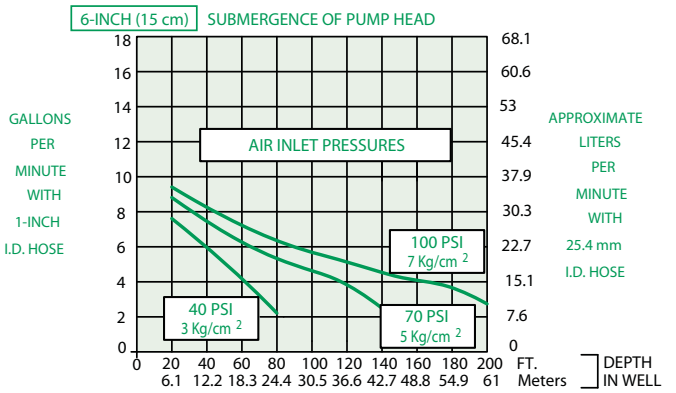
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)

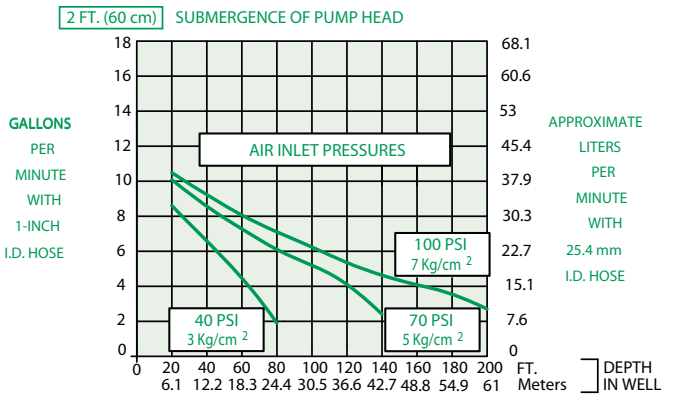


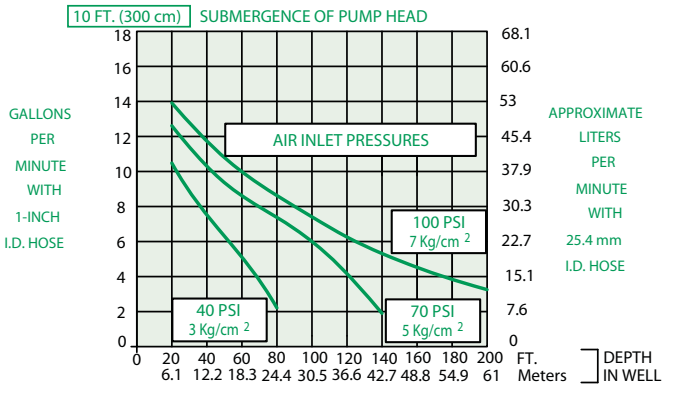




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)





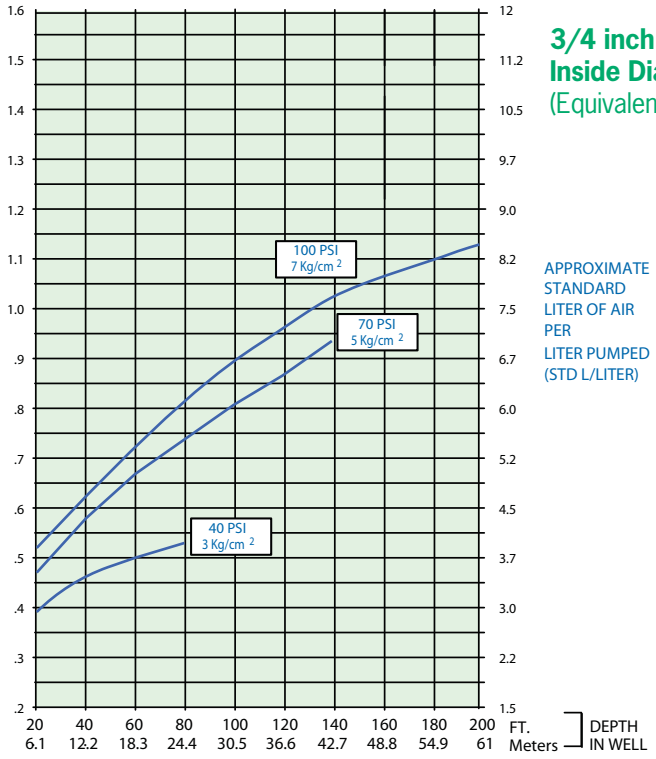


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

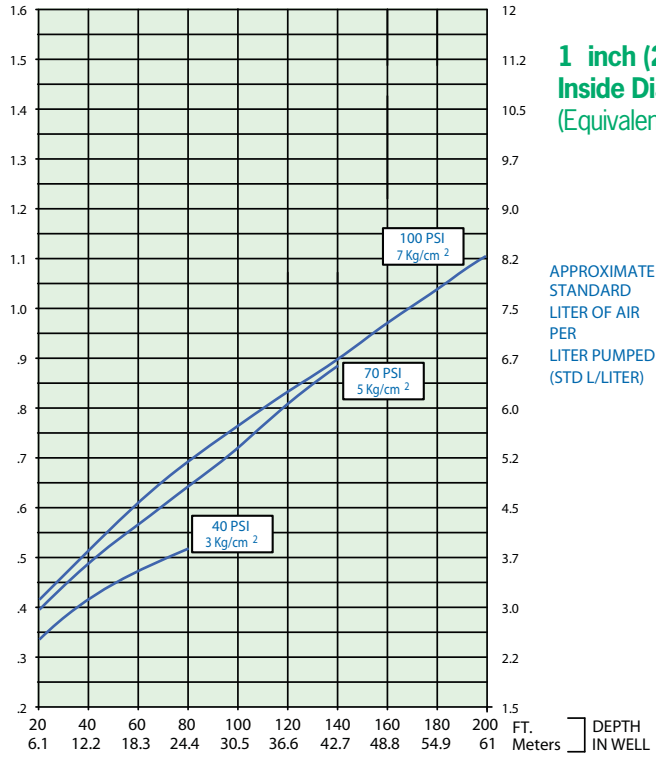
AP4+B

Air Consumption

3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



AP4+B

Max. Flow	**13 gpm (49 lpm)**
O.D.	**3.6 in (91 mm)**
Length	**39.3 in. (100 cm)**

Description

The AP4+ Bottom Inlet Short AutoPump provides maximum capabilities and flow in a bottom inlet pump for 4" (100 mm) diameter and larger wells with shorter water columns and/or the need to pump down to lower water levels, compared to full-length pumps. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 13 gpm (49 lpm)*. The AP4+ Short Bottom Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Bottom Inlet Short AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

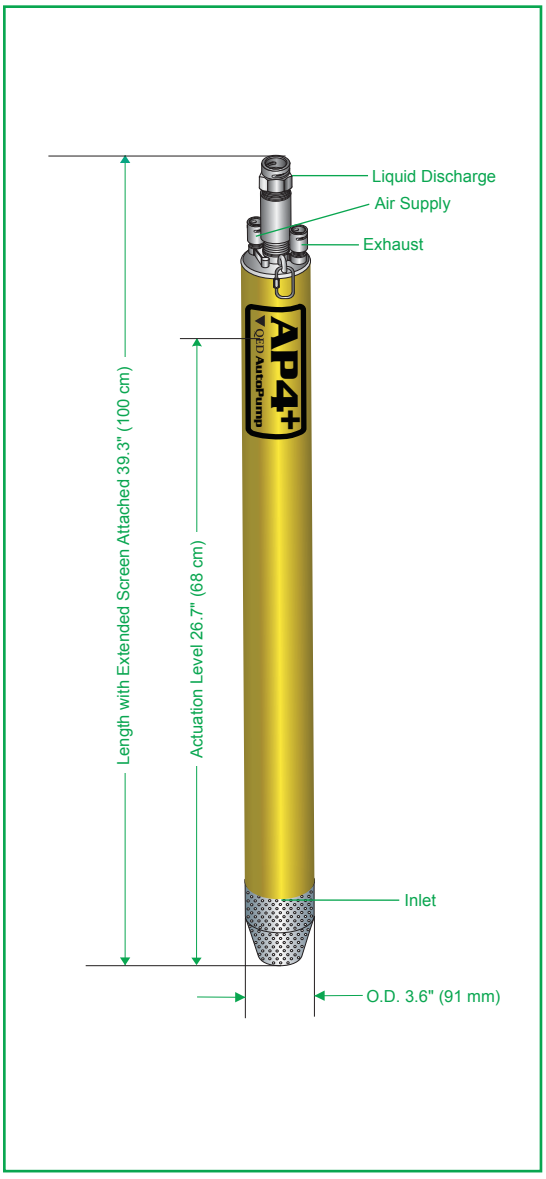
Advantages

1. **The original automatic air-powered well pump, proven worldwide over 23 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

QED Environmental Systems

AP4+B

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Short AP4+ Bottom Inlet**
Liquid Inlet Location	Bottom
O.D.	3.6 in. (91 mm)
Overall Length With Extended Screen	39.3 in. (100 cm)
Weight	13.7 lbs. (6.2 kg)
Maximum Flow Rate	13 gpm (49 lpm)* - See Flow Rate Chart
Pump Volume/Cycle	0.22 - 0.36 gal (.83 - 1.36 L)
Minimum Accuation Level	26.7 in. (68 cm)
Standard Pump	
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.4 - 1.1 scf / gal. (3.0 - 8.5 liter of air / fluid liter) - See air usage chart
High Pressure Pump	
Maximum Depth	425 ft. (130 m)
Air Pressure	5 - 200 psi (0.4 - 14.1 kg/cm2)
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF[3], Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[2]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Material upgrades available
[2] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

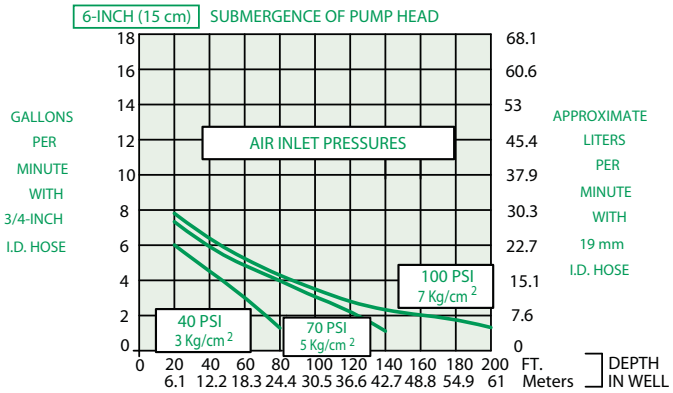
Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

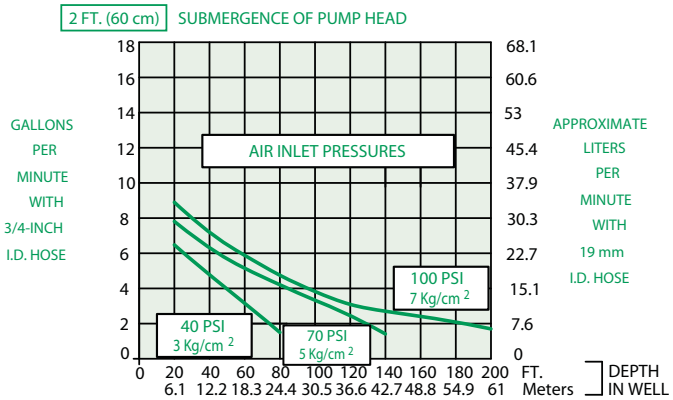
***Consult QED for higher flow requirements**

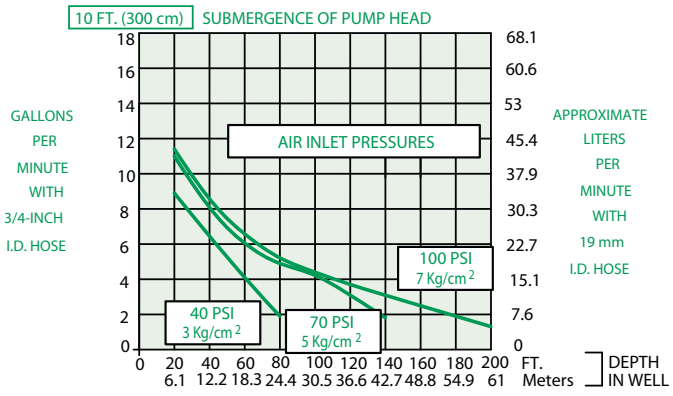
Long and short AP4+ AutoPumps are warranted for five(5) years: Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

Flow Rates[1]

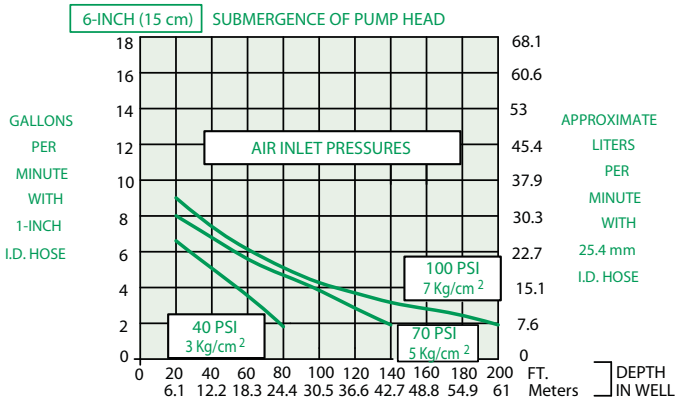
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D.Tubing)

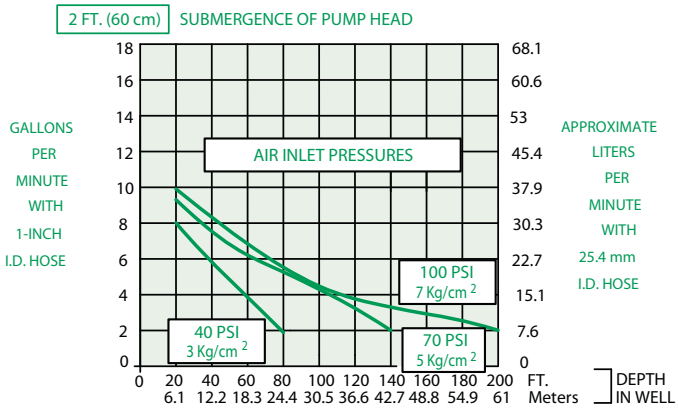


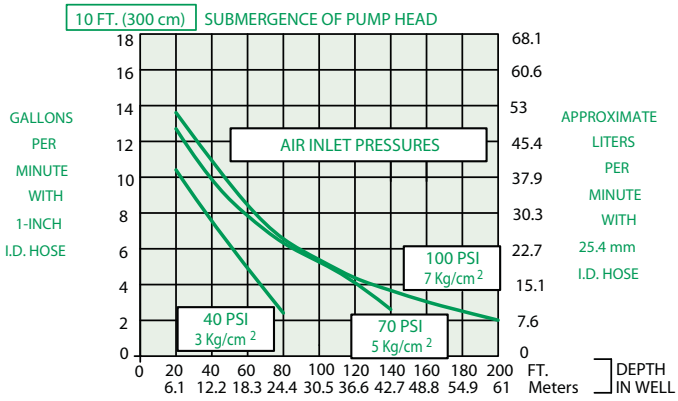




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D.Tubing)





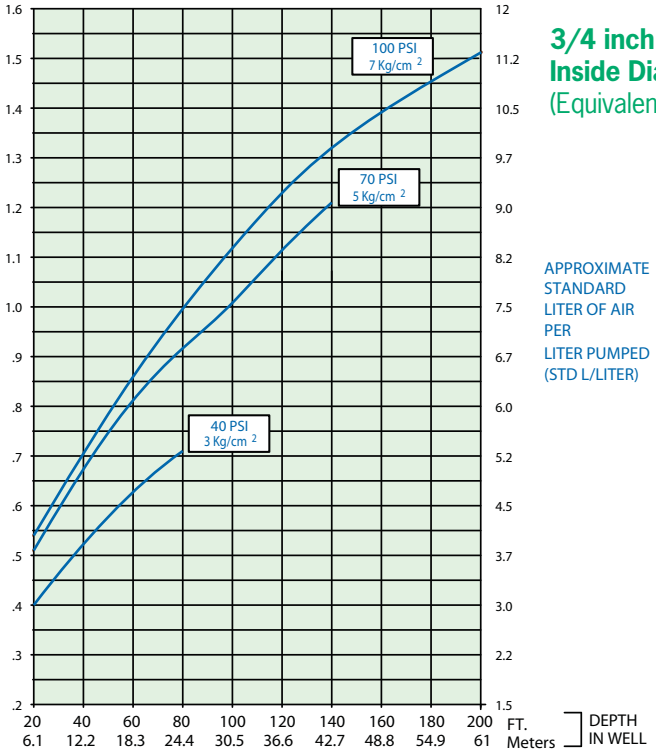


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

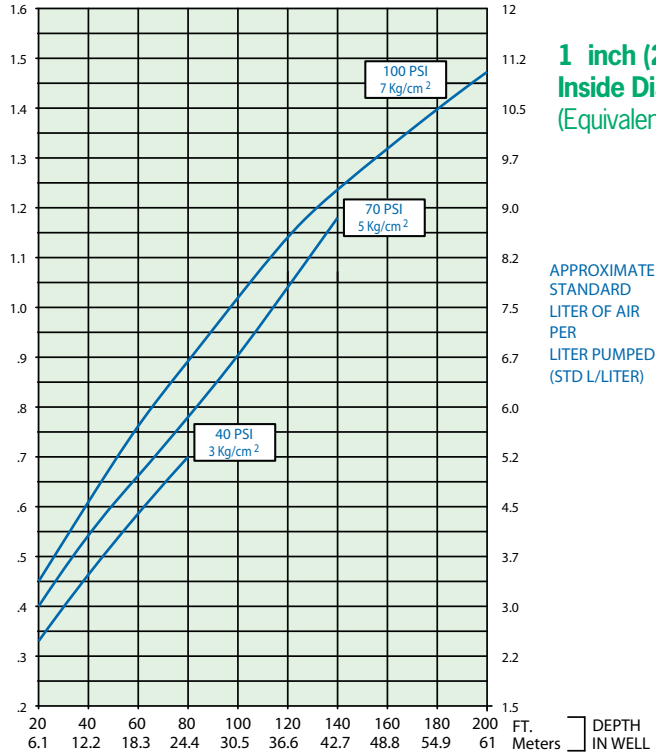
AP4+B

Air Consumption

3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



LDAP4+B

Max. Flow	7.0 gpm (26.5 lpm)
O.D.	3.6 in (91 mm)
Length	27.5 in. (70 cm)

Advantages

1. The original automatic air-powered well pump, proven worldwide over 23 years
2. The highest flow rates and deepest pumping capabilities in the industry in a low drawdown bottom-fill pump
3. Patented, proven design for superior reliability and durability, even in severe applications
4. Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps
5. One-year warranty

Description

The AP4+ Low-Drawdown Bottom Inlet AutoPump provides maximum capabilities and flow in a bottom inlet pump for 4" (100 mm) diameter and larger wells with very short water columns and/or the need to pump down to as low as 15.3 inches (39 cm) above the bottom. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 7 gpm (26.5 lpm). The AP4+ Low Drawdown Bottom Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

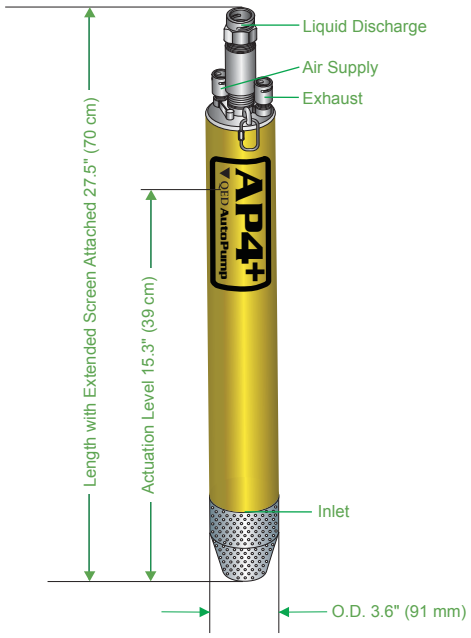
The AutoPump Heritage

The AP4+ Low-Drawdown Bottom Inlet AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

QED
Environmental Systems

LDAP4+B

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Low Drawdown AP4+ Bottom Inlet**
Liquid Inlet Location	Bottom
O.D.	3.6 in. (91 mm)
Overall Length With Extended Screen	27.5 in. (70 cm)
Weight	11.7 lbs. (5.3 kg)
Maximum Flow Rate	7 gpm (26.5 lpm)* - See Flow Rate Chart
Pump Volume/Cycle	0.11 - 0.16 gal (.42 - .61 L)
Minimum Accuation Level	15.3 in. (39 cm)
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	.32 - 2.86 scf/gal. (2.2 - 21.5 liter of air / fluid liter) - See air usage chart
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF, Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[2]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Material upgrades available
[2] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

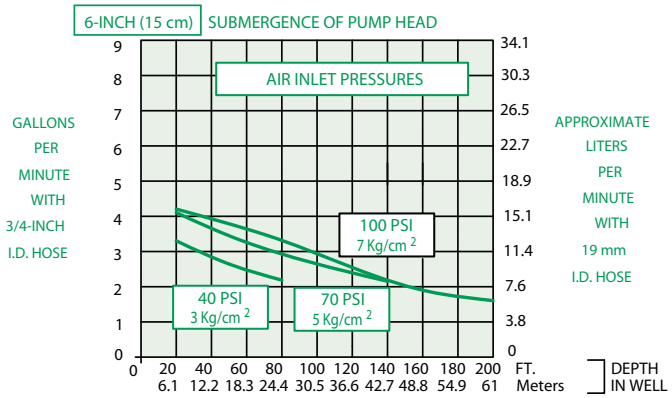
Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

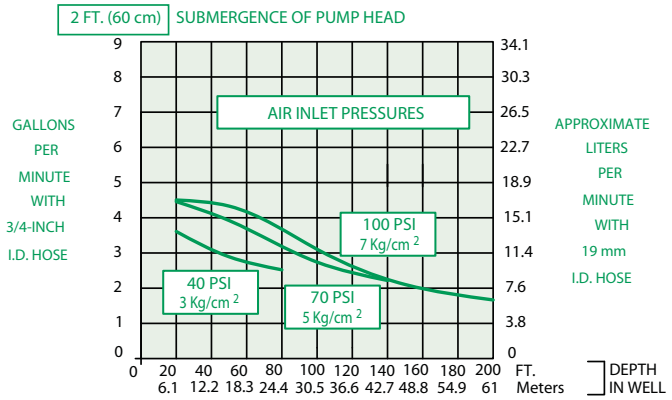
***Consult QED for higher flow requirements**

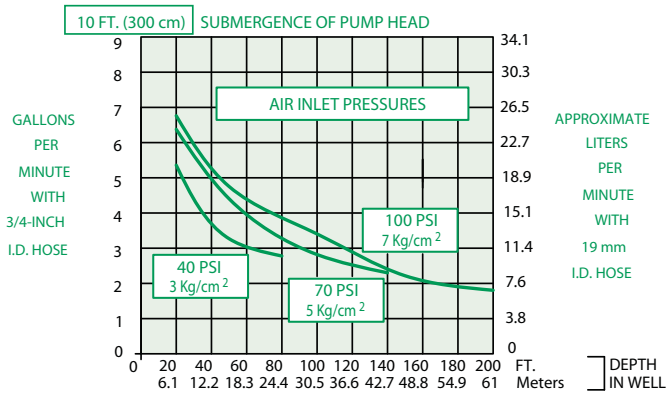
LDAP4+B

Flow Rates[1]

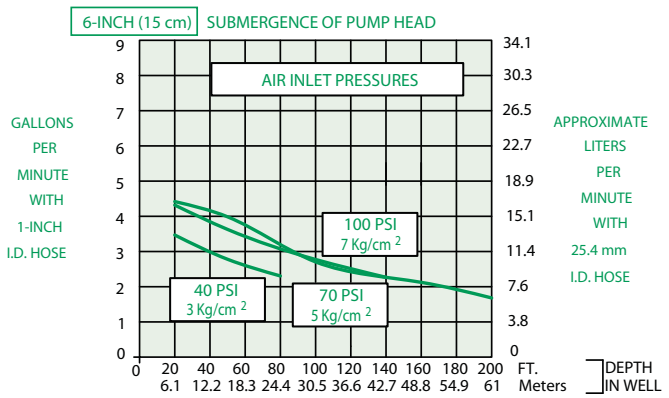
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D.Tubing)

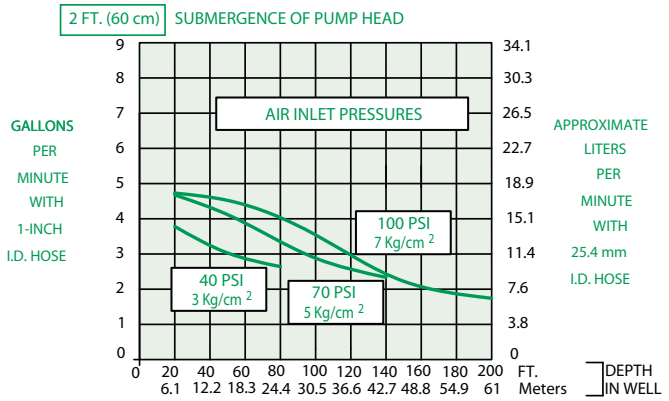


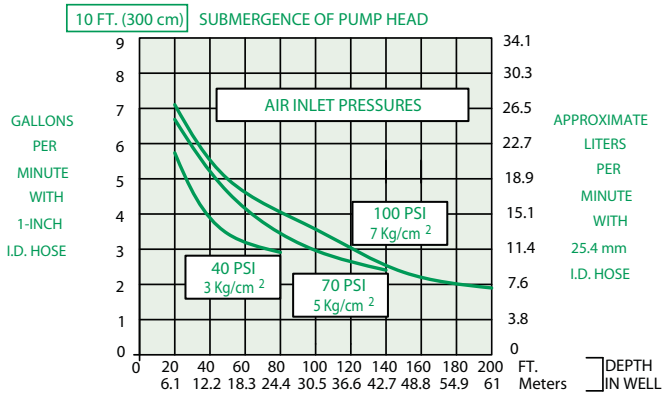




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D.Tubing)





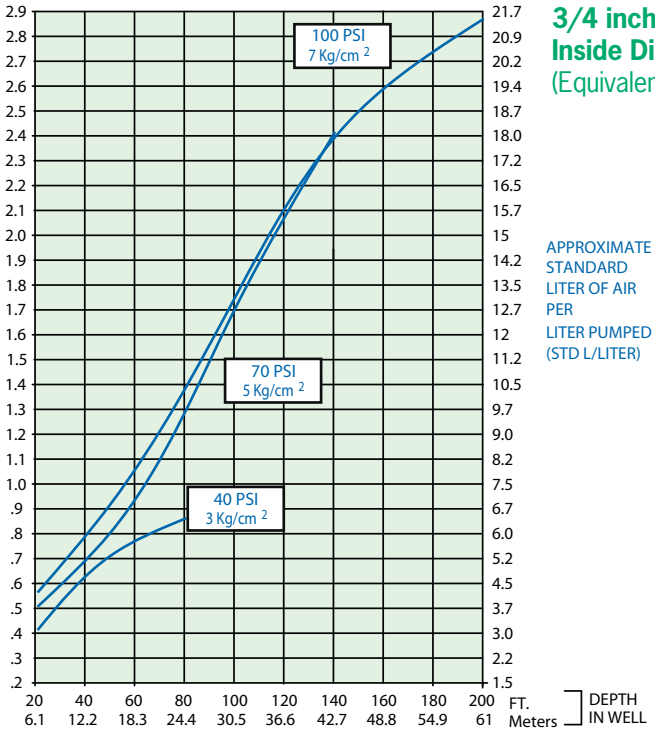


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

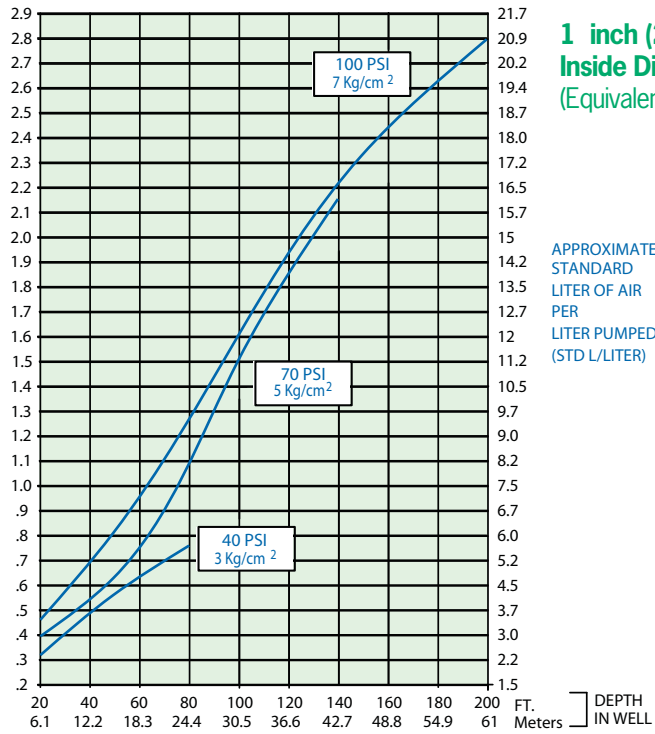
LDAP4+B

Air Consumption

3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



AP4+T

Max. Flow	**10 gpm (38 lpm)**
O.D.	**3.6 in (91 mm)**
Length	**56.7 in. (144 cm)**

Description

The AP4+ Top Inlet Long AutoPump provides maximum capabilities and flow in a top inlet pump for 4" diameter and larger wells needing an elevated inlet, such as pumping total fluids from wells contaminated with LNAPLs. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 10 gpm*. The AP4+ Long Top Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Top Inlet Long AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

Advantages

1. **The original automatic air-powered well pump, proven worldwide over 23 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

QED Environmental Systems

AP4+T

Pump Dimensions

Specifications & Operating Requirements

Model	**4" - Long AP4+ Top Inlet**
Liquid Inlet Location	Top
O.D.	3.6 in. (91 mm)
Overall Length (Pump & Fittings)	56.7 in. (144 cm)
Weight	16.5 lbs. (7.6 kg)
Maximum Flow Rate	10 gpm (38 lpm)* - See Flow Rate Chart
Pump Volume/Cycle	0.58 - 0.78 gal (2.2 - 3L)
Minimum Accuation Level	53.3 in. (135 cm)
Standard Pump	
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.35 - 1.1 scf / gal. (3.0 - 8.4 liter of air / fluid liter) - See air usage chart
High Pressure Pump	
Maximum Depth	425 ft. (130 m)
Air Pressure	5 - 200 psi (0.4 - 14.1 kg/cm2)
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF, Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[1]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Long and short AP4+ AutoPumps are warranted for five(5) years: Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

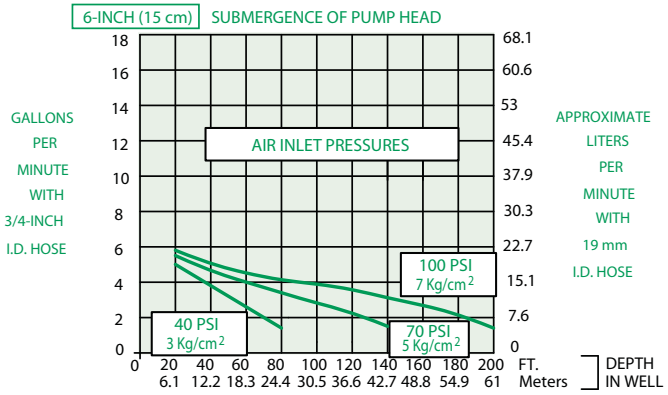
Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

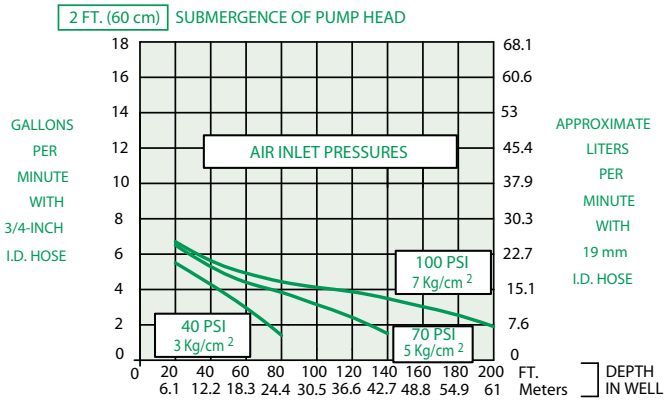
***Consult QED for higher flow requirements**

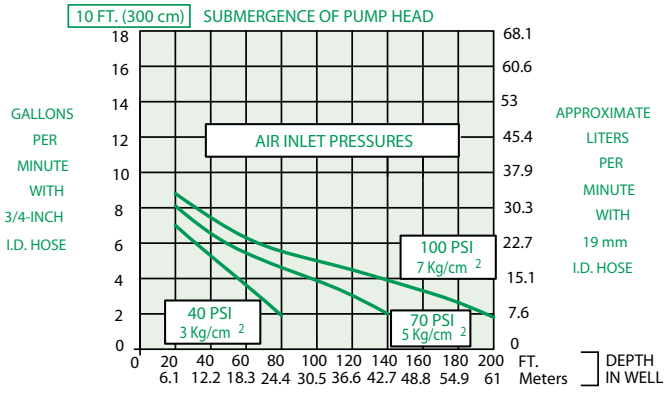
AP4+T

Flow Rates[1]

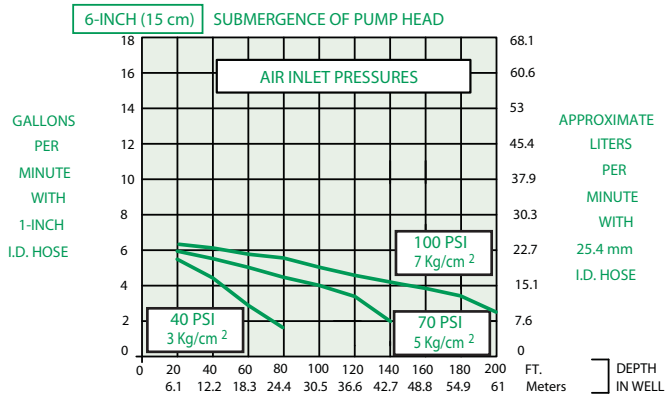
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D.Tubing)

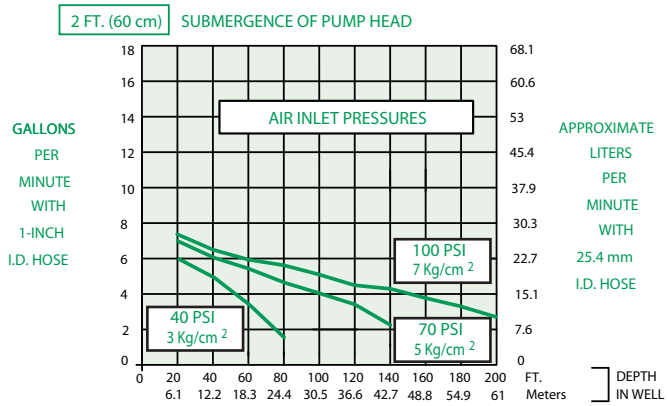


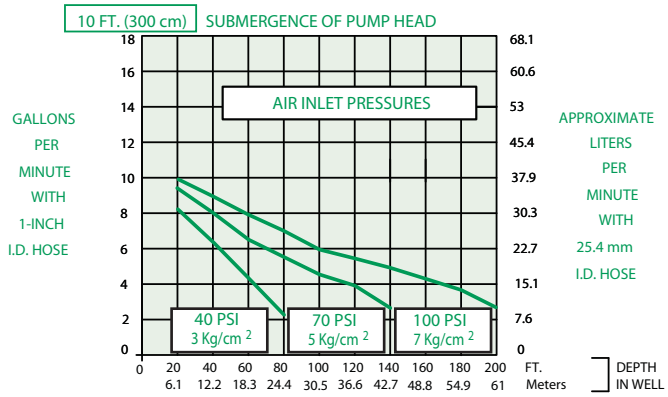




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D.Tubing)





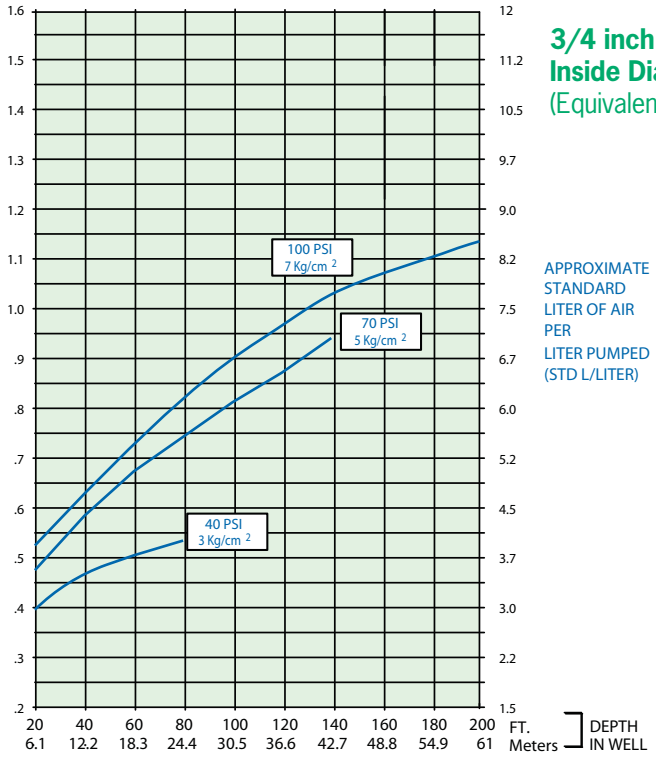


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

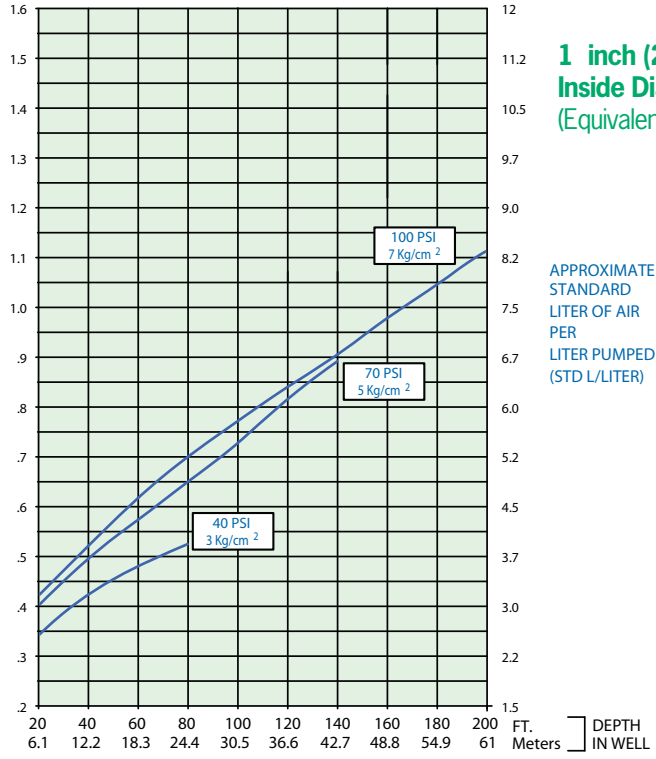
AP4+T

Air Consumption

3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



AP4+T

Max. Flow	**9 gpm (34 lpm)**
O.D.	**3.6 in (91 mm)**
Length	**45 in. (110 cm)**

Description

The AP4+ Top Inlet Short AutoPump provides maximum capabilities and flow in a top inlet pump for 4" (100 mm) diameter and larger wells with shorter water columns and the need for an elevated inlet, such as pumping total fluids from wells contaminated with LNAPLs. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 9 gpm (34 lpm)*. The AP4+ Short Top Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

The AP4+ Top Inlet Short AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as hydrocarbons, solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, wellhead caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

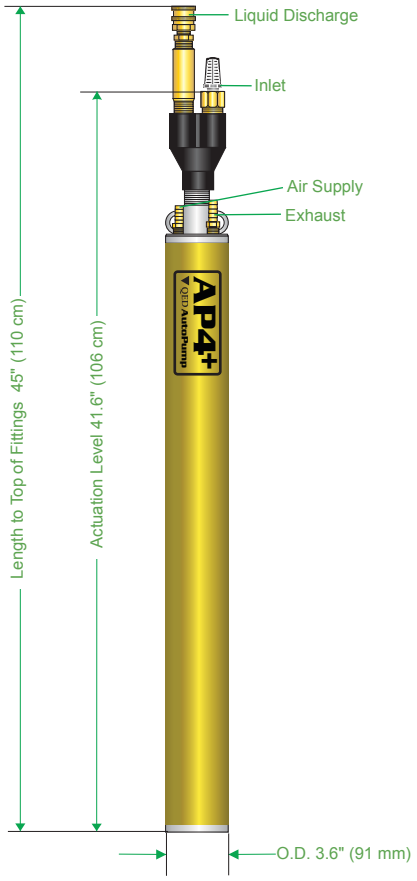
Advantages

1. **The original automatic air-powered well pump, proven worldwide over 23 years**
2. **The highest flow rates and deepest pumping capabilities in the industry**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, hydrocarbons corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **Five-year warranty**

QED Environmental Systems

AP4+T

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Short AP4+ Top Inlet**
Liquid Inlet Location	Top
O.D.	3.6 in. (91 mm)
Overall Length (Pump & Fittings)	45 in. (110 cm)
Weight	15.8 lbs. (7.2 kg)
Maximum Flow Rate	9 gpm (34 lpm)* - See Flow Rate Chart
Pump Volume/Cycle	0.22 - 0.36 gal (.83 - 1.36 L)
Minimum Accuation Level	41.6 in. (106 cm)
Standard Pump	
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	0.35 - 1.5 scf / gal. (2.4 - 8.4 liter of air / fluid liter) - See air usage chart
High Pressure Pump	
Maximum Depth	425 ft. (130 m)
Air Pressure	5 - 200 psi (0.4 - 14.1 kg/cm2)
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF, Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[1]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Long and short AP4+ AutoPumps are warranted for five(5) years: Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

Application Limits (Base model)

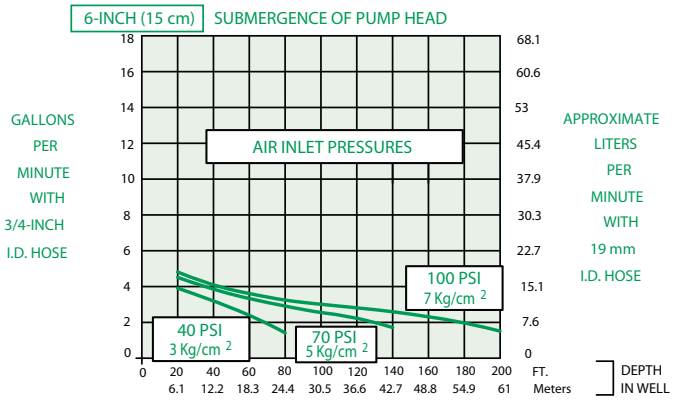
AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

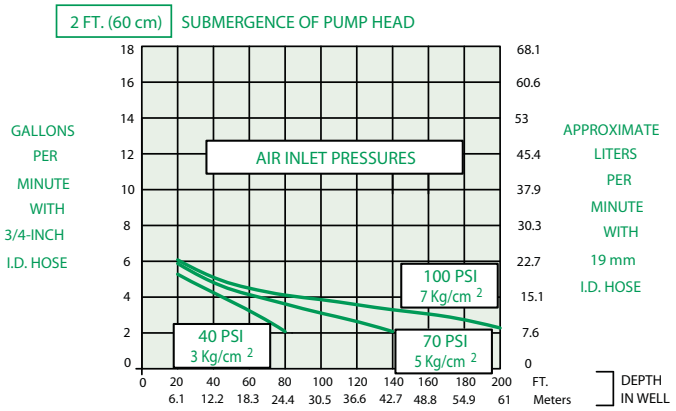
Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

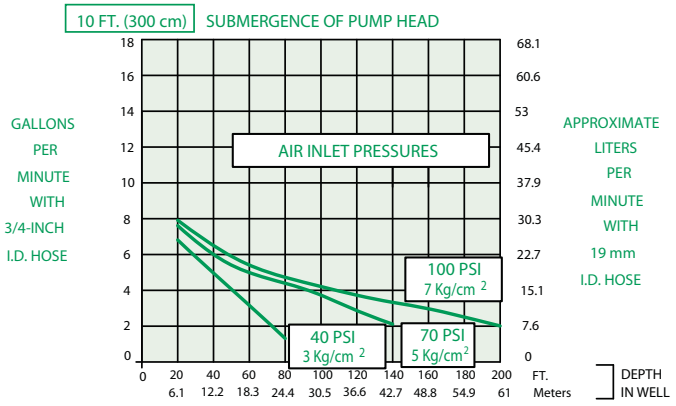
***Consult QED for higher flow requirements**

Flow Rates[1]

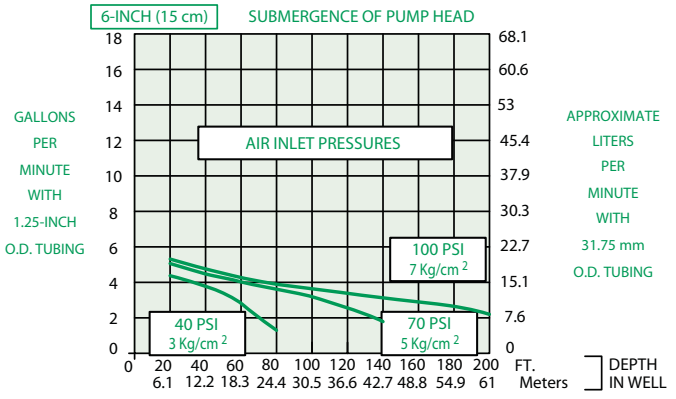
3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D.Tubing)

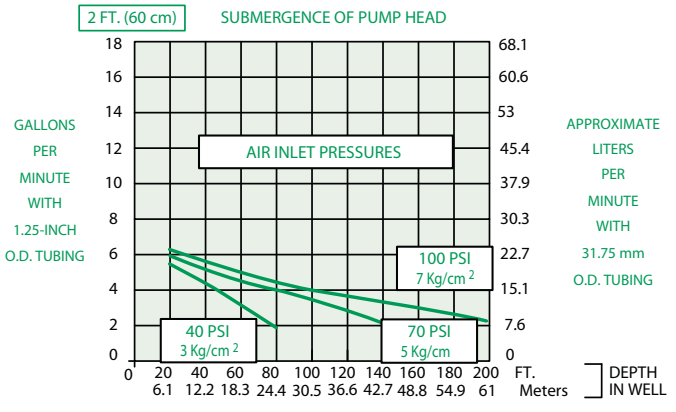


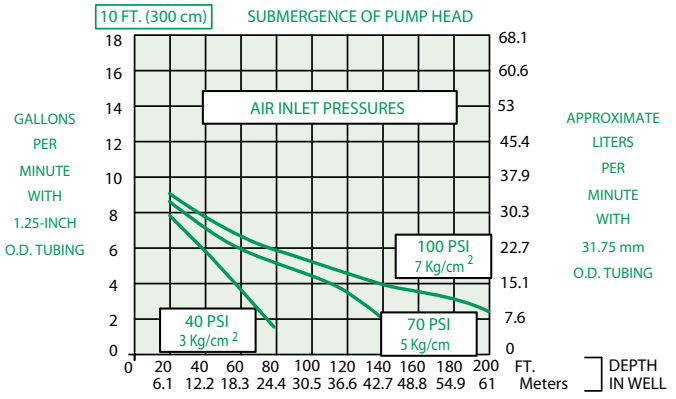




1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D.Tubing)





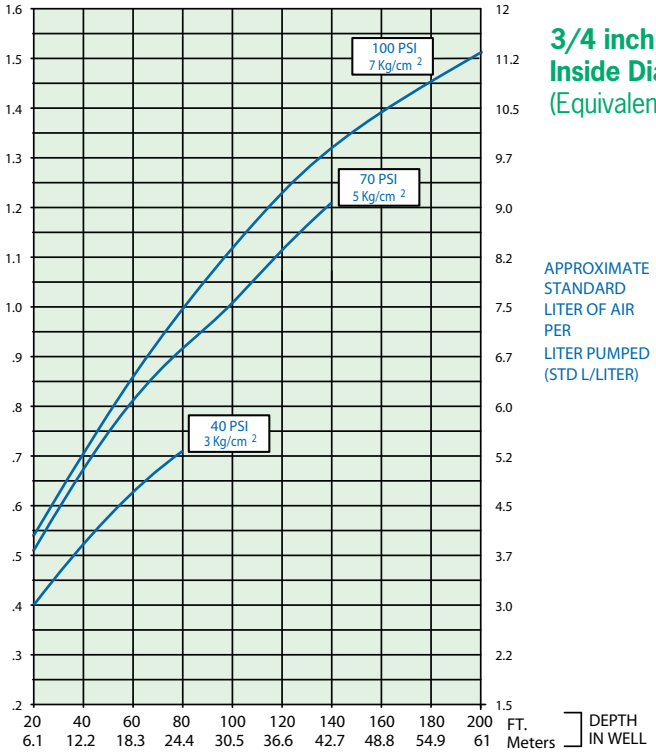


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

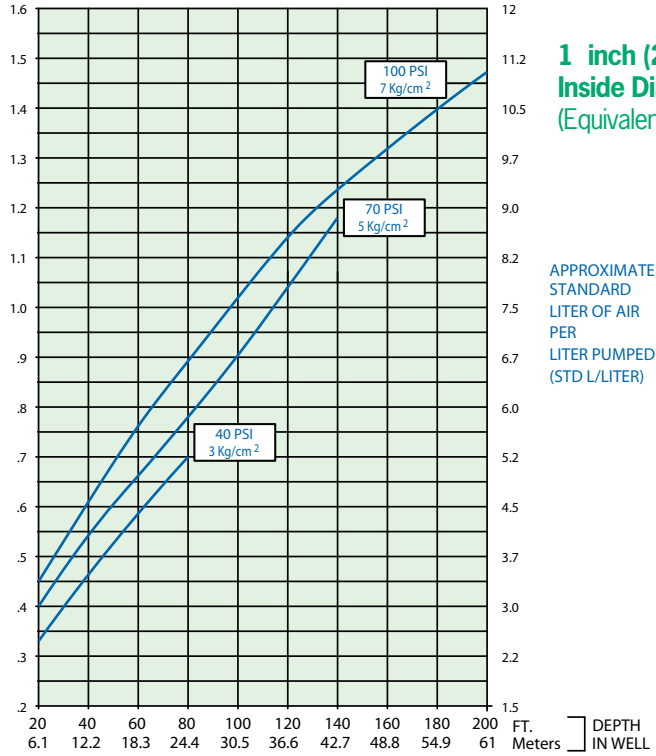
AP4+T

Air Consumption

3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



LDAP4+T

Max. Flow	**6.4 gpm (24 lpm)**
O.D.	**3.6 in (91 mm)**
Length	**30.75 in. (78 cm)**

Description

The Low-Drawdown AP4+ Top Inlet AutoPump provides maximum capabilities and flow in a top inlet pump for 4" (100 mm) diameter and larger wells with very short water columns and/or the need to pump down to as low as 27.4 inches (70 cm) above the bottom. It is offered in optional versions to handle even the most severe remediation and landfill pumping applications, and delivers flow rates up to 6.4 gpm (24 lpm). The Low Drawdown AP4+ Top Inlet AutoPump is complemented by the most comprehensive selection of accessories to provide a complete system to meet site specific requirements. Call QED for prompt, no-obligation assistance on your pumping project needs.

The AutoPump Heritage

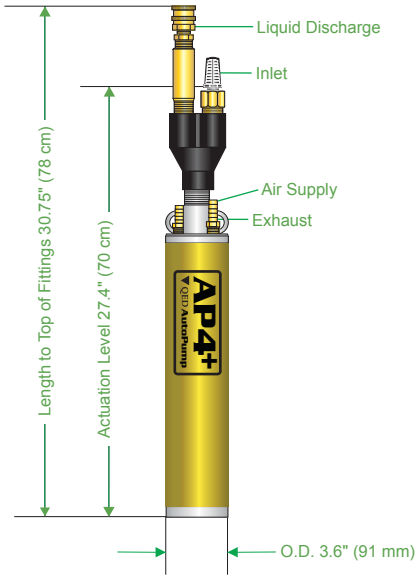
The Low-Drawdown AP4+ Top Inlet AutoPump is part of the famous AutoPump family of original automatic air-powered pumps, developed in the mid 1980s specifically to handle unique pumping needs at remediation and landfill sites. Over the years they've proven their durability at thousands of sites worldwide. AutoPumps are designed to handle difficult pumping challenges that other pumps can't, such as solvents, suspended solids, corrosives, temperature extremes, viscous fluids and frequent start/stop cycles. Beyond just the pump, AutoPump systems offer the most complete range of tubing, hose, connectors, caps and accessories to help your installation go smoothly. This superior pumping heritage, application experience and support back up every AutoPump you put to work on your project.

Advantages

1. **The original automatic air-powered well pump, proven worldwide over 23 years**
2. **The highest flow rates and deepest pumping capabilities in the industry in a low drawdown top-fill pump**
3. **Patented, proven design for superior reliability and durability, even in severe applications**
4. **Handles solids, solvents, corrosive conditions, viscous fluids and high temperatures beyond the limits of electric pumps**
5. **One-year warranty**

LDAP4+T

Pump Dimensions



Specifications & Operating Requirements

Model	**4" - Low Drawdown AP4+ Top Inlet**
Liquid Inlet Location	Top
O.D.	3.6 in. (91 mm)
Overall Length (Pumps & Fittings)	30.75 in. (78 cm)
Weight	9.8 lbs. (4.4 kg)
Maximum Flow Rate	6.4 gpm (24 lpm)
Pump Volume/Cycle	0.11 - 0.16 gal (.42 - .61 L)
Minimum Accuation Level	27.4 in. (70 cm)
Maximum Depth	250 ft. (76 m)
Air Pressure	5 - 120 psi (0.4 - 8.4 kg/cm2)
Air Usage	.31 - 2.85 scf/gal. (2.2 - 21.5 liter of air / fluid liter) - See air usage chart
Minimum Liquid Density	0.7 SpG (0.7 g/cm3)
Standard Construction Materials[1]	
Pump Body	Fiberglass or Stainless Steel
Pump Ends	Stainless Steel
Internal Components	Stainless Steel, Viton, PVDF, Hastelloy-C
Tube & Hose Fittings	Brass or Stainless Steel
Fitting Type	Barbs, Quick Connects or Easy Fittings
Tube & Hose Options	
Tubing Materials[1]	Nylon
Sizes - Liquid Discharge	1 in. (25 mm) or 1-1/4 in. (32 mm) OD
Pump Air Supply	1/2 in. (13 mm) OD
Air Exhaust	5/8 in. (16 mm) OD
Hose Material	Nitrile
Sizes - Liquid Discharge	3/4 in. (19 mm) or 1 in. (25 mm) ID
Pump Air Supply	3/8 in. (9.5 mm) ID
Air Exhaust	1/2 in. (13 mm) ID

[1] Applies to QED supplied tubing; other tubing sources may not conform to QED fittings.

Low-Drawdown AP4+ AutoPumps are warranted for one (1) year.

Application Limits (Base model)

AP4+ AutoPumps are designed to handle the application ranges described below. For applications outside these ranges, consult QED about AP4+ upgrades.

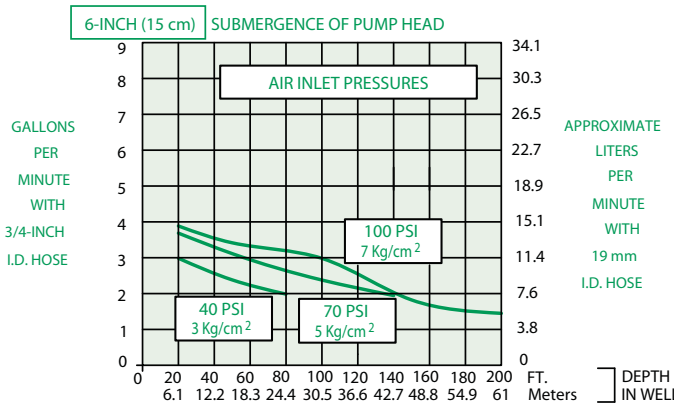
Maximum Temperature: 180°F (82°C)
pH Range: 4-9
Solvents and Fuels: diesel, gasoline, JP1-JP6,#2 heating oils, BTEX, MTBE, landfill liquids

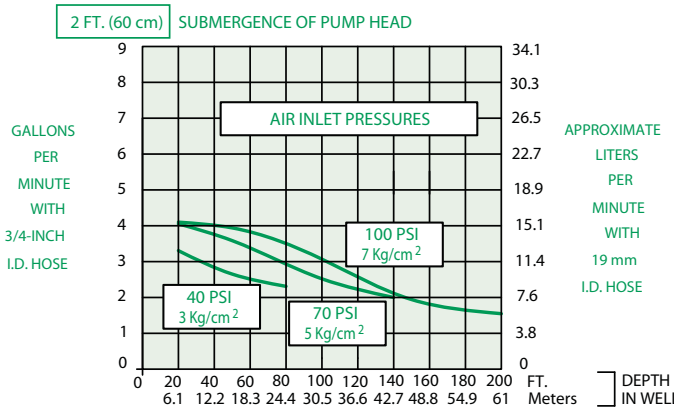
***Consult QED for higher flow requirements**

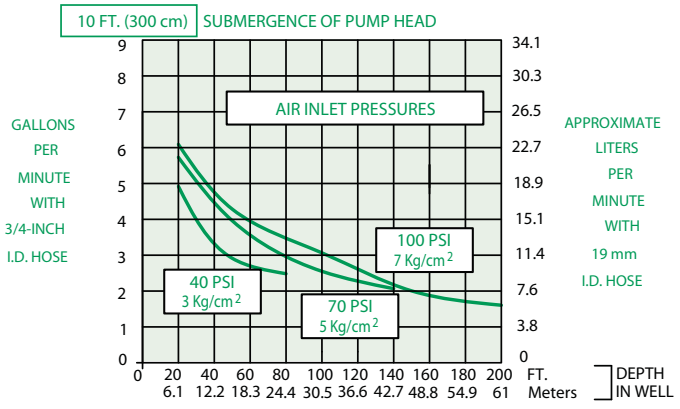
LDAP4+T

Flow Rates [1]

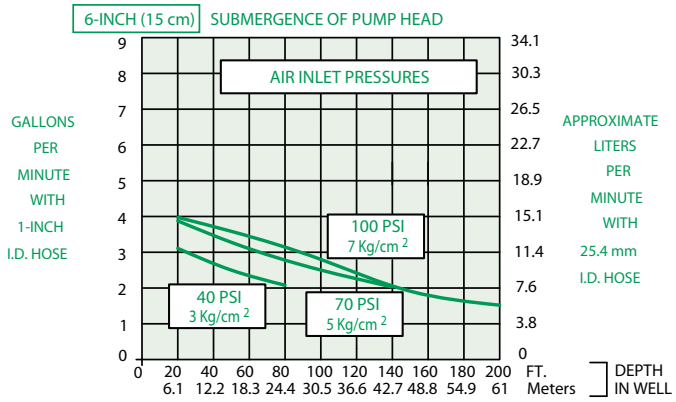
3/4 inch (19 mm) Inside Diameter Discharge Hose (Equivalent to 1-Inch O.D.Tubing)

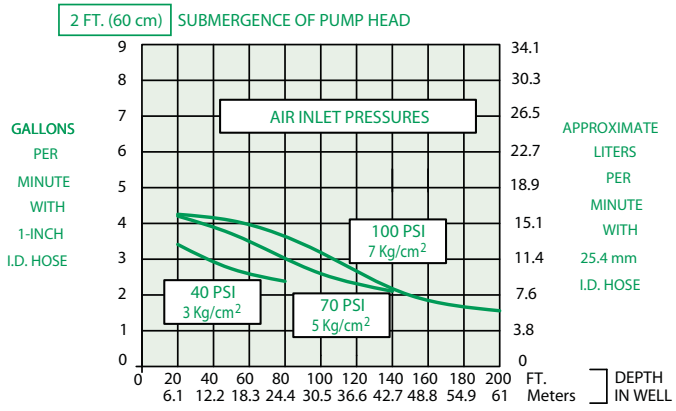


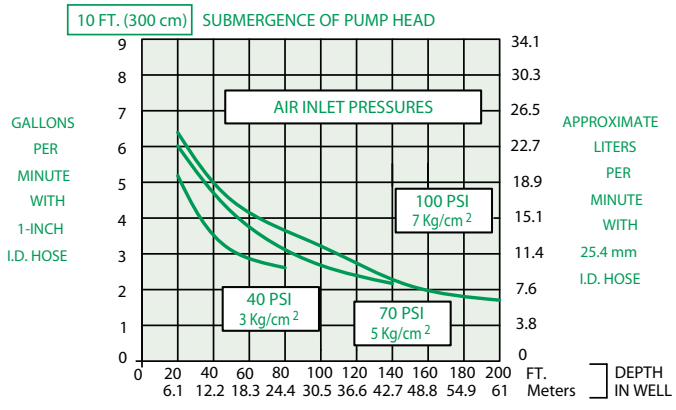




1 inch (25.4 mm) Inside Diameter Discharge Hose (Equivalent to 1.25-Inch O.D.Tubing)





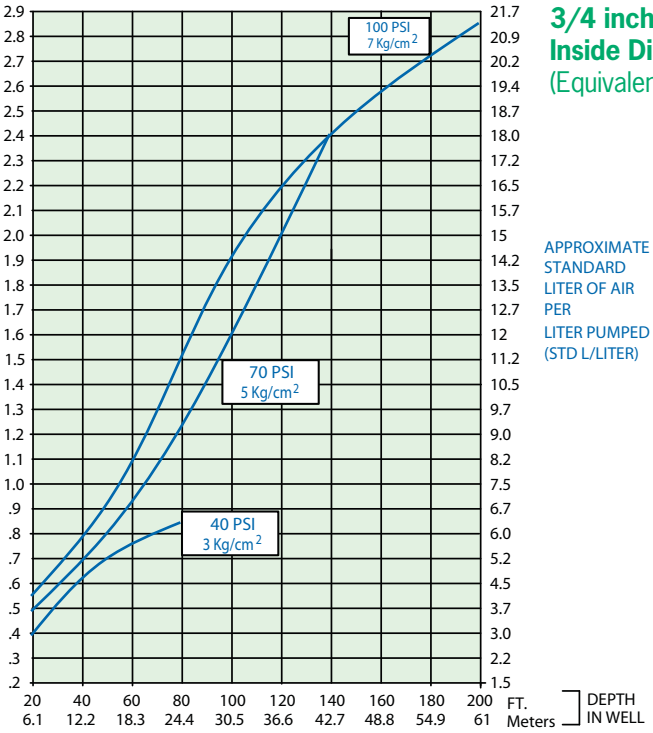


[1]FLOW RATES MAY VARY WITH SITE CONDITIONS. CALL QED FOR TECHNICAL ASSISTANCE.

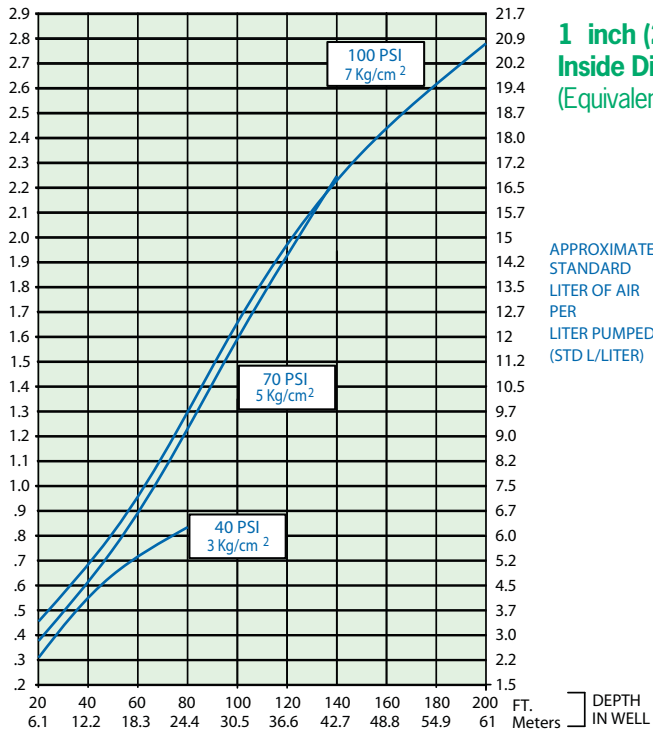
LDAP4+T

Air Consumption

3/4 inch (19 mm) Inside Diameter Discharge Hose
(Equivalent to 1-Inch O.D. Tubing)



1 inch (25.4 mm) Inside Diameter Discharge Hose
(Equivalent to 1.25-Inch O.D. Tubing)



Five Year Warranty

This limited warranty is in lieu of and excludes all other representations made by advertisements, distributors, agents, or manufacturers sales representatives, and all other warranties, both express and implied. There are no implied warranties of merchantability or of fitness for a particular purpose for goods covered hereunder.

QED Environmental Systems warrants to the purchaser of its products that, subject to the limitations and conditions provided within the Terms & Conditions of Sale, products, materials and/or workmanship shall reasonably conform to descriptions of the products and shall be free of defects in material and workmanship.

All warranty durations are calculated from the original date of purchase—determined as beginning the date of shipment from QED facilities and the date QED is notified of a warranty claim. This warranty shall be limited to the duration and conditions set forth below.

1. AP4+ AutoPumps – Warranted for five (5) years: 100% material and 100% workmanship. This limited warranty coverage only applies to long and short AP4+ AutoPumps purchased with this warranty. There will be no warranty for application or material compatibility. The materials used in pumps vary depending upon application and the customer is responsible for knowing the environment in which the pump will be operating and working with QED to determine what materials of construction will be best for the application. Note: The foregoing does not apply to AP4+ Leachate AutoPumps when used in landfill leachate applications.

The warranty is valid when the following conditions exist: when the site has a pH between 4 and 9, has a salinity of 3500 ppm or less, is between 40 and 180 degrees Fahrenheit, is non-corrosive to the construction materials of the pump; and is not abrasive. Typical commercial fuels are acceptable materials in free or dissolved phase. The pumps and accessories must be operated within the specifications and limits given in the manual for the particular piece of equipment. Note: The foregoing does not apply to AP4+ Leachate AutoPumps when used in landfill leachate applications.

2. AP4+ "Leachate" AutoPumps – Warranted for five (5) years: 100% material and 100% workmanship. This limited warranty coverage only applies to long and short AP4+ "Leachate" AutoPumps (301881P, 301882P). Any 304 stainless steel pump component that fails due to chemical attack during this warranty period will be upgraded to 316 stainless steel by QED, free of charge. The warranty is valid when the pumps are used in landfill leachate applications, between 40 and 180 degrees Fahrenheit, that are not abrasive.

3. Hose, Tubing, Fittings, And Air Filtration Housings - Warranted for one (1) year: 100% material and 100% workmanship. There will be no warranty for application or material compatibility. The materials used vary depending upon application and the customer is responsible for knowing the environment in which the equipment will be operating and working with QED to determine what materials of construction will be best for the application.

4. Wellheads, Well Caps, Flow Meters, Pneumatic Data Modules - Warranted for one (1) year: 100% material and 100% workmanship.

5. Precision Fine Tune Control Valves - Warranted for two (2) years: 100% material and 100% workmanship.

6. Parts and Repairs - Warranted for ninety (90) days: 100% material and 100% workmanship; when repairs are performed by QED or its appointed agent; from date of repair or for the full term of the original warranty, whichever is longer. Separately sold parts are warranted for ninety (90) days: 100% materials and 100% workmanship.

This warranty will be void in the event of unauthorized disassembly of component assemblies. Defects in any equipment that result from abuse, operation in any manner outside the recommended procedures, use and applications other than for intended use or exposure physical environments beyond the designated limits of materials and construction, will also void the warranty.

Chemical attack by liquids, gases or abrasive substances contacting equipment and accessories shall not be covered by thiswarranty. A range of materials of construction is available from QED and it is the buyer's responsibility to select materials of construction to fit buyer's application. QED will only warrant that the supplied materials will conform to published QED specifications and generally accepted standards for that particular material. Note: This warranty does cover chemical attack to 304 stainless steel components (see part 2 above) of AP4+ "Leachate" AutoPumps (301881P, 301882P) when the pumps are used in landfill leachate applications, between 40 and 180 degrees Fahrenheit, that are not abrasive.

QED Environmental Systems shall be released from all obligations under all warranties if any product covered hereby is repaired or modified by persons other than QED service personnel (unless such repair by others is made with the written consent of QED); resold to other parties; and/or moved to or used on a site other than originally specified.

It is understood and agreed that QED Environmental Systems shall in no event be liable for incidental or consequential damages resulting from its breach of any of the terms of this agreement, nor for special damages, nor for improper selection of any product described or referred to for a particular application. Liability under this warranty is limited to repair or replacement F.O.B. QED's factory, or its appointed agent's shop, of any parts which prove to be defective within the duration and conditions set forth herein, or repayment of the purchase price at the option of QED, provided the products have been returned in accordance with the duration and conditions set forth herein.

Subassemblies and Other Equipment Manufactured by Others

The foregoing warranty does not apply to major subassemblies and other equipment, accessories, and other parts manufactured by others, and such other parts, accessories, and equipment are subject only to the warranties, if any, supplied by their respective manufacturers. QED makes no warranty concerning products or accessories not manufactured by QED. In the event of failure of any such product or accessory, QED will give reasonable assistance to Buyer in obtaining from the respective manufacturer whatever adjustment is reasonable in light of the manufacturer's own warranty.

Illustrations and Drawings

Reasonable effort has been made to have all illustrations and drawings accurately represent the product(s) as it actually was at the time of doing the illustrations and drawings. However, products may change to meet user requirement and therefore may not be reflected in the literature. In addition, literature may be updated to reflect the most recent equipment revision(s). Changes to either or both equipment and/or literature can be made without notice.

Buyer's Remedies

The buyer's exclusive and sole remedy on account of or in respect to the furnishing of defective material or workmanship shall be to secure replacement thereof as aforesaid. QED shall not in any event be liable for the cost of any labor expended on any such product or material or for any special, direct, indirect or consequential damages to any one by reason of the fact that it shall have been deemed defective or a breach of said warranty.

Changes without Notice

Prices and specifications are subject to change without notice.

Shipping Dates

Shipping dates are approximate and are subject to delays beyond our control.

F.O.B. Point and Title

All material is sold F.O.B. factory. Title to all merchandise sold shall pass to Buyer upon delivery by Seller to carrier at factory. All freight insurance is the responsibility of the Buyer and shall be charged to the Buyer on the invoice unless directed in writing. All Freight claims are the Buyer's responsibility.

Terms

Payment terms are Net 30 days; 1.0% per month past due.

State and Local Taxes

Any taxes, duties or fees which the seller may be required to pay or collect upon or with respect to the sale, purchase, delivery, use or consumption of any of the material covered hereby shall be for the account of the Buyer and shall be added to the purchase price.

Acceptance

All orders shall be subject to the terms and conditions contained or referred to in the Seller's quotation, acknowledgments, and to those listed here and to no others whatsoever. No waiver, alteration or modification of these terms and conditions

shall be binding unless in writing and signed by an executive officer of the Seller. All orders subject to written acceptance by QED Environmental Systems, Ann Arbor, MI, U.S.A.

Warranty Claims Procedure (Responsibility of purchaser)
The original purchaser's sole responsibility in the instance of a warranty claim shall be to notify QED or its appointed agent, of the defect, malfunction, or other manner in which the terms of this warranty are believed to be violated. The purchaser may secure performance of obligations hereunder by contacting the Customer Service Department of QED or its appointed agent, and:

1. Identifying the product involved by model or serial number, or other sufficient description, that will allow QED, or its appointed agent, to determine which product is defective.

2. Specifying where, when, and from whom the product was purchased.

3. Describing the nature of the defect or malfunction covered by this warranty.

4. After obtaining authorization from QED, sending the malfunctioning component via a RMA# (Return Material Authorization number) to the address below or to its appointed agent:

QED Environmental Systems
1565 Alvarado Street
San Leandro, California
94577-2640 USA

(800) 537-1767 Toll-Free in North America
(510) 346-0400 Tele.
(510) 346-0414 FAX

If any product covered hereby is actually defective within the terms of this warranty, purchaser must contact QED, or its appointed agent, for determination of warranty coverage. If the return of a component is determined to be necessary, QED, or its appointed agent, will authorize the return of the component at Purchasers expense. If the product proves not to be defective within the terms of this warranty, then all costs and expenses in connection with the processing of the Purchaser's claim and all costs for repair, parts, labor, and shipping and handling, as authorized by owner hereunder, shall be borne by the Purchaser. In no event shall such allegedly defective products be returned to QED, or its appointed agent, without its consent, and QED's, or its appointed agent's, obligations of repair, replacement or refund are conditional upon the buyer's return of the defective product to QED, or its appointed agent. All equipment returned to QED will be appropriately cleaned of contamination before shipping.

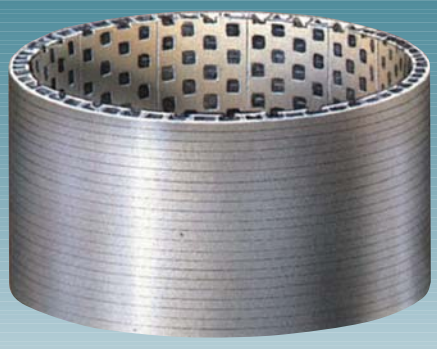
2355 Bishop Circle West
Dexter, Michigan 48130
1-800-624-2026 (North America Only)
(734) 995-2547 - Tele
(734) 995-1170 - Fax
info@qedenv.com - E-mail
www.qedenv.com

1565 Alvarado Street
San Leandro, California 94577-2640
1-800-537-1767 (North America Only)
(510) 346-0400 - Tele
(510) 346-0414 - Fax

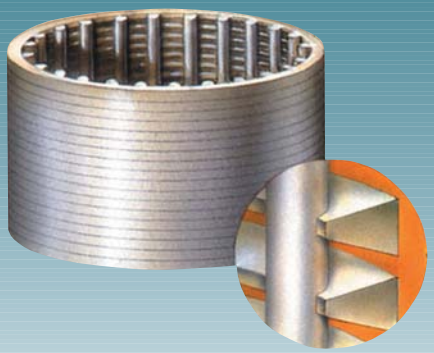
QED Environmental Systems

AP4+ Operations Manual

Leaders in Environmental Compliance Products



The 8-inch design features a channel-rod base for enhanced strength.



Designs up to 6-inch are made with standard rod base.

PVC VEE-WIRE® SCREENS

Commonly used in shallow wells, Johnson Screen's proprietary, sonic-welded PVC Vee-Wire® screens present higher open area for given slot size than any other non-metallic screen available. More economical than metal screens, PVC Vee-Wire screens resist corrosion from salts and gases commonly found in either salt or fresh water, and they may be treated repeatedly with hydrochloric acid or Johnson's Nu-Well® pellets to remove incrustations. PVC screens are furnished with F480 flush threads or plain ends for connecting to standard PVC fittings.

SIZE (INCHES)	NOMINAL O.D. (INCHES)	DIAMETER I.D. (INCHES)(1)	WEIGHT/FT LBS	TENSIL STRENGH LBS (2)	HANG WEIGHT LBS (4)	OPEN AREA (SQ INCHES) PER FOOT OF SCREEN COLLAPSE STRENGTH - PSI (3) SCREEN SLOT SIZE (INCHES)					
						0.006	0.010	0.020	0.030	0.040	0.050
1 - 1/4 PS	1.66	1.12	0.7	780	195	3.0 269	4.8 261	8.9 242	12.5 226	15.6 212	18.4 199
1- 1/2 PS	1.90	1.41	0.8	1245	310	3.4 181	5.5 175	10.2 163	14.3 152	17.9 143	21.0 134
2P/3T	2.37	1.88	0.8	1325	330	4.2 95	6.9 92	12.8 85	17.8 79	22.3 74	26.3 70
2 PS*	2.60	2.00	0.9	1325	330	4.6 72	7.5 70	14.0 65	19.6 61	24.5 57	28.8 54
3 PS	3.50	2.89	1.5	1820	455	5.4 169	8.8 164	16.5 154	23.3 145	29.3 137	34.7 130
4 Special	4.50	3.81	1.7	2100	525	6.9 81	11.3 78	21.2 74	30.0 69	37.7 65	44.6 62
4 PS*	4.62	4.00	1.8	2100	52	7.1 75	11.6 73	21.8 68	30.7 64	38.7 60	45.8 57
5 PS	5.56	4.81	2.5	3920	980	8.1 73	13.1 72	24.6 68	34.9 65	44.1 62	52.4 59
6 PS	6.61	5.75	3.7	4600	1150	8.0 73	13.1 72	24.9 68	35.6 65	45.3 62	54.2 59
8 PS	8.62	7.50	4.6	5500	1375	13.3 60	21.6 59	40.6 55	57.3 52	72.2 49	85.5 46

(1) Clear ID's are minimum inside diameters
(2) Tensile values are based on support rod area, other values are based on flush-thread test values
(3) Collapse strengths are calculated values - no safety factor included
(4) Hang weights are the maximum combined weight of riser and screen to be hung from the top screen joint
(5) Schedule 40 & 80 flush threads available
All strength properties are based on 73° F temperature

*Alternate construction for environmental applications

Highland Tank

Gauge Chart for Round Horizontal with dished heads

Gallons	6,165	**Shell Length+dishes**	ft	207	in
Diameter	8 ft	0 in **Shell Length**	14 ft	7.5	in

Please check for and remove any water from the bottom of the tank monthly

AMEC
6000 GALLON CYL NYC FUELER
PER DWG 92730/REV 3

HIGHLAND TANK
4535 ELIZABETHTOWN RD
MANHEIM, PA 17545

in (1/4)		in (1/4)		in (1/4)		in (1/4)		in (1/4)		in (1/4)	
1/2	3.6	10 1/4	335.9	20	903.4	29 3/4	1,601.4	39 1/2	2,376.2	49 1/4	3,187.5
3/4	6.5	10 1/2	348.2	20 1/4	919.9	30	1,620.5	39 3/4	2,396.7	49 1/2	3,208.4
1	10.1	10 3/4	360.6	20 1/2	936.6	30 1/4	1,639.6	40	2,417.3	49 3/4	3,229.3
1 1/4	14.1	11	373.2	20 3/4	953.3	30 1/2	1,658.8	40 1/4	2,437.8	50	3,250.2
1 1/2	18.6	11 1/4	385.9	21	970.1	30 3/4	1,678.1	40 1/2	2,458.4	50 1/4	3,271.2
1 3/4	23.4	11 1/2	398.8	21 1/4	987.0	31	1,697.3	40 3/4	2,479.0	50 1/2	3,292.0
2	28.7	11 3/4	411.8	21 1/2	1,003.9	31 1/4	1,716.7	41	2,499.7	50 3/4	3,312.9
2 1/4	34.4	12	424.9	21 3/4	1,021.0	31 1/2	1,736.1	41 1/4	2,520.3	51	3,333.8
2 1/2	40.2	12 1/4	438.1	22	1,038.0	31 3/4	1,755.5	41 1/2	2,540.9	51 1/4	3,354.6
2 3/4	46.5	12 1/2	451.5	22 1/4	1,055.2	32	1,775.0	41 3/4	2,561.6	51 1/2	3,375.5
3	53.0	12 3/4	465.0	22 1/2	1,072.4	32 1/4	1,794.5	42	2,582.3	51 3/4	3,396.3
3 1/4	59.8	13	478.6	22 3/4	1,089.8	32 1/2	1,814.1	42 1/4	2,603.0	52	3,417.2
3 1/2	66.9	13 1/4	492.4	23	1,107.2	32 3/4	1,833.7	42 1/2	2,623.7	52 1/4	3,438.0
3 3/4	74.1	13 1/2	506.2	23 1/4	1,124.6	33	1,853.3	42 3/4	2,644.5	52 1/2	3,458.8
4	81.7	13 3/4	520.1	23 1/2	1,142.2	33 1/4	1,873.0	43	2,665.2	52 3/4	3,479.6
4 1/4	89.6	14	534.2	23 3/4	1,159.8	33 1/2	1,892.6	43 1/4	2,686.0	53	3,500.4
4 1/2	97.6	14 1/4	548.4	24	1,177.5	33 3/4	1,912.5	43 1/2	2,706.8	53 1/4	3,521.1
4 3/4	105.9	14 1/2	562.7	24 1/4	1,195.2	34	1,932.2	43 3/4	2,727.6	53 1/2	3,541.9
5	114.4	14 3/4	577.1	24 1/2	1,213.0	34 1/4	1,952.1	44	2,748.4	53 3/4	3,562.6
5 1/4	123.1	15	591.7	24 3/4	1,230.9	34 1/2	1,972.0	44 1/4	2,769.3	54	3,583.2
5 1/2	132.0	15 1/4	606.4	25	1,248.9	34 3/4	1,991.8	44 1/2	2,790.0	54 1/4	3,604.0
5 3/4	141.1	15 1/2	621.1	25 1/4	1,266.9	35	2,011.8	44 3/4	2,810.9	54 1/2	3,624.7
6	150.5	15 3/4	635.9	25 1/2	1,285.0	35 1/4	2,031.8	45	2,831.7	54 3/4	3,645.3
6 1/4	160.0	16	651.0	25 3/4	1,303.1	35 1/2	2,051.8	45 1/4	2,852.7	55	3,665.9
6 1/2	169.7	16 1/4	666.0	26	1,321.3	35 3/4	2,071.9	45 1/2	2,873.6	55 1/4	3,686.6
6 3/4	179.6	16 1/2	681.2	26 1/4	1,339.6	36	2,092.0	45 3/4	2,894.4	55 1/2	3,707.2
7	189.7	16 3/4	696.4	26 1/2	1,357.9	36 1/4	2,112.1	46	2,915.3	55 3/4	3,727.7
7 1/4	200.0	17	711.8	26 3/4	1,376.4	36 1/2	2,132.2	46 1/4	2,936.3	56	3,748.3
7 1/2	210.4	17 1/4	727.2	27	1,394.7	36 3/4	2,152.4	46 1/2	2,957.1	56 1/4	3,768.8
7 3/4	221.0	17 1/2	742.9	27 1/4	1,413.3	37	2,172.6	46 3/4	2,978.1	56 1/2	3,789.3
8	231.8	17 3/4	758.5	27 1/2	1,431.8	37 1/4	2,192.8	47	2,999.0	56 3/4	3,809.8
8 1/4	242.7	18	774.3	27 3/4	1,450.4	37 1/2	2,213.1	47 1/4	3,019.9	57	3,830.2
8 1/2	253.8	18 1/4	790.0	28	1,469.1	37 3/4	2,233.4	47 1/2	3,040.9	57 1/4	3,850.7
8 3/4	265.1	18 1/2	806.0	28 1/4	1,487.9	38	2,253.8	47 3/4	3,061.9	57 1/2	3,871.1
9	276.5	18 3/4	822.0	28 1/2	1,506.6	38 1/4	2,274.1	48	3,082.8	57 3/4	3,891.5
9 1/4	288.1	19	838.2	28 3/4	1,525.5	38 1/2	2,294.5	48 1/4	3,103.7	58	3,911.8
9 1/2	299.8	19 1/4	854.3	29	1,544.4	38 3/4	2,314.9	48 1/2	3,124.7	58 1/4	3,932.2
9 3/4	311.7	19 1/2	870.6	29 1/4	1,563.3	39	2,335.4	48 3/4	3,145.7	58 1/2	3,952.4
10	323.7	19 3/4	886.9	29 1/2	1,582.3	39 1/4	2,355.7	49	3,166.5	58 3/4	3,972.7

Highland Tank

Gauge Chart for Round Horizontal with dished heads

Gallons	6,165	**Shell Length+dishes**	ft	207	in
Diameter	8 ft	0 in **Shell Length**	14 ft	7.5	in

Please check for and remove any water from the bottom of the tank monthly

AMEC
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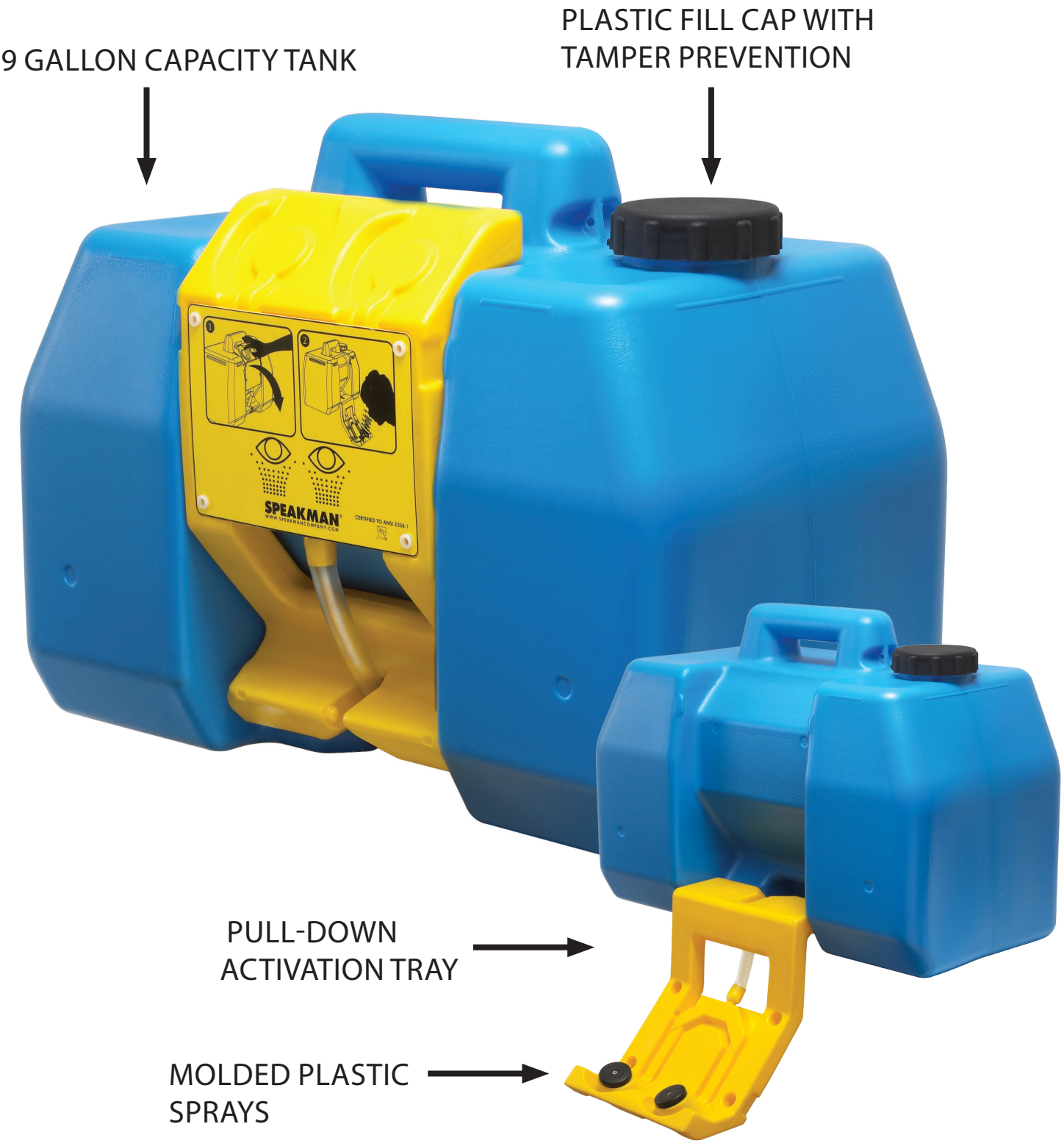
PER DWG 92730/REV 3

HIGHLAND TANK
4535 ELIZABETHTOWN RD
MANHEIM, PA 17545

in (1/4)		in (1/4)		in (1/4)		in (1/4)		in (1/4)	in (1/4)
59	3,992.9	68 3/4	4,752.3	78 1/2	5,422.7	88 1/4	5,944.5		
59 1/4	4,013.2	69	4,770.8	78 3/4	5,438.3	88 1/2	5,955.2		
59 1/2	4,033.4	69 1/4	4,789.2	79	5,453.8	88 3/4	5,965.6		
59 3/4	4,053.5	69 1/2	4,807.6	79 1/4	5,469.2	89	5,975.9		
60	4,073.6	69 3/4	4,826.0	79 1/2	5,484.4	89 1/4	5,986.0		
60 1/4	4,093.7	70	4,844.2	79 3/4	5,499.6	89 1/2	5,995.8		
60 1/2	4,113.7	70 1/4	4,862.4	80	5,514.6	89 3/4	6,005.6		
60 3/4	4,133.8	70 1/2	4,880.6	80 1/4	5,529.6	90	6,015.1		
61	4,153.8	70 3/4	4,898.6	80 1/2	5,544.5	90 1/4	6,024.4		
61 1/4	4,173.7	71	4,916.7	80 3/4	5,559.2	90 1/2	6,033.6		
61 1/2	4,193.7	71 1/4	4,934.6	81	5,573.8	90 3/4	6,042.5		
61 3/4	4,213.5	71 1/2	4,952.6	81 1/4	5,588.4	91	6,051.2		
62	4,233.4	71 3/4	4,970.3	81 1/2	5,602.8	91 1/4	6,059.7		
62 1/4	4,253.1	72	4,988.0	81 3/4	5,617.1	91 1/2	6,068.0		
62 1/2	4,272.9	72 1/4	5,005.8	82	5,631.3	91 3/4	6,076.0		
62 3/4	4,292.6	72 1/2	5,023.4	82 1/4	5,645.5	92	6,083.9		
63	4,312.3	72 3/4	5,041.0	82 1/2	5,659.4	92 1/4	6,091.5		
63 1/4	4,331.9	73	5,058.3	82 3/4	5,673.2	92 1/2	6,098.7		
63 1/2	4,351.5	73 1/4	5,075.8	83	5,687.0	92 3/4	6,105.8		
63 3/4	4,371.0	73 1/2	5,093.2	83 1/4	5,700.5	93	6,112.6		
64	4,390.6	73 3/4	5,110.4	83 1/2	5,714.0	93 1/4	6,119.1		
64 1/4	4,410.1	74	5,127.5	83 3/4	5,727.5	93 1/2	6,125.3		
64 1/2	4,429.5	74 1/4	5,144.6	84	5,740.7	93 3/4	6,131.2		
64 3/4	4,448.8	74 1/2	5,161.6	84 1/4	5,753.8	94	6,136.8		
65	4,468.2	74 3/4	5,178.6	84 1/2	5,766.8	94 1/4	6,142.0		
65 1/4	4,487.5	75	5,195.5	84 3/4	5,779.6	94 1/2	6,146.9		
65 1/2	4,506.8	75 1/4	5,212.2	85	5,792.3	94 3/4	6,151.4		
65 3/4	4,525.9	75 1/2	5,229.0	85 1/4	5,805.0	95	6,155.5		
66	4,545.1	75 3/4	5,245.6	85 1/2	5,817.4	95 1/4	6,159.0		
66 1/4	4,564.2	76	5,262.2	85 3/4	5,829.7	95 1/2	6,162.0		
66 1/2	4,583.2	76 1/4	5,278.6	86	5,841.9	95 3/4	6,164.3		
66 3/4	4,602.2	76 1/2	5,294.9	86 1/4	5,853.9				
67	4,621.2	76 3/4	5,311.3	86 1/2	5,865.7				
67 1/4	4,640.0	77	5,327.4	86 3/4	5,877.4				
67 1/2	4,658.9	77 1/4	5,343.6	87	5,889.0				
67 3/4	4,677.7	77 1/2	5,359.6	87 1/4	5,900.5				
68	4,696.5	77 3/4	5,375.5	87 1/2	5,911.7				
68 1/4	4,715.1	78	5,391.3	87 3/4	5,922.8				
68 1/2	4,733.7	78 1/4	5,407.1	88	5,933.7				

Place Me *practically* Anywhere

On the back of a truck, sitting on a shelf, placed on the table, or mounted on the wall – the GravityFlo Portable Eyewash is engineered to go practically anywhere. This revolutionary safety station is the ideal solution for work sites that lack access to a potable water source. The GravityFlo features a 9-gallon capacity tank, intuitive pull-down activation, and is 100% ANSI Z358.1 Certified.



SPEAKMAN®

GravityFlo® Portable Eyewash

SE-4400

SPECIFICATION

FEATURES:

- Portable gravity-operated eyewash
- 9 gallon capacity tank
- Pull-down activation tray
- Hands-free operation
- Shelf, table or wall mount (bracket included)
- Molded plastic sprays
- Plastic fill cap with integral tamper prevention

COMPLIANCE:

- Certified to ANSI Z358.1

OPTIONS:

ADD SUFFIX TO MODEL #

- Water preservative (case of 4 2oz. bottles) ❑ SE-4210
- Cart to transport SE-4300 series eyewashes ❑ SE-4360

WARRANTY:

- 3 year limited

SEE REVERSE FOR ROUGH-IN DIMENSIONS

THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL.

SPEAKMAN®
400 ANCHOR MILL ROAD | NEW CASTLE, DE 19720
P: 800-537-2107 | F: 800-977-2747
WWW.SPEAKMANCOMPANY.COM

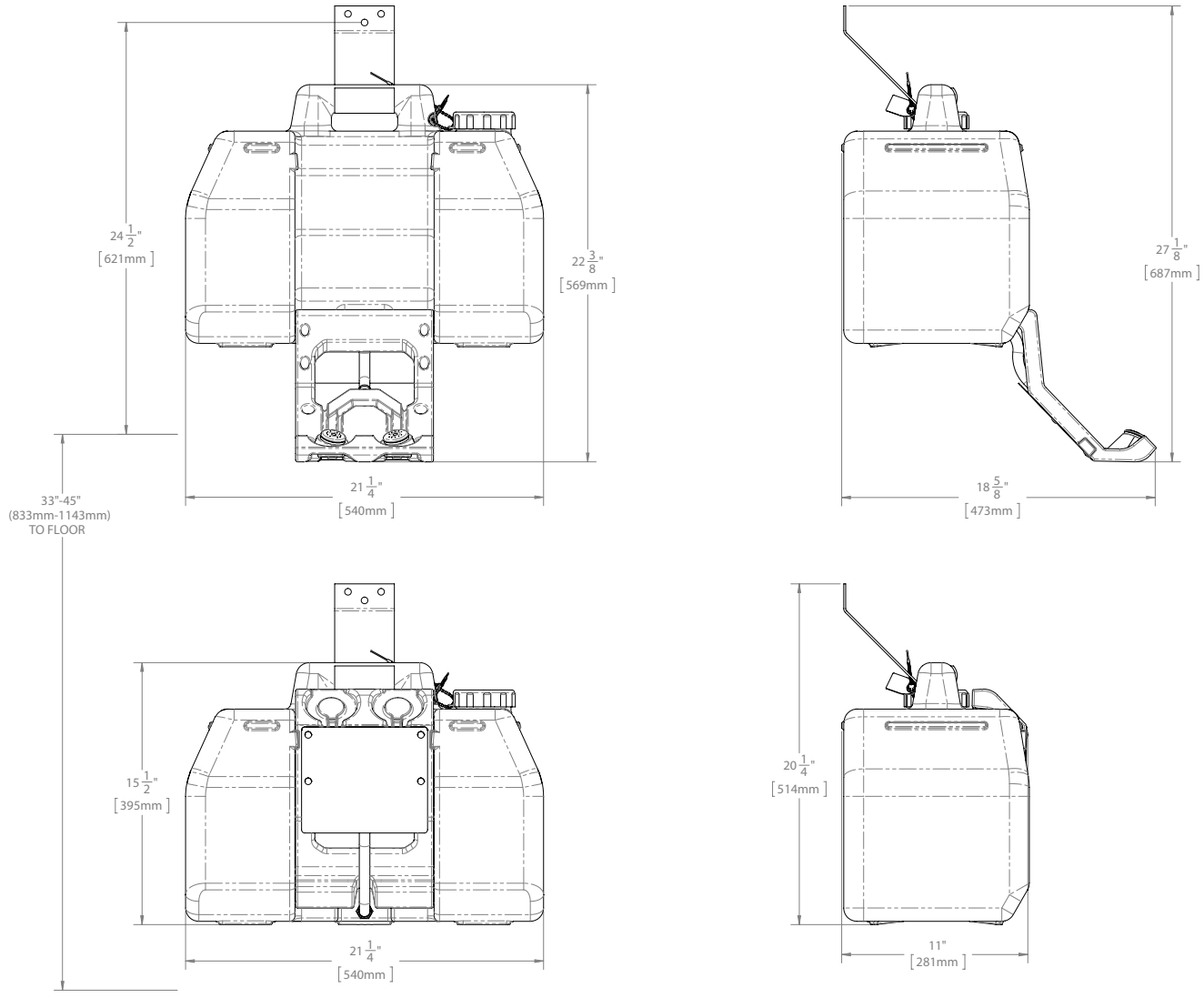
REVISION DATE: JANUARY 2014

Management Systems
Registered to ISO 9001

SPEAKMAN®

GravityFlo® Portable Eyewash SE-4400

SPECIFICATION



NOTE: 1. All dimensions are in inches (millimeters) unless otherwise specified and are subject to change without notice.

THIS SPACE FOR ARCHITECT/ENGINEER APPROVAL.

SPEAKMAN®

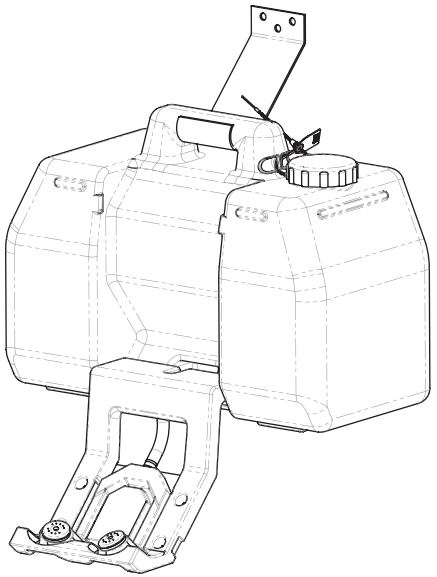
400 ANCHOR MILL ROAD | NEW CASTLE, DE 19720
P: 800-537-2107 | F: 800-977-2747
WWW.SPEAKMANCOMPANY.COM

REVISION DATE: JANUARY 2014

Management Systems
Registered to ISO 9001

INSTRUCTIONS FOR MODELS

SE-4400 GRAVITYFLO® Portable Eyewash



NEED HELP?

For additional assistance or service please contact:

SPEAKMAN® Company
400 Anchor Mill Road
New Castle, DE 19720

800-537-2107

customerservice@speakmancompany.com

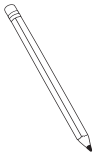
www.speakmancompany.com

92-SE-4400-R1

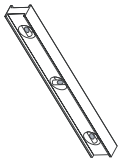
TOOLS AND SUPPLIES

REQUIRED

Pencil



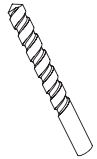
Level



Measuring Tape

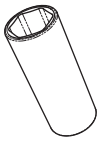
Drill

Drill Bit



Socket Wrench

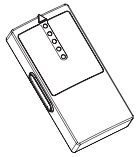
Deep Well Socket



HELPFUL

Safety Glasses

Stud Finder



⚠ IMPORTANT ⚠

ANSI Z358.1 requires that all self-contained eyewash units shall be visually inspected weekly, unless the product is placed in environments with extreme conditions that may affect the form, fit, or function of the unit (temperature, dirt, etc.). If this is the case, then the inspection should be conducted more often as the end user deems necessary. Speakman Company furnishes a testing record tag (91-0635) with each unit. On this tag, the date of inspection and the inspectors' initials should be noted. ANSI Z358.1 specifies that the height of the spray heads is to be between 33"-45" from the floor. The SE-4400 weighs approximately 100 lbs when filled. Ensure the mounting surface and mounting hardware (not supplied) can safely hold a minimum vertical load of 150 lbs. Be sure to read instructions thoroughly before beginning installation. Do not overtighten any connections or damage may occur. The unit should be full at all times, to achieve the minimum 15 minute run time as stated by ANSI, in case of an emergency. Refill the tank to full level after each activation.

SAFETY TIPS

Be sure to always wear proper eye protection. Wear proper skin protect on when cleaning and disinfecting unit.

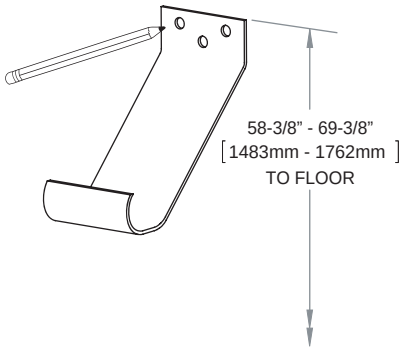
MAINTENANCE

Occasional cleaning and disinfection is recommended. To clean the inside of unit, add 1/4 cup (2 fluid oz.) of Clorox Liquid Bleach to a full tank of potable water. Allow the mixture to penetrate for 15 minutes. Drain tank, and rinse thoroughly several times with potable water. For further information about Clorox Liquid Bleach, call toll-free at 1-800-292-2200. Follow refilling instructions in this manual and place tank back in service. Should any repair part be required, use only genuine SPEAKMAN parts for repair or replacement. See available replacement parts on the final page of this manual. To order replacement parts, please call toll-free at 1-800-537-2107

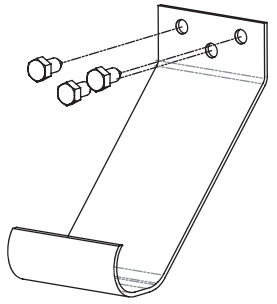
WARRANTY

Additional warranty information can be found at: www.speakmancompany.com

1 Select a suitable mounting location for the SE-4400 capable of supporting 150 lbs. The location should protect the unit from freezing and potential scalding conditions. Place mounting bracket on surface so the top of the mounting bracket is located between 58 3/8"-69 3/8" from the floor. Making sure the bracket is level, mark the mounting locations onto the structure.

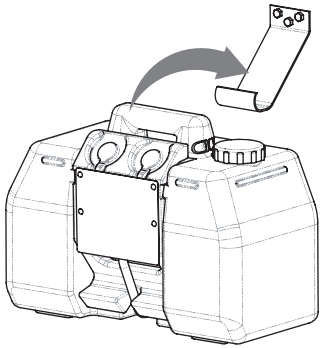


2 Drill necessary holes into mounting surface and secure Mounting Bracket to surface using appropriate hardware, being sure to torque to manufacturer's specifications.

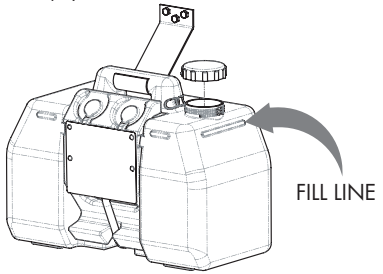


NOTE: Mounting hardware not included. Ensure the mounting surface (wall, etc.) and mounting hardware can safely hold a minimum vertical load of 150 lbs.

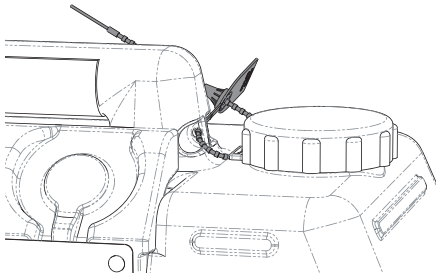
3 Install empty tank onto Mounting Bracket (if wall mounting) or table top surface.



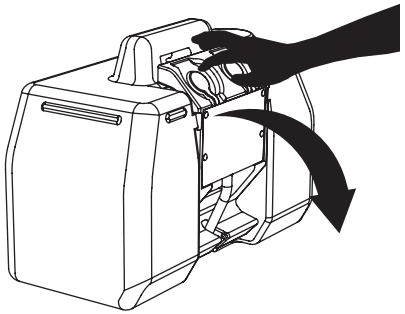
4 Remove Fill Cap and fill tank to line with potable water (approximately 9 gallons). Failure to use potable water can result in emergency units producing impure or contaminated water, possible causing further injury.

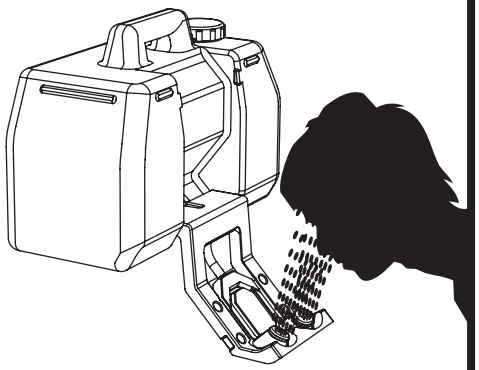


5 Reinstall Fill Cap and secure it with the tamper-evident Seal Tie. Secure the included Maintenance Tag to the tank in a location where it can be easily checked.



6 To activate the flow of water, rotate activation tray downward.



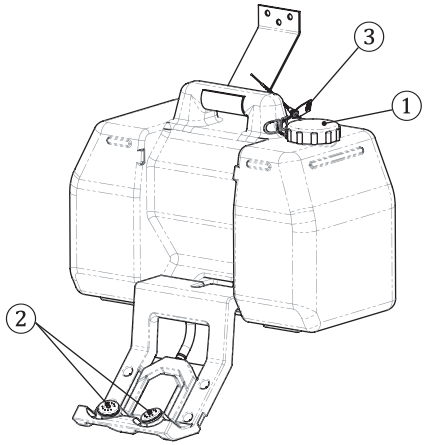


FLOW DATA

Run Time (Full Tank): 15 minutes (minimum)

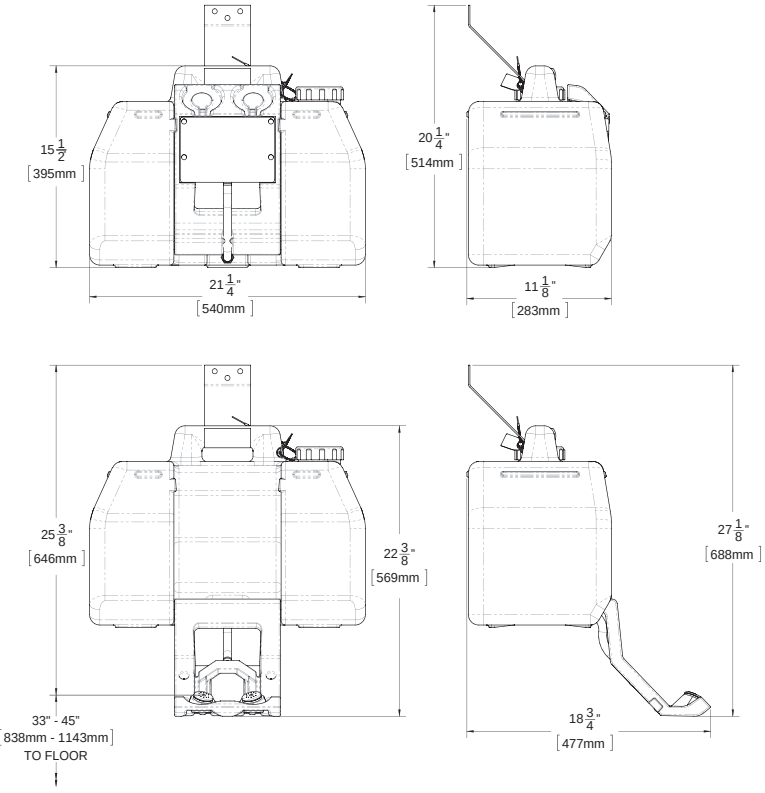
Flow Rate: .4 gpm (1.5 L/min) (minimum)

REPAIR PART GROUPS



1	RPG07-0021	QTY: 1
2	RPG38-0434	QTY: 2
3	RPG05-0935	QTY: 6

ROUGH IN DIMENSIONS



APPENDIX G

System Tracking Sheets

Review Avenue - System Tracking Sheet

Date: **Time:** **Operator:** **TF System Status (ON/OFF)**

Task/reason for visit: **Skimmer System Status (ON/OFF)**

Alarms (if any): **SVE System Status (ON/OFF)**

Pre-Separation Tank (T-701)

Influent Flow Rate (FIT-701):	GPM
Vaport Vent Rate (FI-701):	SCFH
Vapor Vent Vacuum (VI-701):	w.c.
Product Thickness:	ft/in
Influent Oil/Water Ratio:	
Conductivity Sensor Tested?	

Oil Water Separator (OWS-701)

Vaport Vent Rate (FI-702):	SCFH
Vaport Vent Rate (FI-703):	SCFH
Vapor Vent Vacuum (VI-702):	w.c.
Vapor Vent Vacuum (VI-703):	w.c.

Visual Comments/Observations:

T-701 Rotary Skimmer Operation/Adjustments:

OWS Rotary Skimmer Operation/Adjustments:

OWS Belt Skimmer Operation/Adjustments:

Cleanliness in Tank / Quality of Effluent / Other:

LNAPL Product Storage Tanks

From Skimmer Pumps (T-1401)		From Oil/Water Separator (T-802)	
Total Flow (Local - FQ-1401):	gal	Total Flow (Local - FQ-801):	gal
Total Flow (Remote - FIT-1401):	gal	Total Flow (Remote - FIT-801):	gal
Tank Level - Stick Reading:	ft/in	Tank Level - Stick Reading:	ft/in
Tank Level - Gauge (LI-1401):	ft/in	Tank Level - Gauge (LI-801):	ft/in
Time of First Reading:		Time of First Reading:	
Tank Level - Gauge (LI-1401):	ft/in	Tank Level - Gauge (LI-801):	ft/in
Time of Second Reading:		Time of Second Reading:	
Inches H2O in Tank:	in	Inches H2O in Tank:	in
Inches H2O Pumped (if necessary):	in	Inches H2O Pumped (if necessary):	in
		Bypass Valve Open/Closed?:	
		Transfer Pump Pressure (PI-801):	psi

Bag Filters

Transfer Pump Pressure (PI-901):	psi
Differential Pressure (PI-1101 - PI-901):	psi
Bags Changed (Y/N)?	

Liquid Phase Carbon Treatment

LGAC-1101 Inlet Pressure (PI-1101):	psi
LGAC-1102 Inlet Pressure (PI-1102):	psi
Differential Pressure (PI-1102 - PI-1101):	gal
Effluent Total (Local: FQ-1201):	gal
Effluent Total (Remote: FIT-1201):	gal

Review Avenue - System Tracking Sheet

Date: Operator:

Chemical Feed: Biocide

Drum Level (T-710):
Pump Stroke Length (P-710): %
Pump Stroke Rate (P-710): strokes/min

Chemical Feed: Emulsification Breaker

Drum Level (T-711):
Pump Stroke Length (P-711): %
Pump Stroke Rate (P-711): strokes/min

Power

Power Consumption (Local): kWh
Time Recorded:
Power Consumption (Remote): kWh
Time Recorded:

Air Compressor

System Pressure: psi
Temperature: ºF
Operating Hours: hrs
Post-filter Pressure (PI-1502): psi
Regulator Pressure (PRV-1501): psi
Condensate Bucket Drained (Yes / No):

Air Supply Manifold

	Air Pressure (psi)
PI-601:	
PI-602:	
PI-603:	
PI-604:	
PI-605:	
PI-606:	
PI-607:	
PI-1401:	

SVE Manifold

	Zone		Flow (wc)		Vacuum (wc)
PI-601:	On / Off	FI 101:		VI 101:	
PI-602:	On / Off	FI 102:		VI 102:	
PI-603:	On / Off	FI 103:		VI 103:	
PI-604:	On / Off	FI 104:		VI 104:	
PI-605:	On / Off	FI 105:		VI 105:	
PI-606:	On / Off	FI 106:		VI 106:	
PI-607:	On / Off	FI 107:		VI 107:	

Moisture Separator (T-201)

Pre-tank Vacuum (VI-201): wc
Post-tank Temp. (TI-201): ºF
Post-tank Flow (FIT-201): wc
Post-tank Vacuum (VIT-201): wc
P-201 Discharge Pressure (PI-201): psi

SVE Blower (B-301)

Pre-filter Vacuum (VI-301): wc
Post-filter Vacuum (VI-302): wc
Outlet Temperature (TI-301): ºF
Outlet Pressure (PI-301): wc
Outlet Flow (FI-301): wc

Heat Exchange (HX-401)

Temperature Out (TI-401): ºF
Pressure (PI-401): wc

Vapor Phase Carbon Treatment

VGAC-501 Inlet Pressure (PI-501): wc
VGAC-502 Inlet Pressure (PI-502): wc
VC-501 Inlet Pressure (PI-503): wc

Summary of Daily Site Activities:

Review Avenue - Timer Tracking Sheet

Date: Operator:

Total Fluids & Skimmer Timer Schedules

TF Zone 1	TF Zone 2	TF Zone 3	TF Zone 4
MOV-101 On:	MOV-102 On:	MOV-103 On:	MOV-104 On:
MOV-101 Off:	MOV-102 Off:	MOV-103 Off:	MOV-104 Off:
SV-601 On:	SV-602 On:	SV-603 On:	SV-604 On:
SV-601 On:	SV-602 On:	SV-603 On:	SV-604 On:
Changes?	Changes?	Changes?	Changes?
Wells Running:	Wells Running:	Wells Running:	Wells Running:

TF Zone 5	TF Zone 6	TF Zone 7	Skimmers
MOV-105 On:	MOV-105 On:	MOV-105 On:	Timer On:
MOV-105 Off:	MOV-105 Off:	MOV-105 Off:	Timer Off:
SV-605 On:	SV-605 On:	SV-605 On:	
SV-605 On:	SV-605 On:	SV-605 On:	
Changes?	Changes?	Changes?	Changes?
Wells Running:	Wells Running:	Wells Running:	Wells Running:

Biocide Timer Schedule

Injection Time:	Timer 1 On/Off:	Timer 2 On/Off:	Timer 3 On/Off:
Resets Manually:	Timer 1 On Time:	Timer 2 On Time:	Timer 3 On Time:
Changes?	Changes?	Changes?	Changes?

Other Comments:

Review Avenue - Bi-Weekly System Tracking Sheet

Date: **Operator:**

VER (Total Fluids) Well Heads

On / Off?					Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
	TF-1A	**TF-1B**	**TF-1C**	**TF-1D**	
	PI-TF-1A-H				
	PI-TF-1A-L	PI-TF-1B-L	PI-TF-1C-L	PI-TF-1D-L	
	PI-TF-1A-D	PI-TF-1B-D	PI-TF-1C-D	PI-TF-1D-D	
	VI-TF-1A-C	VI-TF-1B-C	VI-TF-1C-C	VI-TF-1D-C	
On / Off?	**TF-2A**	**TF-2B**	**TF-2C**	**TF-2D**	**Comments (clean pump, leaks, adjust pressure, vault condition, etc.):**
	PI-TF-2A-H				
	PI-TF-2A-L	PI-TF-2B-L	PI-TF-2C-L	PI-TF-2D-L	
	PI-TF-2A-D	PI-TF-2B-D	PI-TF-2C-D	PI-TF-2D-D	
	VI-TF-2A-C	VI-TF-2B-C	VI-TF-2C-C	VI-TF-2D-C	
On / Off?	**TF-3A**	**TF-3B**	**TF-3C**	**TF-3D**	**Comments (clean pump, leaks, adjust pressure, vault condition, etc.):**
	PI-TF-3A-H				
	PI-TF-3A-L	PI-TF-3B-L	PI-TF-3C-L	PI-TF-3D-L	
	PI-TF-3A-D	PI-TF-3B-D	PI-TF-3C-D	PI-TF-3D-D	
	VI-TF-3A-C	VI-TF-3B-C	VI-TF-3C-C	VI-TF-3D-C	
On / Off?	**TF-4A**	**TF-4B**	**TF-4C**	**TF-4D**	**Comments (clean pump, leaks, adjust pressure, vault condition, etc.):**
	PI-TF-4A-H				
	PI-TF-4A-L	PI-TF-4B-L	PI-TF-4C-L	PI-TF-4D-L	
	PI-TF-4A-D	PI-TF-4B-D	PI-TF-4C-D	PI-TF-4D-D	
	VI-TF-4A-C	VI-TF-4B-C	VI-TF-4C-C	VI-TF-4D-C	
On / Off?	**TF-5A**	**TF-5B**	**TF-5C**	**TF-5D**	**Comments (clean pump, leaks, adjust pressure, vault condition, etc.):**
	PI-TF-5A-H				
	PI-TF-5A-L	PI-TF-5B-L	PI-TF-5C-L	PI-TF-5D-L	
	PI-TF-5A-D	PI-TF-5B-D	PI-TF-5C-D	PI-TF-5D-D	
	VI-TF-5A-C	VI-TF-5B-C	VI-TF-5C-C	VI-TF-5D-C	
On / Off?	**TF-6A**	**TF-6B**	**TF-6C**	**TF-6D**	**Comments (clean pump, leaks, adjust pressure, vault condition, etc.):**
	PI-TF-6A-H				
	PI-TF-6A-L	PI-TF-6B-L	PI-TF-6C-L	PI-TF-6D-L	
	PI-TF-6A-D	PI-TF-6B-D	PI-TF-6C-D	PI-TF-6D-D	
	VI-TF-6A-C	VI-TF-6B-C	VI-TF-6C-C	VI-TF-6D-C	
On / Off?	**TF-7A**	**TF-7B**	**TF-7C**	**TF-7D**	**Comments (clean pump, leaks, adjust pressure, vault condition, etc.):**
	PI-TF-7A-H				
	PI-TF-7A-L	PI-TF-7B-L	PI-TF-7C-L	PI-TF-7D-L	
	PI-TF-7A-D	PI-TF-7B-D	PI-TF-7C-D	PI-TF-7D-D	
	VI-TF-7A-C	VI-TF-7B-C	VI-TF-7C-C	VI-TF-7D-C	
	TF-7E	**TF-7F**			
	PI-TF-7E-H				
	PI-TF-7E-L	PI-TF-7F-L			
	PI-TF-7E-D	PI-TF-7F-D			
	VI-TF-7E-C	VI-TF-7F-C			

Other Comments:

Notes:

PI-TF-XX-H = Compressed Air Pressure (High) - only applies to regulator at first well of each leg (i.e. TF-1A, TF-2A, TF-3A, etc.)
PI-TF-XX-L = Compressed Air Pressure (Low)
PI-TF-XX-D = Pump Discharge Pressure
VI-TF-XX-C = Casing Vacuum Pressure

Review Avenue - Bi-Weekly System Tracking Sheet

Date: **Operator:**

Skimmer Well Heads

S-1A	S-1B	S-1C	S-1D	S-1E	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-1A-H					
PI-S-1A-L	PI-S-1B-L	PI-S-1C-L	PI-S-1D-L	PI-S-1E-L	
PI-S-1A-D	PI-S-1B-D	PI-S-1C-D	PI-S-1D-D	PI-S-1E-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-2A	S-2B	S-2C	S-2D	S-2E	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-2A-H					
PI-S-2A-L	PI-S-2B-L	PI-S-2C-L	PI-S-2D-L	PI-S-2E-L	
PI-S-2A-D	PI-S-2B-D	PI-S-2C-D	PI-S-2D-D	PI-S-2E-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-3A	S-3B	S-3C	S-3D	S-3E	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-3A-H					
PI-S-3A-L	PI-S-3B-L	PI-S-3C-L	PI-S-3D-L	PI-S-3E-L	
PI-S-3A-D	PI-S-3B-D	PI-S-3C-D	PI-S-3D-D	PI-S-3E-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-4A	S-4B	S-4C	S-4D	S-4E	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-4A-H					
PI-S-4A-L	PI-S-4B-L	PI-S-4C-L	PI-S-4D-L	PI-S-4E-L	
PI-S-4A-D	PI-S-4B-D	PI-S-4C-D	PI-S-4D-D	PI-S-4E-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-5A	S-5B	S-5C	S-5D	S-5E	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-5A-H					
PI-S-5A-L	PI-S-5B-L	PI-S-5C-L	PI-S-5D-L	PI-S-5E-L	
PI-S-5A-D	PI-S-5B-D	PI-S-5C-D	PI-S-5D-D	PI-S-5E-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-6A	S-6B	S-6C	S-6D	S-6E	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-6A-H					
PI-S-6A-L	PI-S-6B-L	PI-S-6C-L	PI-S-6D-L	PI-S-6E-L	
PI-S-6A-D	PI-S-6B-D	PI-S-6C-D	PI-S-6D-D	PI-S-6E-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-7A	S-7B	S-7C	S-7D	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-7A-H				
PI-S-7A-L	PI-S-7B-L	PI-S-7C-L	PI-S-7D-L	
PI-S-7A-D	PI-S-7B-D	PI-S-7C-D	PI-S-7D-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

S-8A	S-8B	S-8C	S-8D	Comments (clean pump, leaks, adjust pressure, vault condition, etc.):
PI-S-8A-H				
PI-S-8A-L	PI-S-8B-L	PI-S-8C-L	PI-S-8D-L	
PI-S-8A-D	PI-S-8B-D	PI-S-8C-D	PI-S-8D-D	
Cycle Rate	Cycle Rate	Cycle Rate	Cycle Rate	
Cycle Freq.	Cycle Freq.	Cycle Freq.	Cycle Freq.	

Other Comments:

Notes:

PI-S-XX-H = Compressed Air Pressure (High) - only applies to regulator at first well of each leg (i.e. S-1A, S-2A, S-3A, etc.)
PI-S-XX-L = Compressed Air Pressure (Low)
PI-S-XX-D = Pump Discharge Pressure

Review Avenue - Monthly System Tracking Sheet

Date: **Operator:**

VER (Total Fluids) Well Heads - Jar Test: Water/Product Observations from Sample Ports

On / Off?					Comments/Adjustments:
	TF-1A	**TF-1B**	**TF-1C**	**TF-1D**	
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
On / Off?	**TF-2A**	**TF-2B**	**TF-2C**	**TF-2D**	**Comments/Adjustments:**
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
On / Off?	**TF-3A**	**TF-3B**	**TF-3C**	**TF-3D**	**Comments/Adjustments:**
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
On / Off?	**TF-4A**	**TF-4B**	**TF-4C**	**TF-4D**	**Comments/Adjustments:**
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
On / Off?	**TF-5A**	**TF-5B**	**TF-5C**	**TF-5D**	**Comments/Adjustments:**
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
On / Off?	**TF-6A**	**TF-6B**	**TF-6C**	**TF-6D**	**Comments/Adjustments:**
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
On / Off?	**TF-7A**	**TF-7B**	**TF-7C**	**TF-7D**	**Comments/Adjustments:**
	Total _____	Total _____	Total _____	Total _____	
	In. Water _____	In. Water _____	In. Water _____	In. Water _____	
	In. Product _____	In. Product _____	In. Product _____	In. Product _____	
	TF-7E	**TF-7F**			
	Total _____	Total _____			
	In. Water _____	In. Water _____			
	In. Product _____	In. Product _____			

Other Comments:

Review Avenue - Monthly System Tracking Sheet

Date: **Operator:**

Skimmer Well Heads - Jar Test: Observations from Sample Ports

S-1A Water Observed? Yes No	**S-1B** Water Observed? Yes No	**S-1C** Water Observed? Yes No	**S-1D** Water Observed? Yes No	**S-1E** Water Observed? Yes No	**Comments/Adjustments:**
S-2A Water Observed? Yes No	**S-2B** Water Observed? Yes No	**S-2C** Water Observed? Yes No	**S-2D** Water Observed? Yes No	**S-2E** Water Observed? Yes No	**Comments/Adjustments:**
S-3A Water Observed? Yes No	**S-3B** Water Observed? Yes No	**S-3C** Water Observed? Yes No	**S-3D** Water Observed? Yes No	**S-3E** Water Observed? Yes No	**Comments/Adjustments:**
S-4A Water Observed? Yes No	**S-4B** Water Observed? Yes No	**S-4C** Water Observed? Yes No	**S-4D** Water Observed? Yes No	**S-4E** Water Observed? Yes No	**Comments/Adjustments:**
S-5A Water Observed? Yes No	**S-5B** Water Observed? Yes No	**S-5C** Water Observed? Yes No	**S-5D** Water Observed? Yes No	**S-5E** Water Observed? Yes No	**Comments/Adjustments:**
S-6A Water Observed? Yes No	**S-6B** Water Observed? Yes No	**S-6C** Water Observed? Yes No	**S-6D** Water Observed? Yes No	**S-6E** Water Observed? Yes No	**Comments/Adjustments:**
S-7A Water Observed? Yes No	**S-7B** Water Observed? Yes No	**S-7C** Water Observed? Yes No	**S-7D** Water Observed? Yes No	**Comments/Adjustments:**	
S-8A Water Observed? Yes No	**S-8B** Water Observed? Yes No	**S-8C** Water Observed? Yes No	**S-8D** Water Observed? Yes No	**Comments/Adjustments:**	

Other Comments:

Review Avenue - Sampling Tracking Sheet

Date: **Operator:**

Vapor Phase Compliance Sampling

Location	Sample Port	PID Reading	Sample ID	Date / Time
SVE Manifold	SP-101			
SVE Manifold	SP-102			
SVE Manifold	SP-103			
SVE Manifold	SP-104			
SVE Manifold	SP-105			
SVE Manifold	SP-106			
SVE Manifold	SP-107			
Pre-Moisture Separator	SP-201			
Pre-SVE Blower	SP-301			
Post-SVE Blower	SP-302			
Pre-VGAC-501	SP-501			
Pre-VGAC-502	SP-502			
Pre-KMnO4 (VC-501)	SP-503			
Effluent	SP-504			

Liquid Phase Compliance Sampling

Location	Sample Port	Sample ID	Date / Time
Influent (Pre-LGAC-1101)	SP-1101		
Midfluent (Pre-LGAC-1102)	SP-1102		
Effluent	SP-1201		

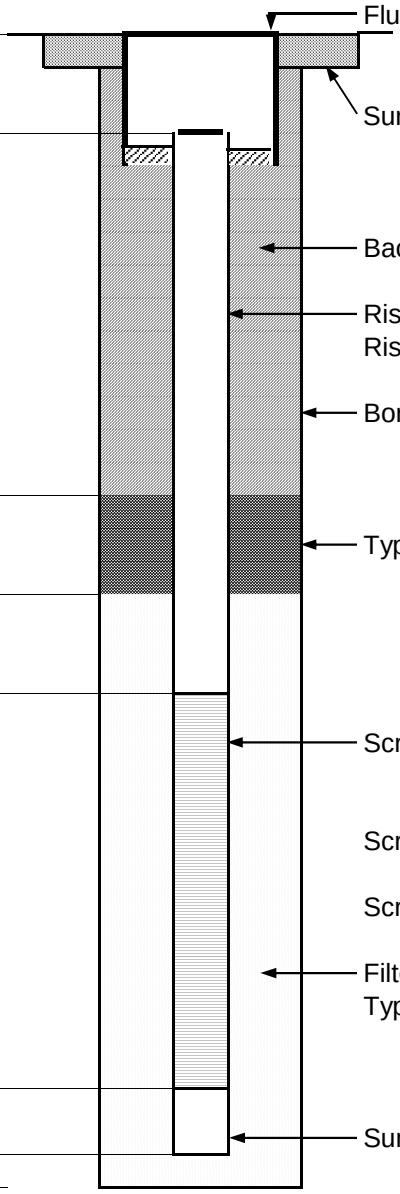
Comments

APPENDIX H

Well Construction Logs

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-1A	
Client:	de maximis, inc.	**Date:**	12/19/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 22.32

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.09	23.41
Riser Pipe	0	22.32
Top of Seal	10.80	11.52
Top of Filter Pack	11.80	10.52
Top of Screen	13.80	8.52
Base of Screen	28.80	-6.48
End Cap	29.80	-7.48
Total Depth	29.80	-7.48

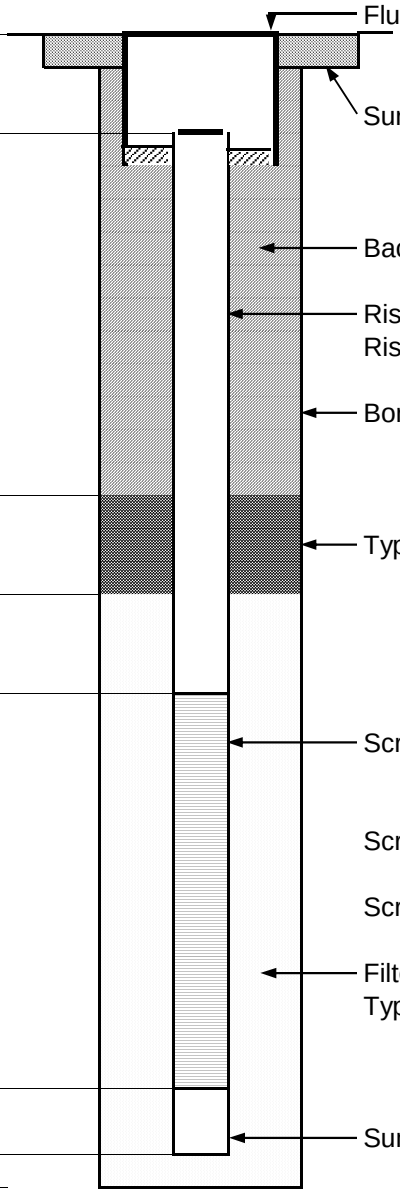


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-1B	
Client:	de maximis, inc.	**Date:**	12/3/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 24.25

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	25.25
Riser Pipe	0	24.25
Top of Seal	8.48	15.77
Top of Filter Pack	9.48	14.77
Top of Screen	11.48	12.77
Base of Screen	31.48	-7.23
End Cap	32.48	-8.23
Total Depth	32.48	-8.23

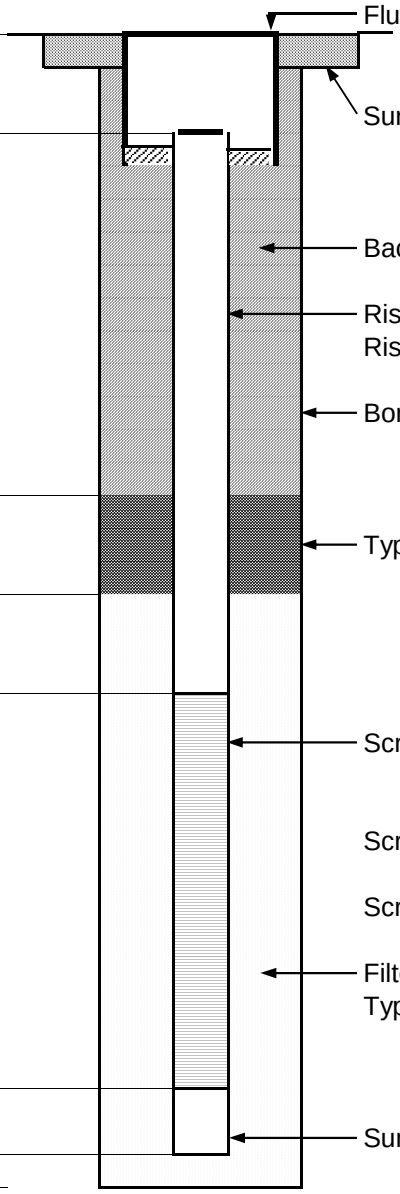


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	20 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-1C	
Client:	de maximis, inc.	**Date:**	12/19/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.02

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	24.02
Riser Pipe	0	23.02
Top of Seal	12.26	10.76
Top of Filter Pack	13.26	9.76
Top of Screen	15.26	7.76
Base of Screen	30.26	-7.24
End Cap	31.26	-8.24
Total Depth	31.26	-8.24

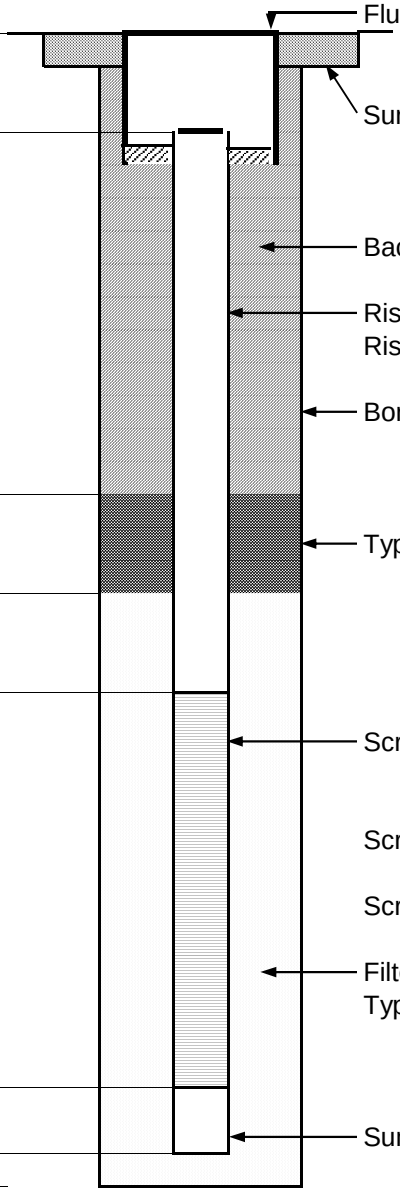


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-1D	
Client:	de maximis, inc.	**Date:**	12/4/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 21.23

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.99	22.22
Riser Pipe	0	21.23
Top of Seal	8.90	12.33
Top of Filter Pack	9.90	11.33
Top of Screen	11.90	9.33
Base of Screen	26.90	-5.67
End Cap	27.90	-6.67
Total Depth	27.90	-6.67

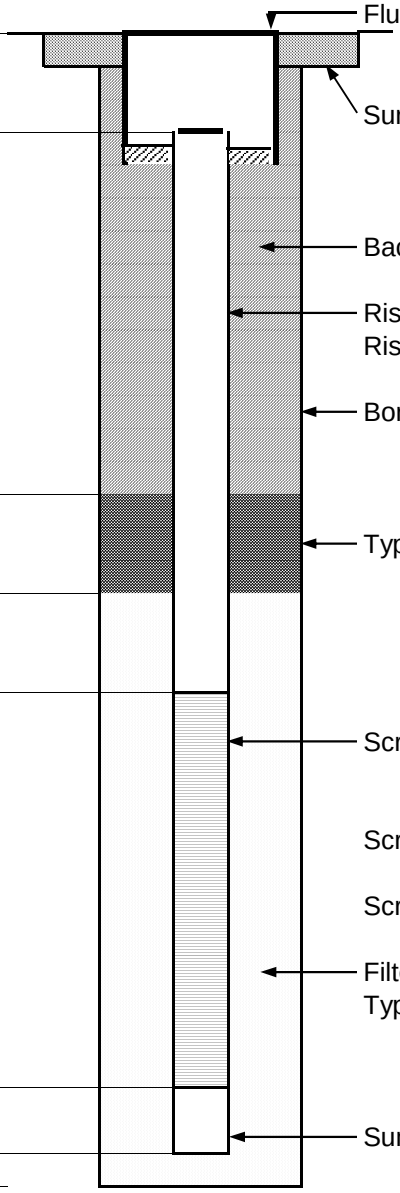


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-2A	
Client:	de maximis, inc.	**Date:**	12/5/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 20.42

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.27	21.69
Riser Pipe	0	20.42
Top of Seal	8.60	11.82
Top of Filter Pack	9.60	10.82
Top of Screen	11.60	8.82
Base of Screen	26.60	-6.18
End Cap	27.60	-7.18
Total Depth	27.60	-7.18

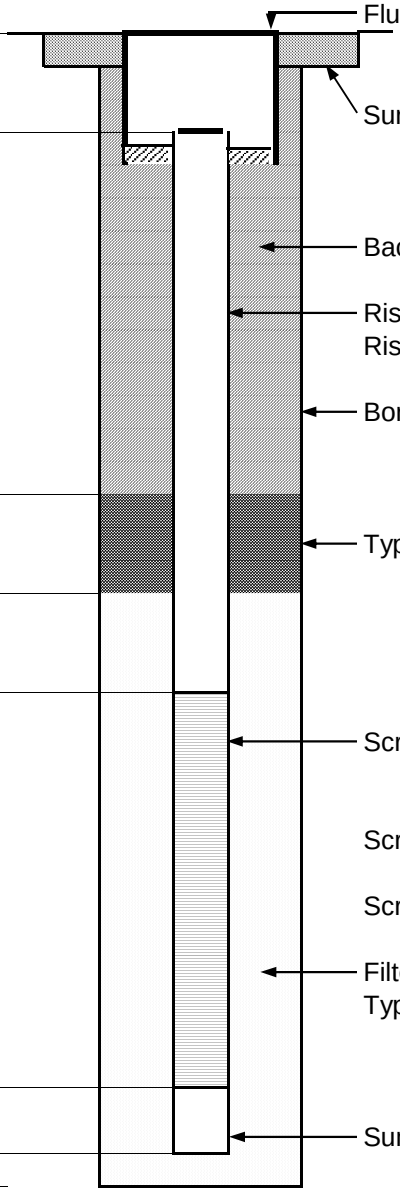


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-2B	
Client:	de maximis, inc.	**Date:**	12/3/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 22.67

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	23.67
Riser Pipe	0	22.67
Top of Seal	-1.40	24.07
Top of Filter Pack	-0.40	23.07
Top of Screen	1.60	21.07
Base of Screen	21.60	1.07
End Cap	22.60	0.07
Total Depth	22.60	0.07

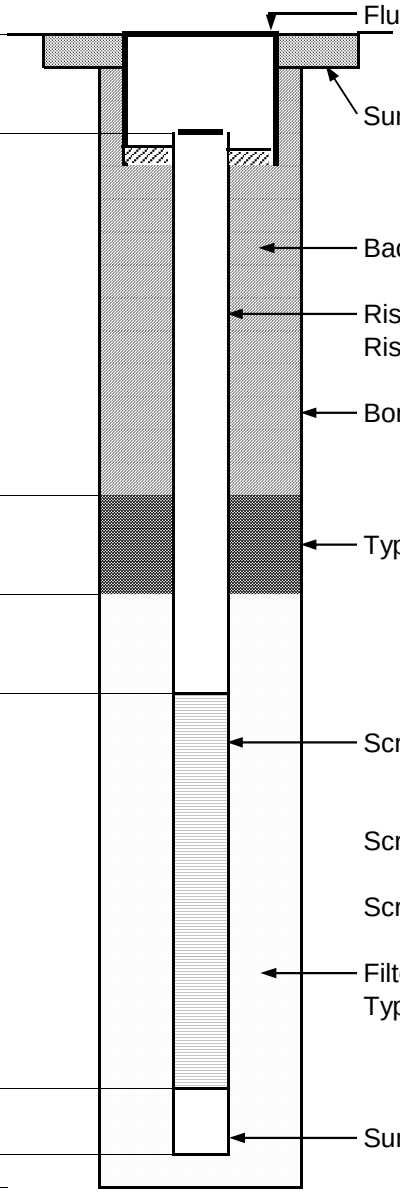


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	20 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-2C	
Client:	de maximis, inc.	**Date:**	12/1/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 22.65

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.17	23.82
Riser Pipe	0	22.65
Top of Seal	13.15	9.50
Top of Filter Pack	14.15	8.50
Top of Screen	16.15	6.50
Base of Screen	31.15	-8.50
End Cap	32.15	-9.50
Total Depth	32.15	-9.50

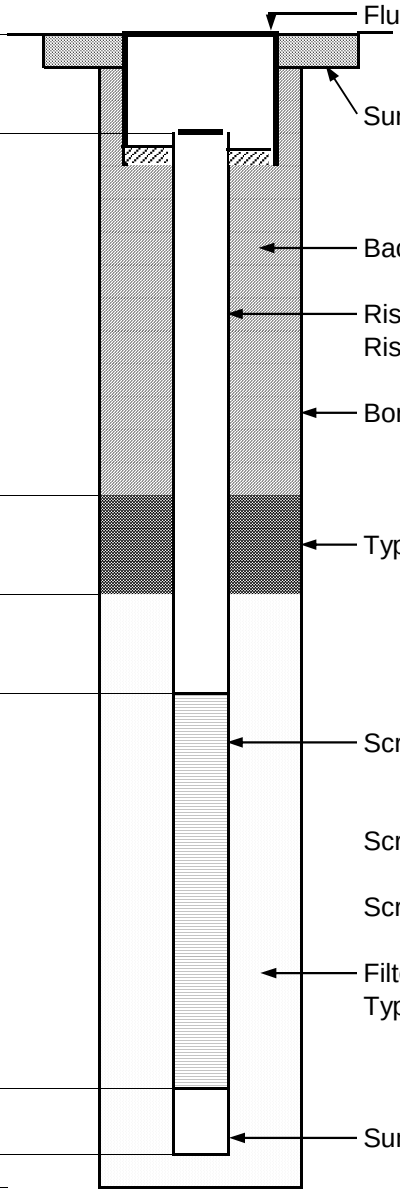


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-2D	
Client:	de maximis, inc.	**Date:**	12/5/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.72

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.46	21.18
Riser Pipe	0	19.72
Top of Seal	8.70	11.02
Top of Filter Pack	9.70	10.02
Top of Screen	11.70	8.02
Base of Screen	26.70	-6.98
End Cap	27.70	-7.98
Total Depth	27.70	-7.98

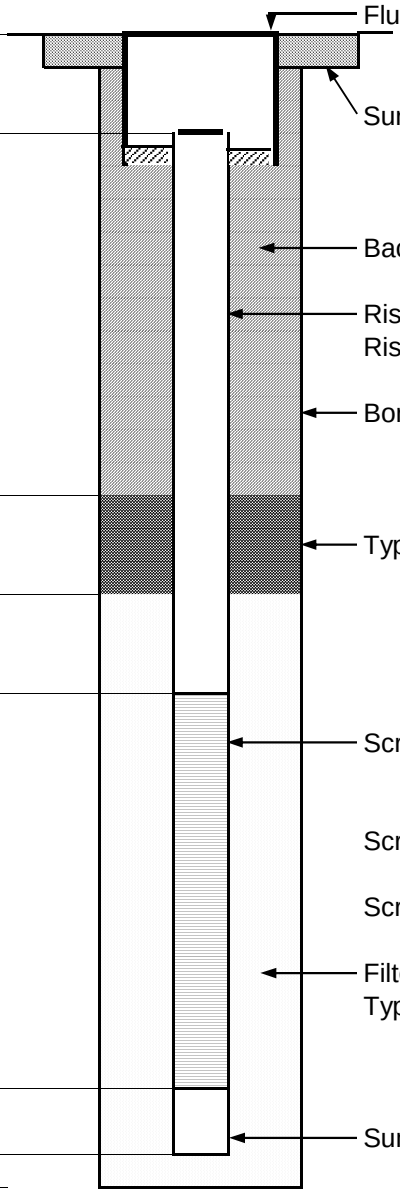


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-3A	
Client:	de maximis, inc.	**Date:**	12/1/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.99

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.81	19.80
Riser Pipe	0	17.99
Top of Seal	8.00	9.99
Top of Filter Pack	9.00	8.99
Top of Screen	11.00	6.99
Base of Screen	26.00	-8.01
End Cap	27.00	-9.01
Total Depth	27.00	-9.01

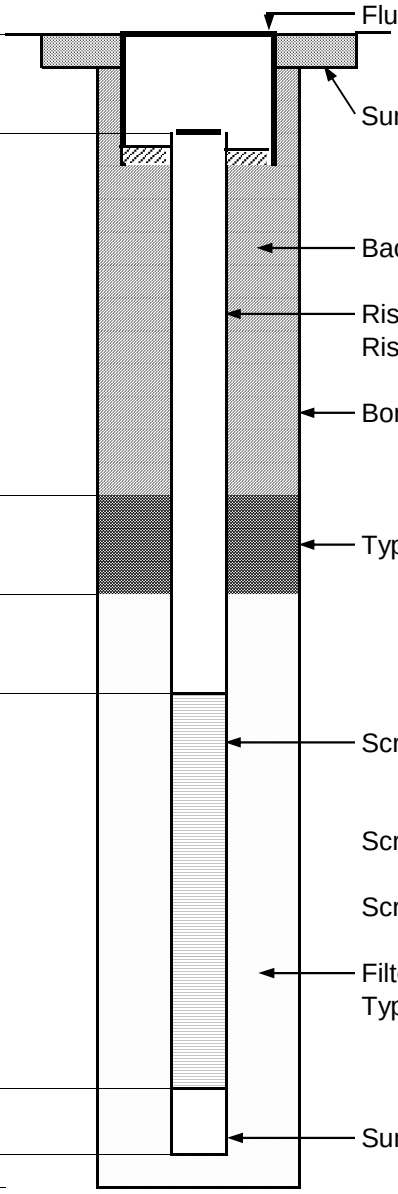


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-3B	
Client:	de maximis, inc.	**Date:**	12/15/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.86

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	20.86
Riser Pipe	0	19.86
Top of Seal	6.43	13.43
Top of Filter Pack	7.43	12.43
Top of Screen	9.43	10.43
Base of Screen	24.43	-4.57
End Cap	25.43	-5.57
Total Depth	25.43	-5.57

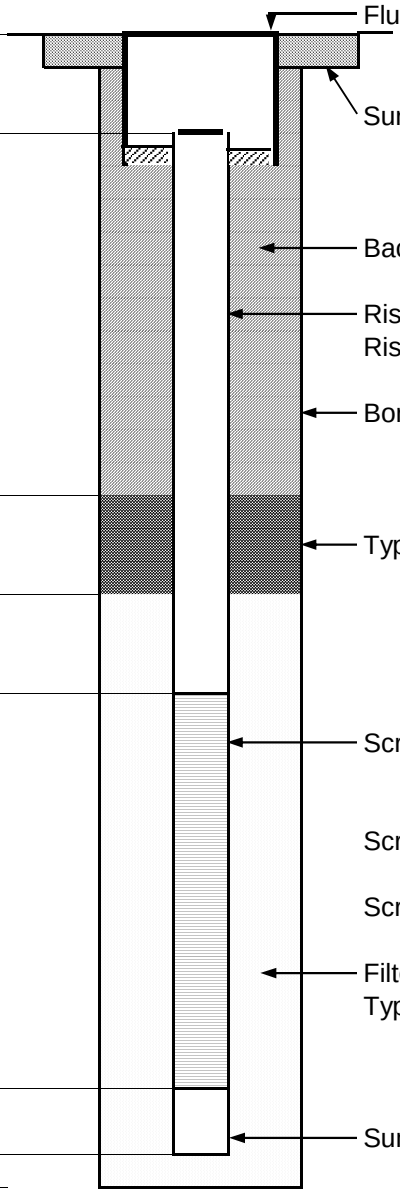


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-3C	
Client:	de maximis, inc.	**Date:**	12/1/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.84

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	20.84
Riser Pipe	0	19.84
Top of Seal	8.80	11.04
Top of Filter Pack	9.80	10.04
Top of Screen	11.80	8.04
Base of Screen	26.80	-6.96
End Cap	27.80	-7.96
Total Depth	27.80	-7.96

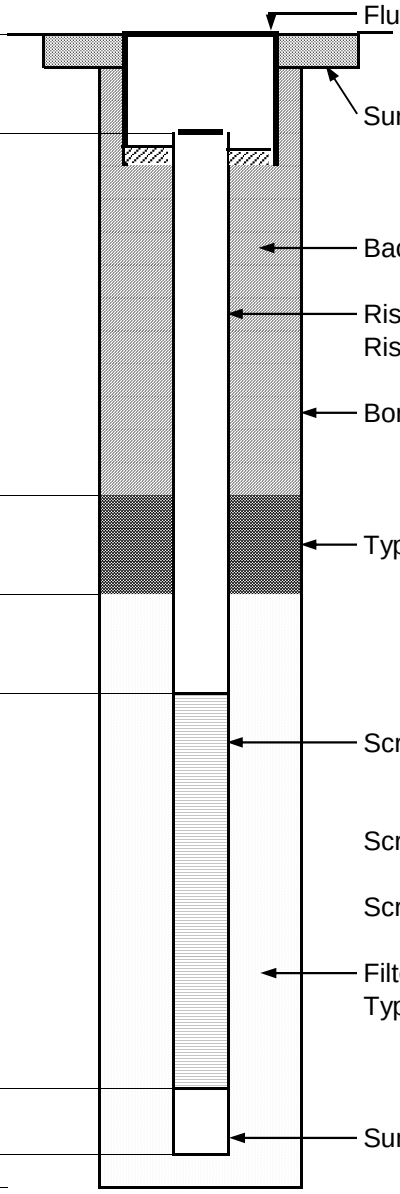


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-3D	
Client:	de maximis, inc.	**Date:**	12/5/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.67

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.86	20.53
Riser Pipe	0	19.67
Top of Seal	8.20	11.47
Top of Filter Pack	9.20	10.47
Top of Screen	11.20	8.47
Base of Screen	26.20	-6.53
End Cap	27.20	-7.53
Total Depth	27.20	-7.53

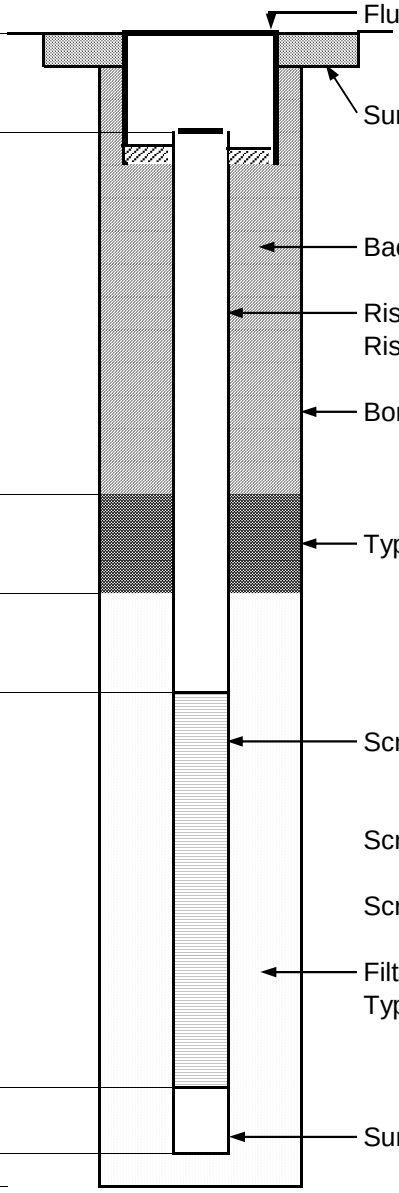


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure			FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**	
Project No:	3480140433	TF-4A	
Client:	de maximis, inc.	**Date:** 11/25/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger		**Measuring Point**
Development Method:	Surging		**Type:** Top Of Riser
Bucking Posts:	N/A		**Elevation (ft):** 17.09

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	18.09
Riser Pipe	0	17.09
Top of Seal	5.49	11.60
Top of Filter Pack	6.49	10.60
Top of Screen	8.49	8.60
Base of Screen	23.49	-6.40
End Cap	24.49	-7.40
Total Depth	24.49	-7.40

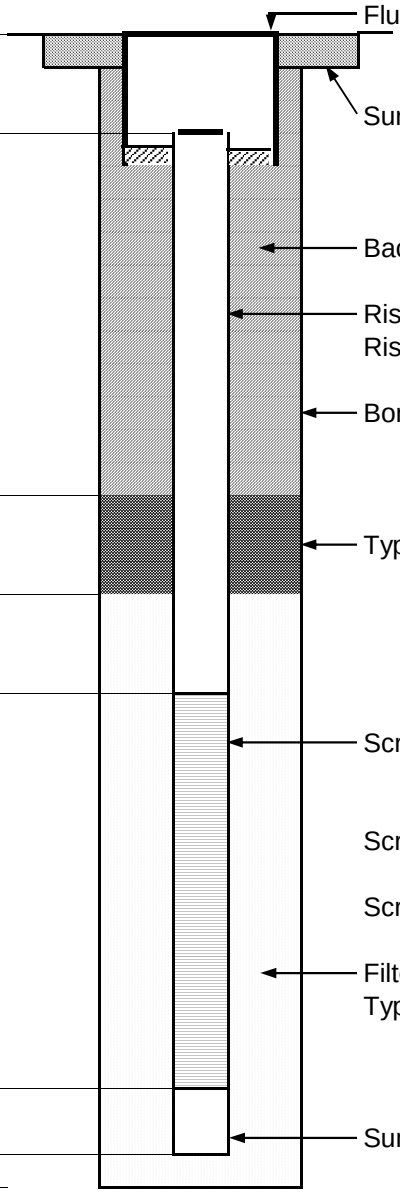


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-4B	
Client:	de maximis, inc.	**Date:**	12/19/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.41

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.04	18.45
Riser Pipe	0	17.41
Top of Seal	7.00	10.41
Top of Filter Pack	8.00	9.41
Top of Screen	10.00	7.41
Base of Screen	25.00	-7.59
End Cap	26.00	-8.59
Total Depth	26.00	-8.59

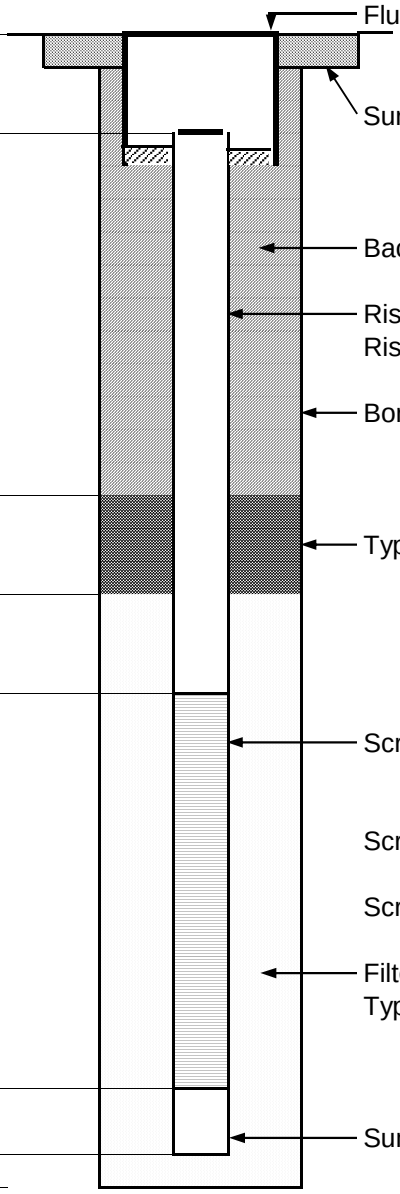


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-4C	
Client:	de maximis, inc.	**Date:**	12/1/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.48

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.91	18.39
Riser Pipe	0	17.48
Top of Seal	6.70	10.78
Top of Filter Pack	7.70	9.78
Top of Screen	9.70	7.78
Base of Screen	24.70	-7.22
End Cap	25.70	-8.22
Total Depth	25.70	-8.22

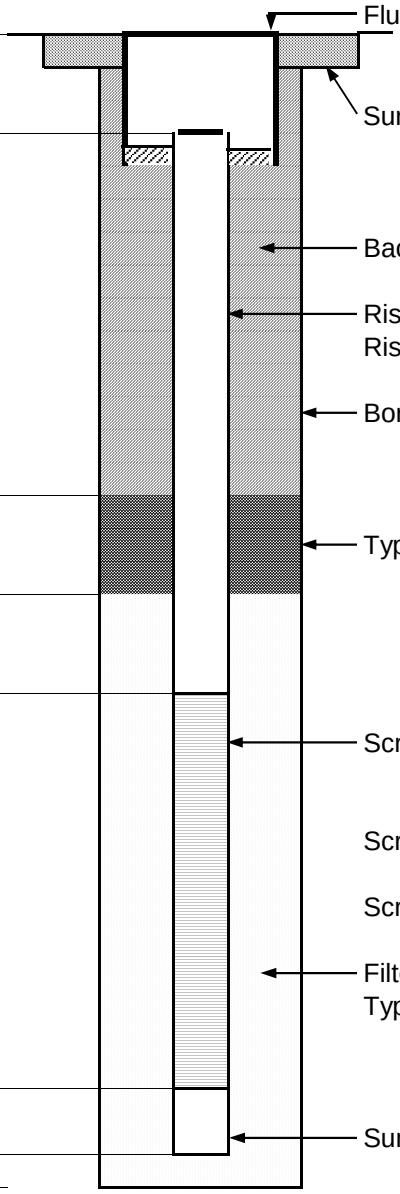


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-4D	
Client:	de maximis, inc.	**Date:**	11/24/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.32

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.01	18.33
Riser Pipe	0	17.32
Top of Seal	9.10	8.22
Top of Filter Pack	10.10	7.22
Top of Screen	12.10	5.22
Base of Screen	27.10	-9.78
End Cap	28.10	-10.78
Total Depth	28.10	-10.78

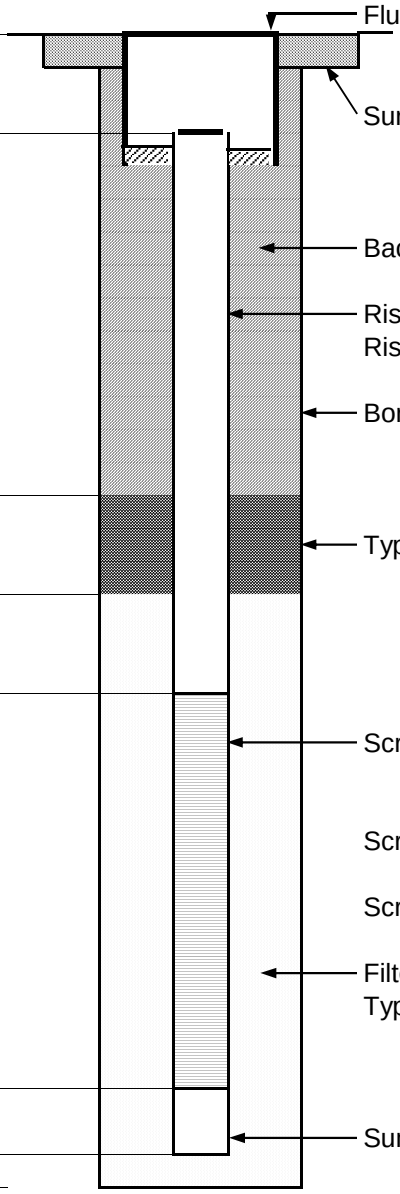


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure			FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**	
Project No:	3480140433	TF-5A	
Client:	de maximis, inc.	**Date:** 11/25/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger		**Measuring Point**
Development Method:	Surging		**Type:** Top Of Riser
Bucking Posts:	N/A		**Elevation (ft):** 15.25

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.95	16.20
Riser Pipe	0	15.25
Top of Seal	6.05	9.20
Top of Filter Pack	7.05	8.20
Top of Screen	8.05	7.20
Base of Screen	23.05	-7.80
End Cap	24.05	-8.80
Total Depth	24.05	-8.80

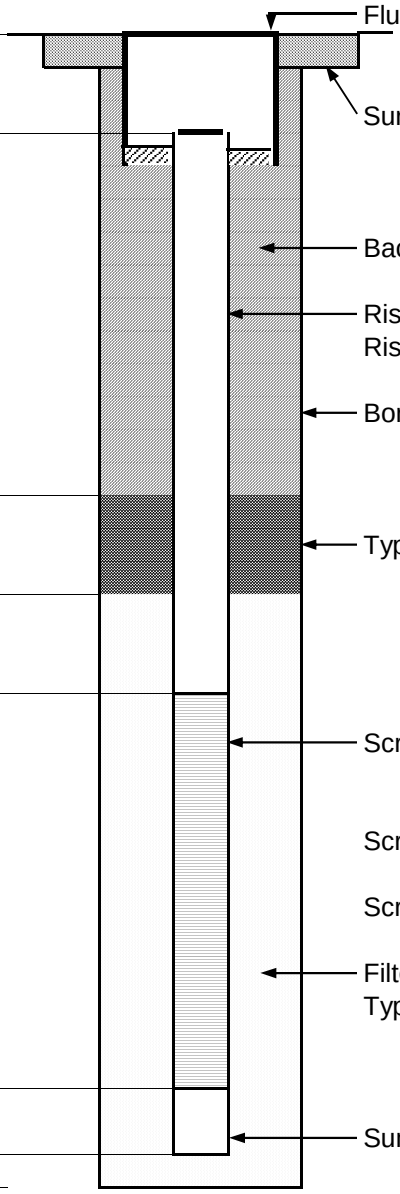


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-5B	
Client:	de maximis, inc.	**Date:**	12/18/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 14.9

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.30	16.20
Riser Pipe	0	14.9
Top of Seal	5.70	9.20
Top of Filter Pack	6.70	8.20
Top of Screen	7.70	7.20
Base of Screen	22.70	-7.80
End Cap	23.70	-8.80
Total Depth	23.70	-8.80

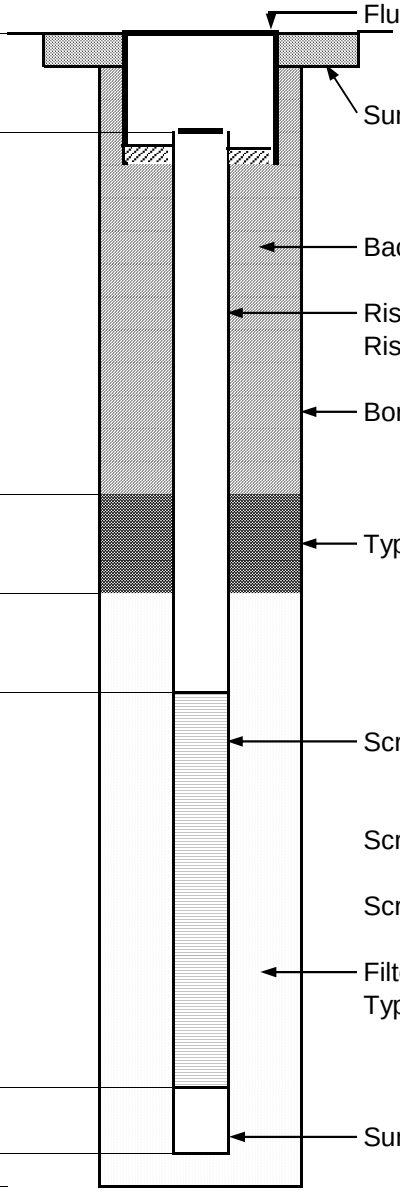


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-5C	
Client:	de maximis, inc.	**Date:**	12/22/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 15.02

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.93	15.95
Riser Pipe	0	15.02
Top of Seal	5.40	9.62
Top of Filter Pack	6.40	8.62
Top of Screen	7.40	7.62
Base of Screen	22.40	-7.38
End Cap	23.40	-8.38
Total Depth	23.40	-8.38

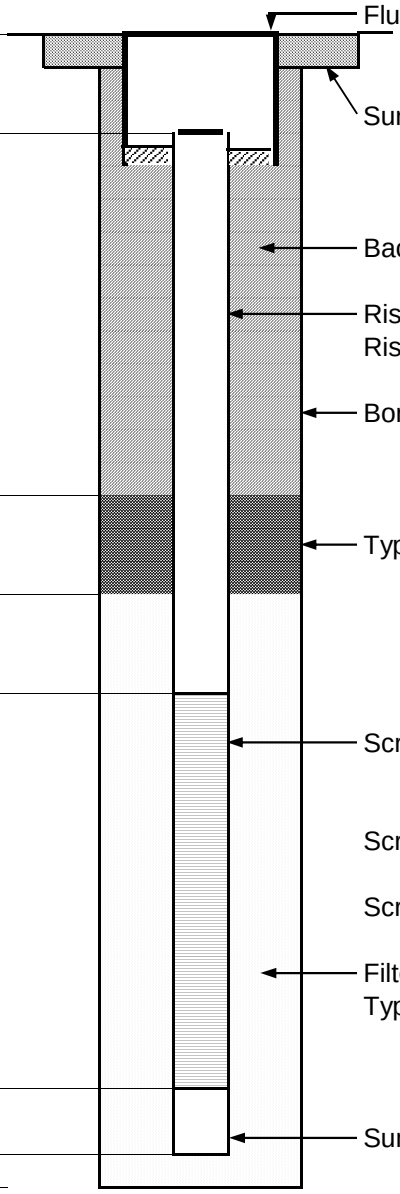


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-5D	
Client:	de maximis, inc.	**Date:**	11/24/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 15.42

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.99	16.41
Riser Pipe	0	15.42
Top of Seal	5.60	9.82
Top of Filter Pack	6.60	8.82
Top of Screen	7.60	7.82
Base of Screen	22.60	-7.18
End Cap	23.60	-8.18
Total Depth	23.60	-8.18

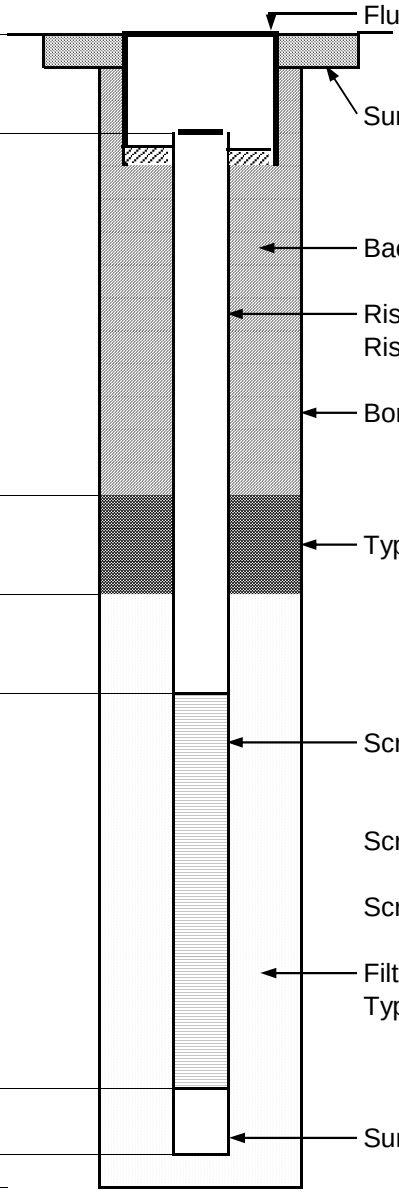


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-6A	
Client:	de maximis, inc.	**Date:**	1/20/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.73

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.96	18.68
Riser Pipe	0	17.73
Top of Seal	7.20	10.53
Top of Filter Pack	8.20	9.53
Top of Screen	10.20	7.53
Base of Screen	25.20	-7.47
End Cap	26.20	-8.47
Total Depth	26.20	-8.47

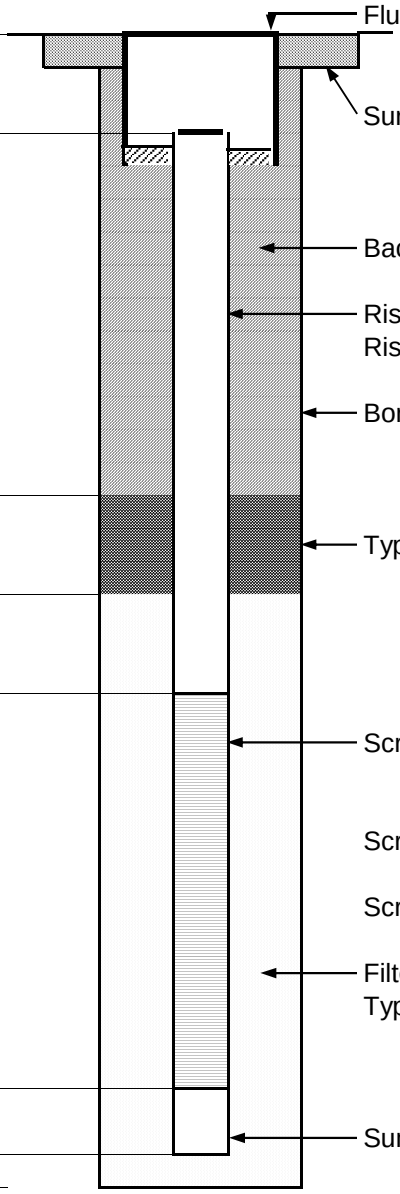


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-6B	
Client:	de maximis, inc.	**Date:**	12/23/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 16.34

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.23	17.57
Riser Pipe	0	16.34
Top of Seal	6.25	10.09
Top of Filter Pack	7.25	9.09
Top of Screen	9.25	7.09
Base of Screen	24.25	-7.91
End Cap	25.25	-8.91
Total Depth	25.25	-8.91

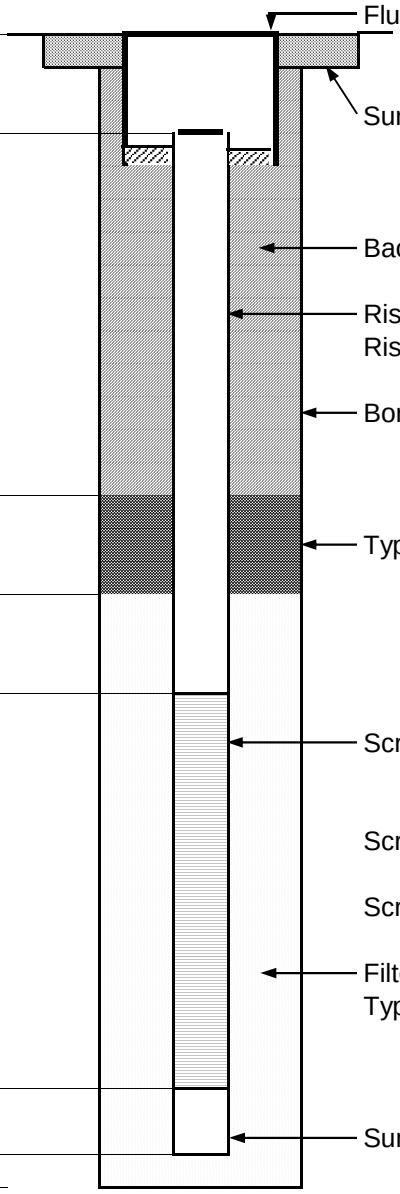


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-6C	
Client:	de maximis, inc.	**Date:**	1/19/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 15.87

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	16.87
Riser Pipe	0	15.87
Top of Seal	4.76	11.11
Top of Filter Pack	5.76	10.11
Top of Screen	7.76	8.11
Base of Screen	22.76	-6.89
End Cap	23.76	-7.89
Total Depth	23.76	-7.89

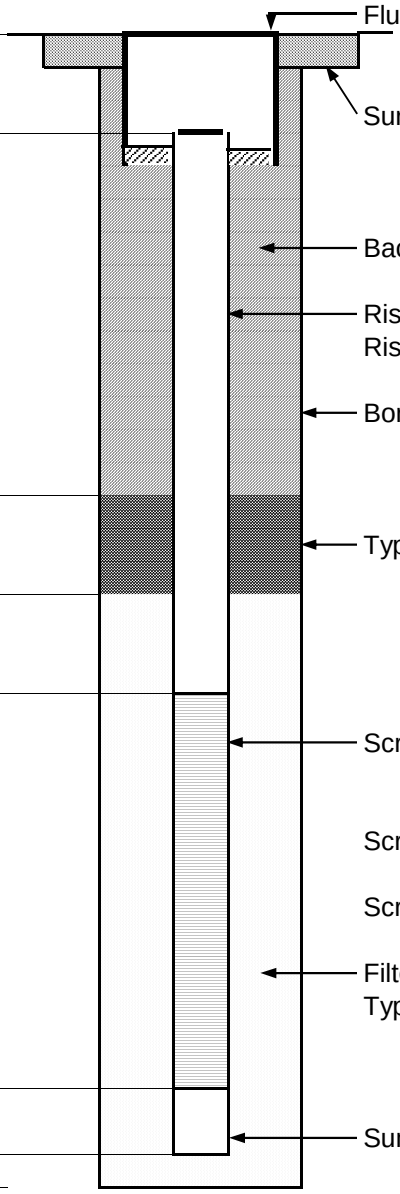


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-6D	
Client:	de maximis, inc.	**Date:**	1/21/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 14.93

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.16	16.09
Riser Pipe	0	14.93
Top of Seal	4.90	10.03
Top of Filter Pack	5.90	9.03
Top of Screen	6.90	8.03
Base of Screen	21.90	-6.97
End Cap	22.90	-7.97
Total Depth	22.90	-7.97

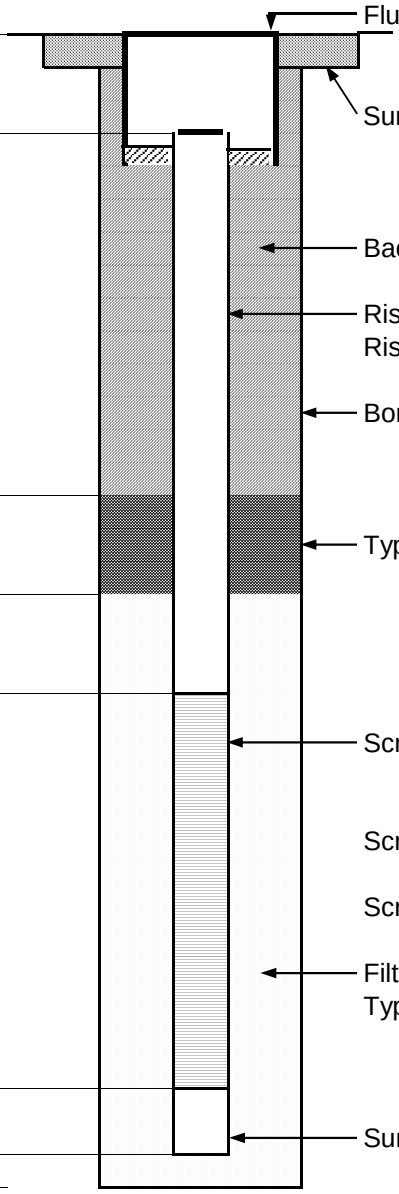


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-7A	
Client:	de maximis, inc.	**Date:**	1/20/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 18.30

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.09	19.39
Riser Pipe	0	18.30
Top of Seal	7.55	10.75
Top of Filter Pack	8.55	9.75
Top of Screen	10.55	7.75
Base of Screen	25.55	-7.25
End Cap	26.55	-8.25
Total Depth	26.55	-8.25

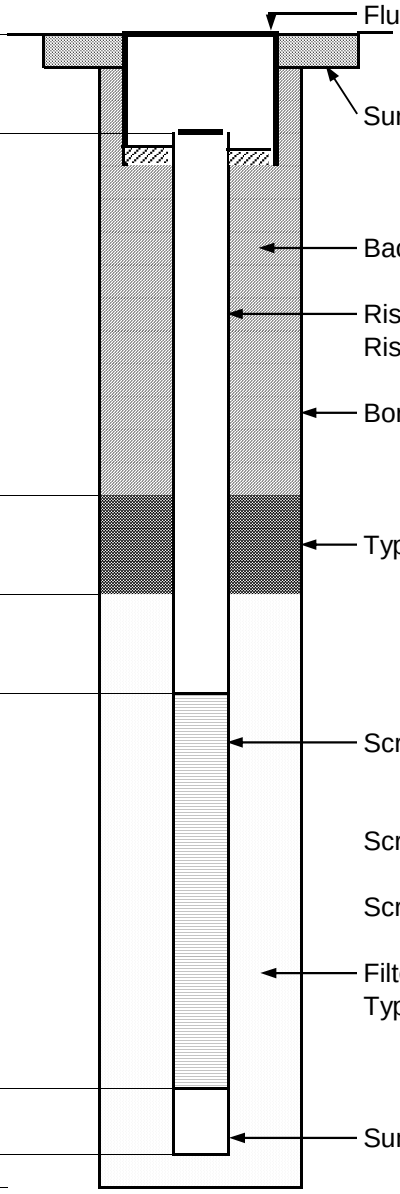


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-7B	
Client:	de maximis, inc.	**Date:**	12/22/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 16.77

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	17.77
Riser Pipe	0	16.77
Top of Seal	5.56	11.21
Top of Filter Pack	6.56	10.21
Top of Screen	8.56	8.21
Base of Screen	23.56	-6.79
End Cap	24.56	-7.79
Total Depth	24.56	-7.79

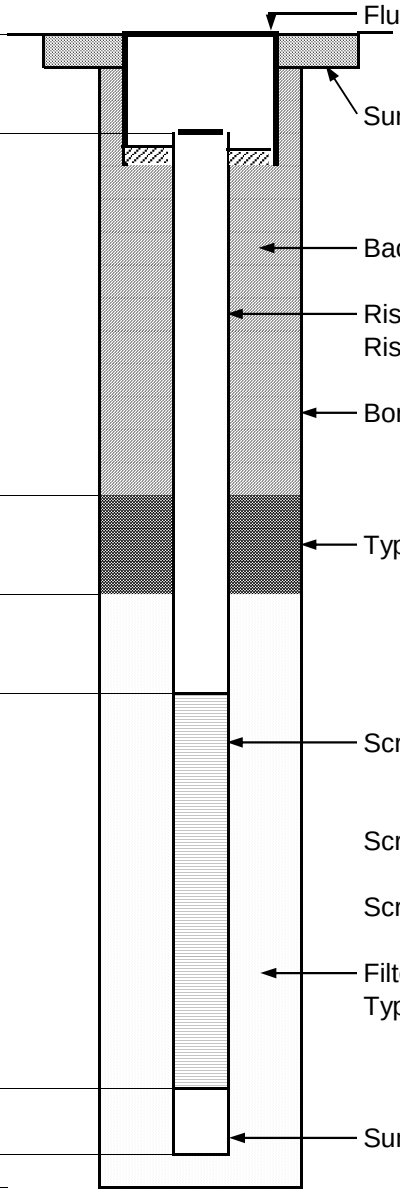


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-7C	
Client:	de maximis, inc.	**Date:**	12/30/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 16.52

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	17.52
Riser Pipe	0	16.52
Top of Seal	4.85	11.67
Top of Filter Pack	5.85	10.67
Top of Screen	7.85	8.67
Base of Screen	22.85	-6.33
End Cap	23.85	-7.33
Total Depth	23.85	-7.33

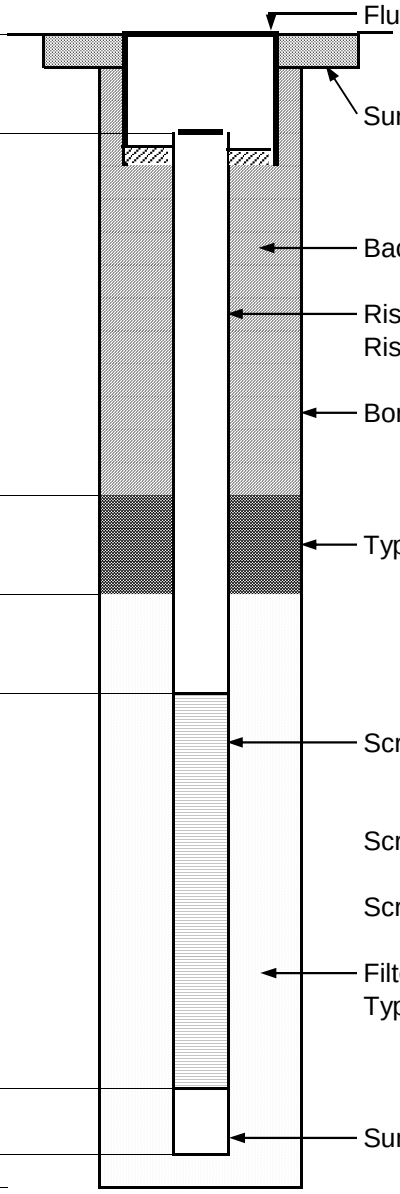


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-7D	
Client:	de maximis, inc.	**Date:**	1/21/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 15.93

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.18	17.11
Riser Pipe	0	15.93
Top of Seal	4.75	11.18
Top of Filter Pack	5.75	10.18
Top of Screen	7.75	8.18
Base of Screen	22.75	-6.82
End Cap	23.75	-7.82
Total Depth	23.75	-7.82

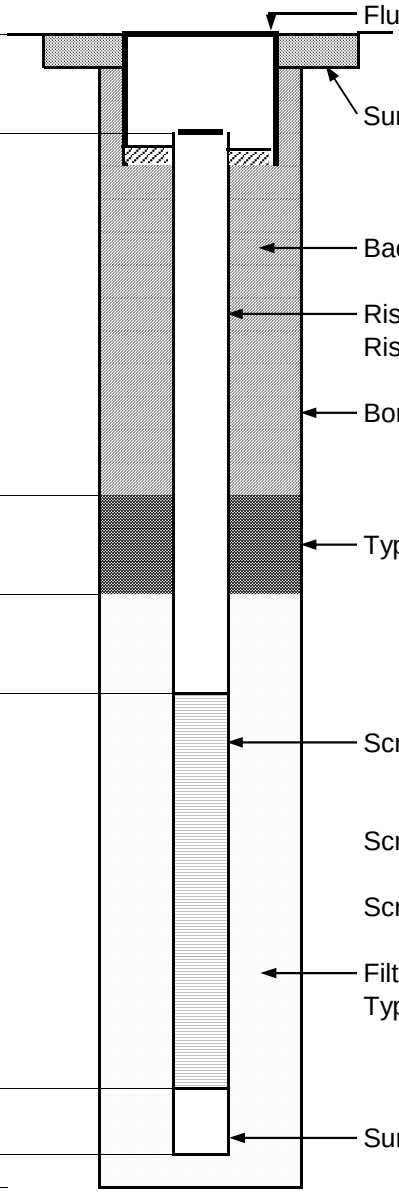


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-7E	
Client:	de maximis, inc.	**Date:**	1/21/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 15.09

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.94	16.03
Riser Pipe	0	15.09
Top of Seal	5.20	9.89
Top of Filter Pack	6.20	8.89
Top of Screen	7.20	7.89
Base of Screen	22.20	-7.11
End Cap	23.20	-8.11
Total Depth	23.20	-8.11

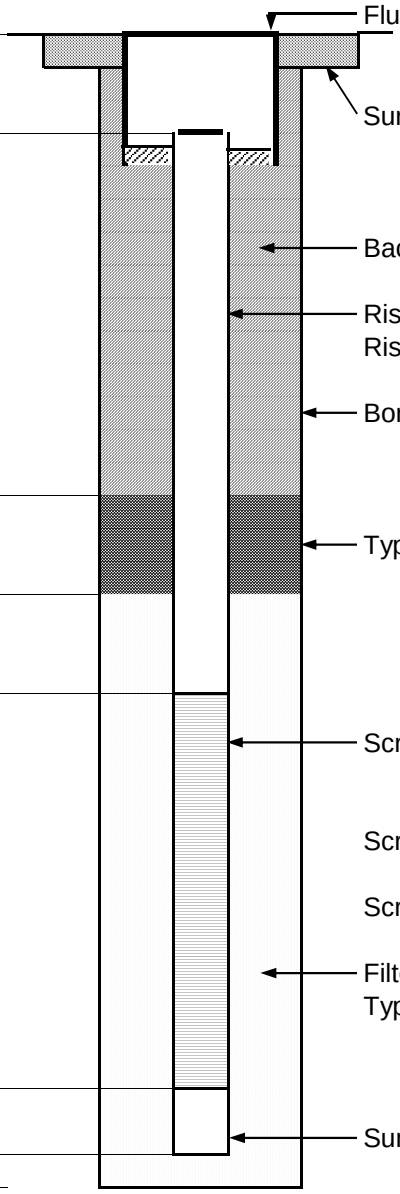


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		TF-7F	
Client:	de maximis, inc.	**Date:**	1/28/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 13.89

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.51	15.40
Riser Pipe	0	13.89
Top of Seal	4.60	9.29
Top of Filter Pack	5.60	8.29
Top of Screen	6.60	7.29
Base of Screen	21.60	-7.71
End Cap	22.60	-8.71
Total Depth	22.60	-8.71

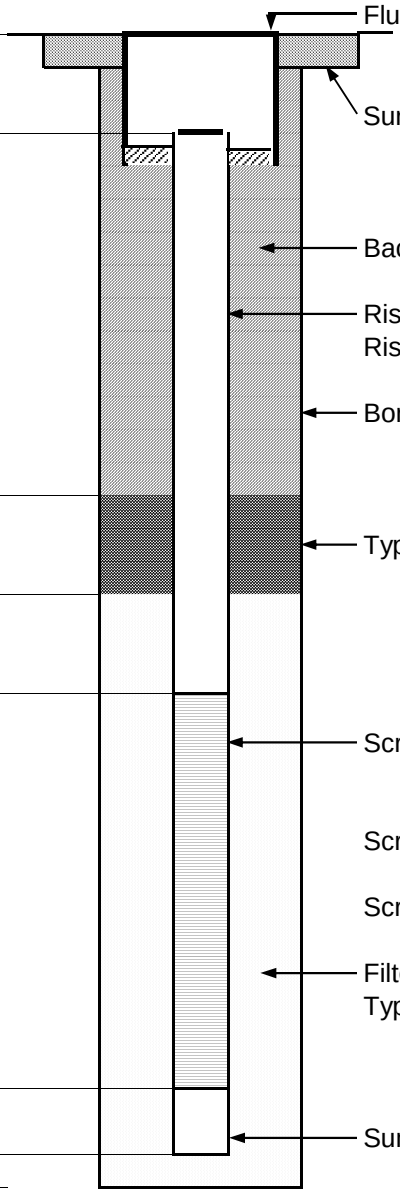


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC Vee-Wire Continuous Slot
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-1A	
Client:	de maximis, inc.	**Date:**	12/10/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 26.25

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.29	27.54
Riser Pipe	0	26.25
Top of Seal	12.95	13.30
Top of Filter Pack	13.95	12.30
Top of Screen	15.95	10.30
Base of Screen	30.95	-4.70
End Cap	31.95	-5.70
Total Depth	31.95	-5.70

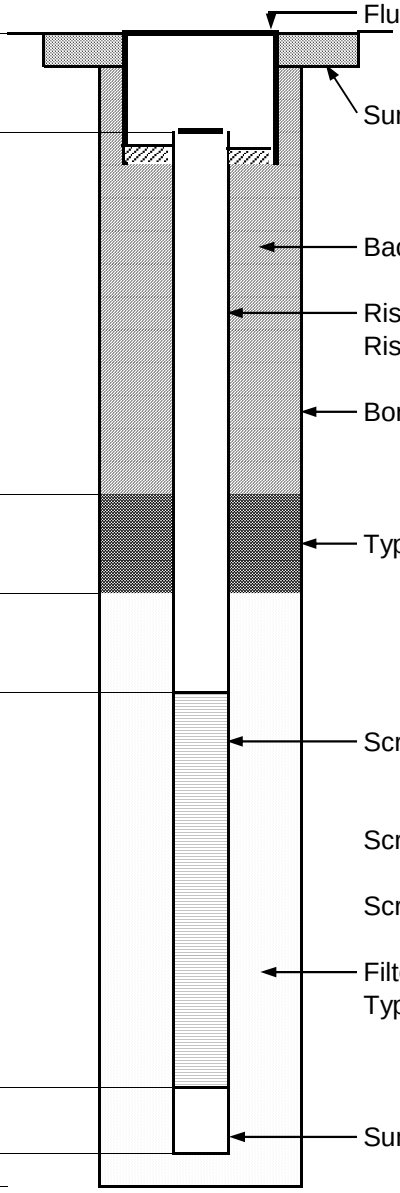


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-1B	
Client:	de maximis, inc.	**Date:**	12/15/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 26.15

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.13	27.28
Riser Pipe	0	26.15
Top of Seal	13.40	12.75
Top of Filter Pack	14.40	11.75
Top of Screen	16.40	9.75
Base of Screen	31.40	-5.25
End Cap	32.40	-6.25
Total Depth	32.40	-6.25

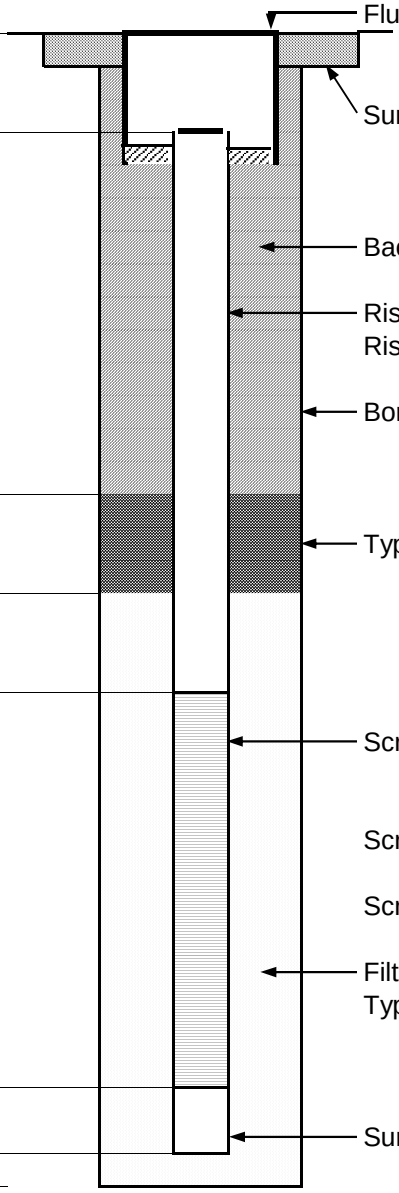


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-1C	
Client:	de maximis, inc.	**Date:**	12/12/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 24.52

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.85	25.37
Riser Pipe	0	24.52
Top of Seal	12.65	11.87
Top of Filter Pack	13.65	10.87
Top of Screen	15.65	8.87
Base of Screen	30.65	-6.13
End Cap	31.65	-7.13
Total Depth	31.65	-7.13

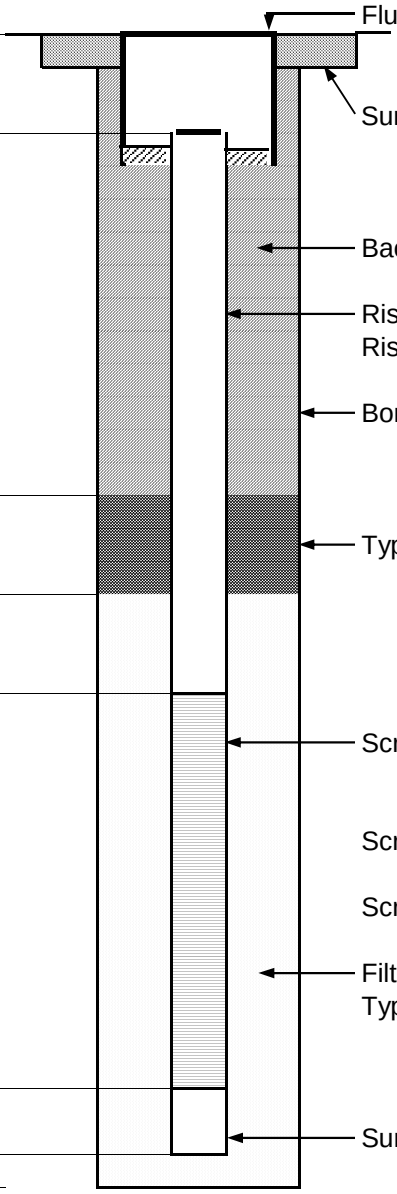


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-1D	
Client:	de maximis, inc.	**Date:**	12/15/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.34

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	24.34
Riser Pipe	0	23.34
Top of Seal	11.59	11.75
Top of Filter Pack	12.59	10.75
Top of Screen	14.59	8.75
Base of Screen	29.59	-6.25
End Cap	30.59	-7.25
Total Depth	30.59	-7.25

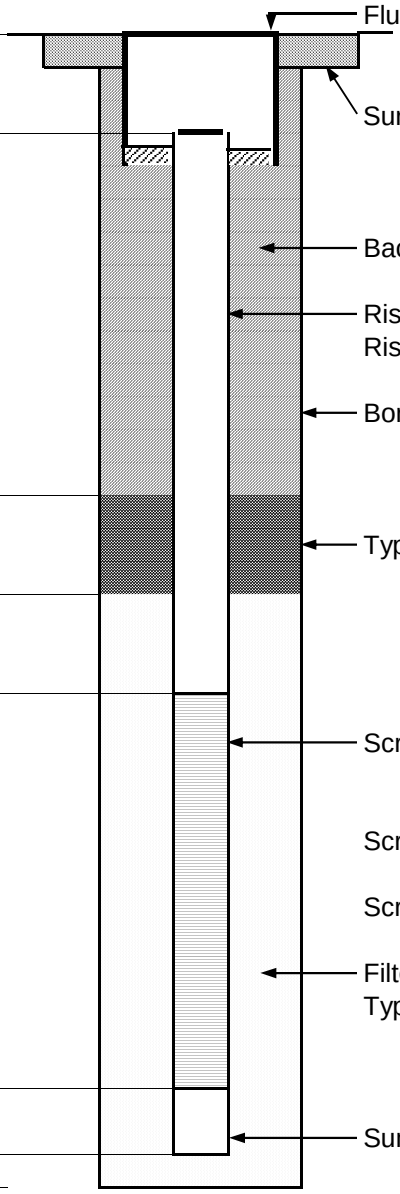


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-1E	
Client:	de maximis, inc.	**Date:**	12/16/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 21.31

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.27	22.58
Riser Pipe	0	21.31
Top of Seal	9.40	11.91
Top of Filter Pack	10.40	10.91
Top of Screen	12.40	8.91
Base of Screen	27.40	-6.09
End Cap	28.40	-7.09
Total Depth	28.40	-7.09

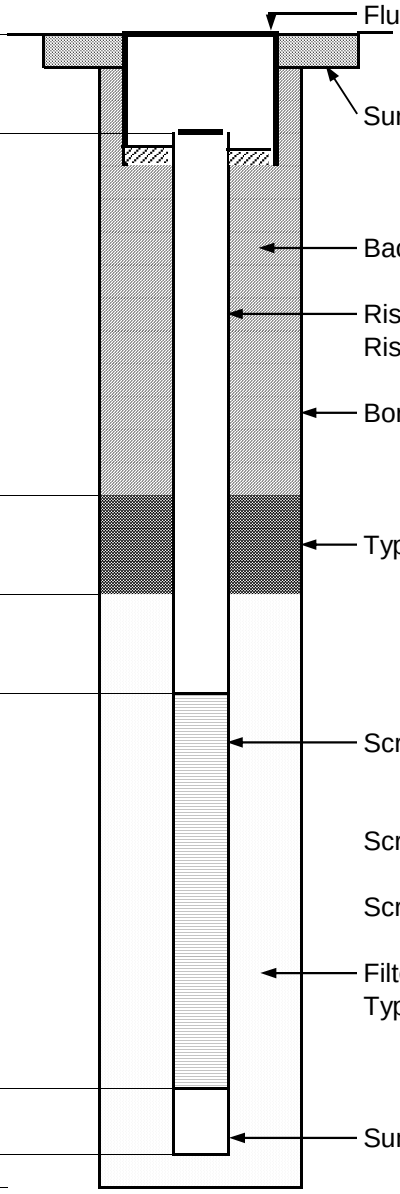


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-2A	
Client:	de maximis, inc.	**Date:**	12/11/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 25.43

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.48	26.91
Riser Pipe	0	25.43
Top of Seal	12.50	12.93
Top of Filter Pack	13.50	11.93
Top of Screen	15.50	9.93
Base of Screen	30.50	-5.07
End Cap	31.50	-6.07
Total Depth	31.50	-6.07

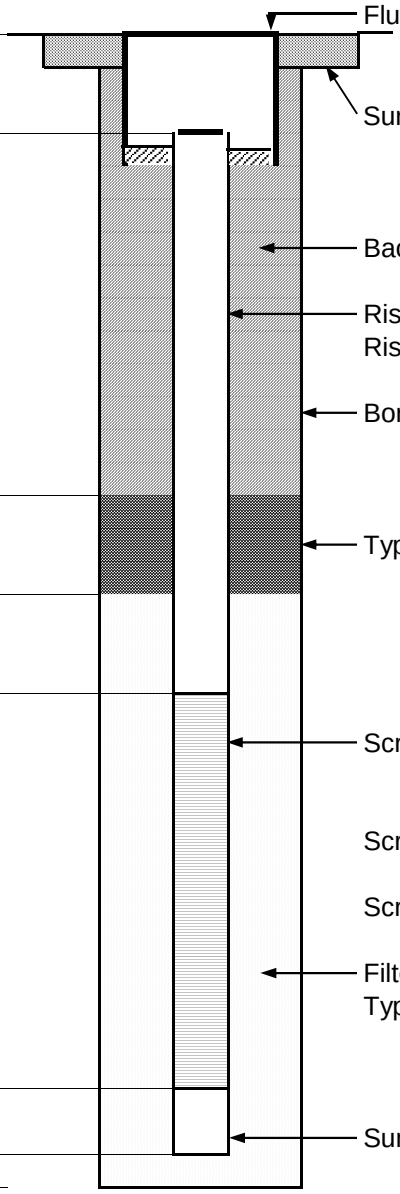


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-2B	
Client:	de maximis, inc.	**Date:**	12/10/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.64

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-2.04	25.68
Riser Pipe	0	23.64
Top of Seal	11.85	11.79
Top of Filter Pack	12.85	10.79
Top of Screen	14.85	8.79
Base of Screen	29.85	-6.21
End Cap	30.85	-7.21
Total Depth	30.85	-7.21

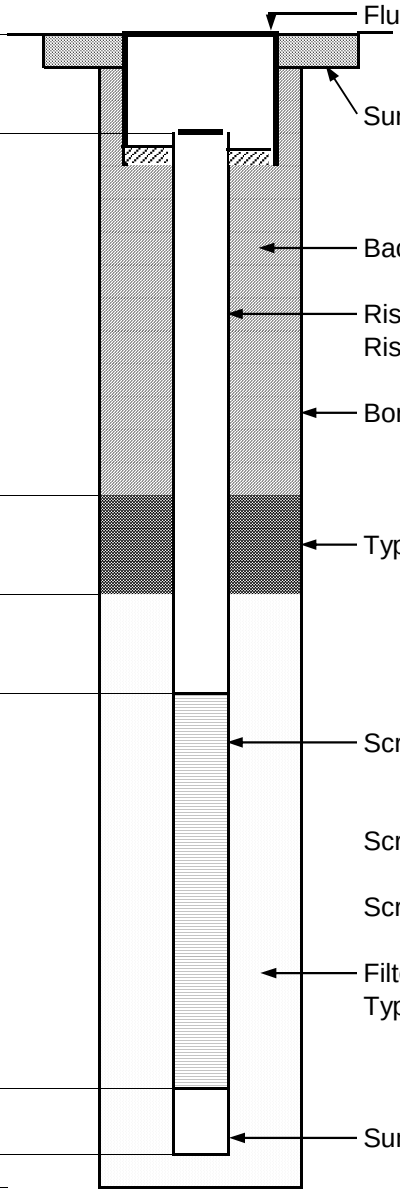


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-2C	
Client:	de maximis, inc.	**Date:**	12/16/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.42

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-2.26	25.68
Riser Pipe	0	23.42
Top of Seal	8.00	15.42
Top of Filter Pack	9.00	14.42
Top of Screen	11.00	12.42
Base of Screen	26.00	-2.58
End Cap	27.00	-3.58
Total Depth	27.00	-3.58

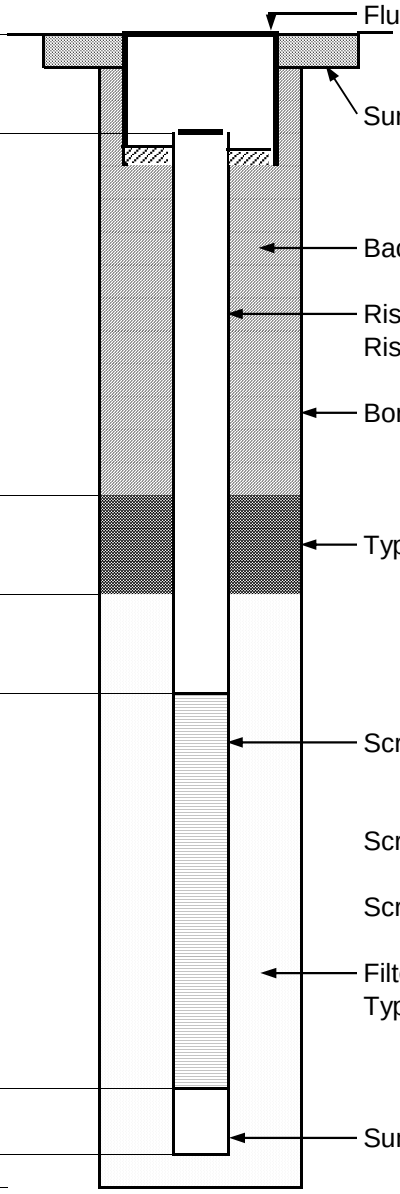


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-2D	
Client:	de maximis, inc.	**Date:**	12/17/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 25.31

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.88	26.19
Riser Pipe	0	25.31
Top of Seal	14.00	11.31
Top of Filter Pack	15.00	10.31
Top of Screen	17.00	8.31
Base of Screen	32.00	-6.69
End Cap	33.00	-7.69
Total Depth	33.00	-7.69

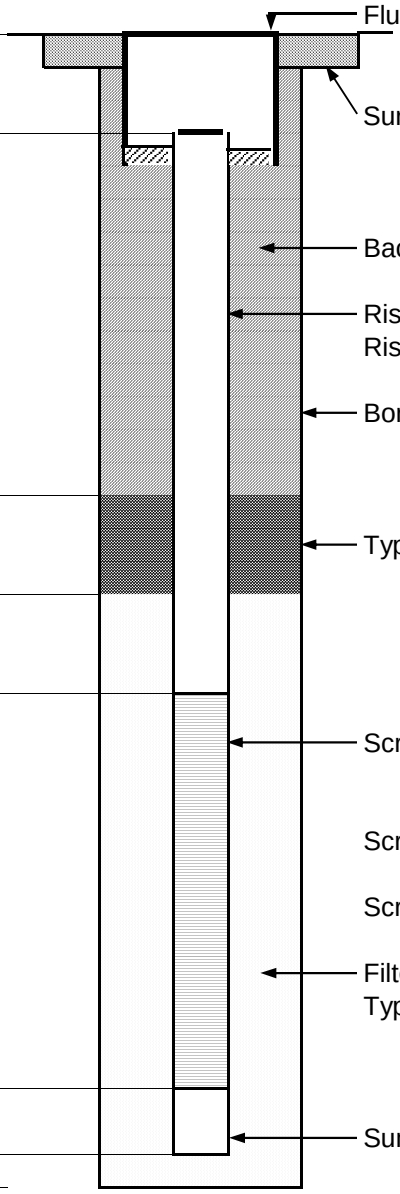


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-2E	
Client:	de maximis, inc.	**Date:**	12/17/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 24.88

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.02	25.90
Riser Pipe	0	24.88
Top of Seal	12.85	12.03
Top of Filter Pack	13.85	11.03
Top of Screen	15.85	9.03
Base of Screen	30.85	-5.97
End Cap	31.85	-6.97
Total Depth	31.85	-6.97

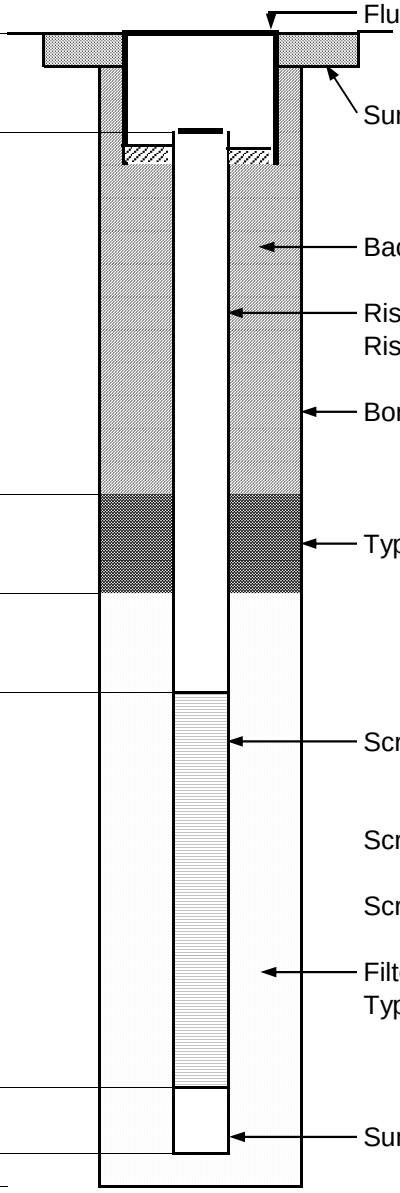


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-3A	
Client:	de maximis, inc.	**Date:**	12/11/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 25.46

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.40	26.86
Riser Pipe	0	25.46
Top of Seal	4.25	21.21
Top of Filter Pack	5.25	20.21
Top of Screen	7.25	18.21
Base of Screen	22.25	3.21
End Cap	23.25	2.21
Total Depth	23.25	2.21

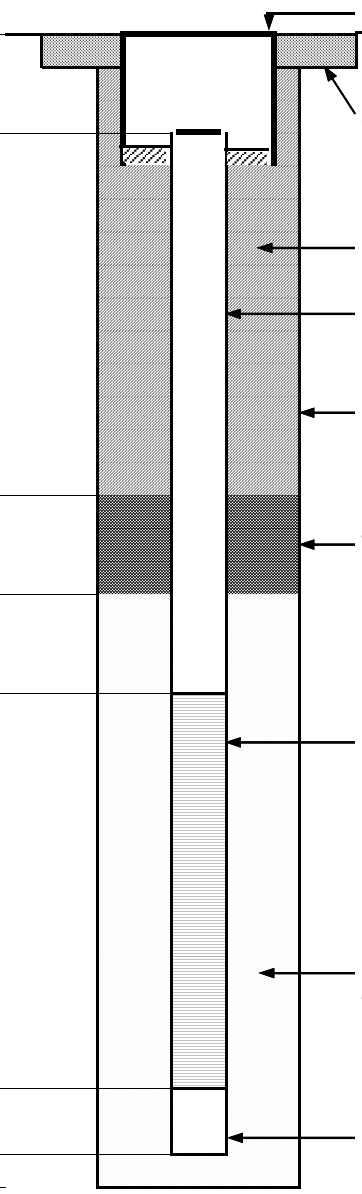


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-3B	
Client:	de maximis, inc.	**Date:**	12/18/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 25.92

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.29	27.21
Riser Pipe	0	25.92
Top of Seal	13.50	12.42
Top of Filter Pack	14.50	11.42
Top of Screen	16.50	9.42
Base of Screen	31.50	-5.58
End Cap	32.50	-6.58
Total Depth	32.50	-6.58

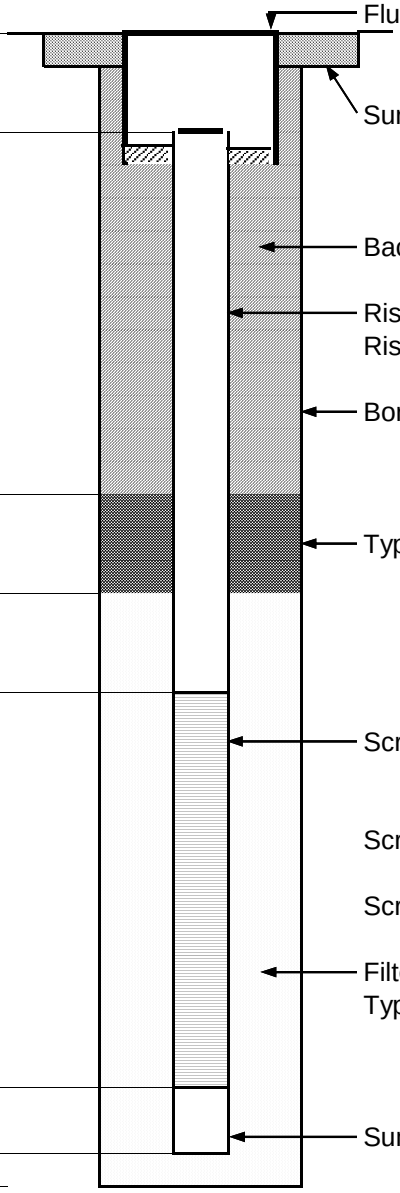


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-3C	
Client:	de maximis, inc.	**Date:**	12/10/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 25.5

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.44	26.94
Riser Pipe	0	25.5
Top of Seal	5.20	20.30
Top of Filter Pack	6.20	19.30
Top of Screen	8.20	17.30
Base of Screen	23.20	2.30
End Cap	24.20	1.30
Total Depth	24.20	1.30

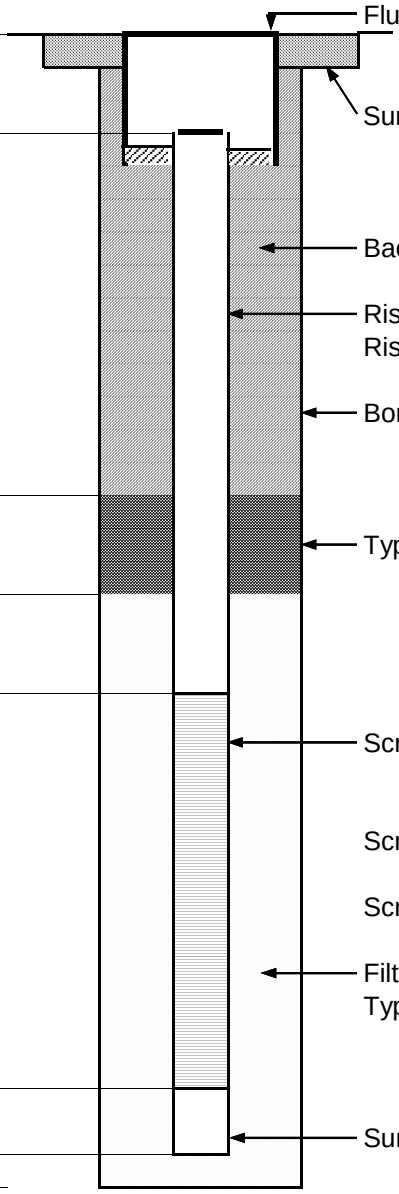


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-3D	
Client:	de maximis, inc.	**Date:**	12/8/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 24.9

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.72	26.62
Riser Pipe	0	24.9
Top of Seal	11.50	13.40
Top of Filter Pack	12.50	12.40
Top of Screen	14.50	10.40
Base of Screen	29.50	-4.60
End Cap	30.50	-5.60
Total Depth	30.50	-5.60

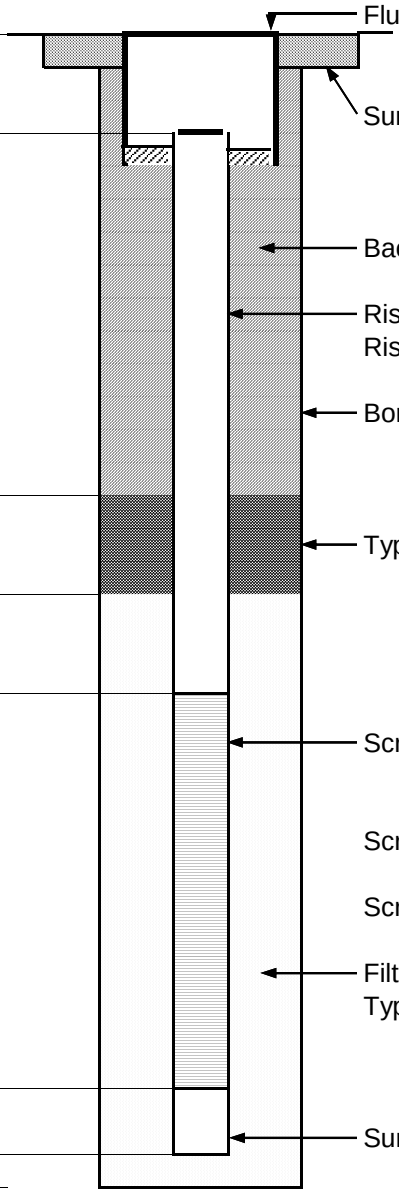


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-3E	
Client:	de maximis, inc.	**Date:**	12/8/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.49

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.99	24.48
Riser Pipe	0	23.49
Top of Seal	11.50	11.99
Top of Filter Pack	12.50	10.99
Top of Screen	14.50	8.99
Base of Screen	29.50	-6.01
End Cap	30.50	-7.01
Total Depth	30.50	-7.01

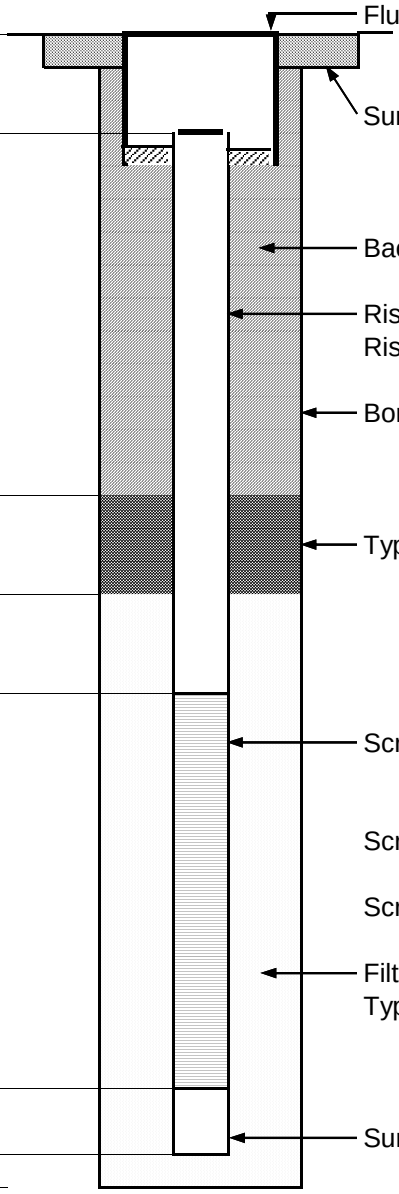


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-4A	
Client:	de maximis, inc.	**Date:**	1/22/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 16.55

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	17.55
Riser Pipe	0	16.55
Top of Seal	6.40	10.15
Top of Filter Pack	7.40	9.15
Top of Screen	9.40	7.15
Base of Screen	24.40	-7.85
End Cap	25.40	-8.85
Total Depth	25.40	-8.85

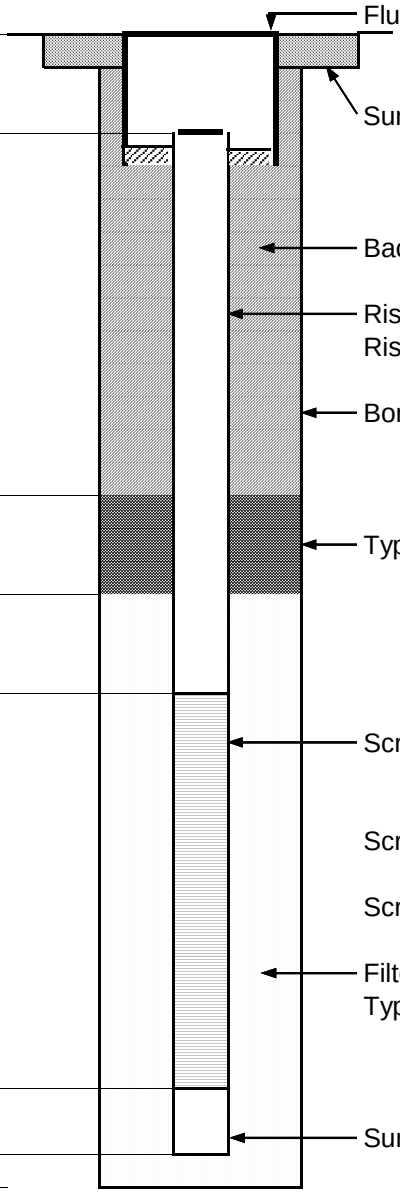


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-4B	
Client:	de maximis, inc.	**Date:**	1/29/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 16.14

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.92	17.06
Riser Pipe	0	16.14
Top of Seal	5.90	10.24
Top of Filter Pack	6.90	9.24
Top of Screen	8.90	7.24
Base of Screen	23.90	-7.76
End Cap	24.90	-8.76
Total Depth	24.90	-8.76

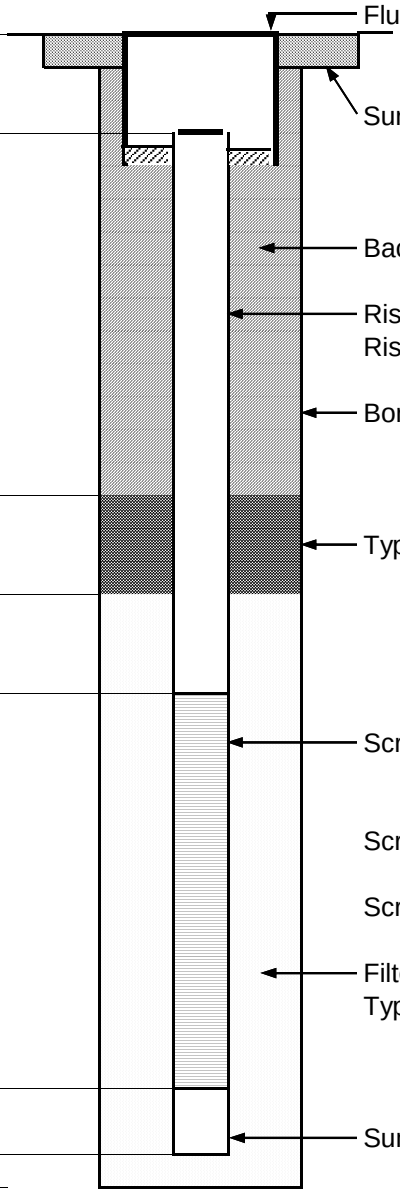


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-4C	
Client:	de maximis, inc.	**Date:**	1/19/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 14.24

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.48	15.72
Riser Pipe	0	14.24
Top of Seal	4.20	10.04
Top of Filter Pack	5.20	9.04
Top of Screen	6.20	8.04
Base of Screen	21.20	-6.96
End Cap	22.20	-7.96
Total Depth	22.20	-7.96

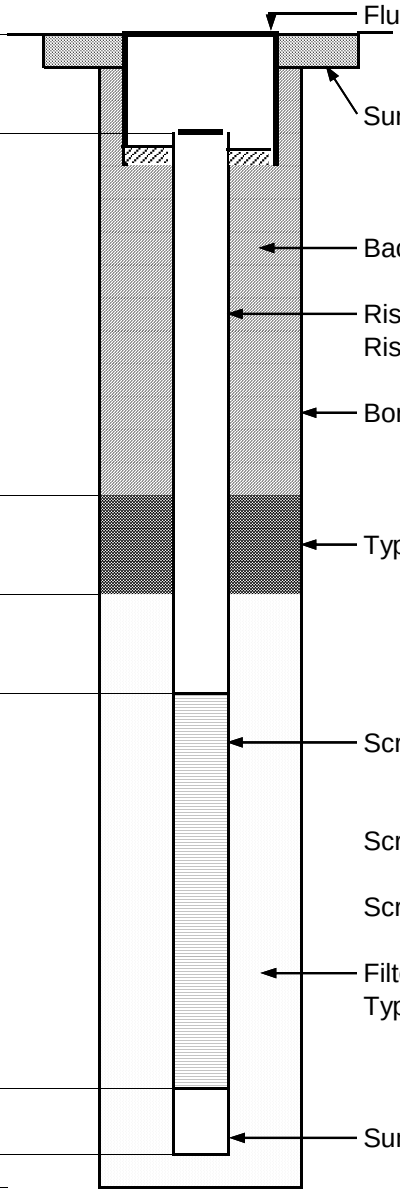


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-4D	
Client:	de maximis, inc.	**Date:**	1/19/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 14.21

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.46	15.67
Riser Pipe	0	14.21
Top of Seal	3.80	10.41
Top of Filter Pack	4.80	9.41
Top of Screen	5.80	8.41
Base of Screen	20.80	-6.59
End Cap	21.80	-7.59
Total Depth	21.80	-7.59

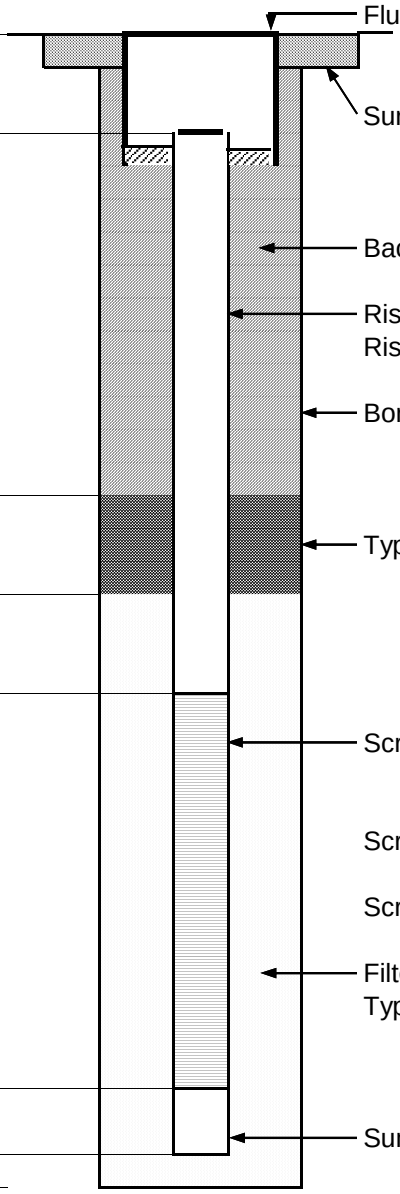


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-4E	
Client:	de maximis, inc.	**Date:**	1/19/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 13.7

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.68	15.38
Riser Pipe	0	13.7
Top of Seal	4.40	9.30
Top of Filter Pack	5.40	8.30
Top of Screen	6.40	7.30
Base of Screen	21.40	-7.70
End Cap	22.40	-8.70
Total Depth	22.40	-8.70

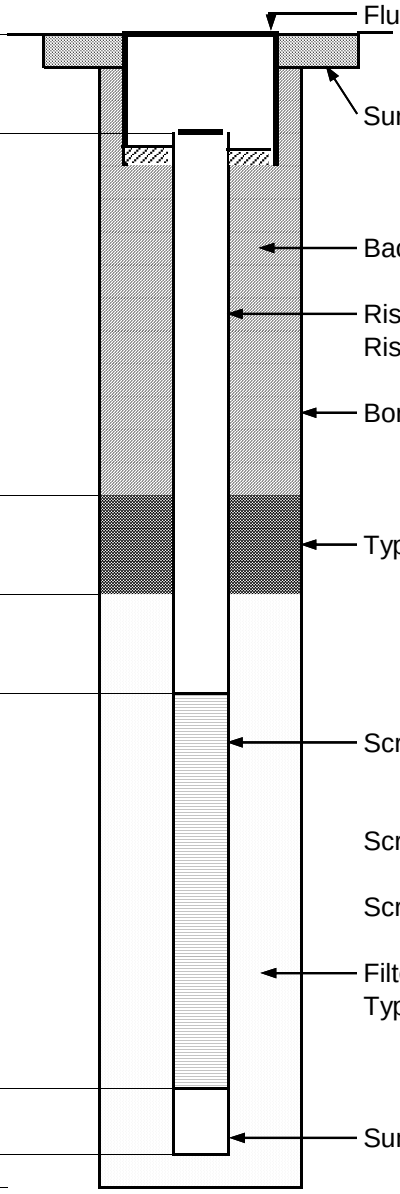


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-5A	
Client:	de maximis, inc.	**Date:**	1/16/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.4

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.93	24.33
Riser Pipe	0	23.4
Top of Seal	12.90	10.50
Top of Filter Pack	13.90	9.50
Top of Screen	15.90	7.50
Base of Screen	30.90	-7.50
End Cap	31.90	-8.50
Total Depth	31.90	-8.50

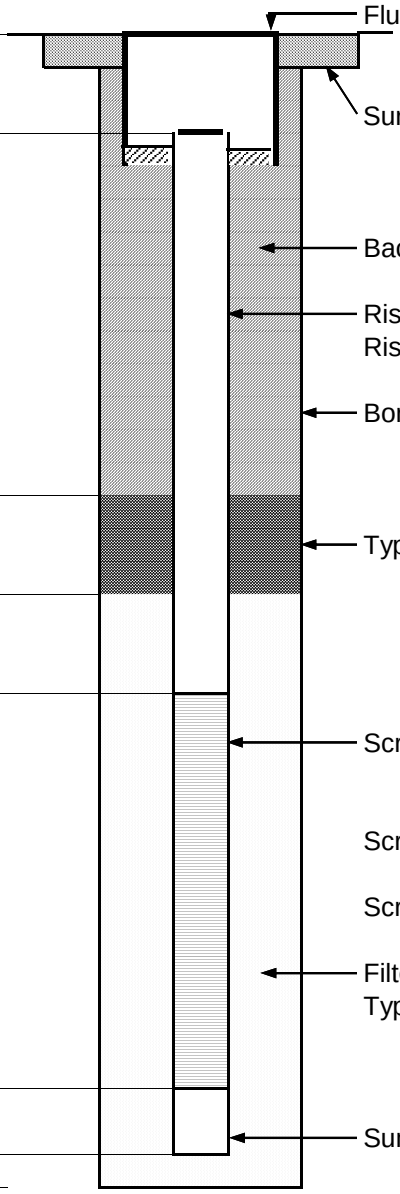


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-5B	
Client:	de maximis, inc.	**Date:**	1/15/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 21.5

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.02	22.52
Riser Pipe	0	21.5
Top of Seal	11.95	9.55
Top of Filter Pack	12.95	8.55
Top of Screen	14.95	6.55
Base of Screen	29.95	-8.45
End Cap	30.95	-9.45
Total Depth	30.95	-9.45

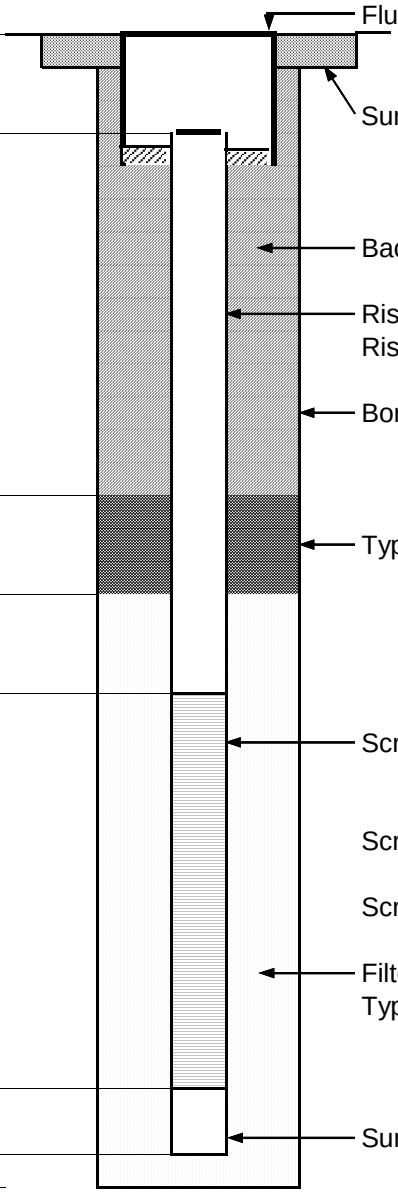


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-5C	
Client:	de maximis, inc.	**Date:**	1/16/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.96

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	20.96
Riser Pipe	0	19.96
Top of Seal	9.81	10.15
Top of Filter Pack	10.81	9.15
Top of Screen	12.81	7.15
Base of Screen	27.81	-7.85
End Cap	28.81	-8.85
Total Depth	28.81	-8.85

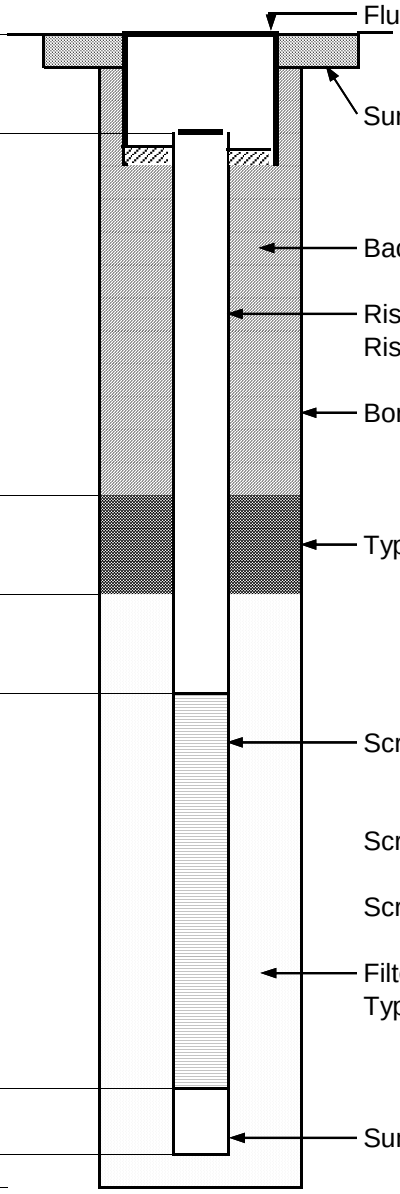


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-5D	
Client:	de maximis, inc.	**Date:**	12/29/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.76

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.99	18.76
Riser Pipe	0	17.76
Top of Seal	7.40	10.36
Top of Filter Pack	8.40	9.36
Top of Screen	10.40	7.36
Base of Screen	25.40	-7.64
End Cap	26.40	-8.64
Total Depth	26.40	-8.64

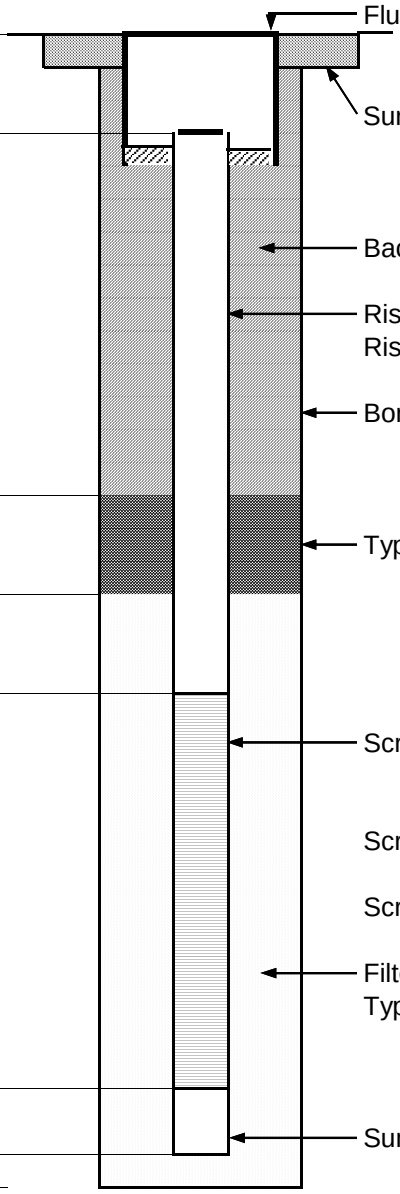


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-5E	
Client:	de maximis, inc.	**Date:**	12/29/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.23

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	18.23
Riser Pipe	0	17.23
Top of Seal	6.08	11.15
Top of Filter Pack	7.08	10.15
Top of Screen	9.08	8.15
Base of Screen	24.08	-6.85
End Cap	25.08	-7.85
Total Depth	25.08	-7.85

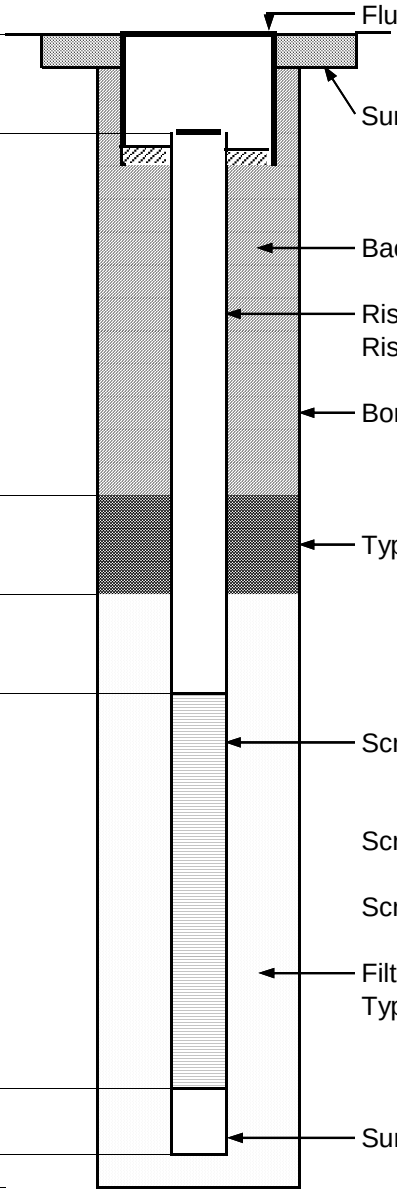


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-6A	
Client:	de maximis, inc.	**Date:**	12/23/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 23.01

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.09	24.10
Riser Pipe	0	23.01
Top of Seal	11.50	11.51
Top of Filter Pack	12.50	10.51
Top of Screen	14.50	8.51
Base of Screen	29.50	-6.49
End Cap	30.50	-7.49
Total Depth	30.50	-7.49

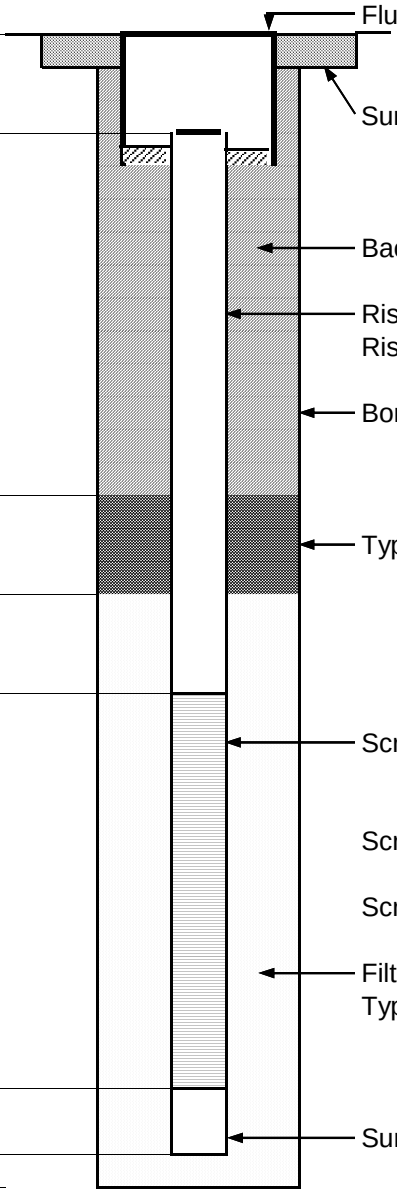


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-6B	
Client:	de maximis, inc.	**Date:**	1/15/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 21.21

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	22.21
Riser Pipe	0	21.21
Top of Seal	11.74	9.47
Top of Filter Pack	12.74	8.47
Top of Screen	14.74	6.47
Base of Screen	29.74	-8.53
End Cap	30.74	-9.53
Total Depth	30.74	-9.53

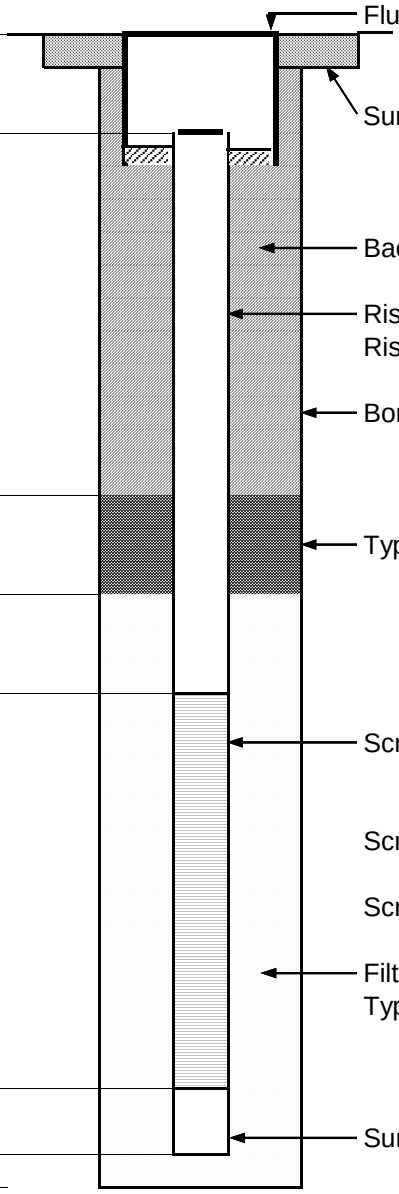


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-6C	
Client:	de maximis, inc.	**Date:**	12/30/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.42

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.09	20.51
Riser Pipe	0	19.42
Top of Seal	9.00	10.42
Top of Filter Pack	10.00	9.42
Top of Screen	12.00	7.42
Base of Screen	27.00	-7.58
End Cap	28.00	-8.58
Total Depth	28.00	-8.58

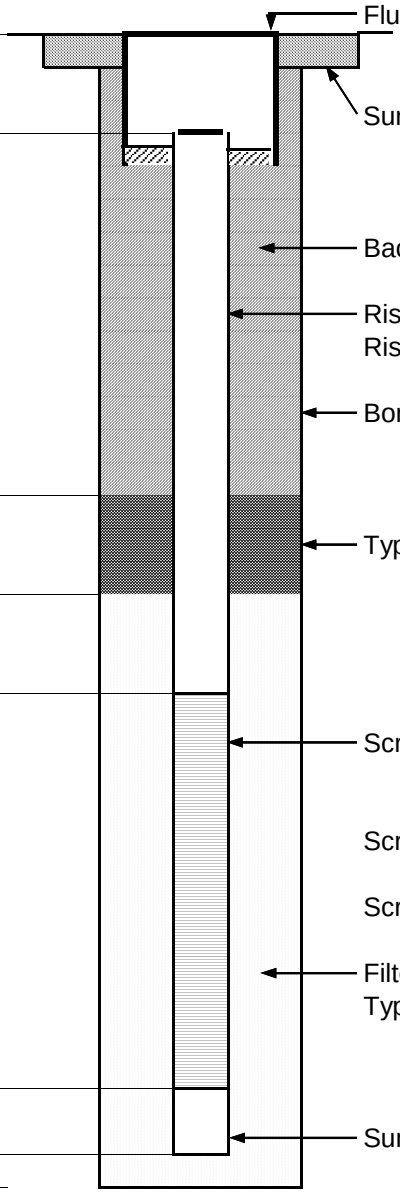


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-6D	
Client:	de maximis, inc.	**Date:**	1/2/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.33

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	18.33
Riser Pipe	0	17.33
Top of Seal	6.26	11.07
Top of Filter Pack	7.26	10.07
Top of Screen	9.26	8.07
Base of Screen	24.26	-6.93
End Cap	25.26	-7.93
Total Depth	25.26	-7.93

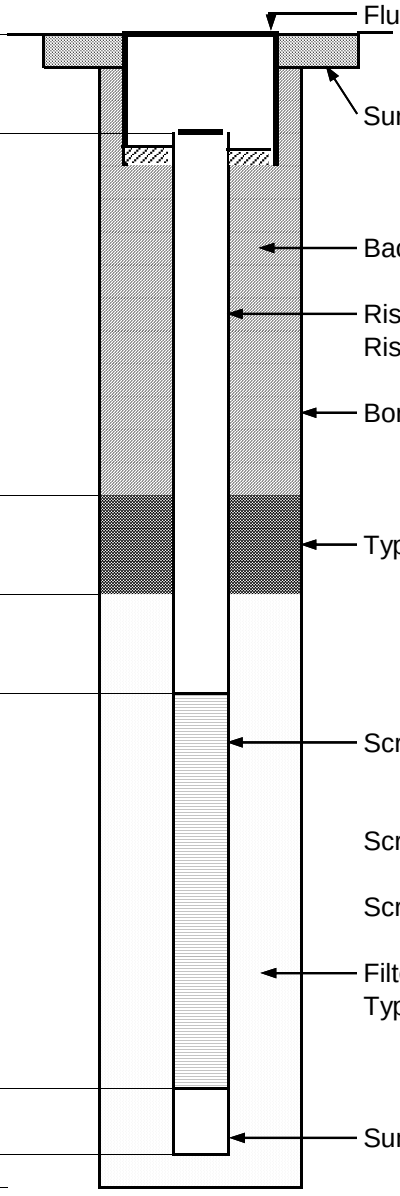


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-6E	
Client:	de maximis, inc.	**Date:**	1/13/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.23

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	18.23
Riser Pipe	0	17.23
Top of Seal	6.14	11.09
Top of Filter Pack	7.14	10.09
Top of Screen	9.14	8.09
Base of Screen	24.14	-6.91
End Cap	25.14	-7.91
Total Depth	25.14	-7.91

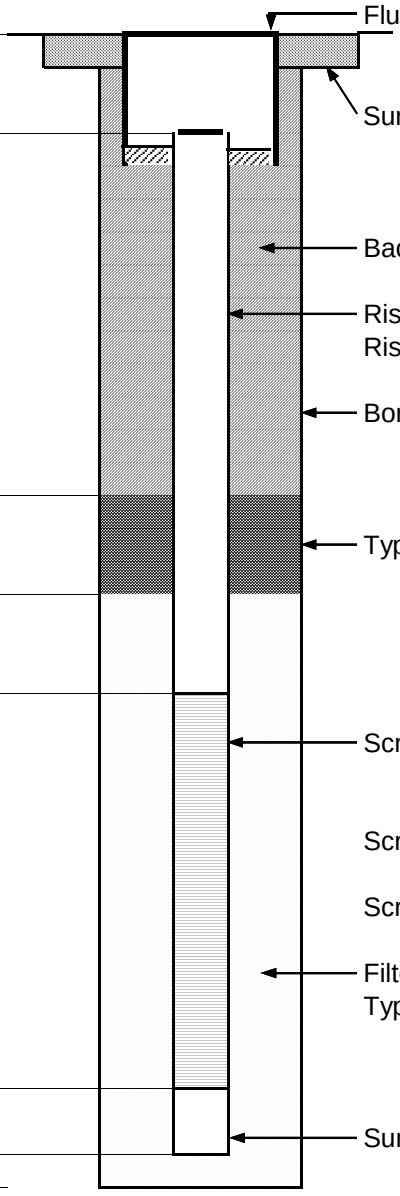


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-7A	
Client:	de maximis, inc.	**Date:**	1/2/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 20.65

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	21.65
Riser Pipe	0	20.65
Top of Seal	9.59	11.06
Top of Filter Pack	10.59	10.06
Top of Screen	12.59	8.06
Base of Screen	27.59	-6.94
End Cap	28.59	-7.94
Total Depth	28.59	-7.94

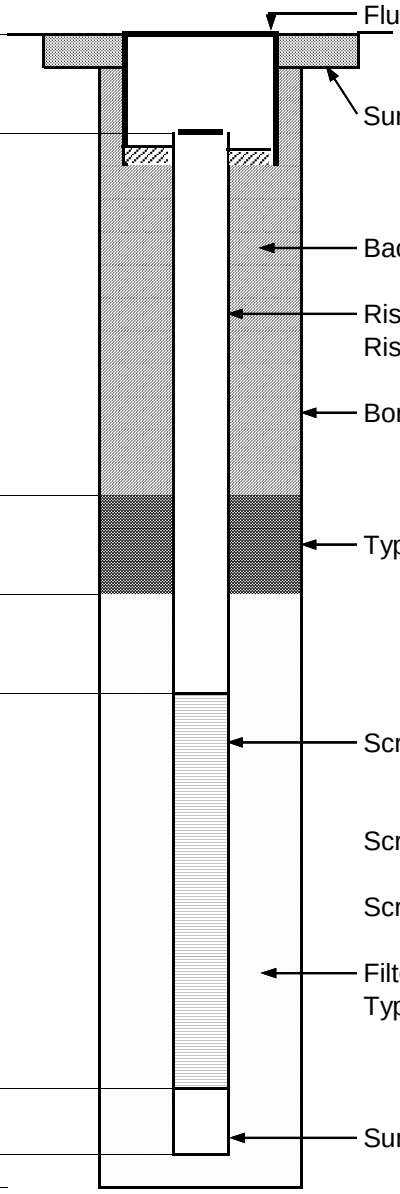


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-7B	
Client:	de maximis, inc.	**Date:**	12/29/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 19.44

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	20.44
Riser Pipe	0	19.44
Top of Seal	7.64	11.80
Top of Filter Pack	8.64	10.80
Top of Screen	10.64	8.80
Base of Screen	25.64	-6.20
End Cap	26.64	-7.20
Total Depth	26.64	-7.20

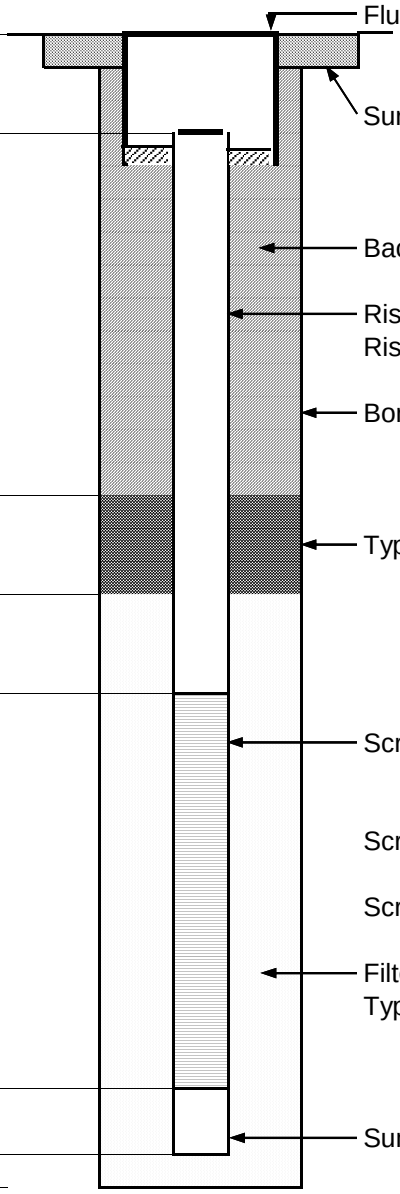


Description	
Flushmount Diameter:	30" x 30" Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-7C	
Client:	de maximis, inc.	**Date:**	1/13/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.24

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.86	18.10
Riser Pipe	0	17.24
Top of Seal	6.90	10.34
Top of Filter Pack	7.90	9.34
Top of Screen	9.90	7.34
Base of Screen	24.90	-7.66
End Cap	25.90	-8.66
Total Depth	25.90	-8.66

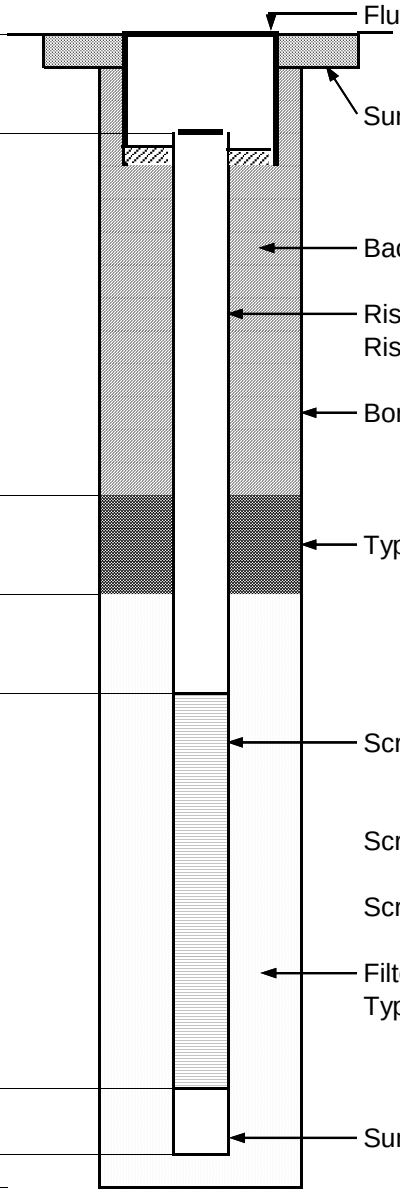


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-7D	
Client:	de maximis, inc.	**Date:**	1/14/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.14

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-0.95	18.09
Riser Pipe	0	17.14
Top of Seal	7.50	9.64
Top of Filter Pack	8.50	8.64
Top of Screen	10.50	6.64
Base of Screen	25.50	-8.36
End Cap	26.50	-9.36
Total Depth	26.50	-9.36

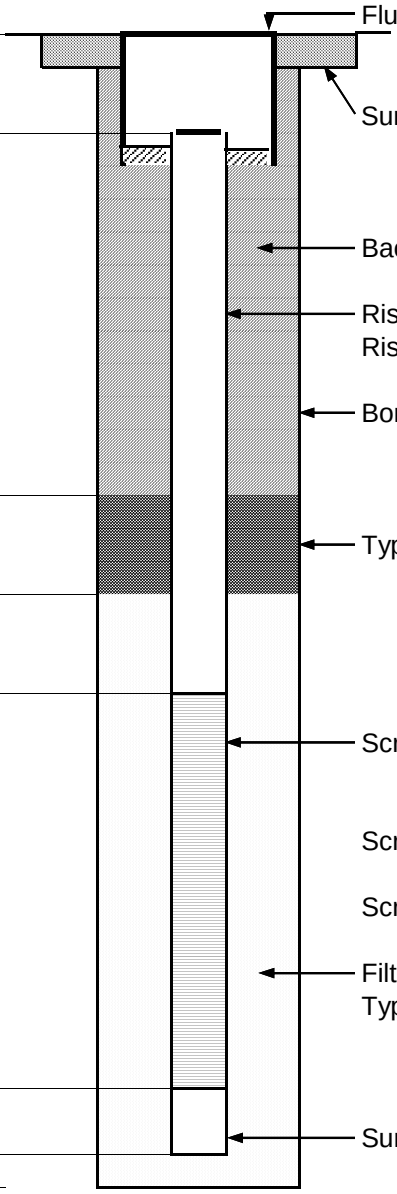


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-8A	
Client:	de maximis, inc.	**Date:**	1/14/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 22.42

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	23.42
Riser Pipe	0	22.4
Top of Seal	11.09	11.32
Top of Filter Pack	12.09	10.32
Top of Screen	14.09	8.32
Base of Screen	29.09	-6.68
End Cap	30.09	-7.68
Total Depth	30.09	-7.68

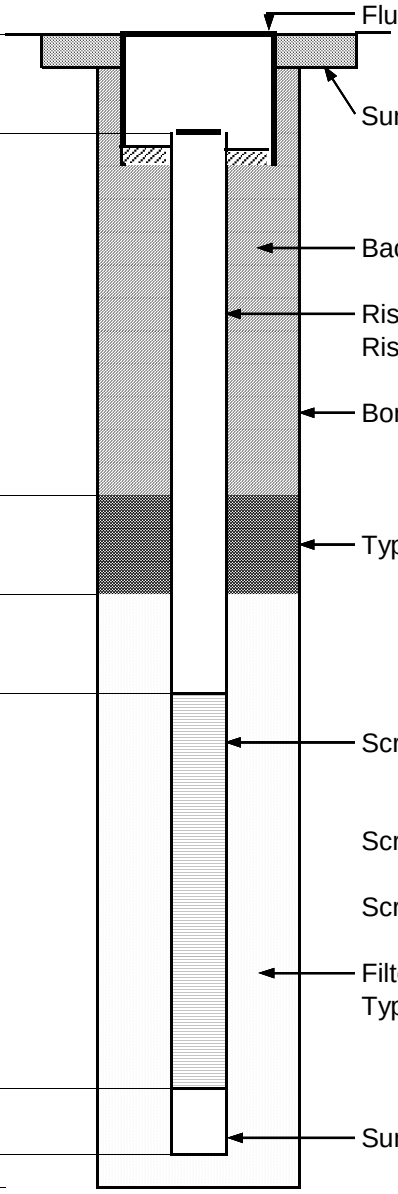


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-8B	
Client:	de maximis, inc.	**Date:**	12/30/2014	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.99

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	18.99
Riser Pipe	0	17.99
Top of Seal	7.76	10.23
Top of Filter Pack	8.76	9.23
Top of Screen	10.76	7.23
Base of Screen	25.76	-7.77
End Cap	26.76	-8.77
Total Depth	26.76	-8.77

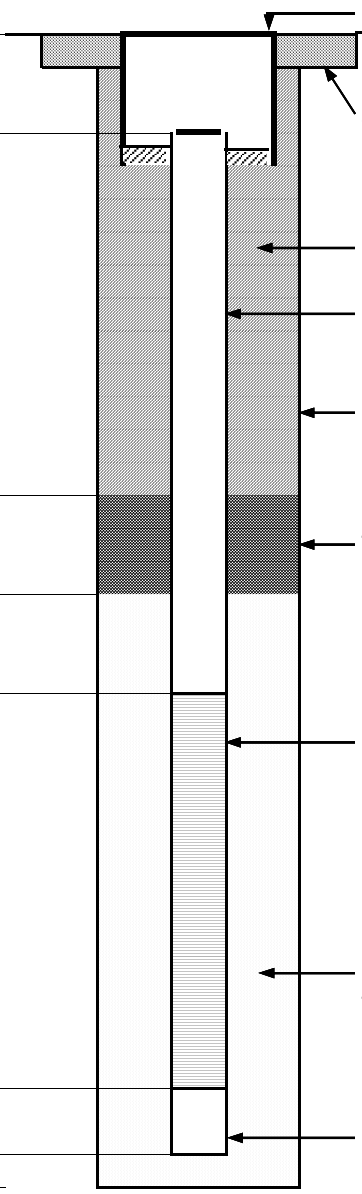


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-8C	
Client:	de maximis, inc.	**Date:**	1/2/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 16.9

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.18	18.08
Riser Pipe	0	16.9
Top of Seal	6.20	10.70
Top of Filter Pack	7.20	9.70
Top of Screen	9.20	7.70
Base of Screen	24.20	-7.30
End Cap	25.20	-8.30
Total Depth	25.20	-8.30

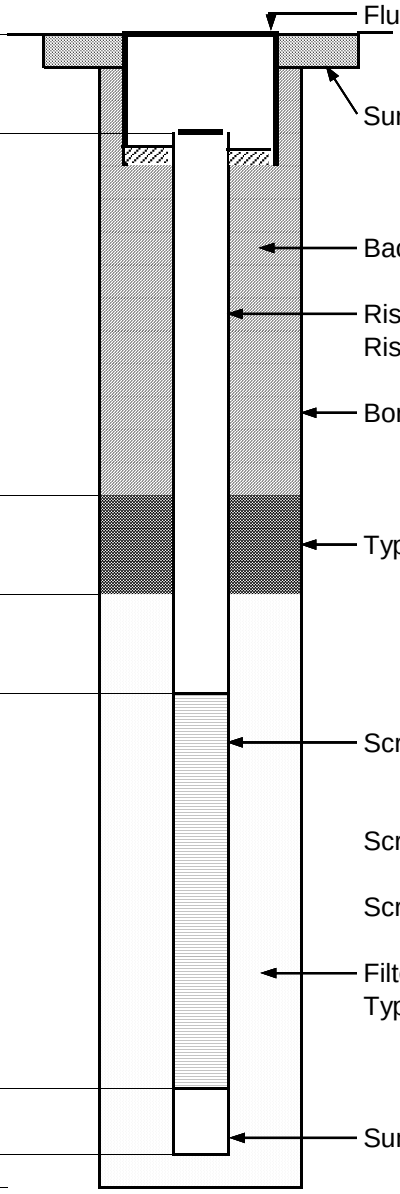


Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

Amec Foster Wheeler Environment & Infrastructure				FLUSHMOUNT OVERBURDEN RECOVERY WELL
Project:	Review Avenue Development Sites	**Well ID:**		
Project No:	3480140433		S-8D	
Client:	de maximis, inc.	**Date:**	1/14/2015	**Subcontractor:** ADT
Drilling Method:	Hollow Stem Auger			**Measuring Point**
Development Method:	Surging			**Type:** Top Of Riser
Bucking Posts:	N/A			**Elevation (ft):** 17.12

Item	Depth, below Measuring Point (ft)	Elevation (ft)
Top of Vault	-1.00	18.12
Riser Pipe	0	17.12
Top of Seal	-0.30	17.42
Top of Filter Pack	0.70	16.42
Top of Screen	2.70	14.42
Base of Screen	17.70	-0.58
End Cap	18.70	-1.58
Total Depth	18.70	-1.58



Description	
Flushmount Diameter:	2' x 2' Square
Surface Seal Type:	Asphalt
Backfill/Grout Type:	Cement
Riser Pipe Type:	Sch 40 PVC
Riser Pipe Diameter:	4 inches
Borehole Diameter:	8.5 inches
Type of Seal:	Bentonite
Screen Type:	4" Ø PVC
Screen Slot Size:	0.020"
Screen Length:	15 feet
Filter/Sand Pack Type:	FilPro #00N Silica Sand
Sump:	1'

Notes:

APPENDIX I

Initial PCB Data

Client ID	S-2C		
Lab Sample ID	460-88367-22		
Sampling Date	12/23/2014 14:15:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	0.17	U	0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	6.3		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	6.3		0.28

Client ID	S-2B		
Lab Sample ID	460-88367-23		
Sampling Date	12/23/2014 14:00:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	0.17	U	0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	0.17	U	0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	0.28	U	0.28

Client ID	S-2A		
Lab Sample ID	460-88367-21		
Sampling Date	12/23/2014 13:25:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	S-3A		
Lab Sample ID	460-88367-18		
Sampling Date	12/23/2014 13:35:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	S-3B		
Lab Sample ID	460-88367-15		
Sampling Date	12/23/2014 12:50:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	S-3C		
Lab Sample ID	460-88367-16		
Sampling Date	12/23/2014 13:50:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.34	U	0.34
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.34	U	0.34
Aroclor 1248	0.34	U	0.34
Aroclor 1254	0.34	U	0.34
Aroclor 1260	0.34	U	0.34
Aroclor 1268	0.57	U	0.57
Aroclor-1262	0.57	U	0.57
Polychlorinated biphenyls, Total	0.57	U	0.57

Client ID	S-1C		
Lab Sample ID	460-88367-19		
Sampling Date	12/23/2014 12:30:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.34	U	0.34
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.34	U	0.34
Aroclor 1248	0.34	U	0.34
Aroclor 1254	0.34	U	0.34
Aroclor 1260	0.34	U	0.34
Aroclor 1268	0.57	U	0.57
Aroclor-1262	0.57	U	0.57
Polychlorinated biphenyls, Total	0.57	U	0.57

Client ID	S-1B		
Lab Sample ID	460-88367-20		
Sampling Date	12/23/2014 12:40:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	TF-1C		
Lab Sample ID	460-92207-1		
Sampling Date	03/25/2015 10:20:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.16	U	0.16
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	0.16	U	0.16
Aroclor 1248	0.16	U	0.16
Aroclor 1254	0.16	U	0.16
Aroclor 1260	0.16	U *	0.16
Aroclor 1268	0.27	U	0.27
Aroclor-1262	0.27	U	0.27
Polychlorinated biphenyls, Total	0.27	U	0.27

Client ID	S-3E		
Lab Sample ID	460-88367-17		
Sampling Date	12/23/2014 13:45:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	TF-1B		
Lab Sample ID	460-92207-2		
Sampling Date	03/25/2015 10:35:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.16	U	0.16
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	0.16	U	0.16
Aroclor 1248	0.16	U	0.16
Aroclor 1254	0.16	U	0.16
Aroclor 1260	0.16	U *	0.16
Aroclor 1268	0.27	U	0.27
Aroclor-1262	0.27	U	0.27
Polychlorinated biphenyls, Total	0.27	U	0.27

Client ID	TF-1A		
Lab Sample ID	460-88367-14		
Sampling Date	12/23/2014 11:40:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	TF-2C		
Lab Sample ID	460-88367-11		
Sampling Date	12/23/2014 11:50:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	17		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	17		0.56

Client ID	TF-2B		
Lab Sample ID	460-92207-3		
Sampling Date	03/25/2015 10:45:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.16	U	0.16
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	0.16	U	0.16
Aroclor 1248	0.16	U	0.16
Aroclor 1254	0.16	U	0.16
Aroclor 1260	5.1	*	0.16
Aroclor 1268	0.27	U	0.27
Aroclor-1262	0.27	U	0.27
Polychlorinated biphenyls, Total	5.1		0.27

Client ID	TF-2A		
Lab Sample ID	460-88367-10		
Sampling Date	12/23/2014 11:30:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	TF-3A		
Lab Sample ID	460-93882-2		
Sampling Date	04/27/2015 13:10:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.16	U *	0.16
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	0.16	U	0.16
Aroclor 1248	0.16	U	0.16
Aroclor 1254	0.16	U	0.16
Aroclor 1260	0.16	U *	0.16
Aroclor 1268	0.27	U	0.27
Aroclor-1262	0.27	U	0.27
Polychlorinated biphenyls, Total	0.27	U	0.27

Client ID	TF-3B		
Lab Sample ID	460-88367-9		
Sampling Date	12/23/2014 11:10:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.34	U	0.34
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	8.9		0.34
Aroclor 1248	0.34	U	0.34
Aroclor 1254	0.34	U	0.34
Aroclor 1260	2.0		0.34
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	11		0.56

Client ID	TF-3C		
Lab Sample ID	460-88367-8		
Sampling Date	12/23/2014 10:55:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	18		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	4.9		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	23		0.56

Client ID	TF-4A		
Lab Sample ID	460-88367-4		
Sampling Date	12/23/2014 10:15:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	TF-4B		
Lab Sample ID	460-88367-5		
Sampling Date	12/23/2014 10:25:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	5.3		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	5.8		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	11		0.56

Client ID	TF-5B		
Lab Sample ID	460-88367-2		
Sampling Date	12/23/2014 09:50:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.34	U	0.34
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.34	U	0.34
Aroclor 1248	0.34	U	0.34
Aroclor 1254	0.34	U	0.34
Aroclor 1260	1.5	J	0.34
Aroclor 1268	0.57	U	0.57
Aroclor-1262	0.57	U	0.57
Polychlorinated biphenyls, Total	1.5	J	0.57

Client ID	TF-5A		
Lab Sample ID	460-88367-3		
Sampling Date	12/23/2014 10:00:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	0.33	U	0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	0.33	U	0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	0.56	U	0.56

Client ID	TF-1D		
Lab Sample ID	460-88367-13		
Sampling Date	12/23/2014 12:15:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	9.9		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	9.6		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	20		0.56

Client ID	TF-2D		
Lab Sample ID	460-88367-12		
Sampling Date	12/23/2014 12:00:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	18		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	14		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	31		0.56

Client ID	TF-7A		
Lab Sample ID	460-89644-2		
Sampling Date	01/23/2015 10:05:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	3.4		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	4.4		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	6.9		0.28

Client ID	TF-6A		
Lab Sample ID	460-89644-1		
Sampling Date	01/23/2015 08:30:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	9.2		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	11		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	20		0.28

Client ID	TF-7B		
Lab Sample ID	460-89644-4		
Sampling Date	01/23/2015 09:40:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	8.0		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	12		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	20		0.28

Client ID	TF-6B		
Lab Sample ID	460-89644-3		
Sampling Date	01/23/2015 09:50:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.16	U	0.16
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	17		0.16
Aroclor 1248	0.16	U	0.16
Aroclor 1254	0.16	U	0.16
Aroclor 1260	13		0.16
Aroclor 1268	0.27	U	0.27
Aroclor-1262	0.27	U	0.27
Polychlorinated biphenyls, Total	30		0.27

Client ID	TF-7C		
Lab Sample ID	460-93882-1		
Sampling Date	04/27/2015 12:45:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.16	U *	0.16
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	0.16	U	0.16
Aroclor 1248	0.16	U	0.16
Aroclor 1254	0.16	U	0.16
Aroclor 1260	0.16	U *	0.16
Aroclor 1268	0.27	U	0.27
Aroclor-1262	0.27	U	0.27
Polychlorinated biphenyls, Total	0.27	U	0.27

Client ID	TF-6C		
Lab Sample ID	460-89644-5		
Sampling Date	01/23/2015 11:10:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	9.1		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	11		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	20		0.28

Client ID	TF-3D		
Lab Sample ID	460-94094-1		
Sampling Date	04/30/2015 07:25:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	21		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	16		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	37		0.28

Client ID	TF-7D		
Lab Sample ID	460-89644-6		
Sampling Date	01/23/2015 10:45:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.22	U	0.22
Aroclor 1232	0.26	U	0.26
Aroclor 1242	11		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	13		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	24		0.28

Client ID	TF-6D		
Lab Sample ID	460-89644-7		
Sampling Date	01/23/2015 10:30:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	30		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	22		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	52		0.56

Client ID	TF-4D		
Lab Sample ID	460-88367-7		
Sampling Date	12/23/2014 10:45:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	30		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	15		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	45		0.56

Client ID	TF-7E		
Lab Sample ID	460-89644-8		
Sampling Date	01/23/2015 10:55:00		
Matrix	Waste		
Dilution Factor	1		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.17	U	0.17
Aroclor 1221	0.21	U	0.21
Aroclor 1232	0.25	U	0.25
Aroclor 1242	20		0.17
Aroclor 1248	0.17	U	0.17
Aroclor 1254	0.17	U	0.17
Aroclor 1260	17		0.17
Aroclor 1268	0.28	U	0.28
Aroclor-1262	0.28	U	0.28
Polychlorinated biphenyls, Total	37		0.28

Client ID	TF-7F		
Lab Sample ID	460-89873-1		
Sampling Date	01/30/2015 11:00:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.42	U	0.42
Aroclor 1232	0.50	U	0.50
Aroclor 1242	27		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	9.8		0.33
Aroclor 1268	0.55	U	0.55
Aroclor-1262	0.55	U	0.55
Polychlorinated biphenyls, Total	36		0.55

Client ID	TF-5D		
Lab Sample ID	460-88367-24		
Sampling Date	12/23/2014 09:25:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	30		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	14		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	43		0.56

Client ID	TF-5C		
Lab Sample ID	460-88367-1		
Sampling Date	12/23/2014 09:40:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.34	U	0.34
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	27		0.34
Aroclor 1248	0.34	U	0.34
Aroclor 1254	0.34	U	0.34
Aroclor 1260	15		0.34
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	42		0.56

Client ID	TF-4C		
Lab Sample ID	460-88367-6		
Sampling Date	12/23/2014 10:35:00		
Matrix	Waste		
Dilution Factor	2		
Unit	mg/kg		
GCSVOA-8082A-WASTE	Result	Q	MDL
WASTE BY 8082A			
Aroclor 1016	0.33	U	0.33
Aroclor 1221	0.43	U	0.43
Aroclor 1232	0.51	U	0.51
Aroclor 1242	29		0.33
Aroclor 1248	0.33	U	0.33
Aroclor 1254	0.33	U	0.33
Aroclor 1260	7.7		0.33
Aroclor 1268	0.56	U	0.56
Aroclor-1262	0.56	U	0.56
Polychlorinated biphenyls, Total	37		0.56

DRAFT

0 20 40 80
SCALE: 1" = 40'

REV.	DATE	STATUS	PRPD BY	CHKD BY

MACTEC PROJECT No. 3480130369
DRAWING: 3480140433-0107-C102-CB20

PREPARED/DATE: STR 12/18/2015

CHECKED/DATE: MS 12/18/2015

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FIGURE 1
PCB DATA
REVIEW AVENUE DEVELOPMENT SITES
RAD I AND RAD II
LONG ISLAND CITY, QUEENS, NY 11101