New York City Taxi of Tomorrow RFI

Appendix 1

Vehicle Technical Specification (VTS)

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1. Executive Summary

1.1 Engineering the Taxi of Tomorrow

It is clear that the current approach of an after-market adaption of existing vehicles does not provide an optimal solution to the needs of the stakeholders. However, it should be understood that the ability of the target vehicles to meet the specifications requested by the Advisory Committee is driven by a number of factors:

- The availability of existing engineering solutions from the vehicle supplier.
- The ability of the manufacturer to adapt the vehicle without compromising other existing safety or durability criteria.
- The ability of the target platform to be recognized as an 'iconic' NYC cab – i.e. one that is recognizable as a symbol of New York by more than just its color.
- The cost and timing of integrating the development and sign-off of an engineering solution into the manufacturers product plan.
- The tooling investment required for both components and assembly, particularly given the low projected volume for this vehicle.

These factors must all be considered when reviewing the solutions offered by the manufacturers. Once the best vehicles(s) have been identified, it may be necessary to adapt these specifications in order to limit the engineering cost and from that, the market price of the final vehicle.

In order to help this, Ricardo has contracted Smart Design to provide a Taxi Solutions document that provides additional information on ways that the objectives of the Taxi of Tomorrow might be achieved. This document is provided in Appendix 2 of the RFI.

1.2 Function of the Vehicle Technical Specification

This VTS summary is intended to provide an overview of the requirements of the Taxi of Tomorrow that are expected to differ significantly from the duty or performance specification expected from the donor vehicle.

- The **VTS** is the top level of a structured set of requirements maintained by vehicle manufacturers to identify the engineering sign-off requirements of a vehicle. Below the VTS, there are Sub-System Technical Specifications (SSTS) and Component Technical Specifications (CTS) which are designed to support the VTS, and which define in much more detail the specifications for lower level parts.
- The **VTS** operates at a 'whole vehicle' level, and represents the interaction of the user with the vehicle.
- The **SSTS** operates at the sub-system level – it defines the interactions between various components in the system.
- The **CTS** represents the lowest level of specification, and identifies specific characteristics of the individual items in the sub-system.
- There is a certain amount of crossover between the specifications – it is by no means guaranteed that particular CTS will meet all of the requirements of a modified VTS.

1.3 Stakeholder Survey

At the end of 2007, a survey was circulated to the Taxi of Tomorrow Advisory Committee to identify the most important stakeholder requirements for the vehicle. Listed below are items prioritized as most important. As you read this document, please bear in mind the following questions in addition to stakeholder priorities.

- Do you believe there are products that already meet the proposed specifications?
- Can you meet these specifications? How do you propose to meet them?
- Do you feel these goals are complementary or are there conflicts among them?
- What roadmap or timeline, including incremental steps, would you recommend to achieve or exceed these goals?

1.3.1 Owners

Cost-of-ownership over the vehicle life must be no more than current vehicles. While it is understood that the vehicle itself may be more expensive, this needs to be offset by reduced service, repair and fuel costs, higher resale vale or adjustments to the current fare structure.

Reduced insurance costs, particularly related to personal injuries and body / frame repair costs.

Replacement parts for both service and repair must be readily obtainable to ensure minimum downtime.

1.3.2 Drivers

Improved cabin ergonomics; ‘office’ environment with work and storage areas; improved peripheral visibility with fewer blind spots; better seating with more adjustability and no restrictions on position due to the partition. Integrated taximeter and taxi-specific controls, improvements to the partition.

1.3.3 Passengers

Improved ease of entry and egress; separate HVAC / ventilation system for rear cabin; improved rear crash safety, vision system to reduce risk when exiting, improved ride quality, configurable cabin with additional luggage storage. Improved identification of cab status (available, off duty, etc).

1.3.4 Disabled Passengers

Different options for people with limited mobility or other conditions (service animal location, turn-out seats, improved control operation).

1.3.5 TLC / Mayor’s Office

A minimum of 25 mpg city fuel economy from Oct 2008 (30 mpg from Oct 2009); 100% ADA compliant fleet. Reduced pollutant emissions and physical footprint; greater recycled content; easier end-of-life recycling.

1.3.6 Public-Space Users

Reduced impact injury to pedestrians and cyclists; reduced physical footprint; reduced emissions and improved air quality.

Given how all of these perspectives fit together, TLC is interested in responses that outline the best way to achieve these goals, including what benefits a partner in this endeavor would need from New York City to participate in this project.

2. Vehicle Technical Specification

2.1 Applicable Documents

In addition to existing documents, TLC and New York City regulations and legal documents must be considered. The expected order of precedence is as follows:

- Federal documents
- State Documents
- **NYC and TLC documents**
- Manufacturer Documents
- Industry Documents
- Supplier Documents

2.2 Environmental Variables

The environmental parameters for a taxi (temperature, humidity, pressure, precipitation, dust levels etc) in the NYC area are within the operating range of a typical automobile released for the US market.

All taxi-specific components must meet the same specifications for environmental exposure as the original vehicle.

The vehicle environmental specifications shall not be reduced by the addition of taxi-specific components.

Environmental parameters to be considered should include:

- Temperature
- Relative humidity
- Atmospheric pressure
- Rain
- Snow
- Hail
- Wind
- Electromagnetic interference and immunity

The manufacturer shall provide a list of specifications used to validate the original vehicle.

2.3 Contaminants

The vehicle must be resistant to fluids typically encountered during its manufacture and service life.

The manufacturer shall provide a list of contaminants that have been tested and the areas of the vehicle on which they were evaluated (exterior, underbody, interior, etc)

A sample list is shown in the table below:

Contaminant	Specification	Vehicle location	Resistance specification
Engine oil			
Transmission fluid			
Axle / differential oil			
Grease			
Brake fluid			
Power steering fluid			
Hydraulic oil			
Coolant blends			
Gasoline			
Diesel fuel			
Fuel additives			
A/C refrigerant			
Washer fluid			
Battery acid			
Chewing gum			
Beverages (soda, coffee, etc)			
Cleaning solvents (carpet and trim)			
Cleaning products (external)			
Car wash chemicals			
Organic materials (sap, animal waste, mold)			
Road repair and maintenance (dust and ice inhibitors)			

2.4 Taxi-Specific Equipment

The NYC taxi must be fitted with a variety of specific equipment mandated by the TLC.

With the exception of some features that have been made available as a taxi package from manufacturers, (seat trim, paint color, pre-wired for roof light and accessories), the modification (or 'hack-up') is currently carried out by third party companies and meter shops licensed by the TLC.

The intent of the Taxi of Tomorrow is to provide **all** of the taxi-specific content as part of the vehicle as supplied by the manufacturer.

If taxi-specific content is not supplied as part of the base vehicle package, appropriate electrical and mechanical interfaces must be provided.

Regardless of whether the taxi-specific equipment is supplied as part of the original vehicle specification, the manufacturer shall design the location and mounting method of

such equipment so that mechanical, electrical, ergonomic and safety criteria for the vehicle are not compromised by the fitment of such equipment.

The vehicle with all taxi-specific equipment fitted must meet all Federal, State and NYC legislative requirements for a passenger vehicle used for hire on public roads in New York City.

Final fitting of taxi-specific content, if not carried out by the manufacturer, will preferably be carried out by companies based in New York City.

2.4.1 Fare Box (taximeter)

The fare box must meet NIST (National Institute of Standards and Technology) and New York State Department of Agriculture standards. It should be fitted in such a way that it does not interfere with visual or tactile contact with any of the other vehicle controls, limit the effectiveness or operation of secondary restraint systems or obstruct access to airflow from air registers in the vicinity. The meter or fare box controls shall be accessible to the driver without removing his/her safety belt. Receipts should be available to the passengers from his/her seated location.

2.4.2 Taxi 'Status' Light

The vehicle shall be fitted with an indicator on the roof to clearly indicate the taxi status. The design of the revised roof light will incorporate improved visibility of the taxi status ('off duty' or 'for hire') by people seeking to hire the cab and other road users, and improved communication of driver intent for other road users and supplementary turn signal lamps when compared to the current roof light and turn signal package.

The indicator shall be integrated into the 'iconic' package content in such a way as to minimize its impact on aerodynamic drag and fuel economy.

Further discussions on the design and implementation of a suitable system are provided in **Appendix 2.**

2.4.3 Driver Safety Communication System

The vehicle shall be fitted with a mechanism for the driver to communicate personal safety issues to law enforcement personnel without attracting the attention of the passenger. If an externally mounted signaling system is used, it must be designed to minimize injury to other road users in the event of impact.

2.4.4 TLC Signage

The vehicle shall be fitted with TLC graphics, including medallion number and NYC Taxi logo. Details of the graphics requirements can be found in the TLC Rules and Regulations.

2.4.5 Paint Color

Paint color should be a distinctive shade of yellow. The paint finish must not be affected by application or removal of TLC graphics applied to the outside of the vehicle. Paints should be water based and meet all applicable regulations. TLC is open to altering the shade of yellow that is currently used.

2.4.6 Driver and Passenger Safety

The vehicle shall be fitted with a security system that provides a positive contribution to the overall safety of the driver and passengers.

The system shall meet the following objectives:

- Provides a physical barrier (either fixed or deployable) separating the driver and passenger, or a deterrent system to limit the possibility of a passenger assaulting the driver.
- Must not interfere with existing secondary safety systems.
- Does not increase the risk of injury to driver or passengers in the event of a crash.
- Has minimum impact on driver-passenger communications.
- Does not restrict passenger forward or drivers rearward visibility.

2.4.7 Media, Payment and Location Technology Package

The vehicle shall be prepared to be fitted with a taxi technology package similar in scope to those currently specified by TLC. At present, this includes a partition-mounted passenger screen, GPS receiver, cell phone link, credit card reader and taximeter interface. The system provides the following functions:

- Credit card payment system.
- Automatic Driver trip log with GPS position and taximeter interface.
- GPS position information for passenger.
- Targeted advertising and news feeds from third party content providers.

2.4.8 Upholstery and Floor Covering

The vehicle shall be fitted with upholstery and flooring that is easy to maintain and clean, while providing a comfortable and inviting interior consistent with the design goals for the iconic taxi (see **Appendix 2 – Smart Design**).

2.4.9 Communication of Driver and Vehicle Licensure

TLC vehicle ID, contact information and driver's license must be visible to the passenger from the back seat.

2.4.10 Driver Work Area

The drivers seating area shall be provided with administrative facilities which shall include the following:

- Work surface at least 300x275 mm. The surface may be storable if required, but must not interfere with operation of the vehicle or its safety systems if the vehicle is capable of being operated with the work surface deployed. Intrusion of the work surface into the front passenger seating area while the vehicle is not operating is permissible.
- Lockable storage bin for personal possessions, paper files and writing implements.
- A minimum of two 12v electrical outlets with attached lockable storage capacity for cell phones, pagers, etc.
- Insulated compartment for food and beverages – may be removable and or electrically powered.
- All storage compartments and work area shall be illuminated under the control of the driver

Other suggestions for driver work area features are welcome; a further discussion of this topic can be found in **Appendix 2**.

2.5 ADA Accessible Vehicles

One goal being explored through this project is a single-model taxi fleet that is 100% ADA-compliant. Currently, mobility needs are not being met sufficiently. TLC is looking for manufacturers to propose solutions that would lead to universal accessibility for all users with the goal of meeting ADA guidelines for wheelchair access. TLC is also interested in accessibility strategies for improved mobility if the fleet cannot be 100% accessible or for full wheelchair accessibility that may not meet all ADA specifications.

It is realized that the additional weight and frontal area of a fully compliant vehicle may conflict with other goals outlined in this document. TLC recognizes the trade-offs that may be necessary to attain wheelchair accessibility and is interested in proposed solutions. At present, third party companies carry out typical conversions for disabled access, but frequently only make limited accommodation for the structural integrity of the original vehicle while adding significant weight.

For all mobility enhancement solutions, the modifications made to the vehicle should be engineered by the manufacturer and integrated into the original manufacturing process. Designs should take account of ease of entry and exit, as well as protection for wheelchair users in the event of a vehicle crash.

2.5.1 Wheelchair Access

Fully ADA compliant ('Accessible') vehicles must meet the requirements of **CFR49.37-38**, the Architectural and Transportation Barriers Compliance Board (**CFR 36, section 1192.23** et seq.), and FMVSS regulations in **CFR49.571**.

A standard wheel chair is 30 inches wide.

2.5.2 Partial Mobility Users

The TLC would like to explore additional options for less-able users, such as turnout seats and wheelchair storage. The design and implementation of these features is at the discretion of the manufacturer; all designs must be approved by the TLC.

Door and window handles should be designed to accommodate users with strength issues.

2.5.3 Blind or Partially-Sighted Users

All operating controls shall be individually identifiable by unique shape, color or Braille identification.

The rear floor of the vehicle shall be large enough to accommodate a large sized service animal in place of a third passenger.

A key orientation attribute for visually impaired passengers is the sound as the vehicle approaches. Given that hybrid vehicles may be running on electric power as they slow down to pick up a fare, the TLC is interested in possible ways to improve this situation for visually impaired passengers.

2.5.4 Service Animals

The floor of the vehicle reserved for service animals shall be designed to have a maximum surface temperature of 30 deg c.

2.6 Vehicle Configuration

2.6.1 Vehicle Cabin Layout

The vehicle must be capable of seating 4 passengers in addition to the driver, with three of the passengers seated behind the driver.

One of the plaNYC initiatives is to reduce the footprint of vehicles on the road – in order to achieve this, a study has been undertaken by Smart Design to develop new paradigms for vehicle internal design. The study is presented in **Appendix 2**. The TLC is interested in reviewing manufacturers' designs for achieving these objectives and is happy to consider different opportunities for improving internal package space provided this does not compromise the safety of the occupants or other road users.

The vehicle shall be fitted with two front and two rear doors. The rear doors may be hinged or sliding.

The luggage area for the vehicle may be integrated into the cabin, or separated from it. If integrated into the cabin, provision shall be made for protecting passengers from luggage movement during a crash.

2.6.2 Powertrain

Taxis represent up to 50% of the traffic in Manhattan; to a certain extent, they control the pace of traffic in the city. In order to provide the improvements to air quality and fuel consumption mandated by plaNYC, it will be necessary to match the power output of the taxi fleet to its operating environment.

When identifying a powertrain for the Taxi of Tomorrow, the following points should be considered:

- The vehicle can use any propulsion system that meets all federal, state and New York City emissions / fuel economy requirements.
- Within these constraints, there is no limitation on the type of engine, aftertreatment system or hybrid technology that can be employed for the taxi.
- When specifying a vehicle for taxi usage, the TLC will review not only the local environment in terms of CO2 emissions and air quality, but also the longer-term manufacture and disposal impact of technologies proposed to improve fuel economy ratings.
- The fuel supply for the taxi fleet is largely under the control of the fleet garages – the use of specific types or grades of fuel to maintain emissions compliance should be considered if the non-availability of a specific type of fuel would eliminate an otherwise viable candidate powertrain technology.
- About 30% of the taxi fleet is operated out of a fixed location and returns there every 12 hours to refuel and change drivers. There are opportunities in this scenario for vehicles that have a reliance on consumable products or reduced maintenance intervals for aftertreatment systems, provided the service or maintenance can be carried out in a minimal amount of time when the vehicle is refueling and other fluid checks are being performed.

2.6.3 Vehicle Transmission and Driveline

The vehicle shall be fitted with a transmission with the ability to change gear automatically after the initial selection of a driving mode by the operator. Any form of automatically shifted or continuously variable transmission can be considered, provided the manufacturer can demonstrate that it meets the durability and service life requirements for NYC taxi use.

The vehicle may be front, rear or all-wheel drive.

2.7 Performance

Maximum speed **55-70 mph.**

As most taxis are resold into markets where the speed limit is higher the 55 mph limit in NY State, provision for resetting the speed limiter should be considered.

2.7.1 0-60mph Acceleration

Minimum: 10 seconds.

Maximum: 12 seconds.

2.7.2 Fuel Economy (revised city cycle)

From October 2008: minimum **25 mpg.**

From October 2009: proposed **30 mpg.**

2.7.3 Operating Range

200 – 250 miles.

2.8 Dimensions and Capacities

With the exception of the items stated below, the dimensions and capacities for the vehicle are at the discretion of the manufacturer. The manufacturer shall demonstrate that dimensions and capacities not stated here are sufficient to permit the vehicle to be operated as a NYC taxi without any degradation to its conditions of operation or effective range while meeting the objectives of the Taxi of Tomorrow advisory committee (see section 2).

A full list of standard measurements used by the manufacturer to characterize the vehicle and the standards used to determine them shall be provided as part of the RFI submission.

2.8.1 Fuel Tank Capacity

The fuel tank shall provide the vehicle with a minimum operating range of **200 miles** from a full tank to the point that a low fuel indication or specific fuel gauge marking indicates the need to refuel.

The vehicle shall be capable of normal operation for an additional range of **30-50 miles** after this point is reached.

The provision of a larger fuel tank to increase the range further is of limited benefit, as the taxi is usually returned to the garage to change drivers at the end of each shift, where it is refueled. A larger fuel tank therefore increases the weight of the vehicle without taking advantage of the increased range that this would afford.

2.8.2 Windshield Washer Fluid Capacity

The vehicle shall have a windshield washer reservoir capacity of at least **5 liters**. If a separate rear washer is fitted, it shall have a minimum capacity of **2 liters**.

If the vehicle is fitted with a headlamp wash system, the capacity of the front reservoir shall be increased by **25%**.

The vehicle shall be fitted with a warning system to indicate the need to replenish the fluid. The recommended trigger level is **0.5-0.75 liters**; the front reservoir system must be designed to accept the contents of a retail one-gallon washer fluid bottle without overflowing, once the warning lamp has been illuminated.

2.8.3 Seating Capacity

The vehicle must be capable of seating **four** passengers plus the driver. The vehicle must be capable of seating **three** passengers **behind** the driver. Any additional space that would otherwise be used for passengers shall be converted for use as luggage space.

2.8.4 Interior Dimensions - Front Compartment

Front seat dimensions are complicated by the position of the steering wheel and pedals – mfr's specified dimensions will be used with the exception of the following:

With the front seat adjusted to the manufacturer-specified Seating Reference Point (SgRP) per SAE J1100 and all taxi-specific content fitted, the front compartment of a sedan approved for use as a taxicab shall meet the following requirements:

Dimension	SAE Ref	Limit (mm)	Target (mm)	Notes
Front Head-Room	H61	986	1016	The distance along a line 8 degrees rear of vertical from the SgRP to the headlining, plus 102 mm.
Front Shoulder room	W3-1	1486	1525	The minimum cross car distance between the trimmed door or quarter trim surfaces within the measurement zone. The zone lies between the beltline and 254 mm above SgRP, on the X plane through SgRP.
Front Hip Room	W5	1422	1473	The minimum cross car distance between the trimmed door or quarter trimmed surfaces within the measurement zone. The zone extends 25 mm below and 76 mm above SgRP, and 76 mm fore and aft of SgRP. If any portion of this 101 mm by 152 mm area is obstructed by the seat, it is excluded. If the area is totally obstructed by the seat, then measure to the unobstructed trimmed surfaces closest to the SgRP location.
Front Leg Room	L51-1	1067	1145	The distance along a line from the ankle pivot center to the SgRP, plus 254 mm (10in), measured within 127 mm to either side of the occupant centerline, with the heel of shoe at FRP.

2.8.5 Occupant Compartment Storage

In addition to the trunk space, the vehicle shall have provision for storing **two 20" carry-on bags** in the rear cabin area **instead** of a third passenger.

The rear floor of the vehicle shall be large enough to accommodate a **large sized service animal in place of a third passenger**.

2.8.6 Interior Dimensions - Rear Compartment

For a standard seating layout, both second and third row passenger seats face forwards. In order to improve the package requirements for the Taxi of Tomorrow, the TLC is interested in exploring opportunities for revised seating layouts that retain the criteria stated below in a smaller external envelope (see **Appendix 2 - Smart Design**).

As the measurement definitions described in SAE1100 may be difficult to replicate with a face-to-face seating layout, some interpretation of the measurement criteria is expected if an alternate seating layout is implemented. However, the occupant comfort levels of this new layout shall be no less than the comfort levels experienced in a conventional seating layout with the dimensions specified below.

Dimension	SAE Ref	Limit (mm)	Target (mm)	Notes
Rear Head Room	H61-2	963	1016	The distance along a line 8 degrees rear of vertical from the SgRP to the headlining, plus 102 mm.
Rear Shoulder Room	W3-2	1499	1549	The minimum cross car distance between the trimmed door or quarter trim surfaces within the measurement zone. The zone lies between the beltline and 254 mm above SgRP, on the X plane through SgRP. The door assist strap is excluded.
Rear hip Room	W5-2	1422	1473	The minimum cross car distance between the trimmed door or quarter trimmed surfaces within the measurement zone. The zone extends 25 mm below and 76 mm above SgRP and 76 mm fore and aft of SgRP. If any portion of this 101 mm by 152 mm area is obstructed by the seat, it is excluded. If the area is totally obstructed by the seat, then measure to the unobstructed trimmed surfaces closest to the SgRP location.
Rear leg room	L51-2	1042	1200	The distance along a line from the ankle pivot center to the SgRP, plus 254 mm (10in). Measured within 127 mm to either side of the occupant centerline, with the heel of shoe at FRP.
Seat height	H30-1	305	330	The vertical distance from SgRP to the appropriate heel reference point. (AHP or FRP). Measure with floor mats if they are standard equipment.
Seat height to ground	N/A	585	660	Measured from the leading edge of the top of the seat cushion to the ground.
Tumblehome	A122	0º	12º	The angle from vertical of the door windows (outside surface). Measured on the X plane through SgRP. For curved side glass, measure to a chord extending from the upper DLO to the lower DLO.

Dimension	SAE Ref	Limit (mm)	Target (mm)	Notes
Entry foot Clearance	L19	204	254	The minimum horizontal distance between the trimmed front seat cushion or supporting structure and the trimmed door or pillar at a height between the sill plate bead and 102 mm (4 in) above the bead with the door in the maximum hold-open position.
Step-over Height	H115	330 - 400		The vertical distance from the top of the sill plate bead to ground, measured at the longitudinal center of the lower door opening. If there is a step, measurement is from the lowest step to the ground. No target specified.
Step in Height	N/A	130	0	Distance between the top of the sill plate bead and the foot well floor.
Wheel House to front of Seat	N/A	178	305	It should be possible to enter the vehicle without touching the leading edge of the wheelhouse.
Center Tunnel Width	N/A	360	0	Measured to first flat area of outboard foot wells at leading edge of seat. Design intent is to provide a flat floor if possible.
Center Tunnel Height	N/A	180	0	Measured to flat area on foot well on either side of tunnel. If the tunnel height is greater than 50mm, tunnel must have a flat top section a minimum of 360mm wide.
Seat to Door Vertical Clearance	N/A	737	788	Measured from the leading edge of the top of the rear seat cushion vertically to the top of the door opening.
Vertical Door Opening Height	N/A	965	1041	Measured vertically from the flat portion of door tread plate at the leading edge of the rear seat.

2.8.7 Cargo Compartment / Trunk

Dimension	SAE Ref	Limit (mm)	Target (mm)	Notes
Lift-Over Height	N/A	800	550	The distance from the highest point of the trunk load lip to the ground
Trunk lip height	N/A	180	0	The height from the highest point of the trunk load lip to the trunk floor.
Reach-in	N/A	270	50	The distance from the rearmost part of the bumper to the trunk load lip.
Cargo Volume Index	V1 / V2 / V3	566 liters	>625 liters	Approximate volume of cargo area – Max Length x Max width x Max Height

2.8.8 Ground Clearance

The vehicle must maintain a ground clearance of **127mm** at its laden (GVW) condition.

The clearance from an opened door to ground (**H132-1 and H132-2**) with the vehicle at its laden (GVW) condition shall be no less than **152mm.**

2.8.9 Weights and Weight Distribution

The manufacturer shall provide the following information for the vehicle in its final taxi configuration:

Parameter	SAE Ref	Value	Units
Vehicle Mass			
Length, overall	L108		
Height			
Wheelbase			
Width Overall to trim line	W103		
Width at Front Wheel arch			
Width at Rear Wheel arch			
Width at Mirror Tip			
Track - Front	W101-1		
Track -Rear	W101-2		
Base Curb Mass			
Certification Mass			
Maximum Gross Vehicle Mass Rating			
Maximum Percent Front Lightly Loaded			
Maximum Percent Front Heavily Loaded			
Maximum Percent Rear Lightly Loaded			
Maximum Percent Rear Heavily Loaded			
Aerodynamic properties			
Drag Area			
Coefficient of Drag			

2.9 Vehicle External Interfaces

Unless stated below, vehicle system interfaces shall be at the discretion of the manufacturer. Existing interfaces shall not interfere with or reduce the effectiveness of the taxi content.

2.9.1 Fuel Filler

The fuel filler and door opening shall meet the requirements of SAE J1140 – Filler pipes and openings of motor vehicle tanks.

Filler gun dimensions are defined by SAEJ285 – Gasoline dispenser nozzle spouts.

Filler interface must meet all New York State evaporative and safety standards.

The vehicle must be capable of being refueled to 'first click' (>95% capacity) with the filler gun oriented at any angle in the filler pipe under all operating conditions.

2.9.2 Fuel and Lubricant Service

The vehicle must be capable of having all consumable and service fluids changed without the use of special tools.

2.9.3 Service Station Hoists

When configured as a taxi, the vehicle must be able to be serviced using commercially available workshop equipment.

2.9.4 Towing

Configuring the vehicle as a taxi shall not affect its ability to be towed using commercially available vehicles.

The vehicle shall be towable with one axle off the ground.

2.9.5 Automated Car Wash

The vehicle must be engineered to use commercially-available automated car wash equipment.

The vehicle shall be designed to withstand **4000** automated wash cycles over its life cycle without deterioration to the paint or external fittings. Particular attention should be paid to sealing of penetrations (roof lamp, medallion mount) to prevent corrosion or water ingress.

2.10 Vehicle Human Interfaces

2.10.1 Driver Seat

The fitment of taxi-specific equipment shall not reduce the range of longitudinal or height adjustment of the seat. The seat recline function may be limited if a partition is fitted, but should retain a minimum of **30%** of its original angular operating range when the seat is adjusted fully rearwards.

2.10.2 Arm Rest

The vehicle shall be fitted with an outboard armrest for the driver and both outboard rear seat passengers.

2.10.3 Occupant Support Controls

The vehicle must be fitted with assist straps or grab handles adjacent to each rear door. The fitment of such devices must not interfere with the operation of the existing vehicle safety equipment.

2.10.4 Interior Trim

The vehicle should be designed to provide a welcoming environment for passengers, while being easy to clean. Manufacturers are encouraged to put forward suggestions for how to improve the interior presentation of the vehicle. Further discussion regarding improved interior systems can be found in **Appendix 2**.

All interior trim and upholstery materials shall be made of an impermeable material to facilitate cleaning and shall be resistant to common solvents, food products and human waste products.

All upholstery material must meet manufacturers' existing requirements for flammability and durability.

The rear seat of the taxi in particular is subject to increased wear over its life due to the number of entries and exits made from the vehicle.

Seat covers shall be designed to be user replaceable.

2.10.5 Ergonomics/Arrangement of Control Elements

The location identification and illuminations of all taxi-specific vehicle controls and displays must be operable and visible to a lap and shoulder belted driver.

2.10.6 Recognition of Operating Elements in the Dark

In addition to illumination of driver controls, all taxi-specific content provided by the vehicle manufacturer shall have controls that are illuminated when the headlamps are turned on.

Brightness of illuminated driver controls shall be controlled by the vehicle IP dimmer circuit.

Brightness of the rear passenger controls shall be independent of the dimmer circuit, and should always be visible to the rear seat passengers.

If the rear controls themselves are not illuminated, a task light can be used to illuminate the area of the controls.

All illuminated interior controls shall be designed to prevent reflections from the drivers seating position in window glass or partition vision panel (if fitted).

Further discussion regarding this feature can be found in **Appendix 2**.

2.10.7 Center Console / Dashboard

The dashboard area should include provision for the direct mounting of the fare box.

The box should be fitted in such a way that it does not interfere with visual or tactile contact with any of the other vehicle controls or obstruct access to, or flow from, air registers in the vicinity.

The fare box controls and receipt printer shall be accessible to the driver without removing his/her safety belt.

The fare box shall be mounted in a location that makes it easily visible by rear seat passengers.

Note: the fare box may also be mounted in an overhead location. If mounted in an overhead location, view through the rear view mirror must comply with the requirements of **FMVSS 111-V (**rear view mirrors).

The center console shall be fitted with a storage and work area package to enable the driver to carry out administrative tasks when the vehicle is parked. The system should include the following features:

- Work surface at least **300mm x275mm**. The surface may be storable if required, but must not interfere with operation of the vehicle or its safety systems if the vehicle is capable of being operated with the work surface deployed. Intrusion of the work

surface into the front passenger seating area while the vehicle is not operating is permissible.

- Lockable storage bin for personal possessions, paper files and writing implements.
- A minimum of two 12v electrical outlets with attached lockable storage capacity for cell phones, pagers, etc.
- Insulated compartment for food and beverages – may be removable and or electrically powered.
- All storage compartments and work area shall be illuminated under the control of the driver.

2.10.8 Door and window controls – rear cabin.

Interior door handles and lock buttons shall be clearly identifiable with their function and direction of operation (i.e. locked / unlocked, pull to open, etc). Such signage shall if possible be integrated into the door trim or bezel and shall not be affected by typical automotive cleaning solutions

Door and window controls shall be clearly identifiable at night without turning on another light.

2.10.9 Entry and Egress – Rear Passengers

The vehicle shall be easy to enter and exit without contacting any surrounding bodywork, particularly the leading edge or the rear wheel well.

If the vehicle is not ADA accessible, provision for fitting a turnout seat and additional entry aids (depending on the particular vehicle configuration) are desired. These provisions shall be designed as an integral part of the vehicle and shall be approved by the vehicle manufacturer. Stowing and deployment of these features must not have any negative impact on the occupant safety or vehicle durability.

The vehicle must be fitted with two rear doors.

The fitment of any ADA accessible options shall not have any negative impact on the use of secondary safety devices or the vehicle crash performance.

2.10.10 Interior Lighting

In addition to the existing cabin lighting, the vehicle shall be fitted with separate illumination for the rear seat passengers. Such illumination shall be operable from any rear seat location while wearing a seatbelt and shall not result in reduced rearward visibility due to glare or reflections for the driver.

The driver shall have an illumination system for their work area.

Further discussion regarding this topic can be found in **Appendix 2**.

2.10.11 Emergency Egress from the Vehicle

In the event of an accident, consideration should be given to means of emergency egress for drivers and rear passengers. While vehicle door systems are designed to retain the integrity of the body structure while still being operable after an accident, any partition or security device used in a taxi shall not hinder the escape of passengers or the driver from the vehicle in the event of in an accident.

It should be noted however that devices typically used in a private vehicle for emergency egress (combination glass hammer / seat belt cutter) if accessible for use in the event of an accident are (a) easy to steal, and (b) could be used as a weapon against the driver, and cannot therefore be considered as a suitable solution.

2.10.12 Trunk Access

The trunk shall be fitted with a remote release capability and a pull down handle or strap to allow the trunk to be closed without contacting the vehicle bodywork, which may be wet or dirty.

A remote close capability can be used provided adequate safety provisions exist to prevent injury to passengers in the event of an accidental operation of the closure device.

A vehicle fitted with an automatic closing device must have a clearly identified switch at the rear of the vehicle to activate the device with an override control at the driver location.

The trunk lid shall be fitted with a switch and lamp visible to the driver to indicate that the lid is not latched correctly.

The trunk interior should be illuminated.

2.10.13 Cabin Storage

The rear passenger cabin shall have provision for stowing a briefcase or handbag for each rear seat occupant (up to three) without impeding access to the seating location or leg / foot room.

While the cabin must be designed to accommodate three persons, seating locations that are not in use should be convertible to additional luggage space. When used as luggage space, luggage in that location shall not pose an injury risk to occupants in the event of an accident.

2.10.14 Fuses and Electrical Center

The electrical system must be designed to accommodate fused or breaker protected circuits for the taxi-specific content including, but not limited to:

- Roof light
- Trouble lights
- Additional roof-mount turn signals
- Taxi Technology package
- Taximeter
- Rear passenger

The vehicle shall be fitted with a warning system to indicate the non-operation of any externally mounted taxi-specific features that are not visible from the drivers seat.

Fuses or breakers used to control fare systems shall be tamperproof in accordance with TLC regulations.

Harnesses shall be designed and released by the vehicle manufacturer, based on data provided by the taximeter and technology package supplier. Harnesses shall retain the manufacturers rating safety factors used in the original vehicle, and shall be integrated into the vehicle during the assembly process.

The vehicle alternator shall be specified to provide adequate charging capability to maintain a positive state of charge at all times over the taxi duty cycle. The use of a higher power alternator or reduced pulley size on the existing component shall not affect the NVH performance of the vehicle.

2.10.15 Vision Panels, Visors and Sunshades

The minimum transmissibility allowed for the all window glass in a New York City taxi is **70%**, with the exception of the top 152mm of the windshield**.** Consideration should be

given for the fitment of side and rear screen shades to enhance passenger comfort, provided they comply with all laws and regulations and do not interfere with driver vision.

The fitment of a vision panel in the rear passenger compartment roof has been identified as a desirable feature. There is no requirement for the panel to be operable; however, if a panel is fitted, it shall have a provision for blocking or shading to limit the amount of light entering the cabin. Operation of the shade feature shall be under the control of the rear seat passenger; the shade must be capable of being deployed by any passenger while wearing his/her seat belt.

2.10.16 Power Windows

Power windows, roof panels or partitions shall be fitted with safety systems to minimize the likelihood of death or injury from their accidental operation.

2.10.17 Assist (Grab) Handles

The vehicle must be fitted with assist handles adjacent to each rear door.

2.10.18 Intercom System

Provision for an intercom system between the driver and passenger compartments shall be provided. This shall be designed to improve communications between driver and passenger and may include noise-canceling technology if required.

2.10.19 Radio Antenna

The radio antenna shall be integrated into the vehicle glass. Retractable or whip antennas shall not be used.

2.10.20 Other Antenna

GPS and cellular antennas must meet the environmental, water ingress and durability criteria defined for the rest of the vehicle.

2.10.21 Speaker System

The rear volume of the vehicle audio system shall be controllable or turned off by the rear seat passenger

2.10.22 Driver Security System

The vehicle shall be fitted with a security system that provides a positive contribution to the overall safety of the driver and passengers.

The system shall meet the following objectives:

- Provides a physical barrier (either fixed or deployable) separating the driver and passenger, or a deterrent system to limit the possibility of a passenger assaulting the driver.
- Does not interfere with existing vehicle secondary safety systems.
- Does not increase the risk of injury to driver or passengers in the event of a crash.
- Has minimum impact on driver-passenger communications.
- Provide a means to transfer payment from the passenger to the driver in the event of a physical barrier being employed.
- Does not restrict passenger visibility to the front of the vehicle.

While no test criteria currently exist for front impact forces on rear seat passengers, the addition of a rigid panel will change the interaction between the vehicle and occupants in the event of an impact.

As part of the design integration of the partition, manufacturers will be expected to demonstrate a positive safety contribution from the partition for both driver and rear seat passengers.

If a partition is used as the security system, the provision of an integrated secondary restraint system should also be considered, particularly as there is no legal provision to force people in the rear of the vehicle to wear the seat belts that have been provided for them.

The provision of the partition as an additional lateral stiffening member and its contribution to side impact performance must also be considered.

2.10.23 Taxi Information Panel

The vehicle must contain a provision for displaying the following information:

- TLC contact info panel.
- Taxi ID in both Braille and text.
- Driver license and information.

2.11 HVAC System

The HVAC system in the Taxi of Tomorrow must satisfy a wider range of operating conditions than that encountered in a typical passenger car, principally due to the additional comfort requirements of rear seat passengers.

The vehicle may be fitted with a supplementary HVAC system to meet the rear passenger compartment temperature and air flow targets.

If fitted, a supplementary HVAC system must be supplied as part of the vehicle original equipment, and shall not reduce any of the original manufacturers' performance criteria relating to the original system.

If fitted, a supplementary HVAC system must not affect any existing vehicle systems or increase the risk of injury to passengers in the event of an impact.

2.11.1 System Configuration

In addition to the standard heating and air conditioning system for the driver and front seat passenger, the vehicle shall be fitted with an air supply and temperature control system for rear seat passengers that meet the following specifications:

- The system may be fed from a separate HVAC source if desired.
- The system must be fitted with a minimum of one face-level air register for each rear seat passenger; two floor registers and demist vents for rear passenger side windows.
- Face-level registers shall be adjustable to allow air to be directed to the face of its respective passenger and shall be able to be closed to prevent airflow without interrupting flow to the other registers.
- The system shall be capable of delivering fresh, heated or cooled air with adjustable flow rate, distribution and temperature to the rear seat area under the control of the rear seat passengers.
- Controls and rear face registers shall be mounted within reach of all rear seat passengers without having to remove their safety belts.
- Regardless of whether a supplementary system is used, the rear passenger compartment shall have the same operating temperature range, fan noise performance, time-to-temperature performance and bi-level split capability as the front system.
- The system shall be fitted with a cabin air filtration system to control pollen, dust, pollutants and odors that enter the passenger compartment via the HVAC system. The system shall filter the air in both recirculation and fresh air modes.
- It should be noted that a safety partition, if fitted, may reduce the effectiveness of air extractors mounted in the rear of the vehicle. The HVAC system should be

performance tested to ensure that both driver and passenger compartments are able to meet their targets independently.

2.11.2 Controls and Displays

The vehicle controls shall be designed such that a directional change in a given control setting results in a directional and proportional change in the appropriate system response. Controls and displays shall be illuminated or visible in the dark such that the various control functions can be clearly differentiated. Manual and automatic HVAC controls shall receive a minimum subjective rating of 8 when assessed in terms of usability, handling, visibility and logic of functions.

2.11.3 Noise Levels

Cabin noise levels with the HVAC system operating in various modes are provided in **section 2.14**.

In general, operation of the HVAC system shall be smooth and inaudible (with exception of audible wind rush at moderate to high blower). The noise made by any changes in mode, temperature, distribution, etc. shall be masked by the engine idling.

There should be no tones or whines, ticks or clicks, motorboating, squeal, chirp, hiss, flutter, or rumble during any operation of the unit audible to or felt by the driver or passenger.

Operation of the HVAC system shall exhibit a subjective noise rating of 9 or better when the system is operated in its various modes. This subjective review applies to all manner of noise generation (such as refrigerant expansion, compressor clutch engagement, blower noise, engine cooling fan noise, compressor cycling, etc.).

The operation of a supplementary HVAC system if fitted shall be rated subjectively as good or better than the original system fitted to the vehicle when the two are operated independently.

2.11.4 Vibration

The front HVAC system must meet the vibration requirements of the manufacturer when the vehicle is fitted with all taxi-specific equipment.

The rear HVAC systems shall have a subjective rating of >8 for perceived vibration at any occupant interface location.

There shall be little to no perceived increase in vibration due to normal operation of the HVAC system at any occupant interface location. Typical locations include but are not limited to the steering wheel, seat track attachments, brake pedal, armrest, center console, etc. The HVAC system includes vibration being generated by the operation of powertrain cooling fans, blower fans, and the A/C compressor.

2.11.5 Squeak and Rattle

The following requirements apply to all configurations of the HVAC subsystem when installed in a vehicle:

a. The HVAC subsystem, when new, shall not cause or contribute to any squeak and rattle sound annoyances when subjected to the static and dynamic test conditions or when subjected to moderate hand flexure forces and moderate hand impacts at locations where vehicle occupants are likely to contact the subsystem.

b. The squeak and rattle performance of the HVAC subsystem shall not degrade over the first 40% of the vehicle life by more than 1 subjective rating point. If the HVAC subsystem or its components are sensitive to audio system excitation, the subsystem shall have a subjective rating of nine when tested.

2.11.6 Cabin Airflow

There is no specific requirement for a supplementary HVAC system. However, given the increased performance requirements of the Taxi of Tomorrow, it is expected that, depending on the donor vehicle, cabin airflow may need to be increased by up to 50% in order to meet rear passenger comfort levels.

2.11.7 Cabin Temperature Control and Range

a) A/C Cooling Performance

The vehicle shall meet the following targets when tested at 43°C x 20%rh and 1000 W/m2 solar load. All electrical systems shall be powered by the internal vehicle power supply and set at high blower setting.

Test point	Ambient. Temp. (°C)	Time (min)	Avg. Front Breath (Max. Temp. °C)	Avg. Rear Breath (Max. Temp. °C)	Avg. 3rd Seat Breath (Max. Temp. °C)
50 km/h, recirc	43°C	5	23	23	23
50 km/h, recirc	43°C	10	20	20	20
80 km/h, recirc	43°C	10	20	20	20
50 km/h, fresh	43°C	10	23	23	23
80 km/h, fresh	43°C	10	23	23	23
Idle, fresh	43°C	15	See note *		
Idle, recirc	43°C	15	24	24	24
City Traffic	43°C	5	23	23	23

** Idle in Fresh (OSA – Out Side Air) mode is not normally specified. To ensure that no A/C cutout occurs, the compressor out pressure shall be at minimum 300 kPa below the supplier specified cutout and the compressor shall not cutout during the post-test drive away.*

b) Interior Heating Performance Requirements

Starting from a -20º c start, the performance of the heater system shall meet the following targets in fresh air mode with the blower set to its maximum speed:

Test Point	Engine Condition	Time [min.]	Front Floor Avg. (Min. Temp. °C)	Rear Floor Avg. (Min. Temp. °C)
50 km/h Road Load	From cold	10	18	18
50 km/h Road Load	From cold	20	30	30
50 km/h Road Load	Fully warm	5	30	30
Idle	From cold	10	15	15
Idle	From cold	50	27	27
Idle	Fully warm	5	27	27
City Traffic	From cold	10	25	25
City Traffic	From cold	25	28	28
City Traffic	Fully warm	5	30	30

If it is not possible to meet both cold start and fully warm targets, the fully warm target shall take priority.

2.11.8 Interior System Zone and Mode Performance

The following air flow distribution requirements for both front and rear compartments (includes floor, vent, bi-level and defog modes) shall be met when tested and checked at the appropriate test times per the requirements in **2.11.11**.

- The side-to-side average floor temperatures shall be within 2 °C of each other.
- The side-to-side average breath temperature imbalance shall not exceed 2 °C.
- The average front breath temperature shall be between 3 to 7 °C lower than floor temperatures (heating mode).
- The temperature distribution within an occupant's floor area shall be within 4 °C (heating mode).

The system shall be capable of maintaining a difference in average temperature between the front and rear compartments of 10ºc under all stable operating conditions.

2.11.9 Static body Leakage

The vehicle's static body leakage, with all seats in normal seating position, at 125 Pa shall be as follows when tested:

- Uncontrolled body leakage shall be a maximum of 30 l/s.
- Controlled body venting that exits through the body pressure relief valve (and body air inlet in outside air mode) shall be a minimum of 150 l/s at a maximum static pressure of 125 Pa.

2.11.10 Interior Airflow

The existing vehicle HVAC system for the driver and front seat passenger must meet the manufacturer's requirements for heating, cooling and ventilation performance after the addition of the taxi-specific HVAC components.

When tested with temperature door(s) at full cold and 12V applied to the blower with no cabin filters installed, the rear HVAC components shall meet the requirements of table 2.11.11 and the static body leakage specification requirements (2.11.10).

Table 2.11.11 Dynamic Airflow – rear HVAC components

Mode	Vehicle Speed (km/h)	Inlet Air Mode	Blower Setting	Temp. Setting	Total Air Flow (l/s)
Vent	0	Recirc	High	Full cold	120
	50				120
	100				120
Vent	0	Fresh	High	Full cold	120
	80				120
	100				120
Vent	<15	Fresh	Low	Full cold	120
Floor	0	Fresh	High	Full hot	80
	50				80
	100				80
Floor	<15	Fresh	Low	Full cold	80
Off	0	Fresh	OFF	Full cold	<10
	50				<50
	100				<65

2.11.11 Passenger Air Flow Distribution

Each rear occupant seating position must have a minimum air flow of 30 l/s available from the face level registers as measured when in outside air, vent mode, temperature door(s) at full cold and 12V is applied to the blower with no cabin filters installed in the vehicle.

The passenger must have the ability to control the airflow, direction and volume at the register.

Registers shall be adjustable from the passenger location without removing seat belts.

Registers shall be adjustable to allow airflow on to the face of 5-95th percentile passengers.

2.11.12 Interior Air Quality

The vehicle's interior airflow system shall be designed to minimize CO_2 buildup in the vehicle with the HVAC in recirc mode. The minimum airflow in recirc mode shall be adequate to limit the CO_2 level to <3 % by mass of the total gas concentration in the interior of the vehicle when tested in all operating modes.

An air filtration system must be installed on all fresh air HVAC intakes to the vehicle. The HVAC system must remove >90% of the particles over the size range specified by the filter manufacturer when the filter is installed in the system during it's normal service life. Manufacturers shall provide specifications for the filtration capability of their system.

If a filtration system is specified as standard equipment for the original vehicle, any additional filters must meet the same filtration specification as the original equipment.

In order to minimize the service changes to the air filter, manufacturers should consider a means of notifying the operator when a filter change is required.

2.11.13 Particle Ingression - HVAC Blower Air Inlet

Any supplementary air intake systems shall meet the original manufacturers requirements for particle ingress prevention. In the absence of a manufacturers standard, a value of 4mm shall be used as the maximum particle size that can pass through the inlet screen.

2.11.14 Floor Temperature

Extended slow-speed running will tend to raise the temperature of the passenger floor. While uncomfortable for passengers, it puts an even higher burden on service animals, which l typically lie on the floor of the passenger compartment. Provision shall be made for maintaining the temperature of the floor surface below 30 deg C under all operating conditions.

2.12 Ride

In addition to driver ride comfort, good rear passenger ride comfort is a principal attribute of the Taxi of Tomorrow.

The ride objectives of the Taxi of Tomorrow are to provide a subjective ride comfort level significantly higher than the existing fleet.

While objective data can provide a good baseline, subjective ride performance shall be used for final vehicle sign-off, assuming all other durability criteria have been met.

2.12.1 New York Taxi Standard Load Condition

All ride measurements should be made with the taxi at the following load condition:

- 150 lb driver and two150 lb rear seat passengers in the outboard seating locations.
- Fuel tank at 50% full.
- 100 lb of luggage in the trunk.

2.12.2 Ride Index

Following the ISO 2631-1 Evaluation of Human Exposure to Whole Body Vibration test standard, targets for front and rear seating position Overall Vibration total Value (OVTV) for typical Manhattan road surfaces are given in the table below. Vibration measurements shall be taken in each of the three orthogonal directions on the seat surface and in the fore-aft direction on the seat back, in the frequency range from 0.5-80Hz, at both the driver and rear left passenger locations. Data should be recorded on dry roads.

Vehicle Speed (mph)	Target OVTV Values (m/s^2)	
	Front	Rear
35	0.42 - 0.57	0.34 - 0.5
30	0.61	0.68
20	0.47	0.70
15	0.76	0.95

In addition to the OVTV values, the weighted 1/3 octave spectrum plot for each road section and seating position shall not have any individual peaks above **0.30 m/s^2** for the frequency range from **0.5-80Hz**.

The target speeds are based on road quality (poorer roads were driven more slowly consistent with expected use patterns) and the practical implications of reaching higher target speeds on short road segments.

Details of the specific road segments used for these evaluations and the original data files are available for further post-processing on request.

The TLC reserves the right to change the targets if the quality of available road surfaces sections changes significantly.

2.12.3 Front Wheel Ride Frequency

The ride frequency should be optimized for ride comfort, subject to the available wheel travel, low-frequency ride discomfort, and motion coupling limitations.

The target front ride frequency will be between **1.1Hz** and **1.4Hz**, when loaded to the New York Taxi Standard Load Condition.

2.12.4 Rear / Front Wheel Ride Frequency Ratio

The Rear / Front Wheel Ride frequency ratio should be optimized for a 'flat-ride' primary ride refinement, whilst considering any affects on rear stiffness limitations from secondary ride refinement and impact harshness.

The target front: rear wheel ride ratio will be **1:1.1** to **1:1.2.**

2.12.5 Effective Ride Travel

The Ride Travel should be maximized in order to allow for the lowest possible Wheel Ride Frequencies whilst considering dynamic ground clearance, and low-frequency ride discomfort.

Both Jounce and rebound travel for both front and rear suspension should be **100-130mm** with the vehicle laden to the New York Taxi Standard Load Condition.

2.12.6 Ride Damping

Damping levels should be maximized for ride comfort with the following additions:

Damper mount stiffness should be sufficient to allow efficient operation of the damper (within the application-necessary requirements of mount twist and coning), minimizing lost motion due to soft mounts, un-damped damper resonances and unsprung mass resonances.

Sufficient low frequency on-center control shall be maintained to minimize low frequency freeway float, whether due to side wind gusts or small amplitude primary inputs.

2.12.7 Ride – Subjective Level Requirements

Subjective assessments shall be carried out by an independent ride and handling expert as appointed / approved by the New York Taxi and Limousine Commission. All ride and handling assessments are to be conducted at the New York Taxi Standard Load Condition.

The intent of this selection of subjective metrics is passenger ride comfort. All ratings are for a rear passenger sat in either LH or RH outboard position of the first row of passenger seating.

Criteria	Minimum	Target
Primary ride		
Pitch	7.5	8.5
Travel	8	9
Balance	8	9
Roll-rock (head toss)	8	9
Secondary ride		
Smooth Road Isolation	8	9
Rough Road Isolation	7.5	9
Engine Shake	8	9
Unsprung Mass Shake	8	9
Structural Shake	8	9
Impact harshness		
Straight Line	8	9
Cornering	7.5	8.5
Small Disturbance (transverse ridges)	8	9
Large Disturbance (pot holes)	7.5	8.5
Road Noise	7.5	8.5
Launch Response		
Jerk Response for Full Accelerator Pedal Displacement	8	8.5
Steady Speed Control		
Acceleration Variation at Steady Speed	8	8.5
Tip-In Response from a Deceleration Condition.	8	8.5
Tip-Out Response from an Acceleration Condition	8	8.5
Shift Mode		
Acceleration during Garage Shift	7.5	8
Acceleration Disturbance for upshifts	7.5	8
Acceleration Disturbance for Downshifts	7.5	8
Jerk during Shift	7.5	8
Shift Duration	7.5	8

Subjective Rating Index

Rating Index		Evaluation	Rating	Condition noted by:	Rectification Process
1	Unacceptable	Poor	Not Acceptable	All Customers	Action
2				Average Customer	
3					
4		Customer Complaint	Objectionable	Critical Customer	
5	Border-line	Borderline	Needs Improving		Investigate
6		Barely acceptable	Medium		
7	Acceptable	Fair	Light		Accept
8		Good	Very light	Trained observer	
9		Very Good	Trace		
10		Excellent	Not Noticeable	Not Perceptible	Check results

2.13 Cooling System

The vehicle cooling system must be capable of maintaining the powertrain and HVAC performance within its normal operating temperature range when the vehicle is operated as a taxi.

Radiator and condenser plugging due to dust is a common occurrence in taxis. Ideally, the cooling system shall be designed to be unaffected by the presence of dust or other particles in the air that may plug the radiator and cause a reduction in cooling or HVAC performance; however it is understood that at least some drop in performance is to be expected.

Manufacturers are encouraged to suggest ways in which this reduction in performance can be mitigated by either reducing the incidence or extent of plugging, simplifying the cleaning process or resizing the cooling system components.

2.14 Noise, Vibration and Harshness (NVH) - Idle NVH

2.14.1 Operating Condition

- Engine at operating temperature.
- For automatic transmissions test with transmission in park and drive.
- A/C on and blower fan positioned to; off, 25%, 50%, 75% and 100%.

2.14.2 Sound

Microphone located 1m from vehicle centerline, at center of rear door and 1.5m from ground.

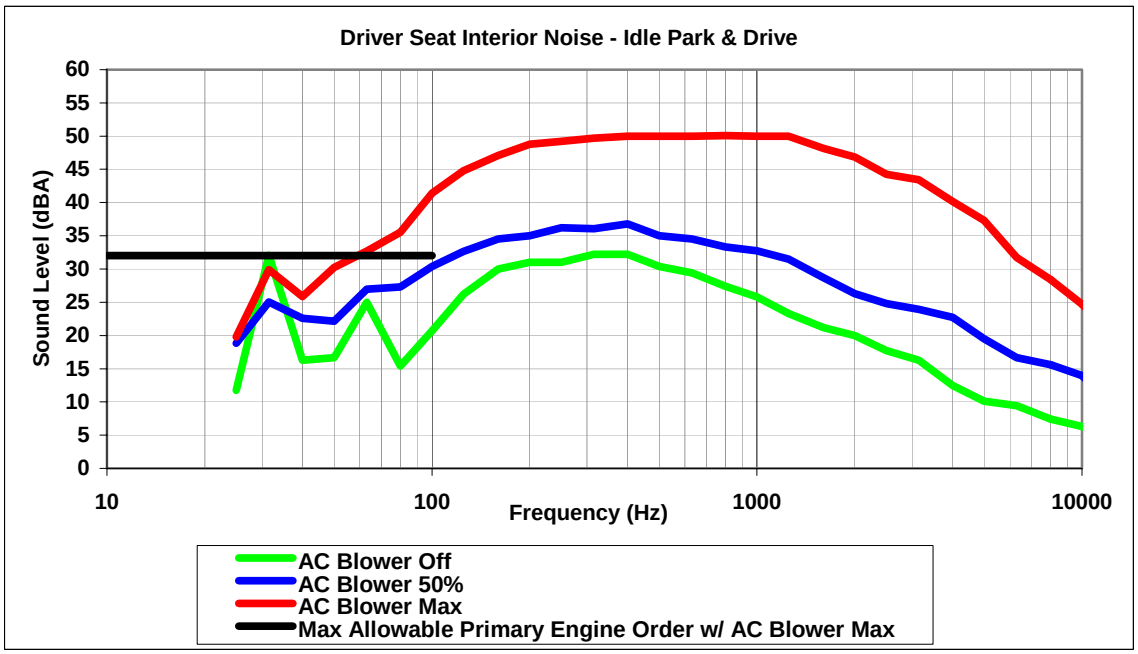
- Interior noise evaluation (dB (A) overall level and 1/3octave).
- Driver's outboard ear.
- Right rear passenger outer ear.
- External noise at idle (dB (A) overall level).

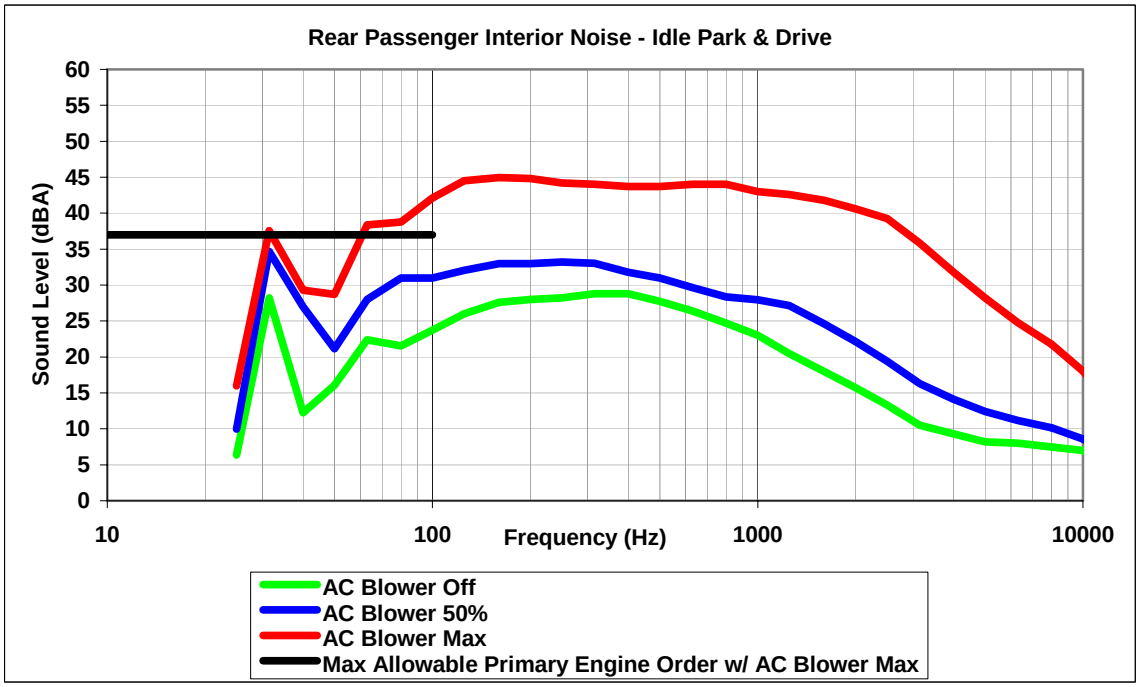
2.14.3 Vibration

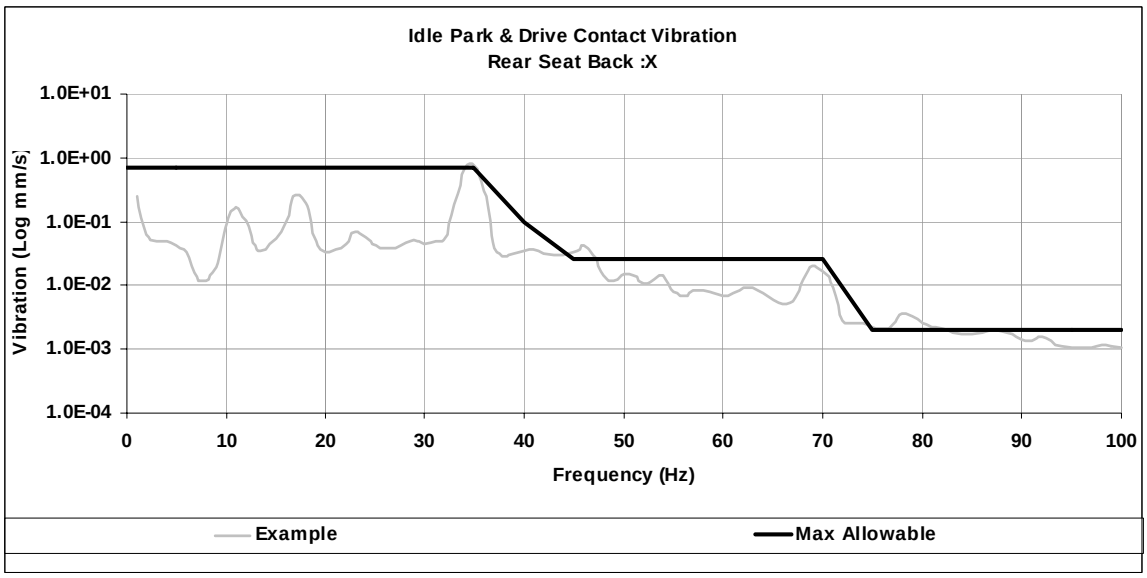
- Objective evaluation (mm/s versus frequency).
- Steering wheel.
- Driver's outboard seat track front attachment bolt.
- Rear seat cushion vibration.
- Rear seat back vibration.

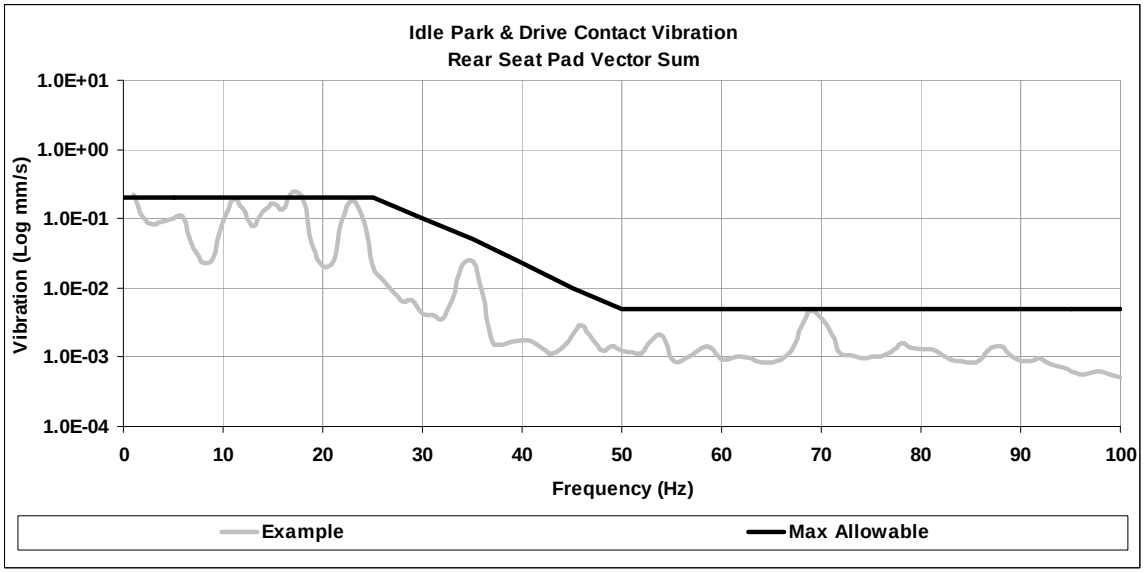
Overall Level (dB(A)) Max Allowable			
Location	AC Blower Off	AC Blower 50%	AC Blower 100%
Driver's Seat	41	45	60
Rear Passenger Seat	41	44	55
Exterior Noise	57	56	56

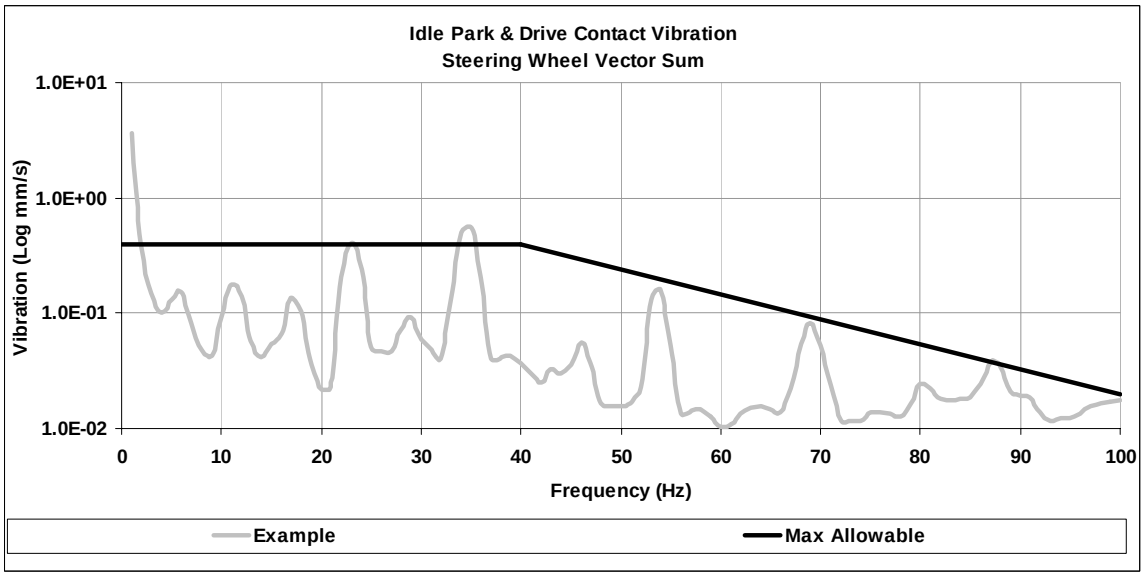
Interior Noise Target Levels






Idle Park & Drive Contact Vibration
Rear Seat Back :X
Vibration (Log mm/s)
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Idle Park & Drive Contact Vibration
Rear Seat Pad Vector Sum
Vibration (Log mm/s)
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Idle Park & Drive Contact Vibration
Steering Wheel Vector Sum
Vibration (Log mm/s)
1.0E+01
1.0E+00
1.0E-01
1.0E-02
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

2.15 Noise, Vibration and Harshness – Full Load Accel

2.15.1 Full Load Acceleration NVH

- Full load acceleration from 0-70mph.
- Transmission in automatic mode.
- Accessories off.

2.15.2 Sound

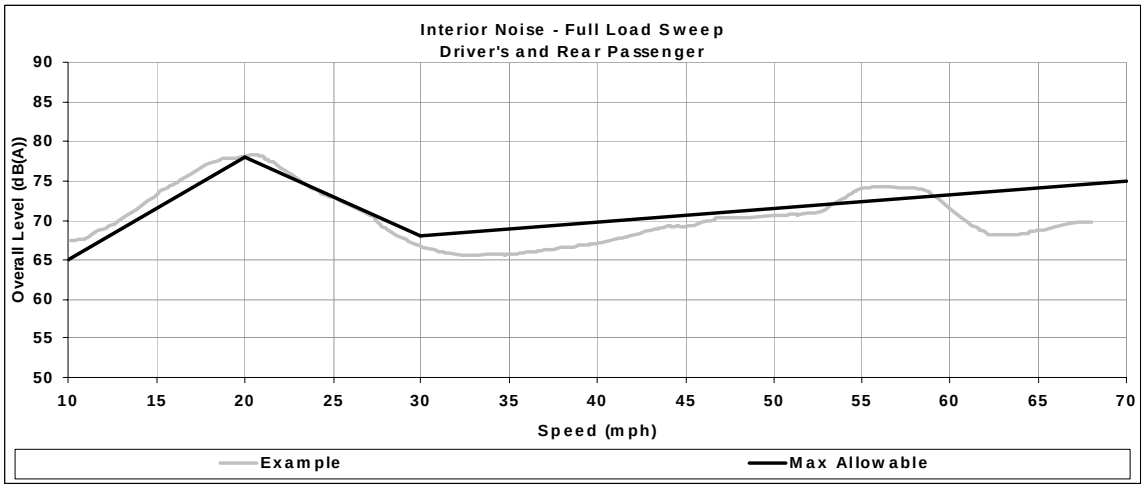
Objective evaluation (dB (A) versus vehicle speed):

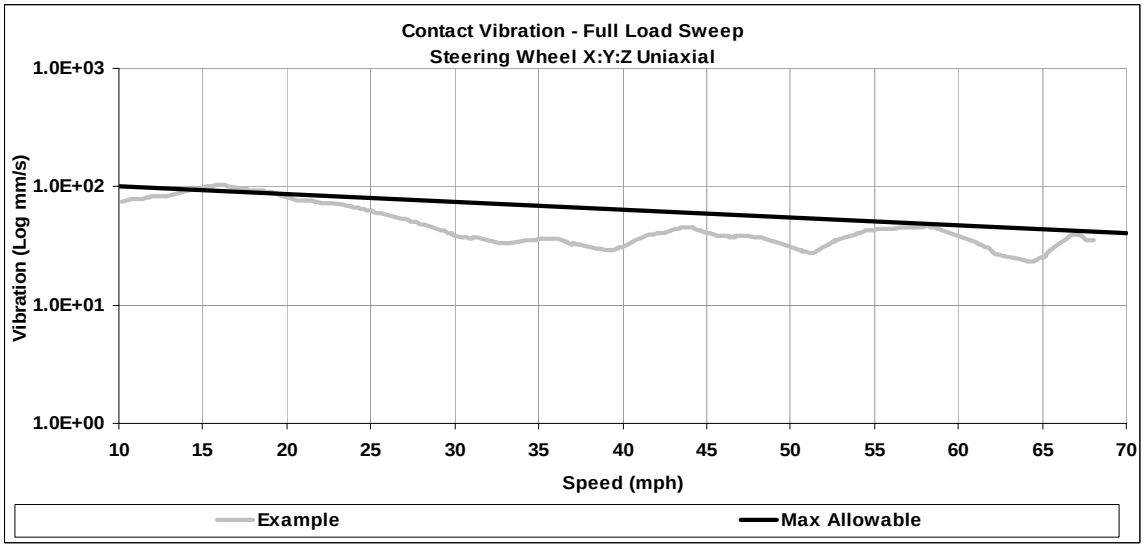
- Driver's outboard ear.
- Right rear passenger outer ear.

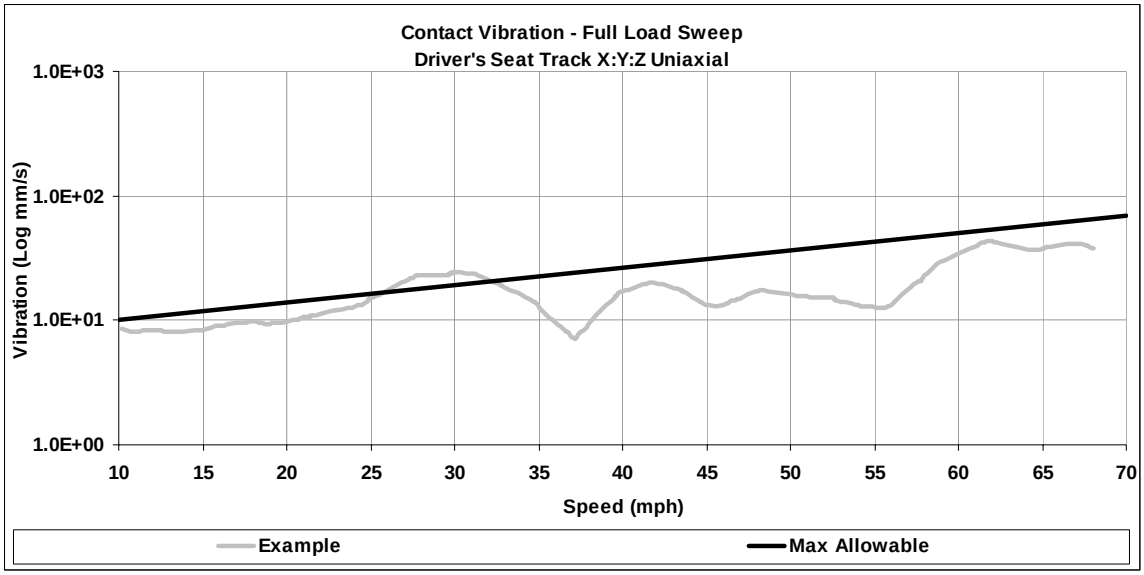
2.15.3 Vibration

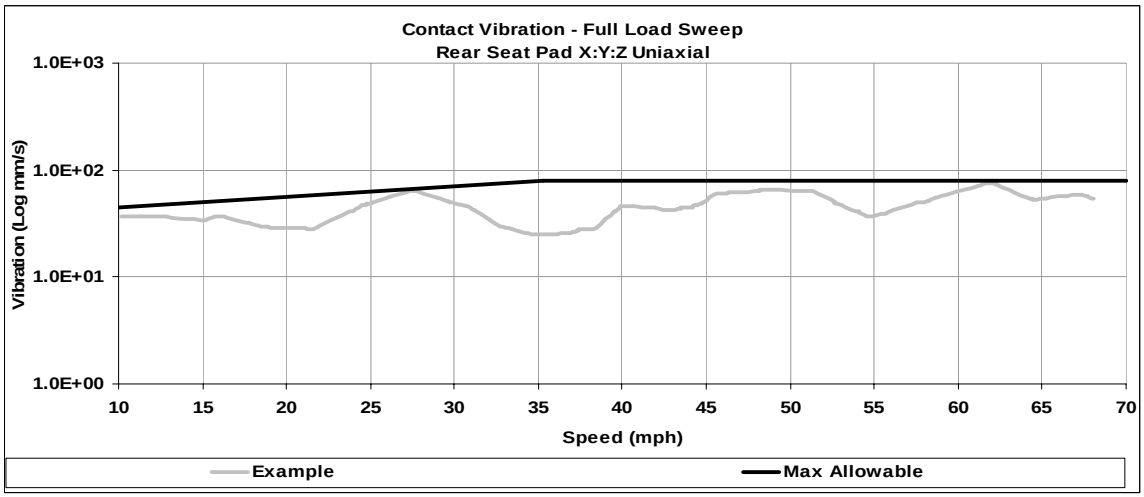
Objective evaluation (mm/s versus vehicle speed):

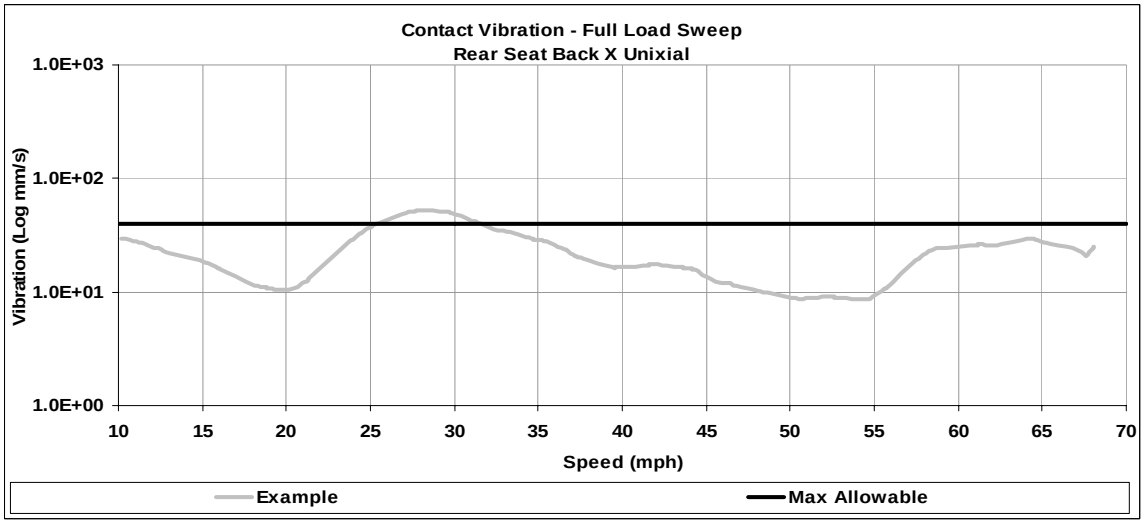
- Steering wheel.
- Driver's outboard seat track front attachment bolt.
- Rear seat cushion vibration.
- Rear seat back vibration.






Contact Vibration - Full Load Sweep
Driver's Seat Track X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
10
15
20
25
30
35
40
45
50
55
60
65
70
Speed (mph)
Example
Max Allowable


Contact Vibration - Full Load Sweep
Rear Seat Pad X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
10
15
20
25
30
35
40
45
50
55
60
65
70
Speed (mph)
Example
Max Allowable


Contact Vibration - Full Load Sweep
Rear Seat Back X Unixial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
10
15
20
25
30
35
40
45
50
55
60
65
70
Speed (mph)
Example
Max Allowable

2.16 Noise, Vibration and Harshness – Part load Accel

2.16.1 0.2g acceleration from 0-70mph

- Transmission in automatic mode.
- Accessories off.

2.16.2 Sound

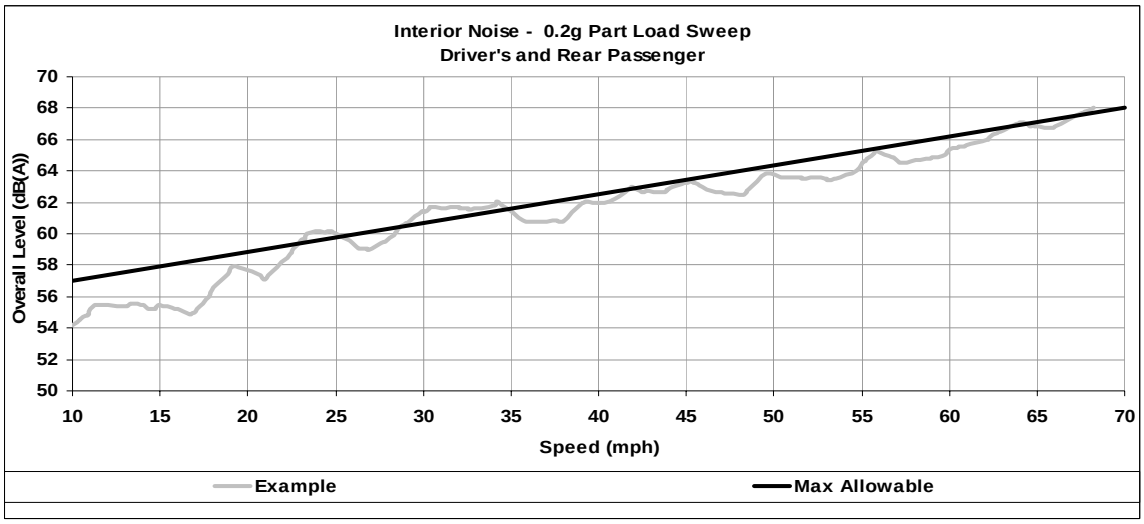
Objective evaluation (dB (A) versus vehicle speed):

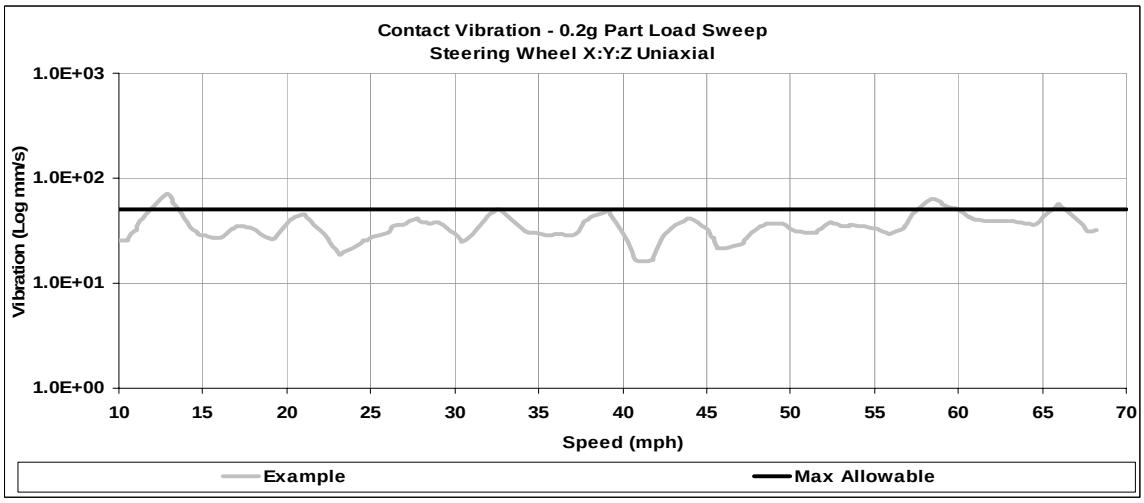
- Driver's outboard ear.
- Right rear passenger outer ear.

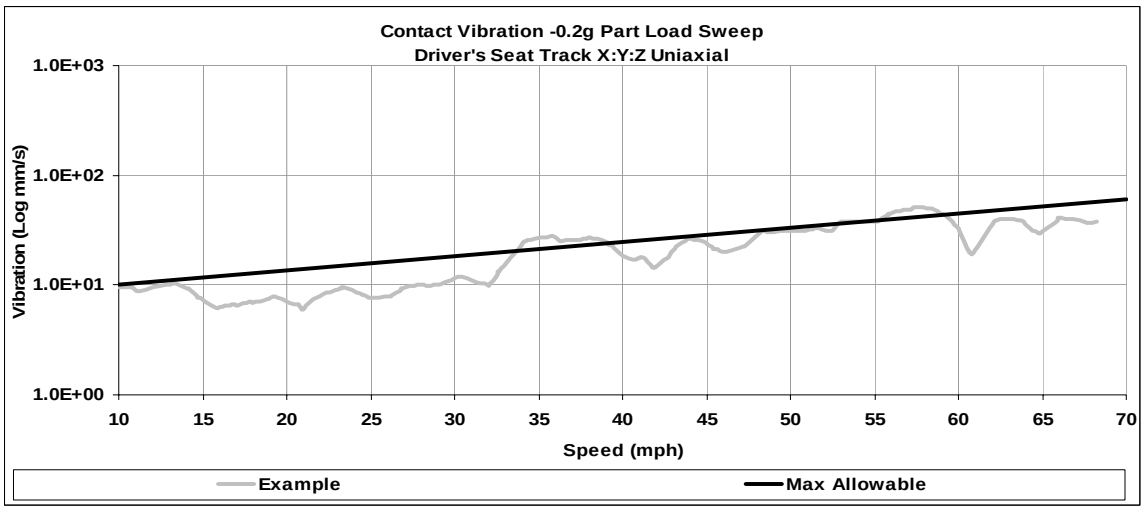
2.16.3 Vibration

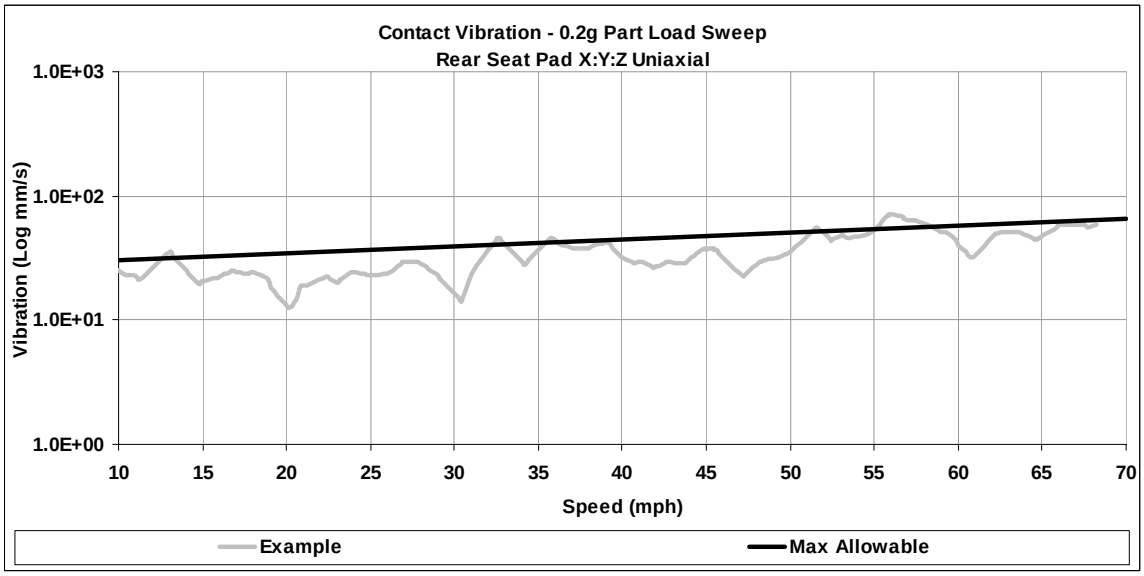
Objective evaluation (mm/s versus vehicle speed):

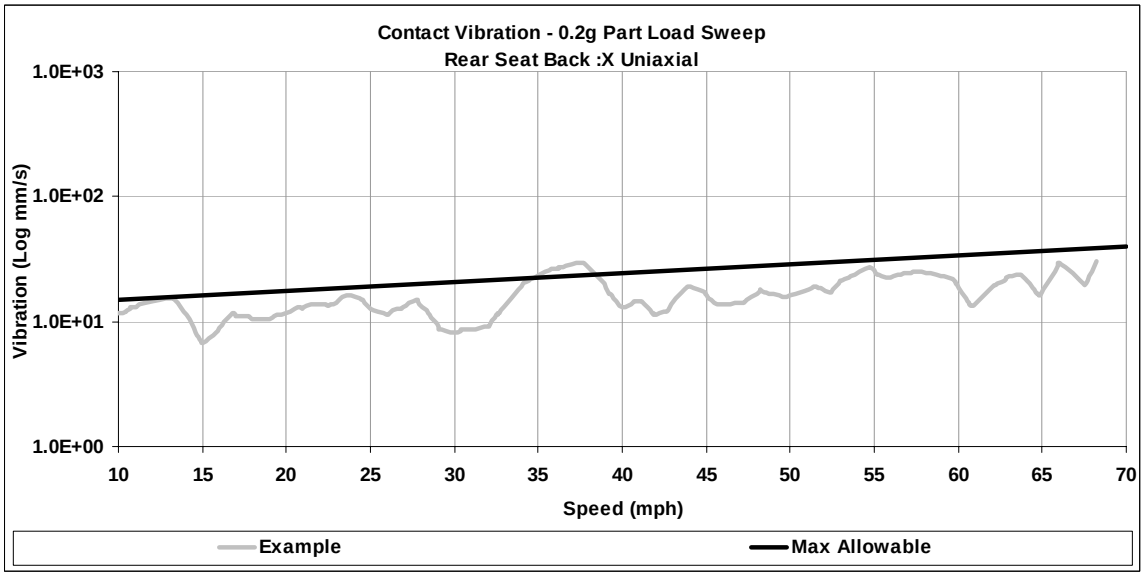
- Steering wheel.
- Driver's outboard seat track front attachment bolt.
- Rear seat cushion vibration.
- Rear seat back vibration.






Contact Vibration -0.2g Part Load Sweep
Driver's Seat Track X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
10
15
20
25
30
35
40
45
50
55
60
65
70
Speed (mph)
Example
Max Allowable


Contact Vibration - 0.2g Part Load Sweep
Rear Seat Pad X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
10
15
20
25
30
35
40
45
50
55
60
65
70
Speed (mph)
Example
Max Allowable


Contact Vibration - 0.2g Part Load Sweep
Rear Seat Back :X Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
10
15
20
25
30
35
40
45
50
55
60
65
70
Speed (mph)
Example
Max Allowable

2.17 Noise, Vibration and Harshness - Smooth Road Cruise

Cruise at 20, 30, 50 mph constant speed:

- Transmission in automatic mode
- Accessories off

2.17.1 Sound

Objective evaluation (dB (A) overall level and 1/3octave):

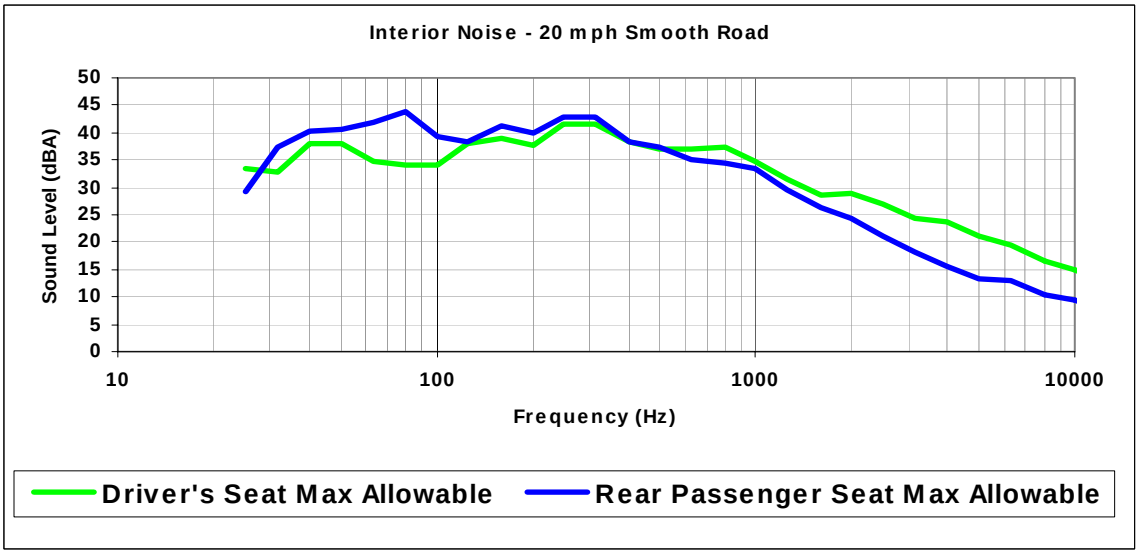
- Driver's outboard ear.
- Right rear passenger outer ear.

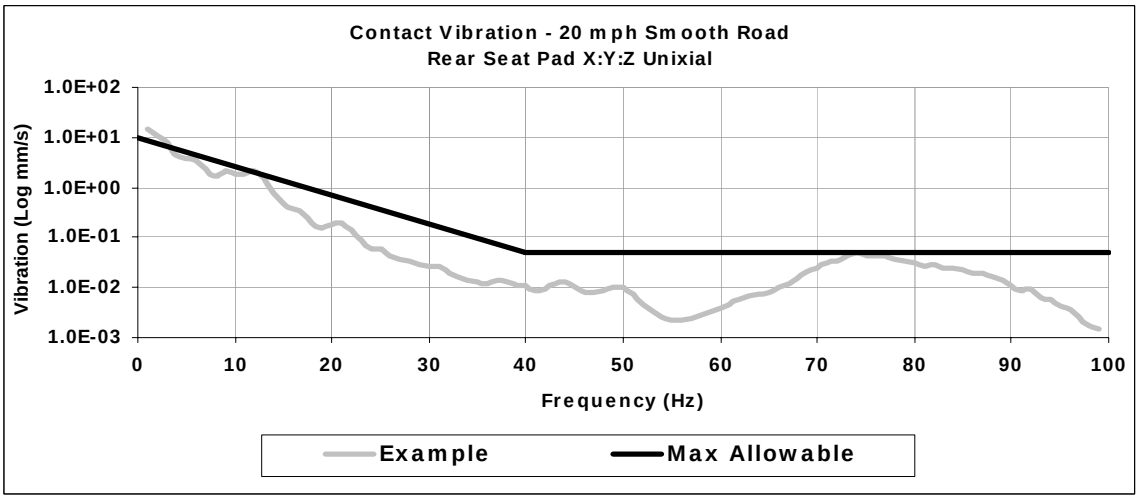
2.17.2 Vibration

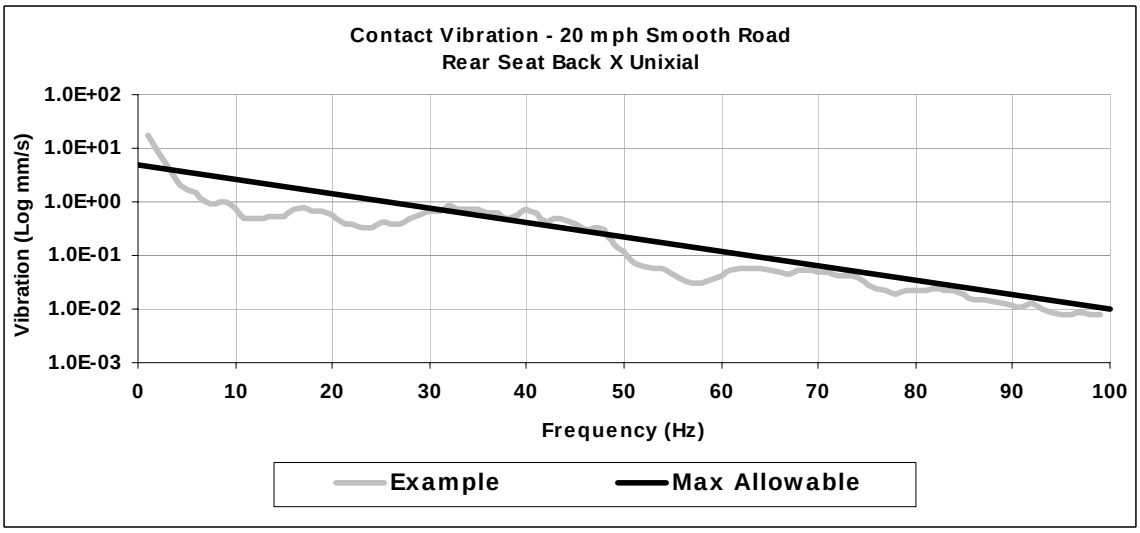
Objective evaluation (mm/s versus frequency):

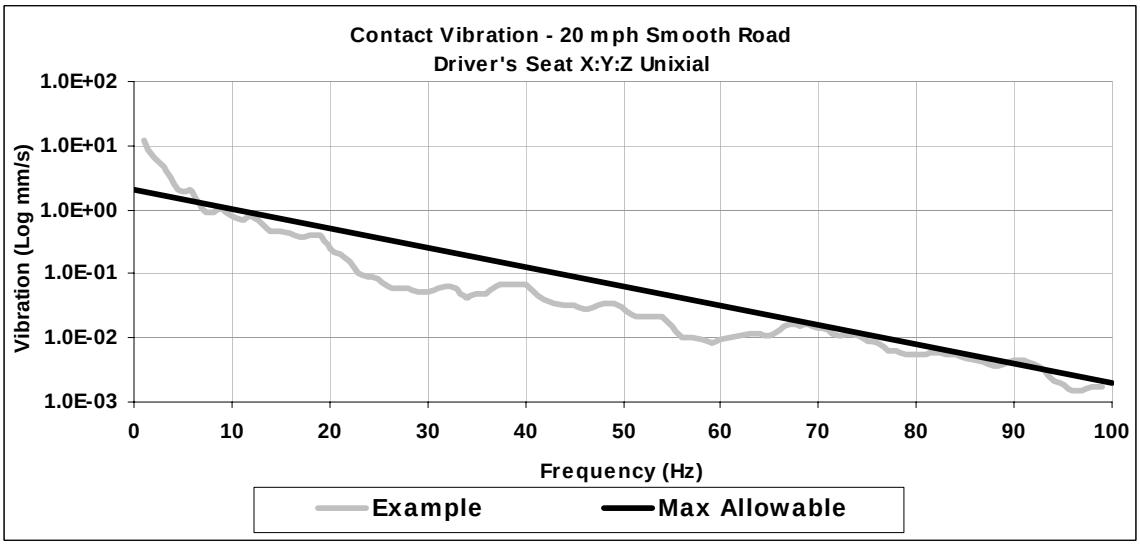
- Steering wheel.
- Driver's outboard seat track front attachment bolt.
- Rear seat cushion vibration.
- Rear seat back vibration.

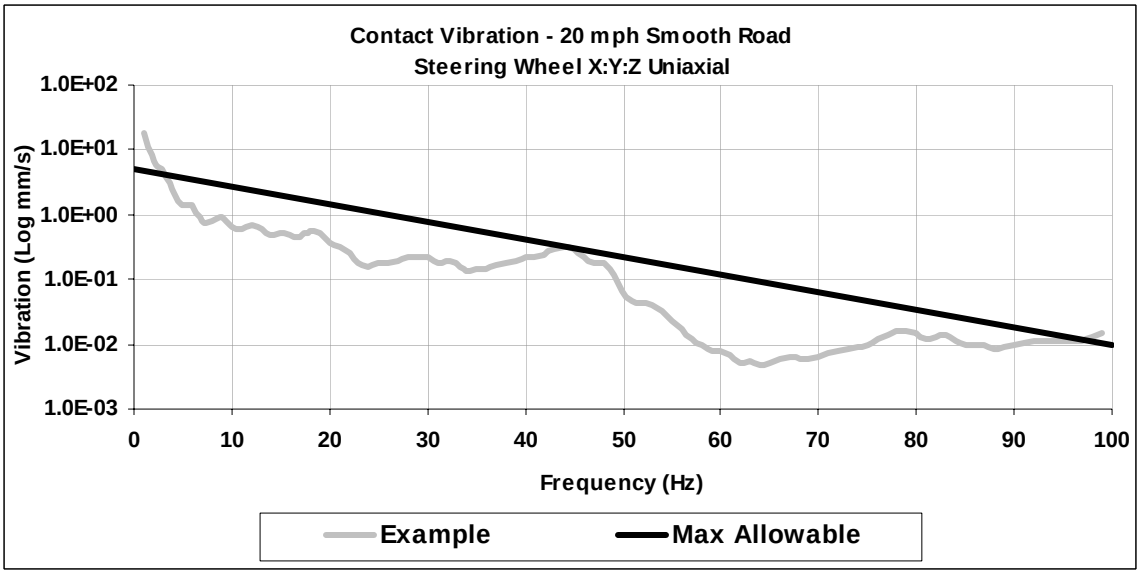
Overall Level (dB(A)) Max Allowable over Smooth Road				
	20mph	30mph	50mph	70mph
Driver's Seat	50.0	55.0	61.0	65.0
Rear Passenger Seat	53.0	58.0	63.0	66.0

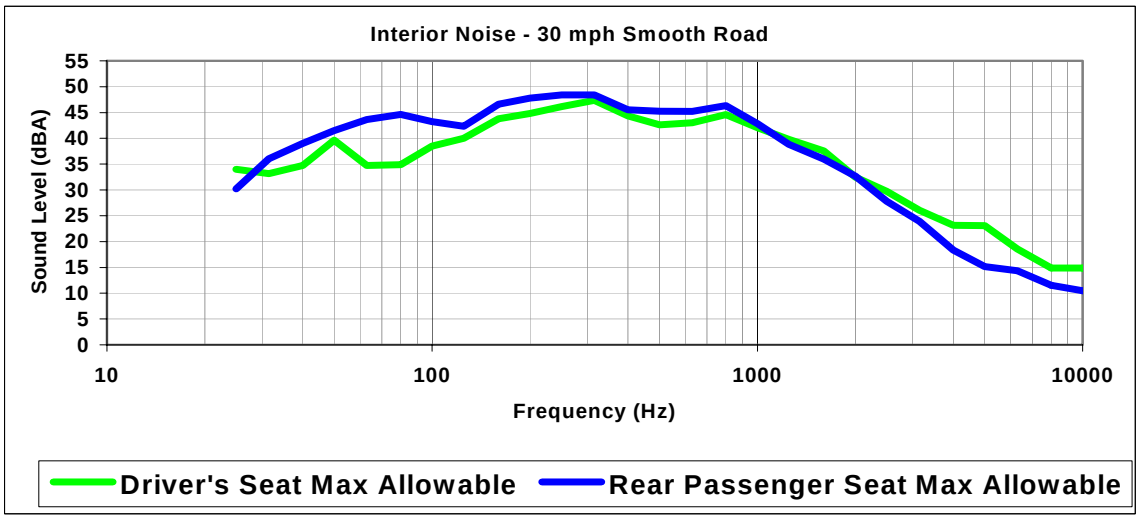


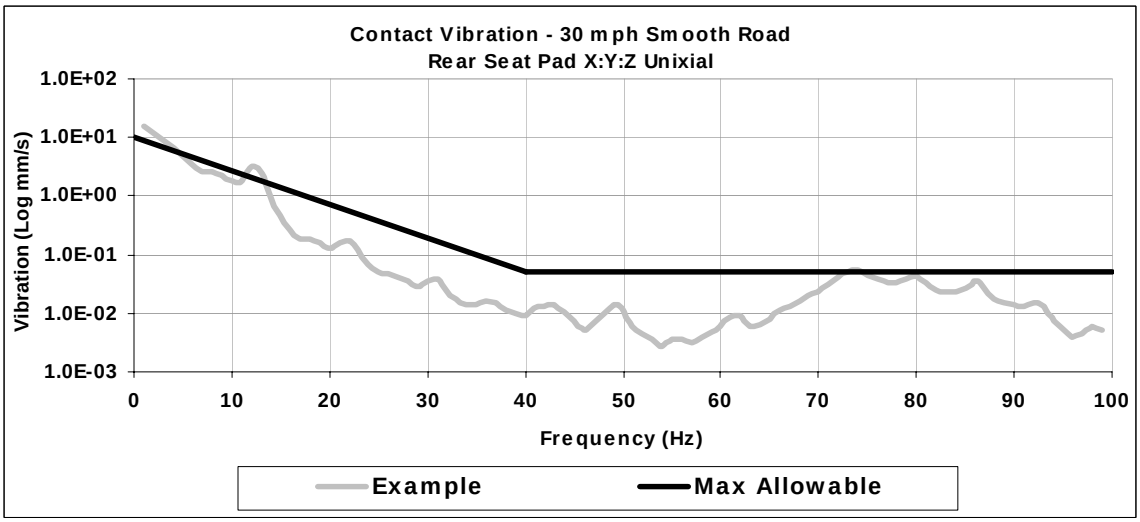

Contact Vibration - 20 mph Smooth Road
Rear Seat Pad X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

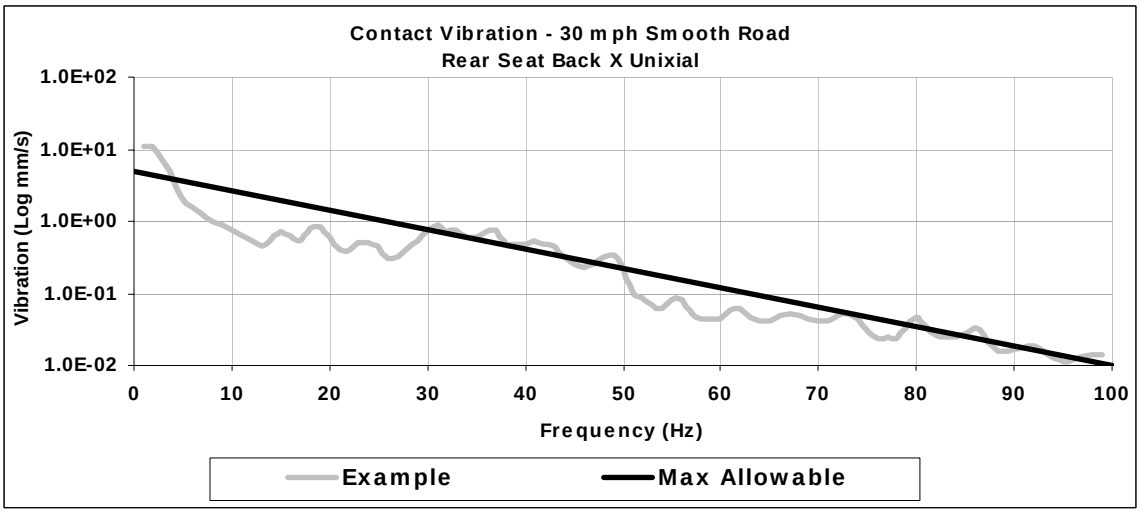

Contact Vibration - 20 mph Smooth Road
Rear Seat Back X Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

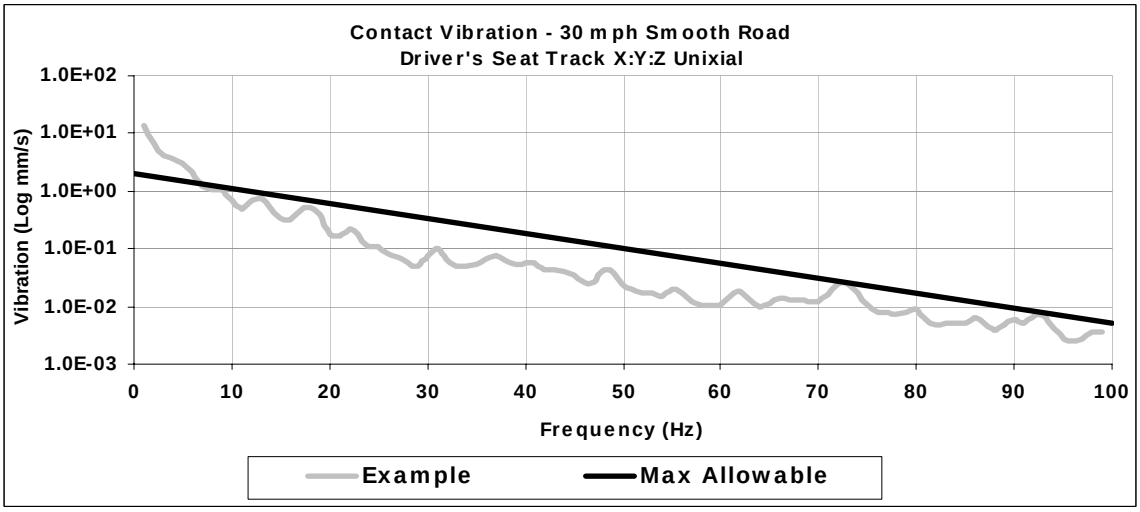

Contact Vibration - 20 mph Smooth Road
Driver's Seat X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

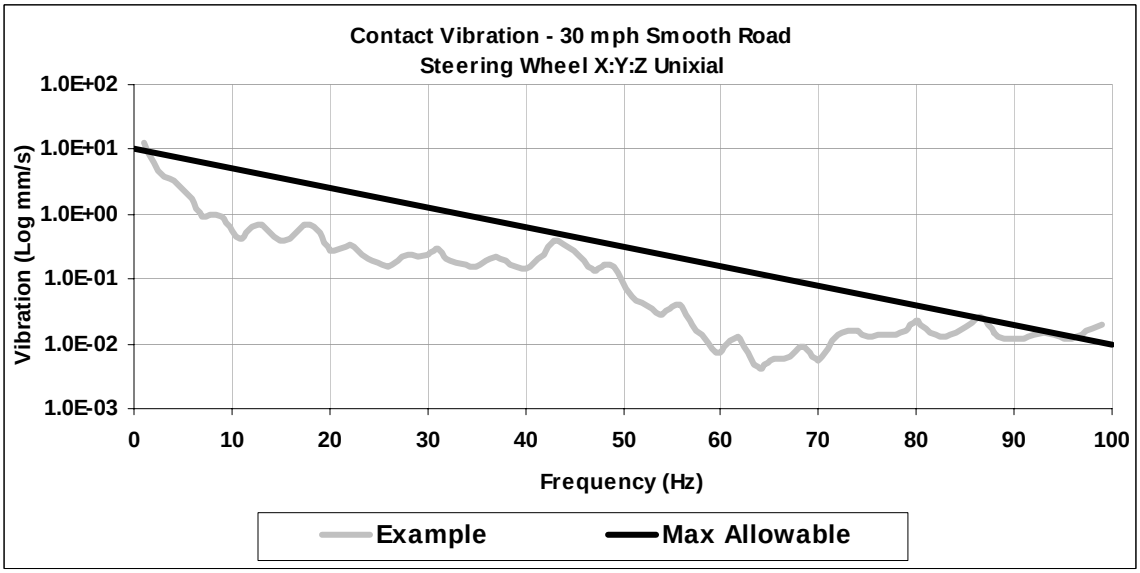

Contact Vibration - 20 mph Smooth Road
Steering Wheel X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

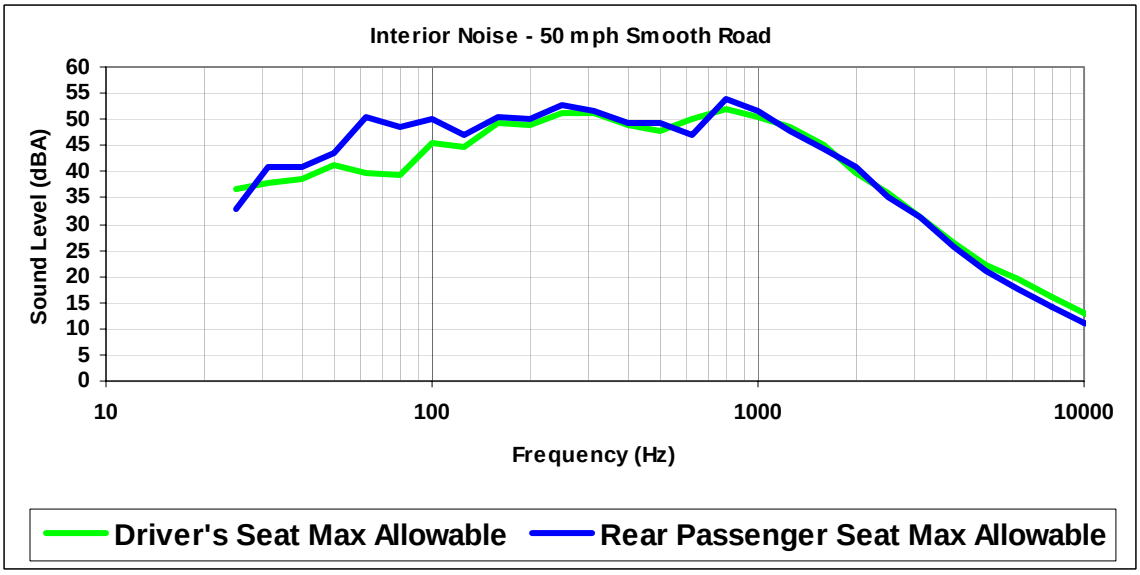

Interior Noise - 30 mph Smooth Road
Sound Level (dBA)
55
50
45
40
35
30
25
20
15
10
5
0
10
100
1000
10000
Frequency (Hz)
Driver's Seat Max Allowable
Rear Passenger Seat Max Allowable

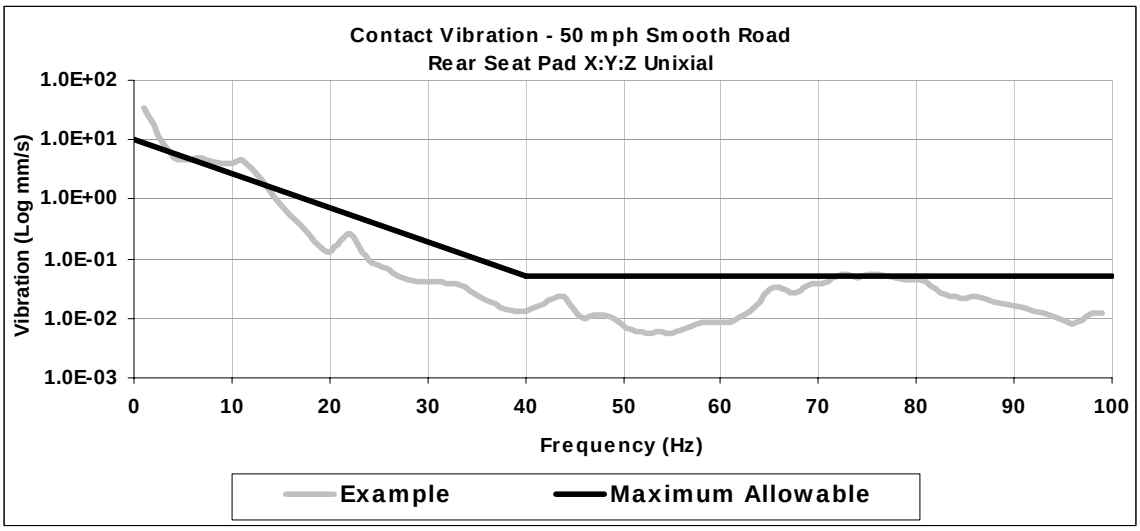

Contact Vibration - 30 mph Smooth Road
Rear Seat Pad X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

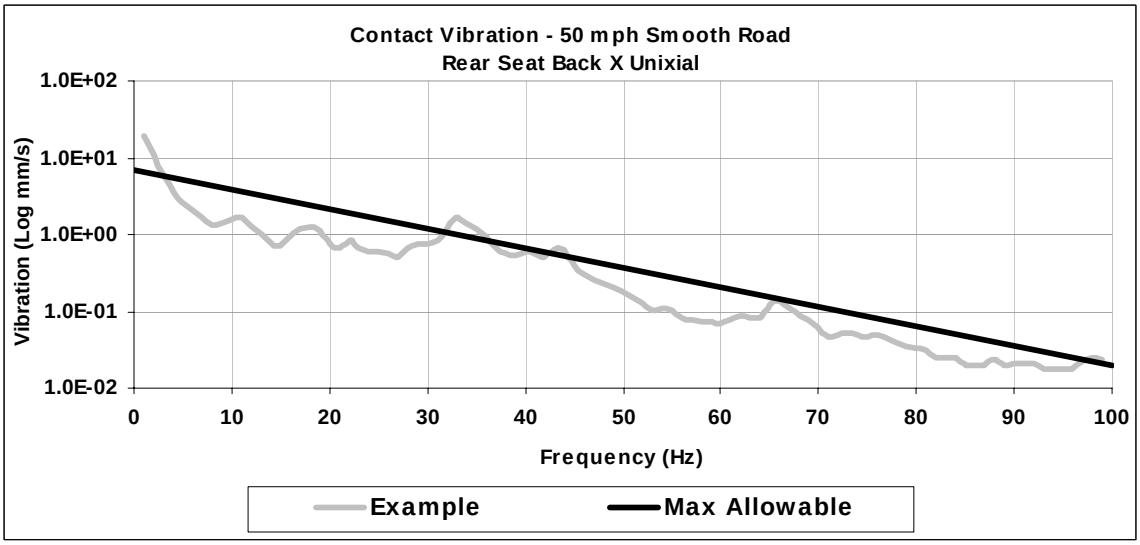

Contact Vibration - 30 mph Smooth Road
Rear Seat Back X Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

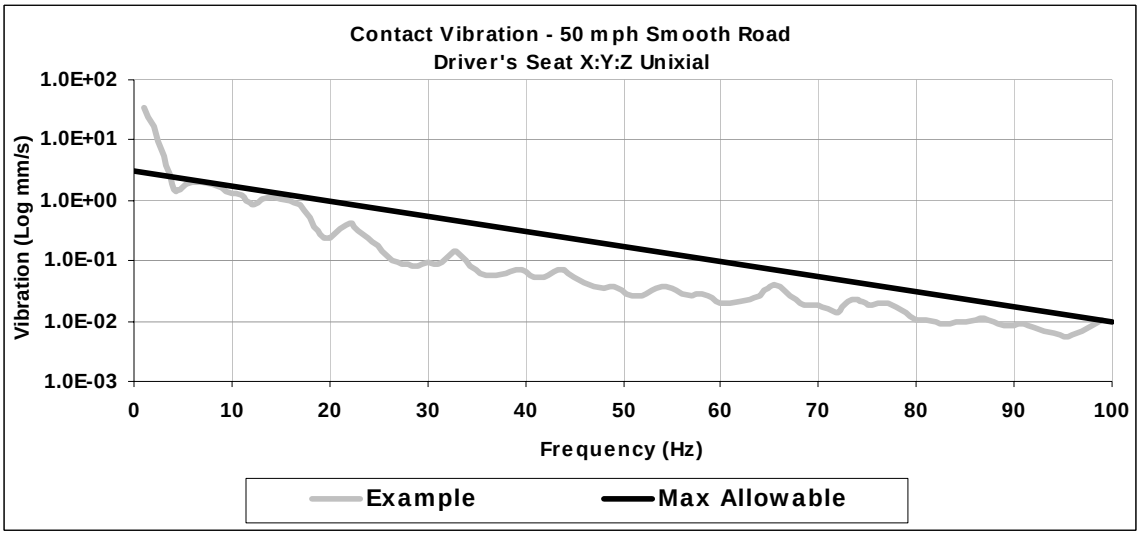

Contact Vibration - 30 mph Smooth Road
Driver's Seat Track X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

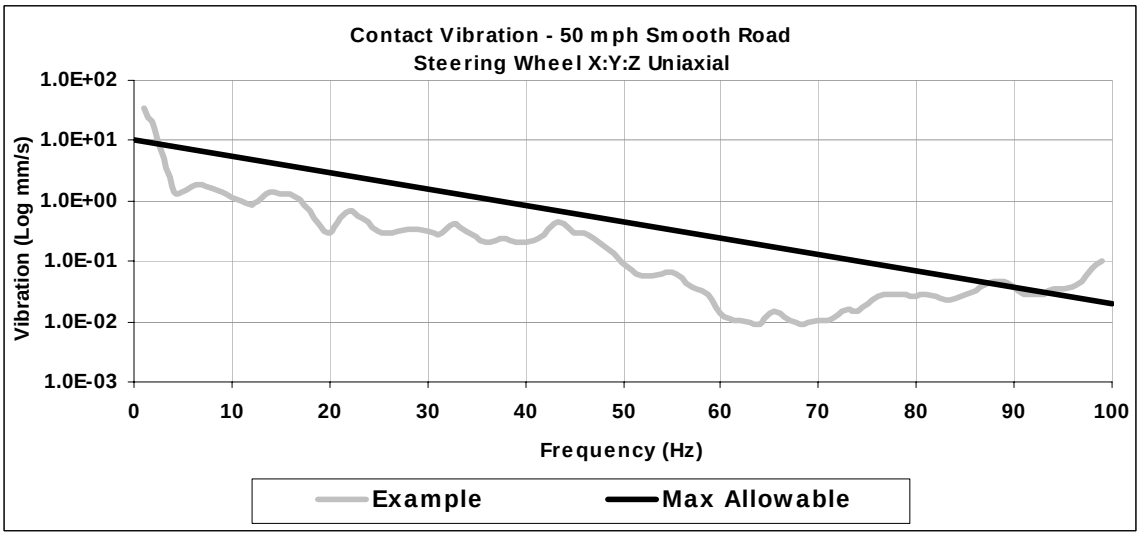

Contact Vibration - 30 mph Smooth Road
Steering Wheel X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Interior Noise - 50 mph Smooth Road
Sound Level (dBA)
60
55
50
45
40
35
30
25
20
15
10
5
0
10
100
1000
10000
Frequency (Hz)
Driver's Seat Max Allowable
Rear Passenger Seat Max Allowable


Contact Vibration - 50 mph Smooth Road
Rear Seat Pad X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Maximum Allowable


Contact Vibration - 50 mph Smooth Road
Rear Seat Back X Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Contact Vibration - 50 mph Smooth Road
Driver's Seat X:Y:Z Unixial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Contact Vibration - 50 mph Smooth Road
Steering Wheel X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

2.18 Noise, Vibration and Harshness - Coarse/Rough Road Cruise

Cruise at 20, 30, 50mph constant speed:

- Transmission in automatic mode.
- Accessories off.

2.18.1 Sound

Objective evaluation (dB (A) overall level and 1/3octave):

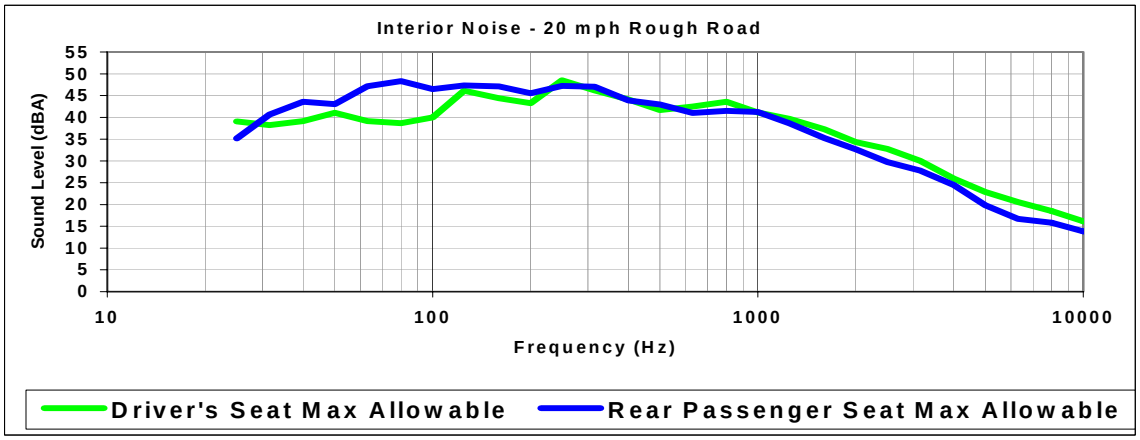
- Driver's outboard ear.
- Right rear passenger outer ear.

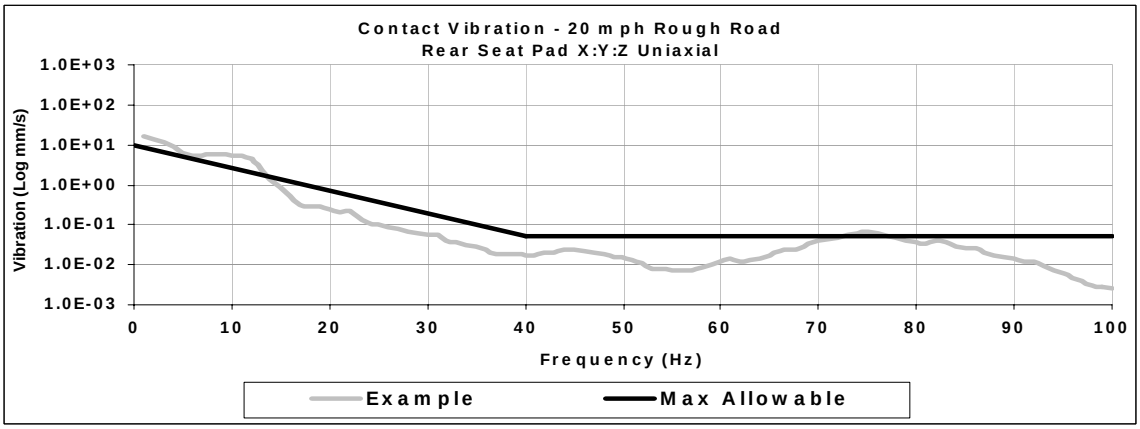
2.18.2 Vibration

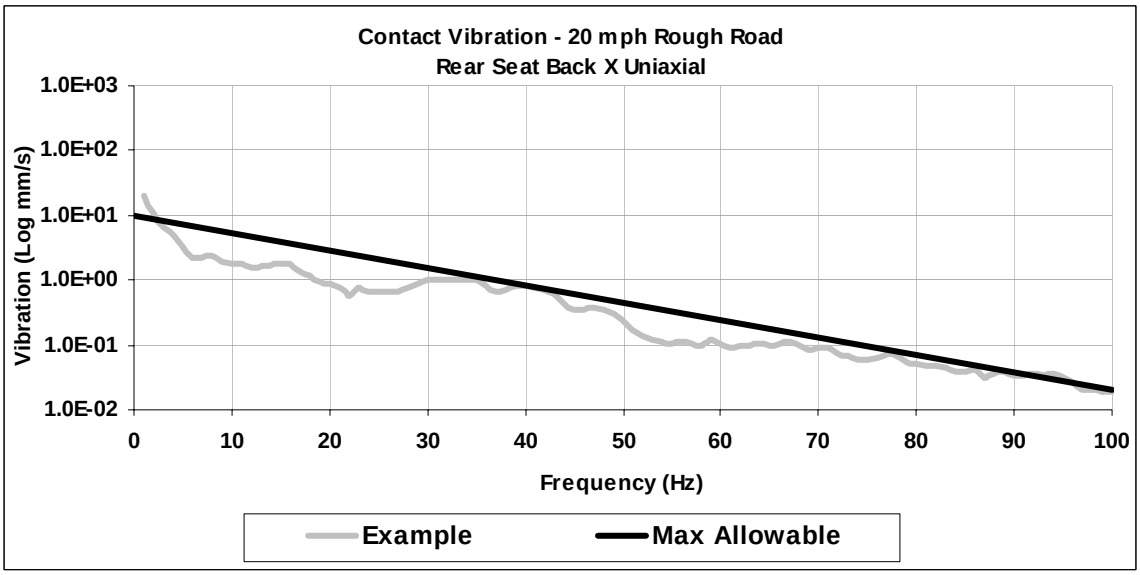
Objective evaluation (mm/s versus frequency):

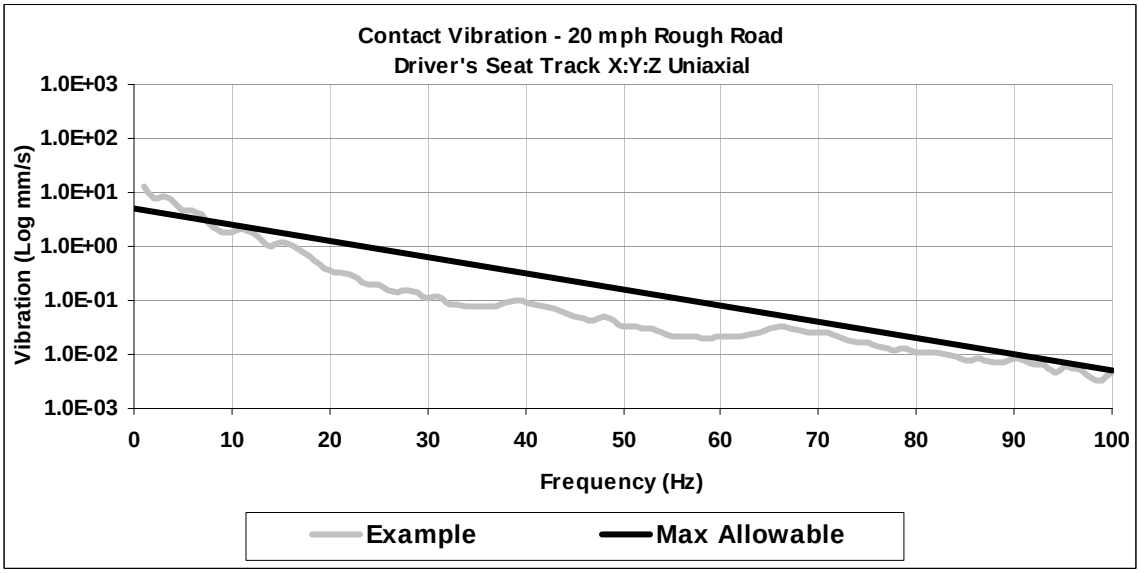
- Steering wheel.
- Driver's outboard seat track front attachment bolt.
- Rear seat cushion vibration.
- Rear seat back vibration.

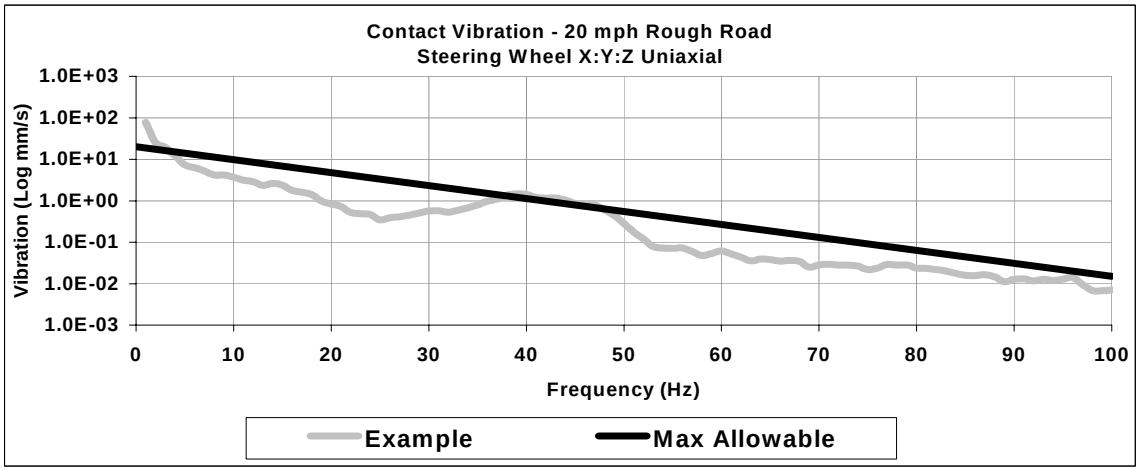
Overall Level (dB(A)) Max Allowable over Course Road			
	20mph	30mph	50mph
Driver's Seat	56.0	55.0	61.0
Rear Passenger Seat	58.0	58.0	63.0

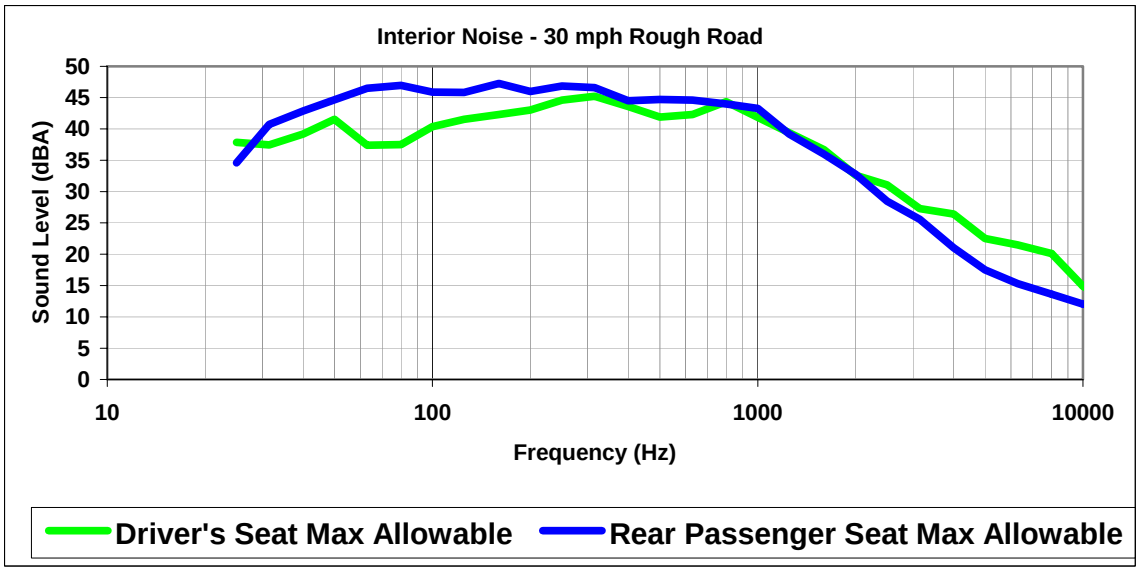


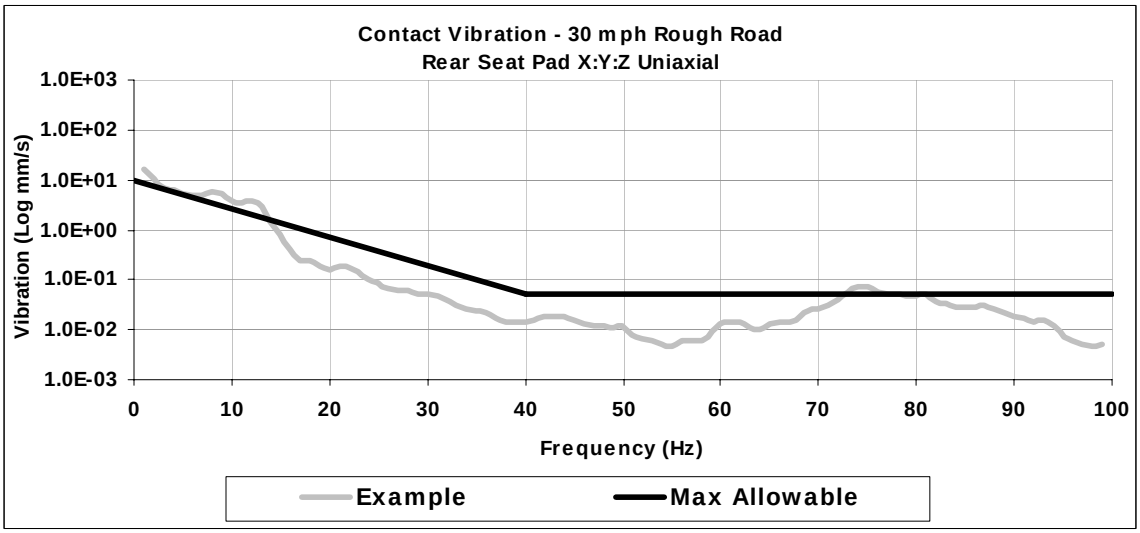


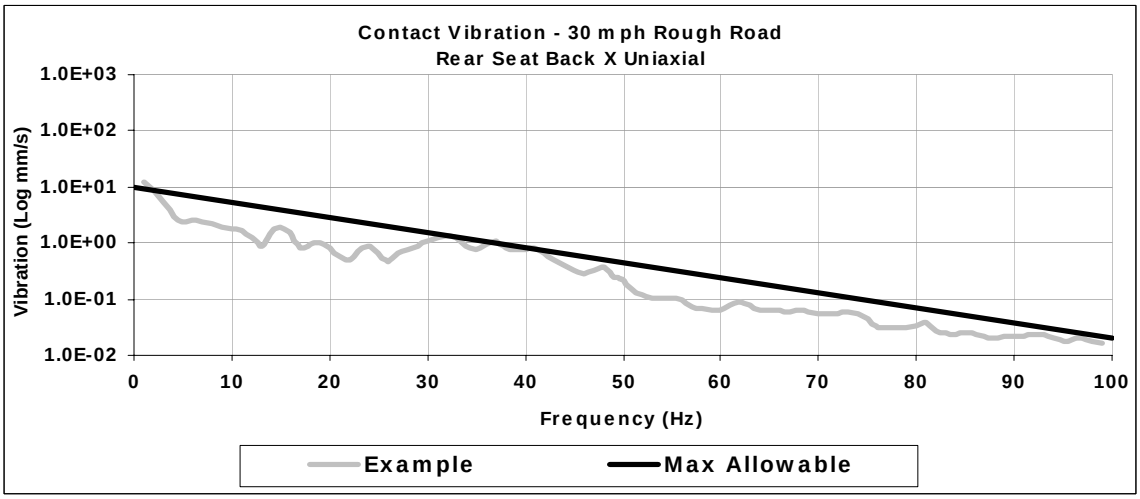

Contact Vibration - 20 mph Rough Road
Rear Seat Back X Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

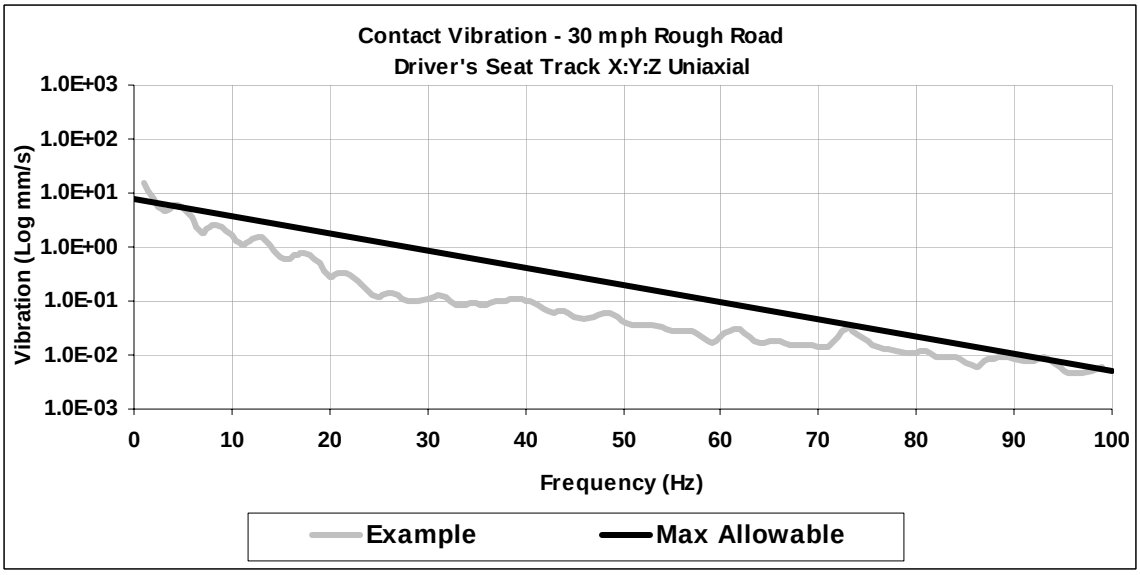

Contact Vibration - 20 mph Rough Road
Driver's Seat Track X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

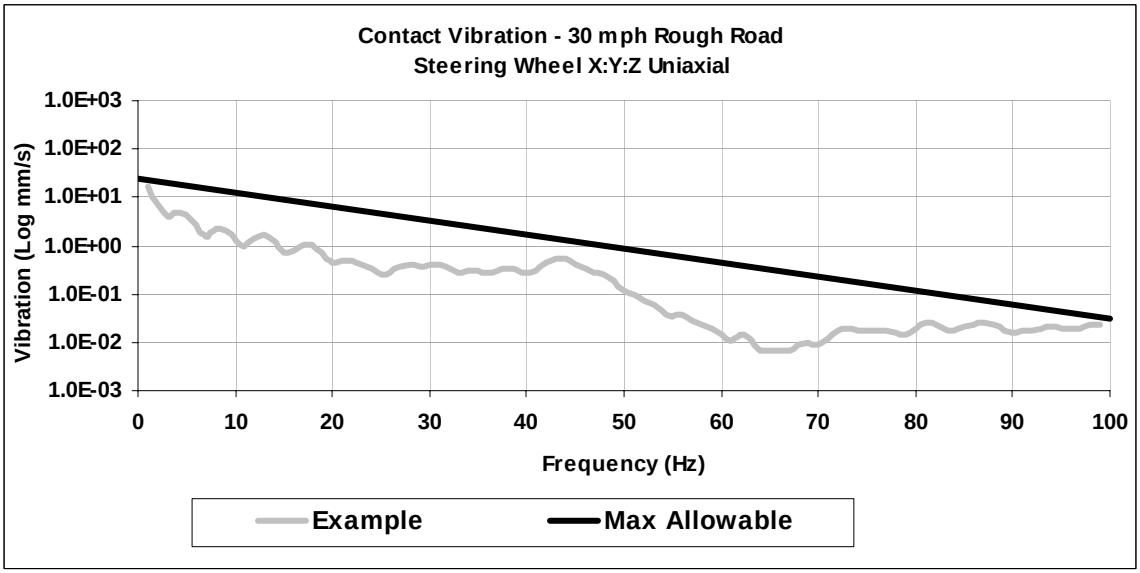

Contact Vibration - 20 mph Rough Road
Steering Wheel X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

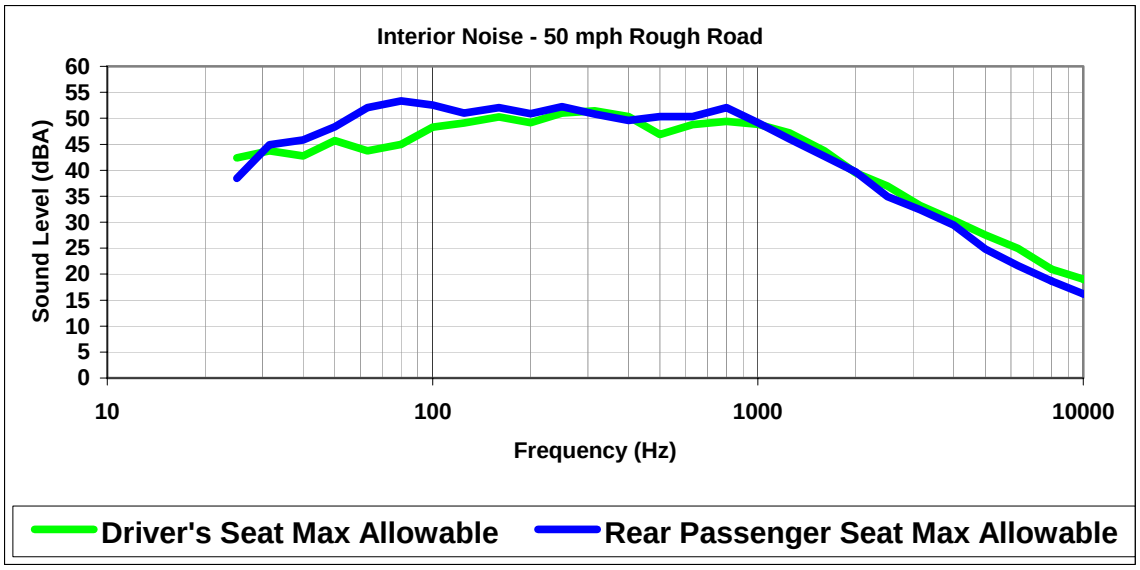

Interior Noise - 30 mph Rough Road
Sound Level (dBA)
50
45
40
35
30
25
20
15
10
5
0
10
100
1000
10000
Frequency (Hz)
Driver's Seat Max Allowable
Rear Passenger Seat Max Allowable

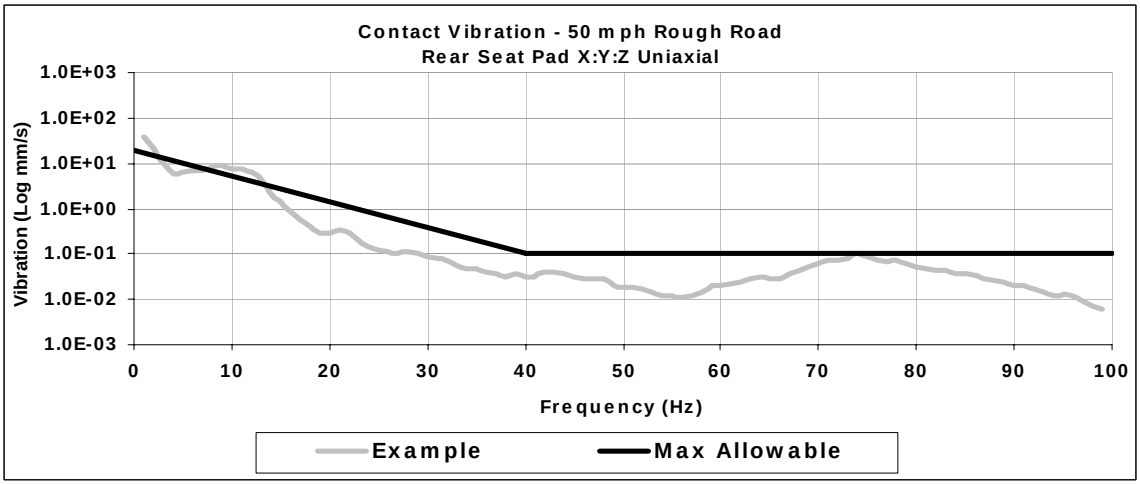

Contact Vibration - 30 mph Rough Road
Rear Seat Pad X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

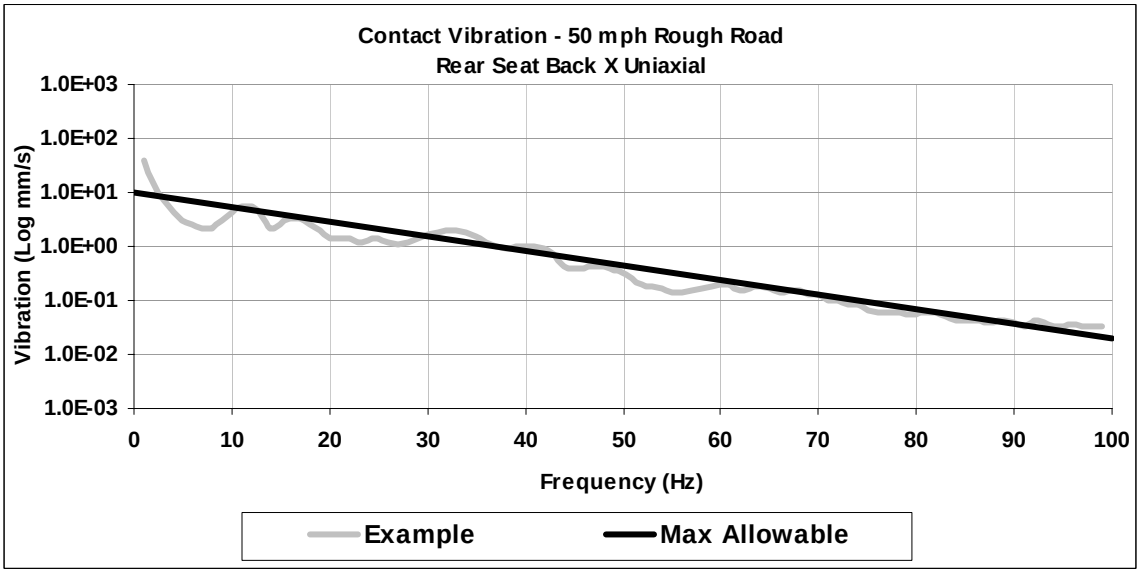

Contact Vibration - 30 mph Rough Road
Rear Seat Back X Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

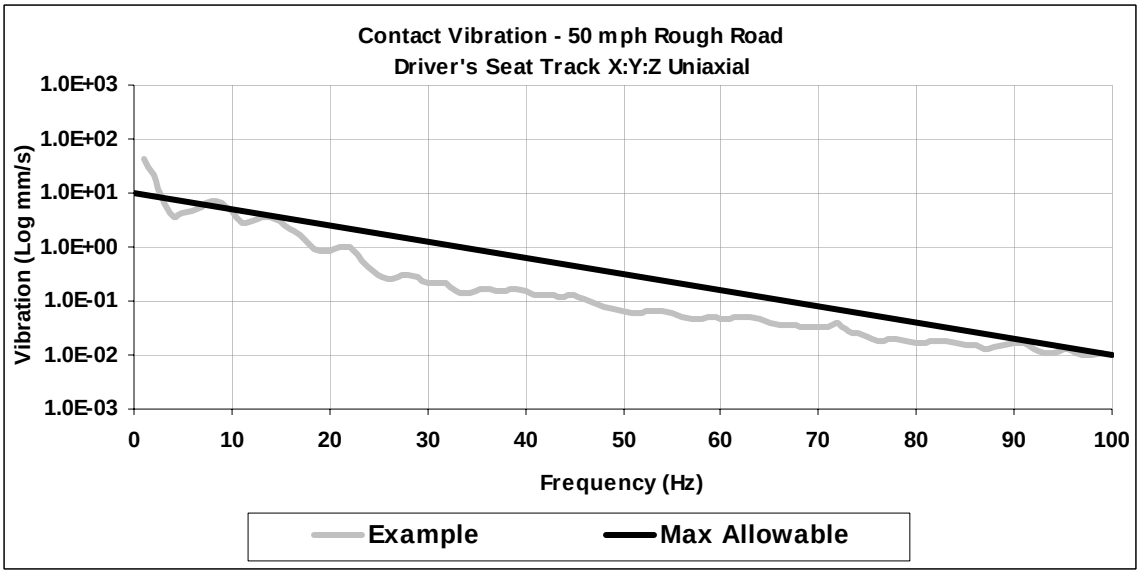

Contact Vibration - 30 mph Rough Road
Driver's Seat Track X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

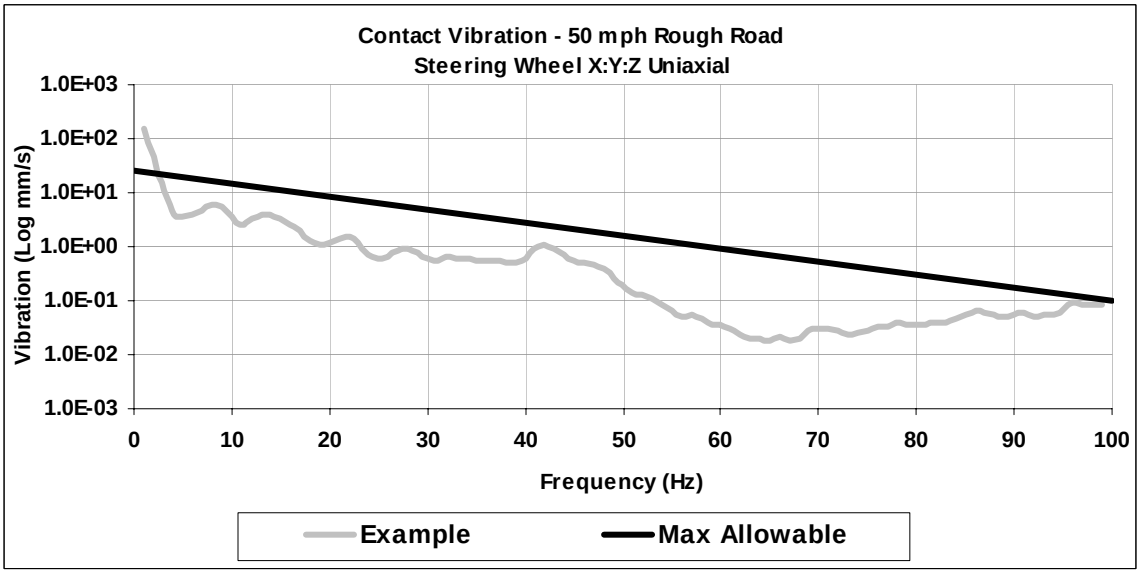

Contact Vibration - 30 mph Rough Road
Steering Wheel X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Interior Noise - 50 mph Rough Road
Sound Level (dBA)
60
55
50
45
40
35
30
25
20
15
10
5
0
10
100
1000
10000
Frequency (Hz)
Driver's Seat Max Allowable
Rear Passenger Seat Max Allowable


Contact Vibration - 50 mph Rough Road
Rear Seat Pad X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Contact Vibration - 50 mph Rough Road
Rear Seat Back X Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Contact Vibration - 50 mph Rough Road
Driver's Seat Track X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable


Contact Vibration - 50 mph Rough Road
Steering Wheel X:Y:Z Uniaxial
Vibration (Log mm/s)
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
0
10
20
30
40
50
60
70
80
90
100
Frequency (Hz)
Example
Max Allowable

2.19 Noise, Vibration and Harshness – Impact Over Obstacles

20mph constant speed over 0.75in high x 3.0in wide 60H (Shore A) rubber bump strip:

2.19.1 Sound

Objective evaluation (Loudness Zwicker versus time):

- Driver's seat outboard ear.
- Right rear passenger outer ear.

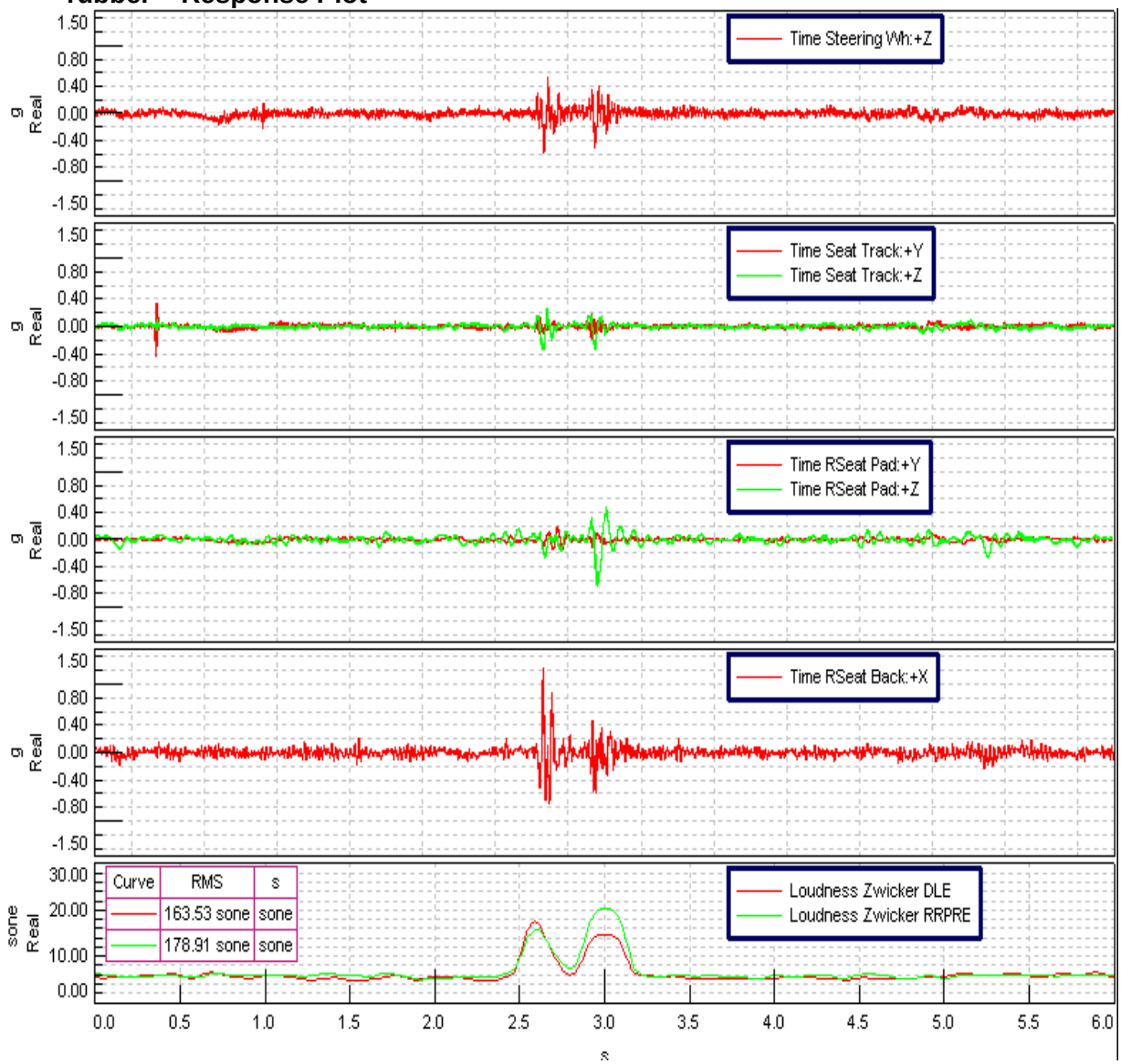
2.19.2 Vibration

Objective evaluation (Acceleration g versus time):

- Steering wheel.
- Driver's outboard seat track front attachment bolt.
- Rear seat cushion vibration.
- Rear seat back vibration.

	Max Allowable Peak Levels
Steering Wheel :Z	+/- 0.6g
Driver's Seat Track:Y	+/- 0.3g
Driver's Seat Track :Z	+/- 0.4g
Rear Seat Back :X	+/- 1.2g
Rear Seat Pad :Y	+/- 0.2g
Rear Seat Pad :Z	+/- 0.7g
Driver's Seat Loudness	18 sones
Rear Passenger Seat Loudness (Zwickers)	20 sones

20mph constant speed over 0.75in high x 3.0in wide 60H bump strip that (Shore A) rubber – Response Plot



2.20 Handling

Due to the low-speed nature of the taxi driving cycle, no targets have been specified for high-speed handling performance. The vehicle manufacturer must demonstrate that the vehicle meets the same performance targets as the donor vehicle when configured as a NYC taxi.

2.20.1 Roll-Over Propensity

Vehicles shall be fitted with an electronic stability and traction control system.

The vehicle must meet the following specifications for rollover propensity when tested to NHTSA specifications:

Test	Minimum	Target
Static Stability Factor	1.36	1.51
Chance of Rollover in a Single Vehicle Crash	12%	9%
Star Rating	4	5

2.20.2 Understeer Gradient

The understeer gradient at all operating speeds shall have a positive gradient up to the vehicle's maximum possible lateral acceleration, when loaded to the New York Taxi Standard Load Condition and tested in accordance with SAE J266 under the following conditions:

- 30.48 m radius circle, dry, high-mu (>0.8) surface.
- 56 m radius circle, 0.4 mu surface.

2.20.3 Roll Damping

Roll damping (roll gain from freeform lane change test / roll gain from constant radius test) shall be between **1.0 and 1.15.**

2.20.4 Yaw Damping

Sufficient body control shall be retained such that, the yaw overshoot following a GVW, free-form lane change at **0.75 g** is minimized.

2.20.5 On to Off-Center Steering Torsional Rate Ratio

Using an On-Center test with a maximum lateral acceleration of 0.3 g, carried out at speeds of 30, 50 and 70 mph, the ratio of On-Center to Off-Center Torsional rate shall be no more than **4.5**.

2.20.6 Static Steering Effort and Turning Circle

Test	Maximum	Target
Static Steering Effort (Nm)	5	4
Turning Circle	12.5	<11.9

If the vehicle is fitted with a power brake system which uses the same power assistance system as the steering (such as Hydro-Boost®), there shall be no subjective difference in assistance levels whether the brakes are applied (with a force of 60 N) or not.

2.20.7 Yaw Rate Gain

Using an On-Center test with a maximum lateral acceleration of 0.3 g carried out at speeds of between 10 and 120 mph (or less if the vehicle's maximum is less) with increments of 10 mph, the yaw rate gain shall be negative at speeds in excess of 50 mph. There shall be no reduction in the negative gradient from the initial gradient allowed (increasingly negative is allowed).

2.21 Brakes

The vehicle shall meet the requirements of FMVSS 135 or an equivalent manufacturer standard when fitted with all taxi-specific content.

The vehicle manufacturer must demonstrate that the vehicle when configured as a taxi meets the original manufacturer's performance targets for the donor vehicle

In addition to the OEM standards, the vehicle should meet the following specific conditions:

2.21.1 Design Stopping Distance

The brakes should be able to lock all wheels under all conditions. A **0.9g** fully developed decel should be achievable. This would produce, from **100km/h**, a stopping distance of **43.45m** with the ABS system activated.

2.21.2 Low Temperature Response Time

The braking response and release time shall be no more than 120% of the Ambient Temperature response time when measured at -30 degrees C.

2.21.3 Park Brake Gradeability

- The vehicle must meet the requirements of FMVSS 135 on a test grade of **30%.**
- The park brake system shall be capable of retarding the vehicle at **0.25g** from **50 kph.**

2.21.4 Max Speed Braking

During a maximum deceleration stop from **110 kph**, the maximum steering wheel correction allowable is **+/- 45 degrees** to keep within a **3m** wide lane.

2.21.5 Brake Fade Test

When braking as hard as possible from 100 kph ten consecutive times, the stopping distance shall not increase by more than 15% between the first and last stops.

2.21.6 Split Coefficient Braking Yaw Response

When braking on a lateral split mu test, with dry asphalt and polished ice, the maximum acceptable steering wheel correction is +/- 45º. The "split line" of the test two test surfaces must be maintained within the vehicle track width.

2.21.7 Non Systematic Pedal Travel Increase during Operation (Knockback)

Target 0mm. Knockback should not exceed 15% of total pedal travel.

2.21.8 Pedal feel Hysteresis

Pedal effort (N) hysteresis at 50 Bar = **30 to 40 N.**

Pedal travel (mm) hysteresis at 10 Bar = **5 to 10 mm.**

Pedal travel (mm) hysteresis at 50 Bar = **4 to 8mm.**

2.21.9 Lining Wear Sensors

The vehicle should be fitted with lining wear sensors with a minimum of one sensor per axle. The sensors (whether visual or audible) shall provide a warning to the driver not less than 1000 miles (and not more than 2000 miles) before first direct contact between the rotor/drum and the backing plate. The warning (whether visual or audible) shall continue to function for not less than 1000 miles of driving following initial indication.

2.22 Life Cycle, Durability and Service Life Requirements

2.22.1 Vehicle Life

Target vehicle life: **400,000 miles**, **60 months**.

2.22.2 Operating Environment

The typical NYC taxi fleet garage is in Long Island City, Queens. Vehicles spend most of their time in Mid-town Manhattan and the Financial District, with limited excursions to the outer suburbs and metro airports.

Trips to and from NYC airports account for about **5%** of all taxi trips.

The average number of passengers per trip is **1.4.**

This duty cycle results in increased numbers of throttle pedal operations, gear shifts and launch / brake events, as well as increased operation of rear doors and trunk. The average taxi picks up about **30 fares** in a **12-hour shift** – **108,000** fares over the service life of the vehicle.

While some road surfaces in Manhattan are very poor, they qualify for the most part as 'paved road' when put into the context of a typical vehicle durability cycle. Although the streets are paved, potholes and drain covers (which can create significant impact disturbances) are more prevalent than on the average urban road.

The vehicle is expected to spend the majority of its time in a city traffic environment with only **5%** of its time operating on freeways.

A fleet vehicle is expected to operate for two **12-hour shifts per day, 360 days per year.**

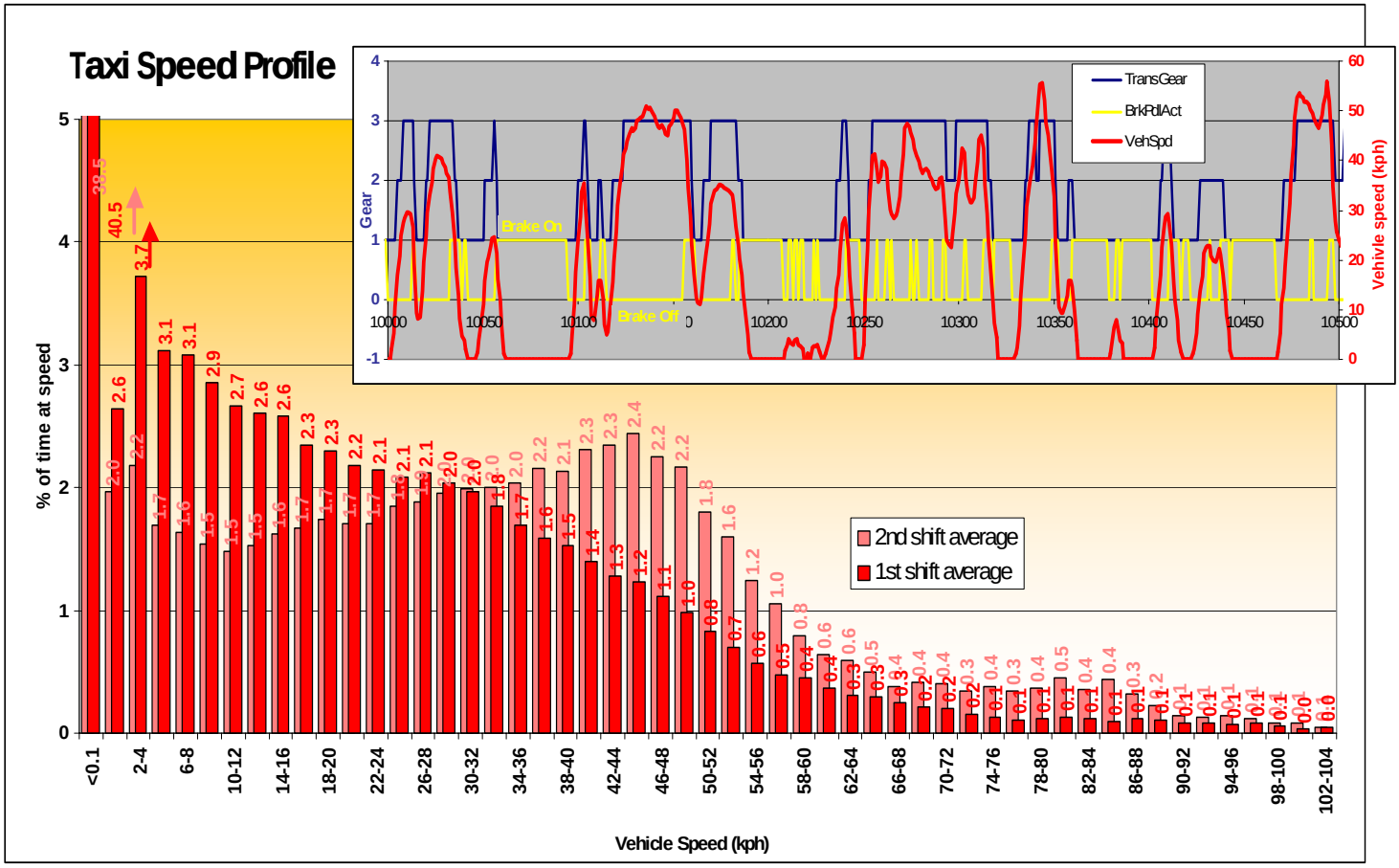
2.22.3 Vehicle Speed Profile

Data has been provided for both first and second shifts.

The vehicle spends approximately 40% of its time stationary; the remaining time is split evenly between accelerating and decelerating. Less than 1.5% of its time is spent at steady speed.

The average 'paid' trip length is **3.7 miles**; the average distance between fares is **2.87 miles**.

The average speed of the whole shift is approximately **16mph**; the average speed is much lower (approx.**7mph**) when looking for a fare.



Vehicle Speed data from this test is available at 1Hz and 50Hz sample rates

Table 2.5.13 Vehicle Speed Profile for typical 12 Hour Shifts

Speed range (kph)	1st Shift (% of time)	2nd Shift (% of time)
<0.1	40.5	38.5
0.1- 2	2.6	2.0
2-4	3.7	2.2
4-6	3.1	1.7
6-8	3.1	1.6
8-10	2.9	1.5
10-12	2.7	1.5
12-14	2.6	1.5
14-16	2.6	1.6
16-18	2.3	1.7
18-20	2.3	1.7
20-22	2.2	1.7
22-24	2.1	1.7
24-26	2.1	1.8
26-28	2.1	1.9
28-30	2.0	2.0
30-32	2.0	2.0
32-34	1.8	2.0
34-36	1.7	2.0
36-38	1.6	2.2
38-40	1.5	2.1
40-42	1.4	2.3
44-46	1.2	2.4
46-48	1.1	2.2
48-50	1.0	2.2
50-52	0.8	1.8
52-54	0.7	1.6

Speed range (kph)	1st Shift (% of time)	2nd Shift (% of time)
54-56	0.6	1.2
56-58	0.5	1.0
58-60	0.4	0.8
60-62	0.4	0.6
62-64	0.3	0.6
64-66	0.3	0.5
66-68	0.3	0.4
68-70	0.2	0.4
70-72	0.2	0.4
72-74	0.2	0.3
74-76	0.1	0.4
76-78	0.1	0.3
78-80	0.1	0.4
80-82	0.1	0.5
82-84	0.1	0.4
84-86	0.1	0.4
86-88	0.1	0.3
88-90	0.1	0.2
90-92	0.1	0.1
92-94	0.1	0.1
94-96	0.1	0.1
96-98	0.1	0.1
98-100	0.1	0.1
100-102	0.0	0.1
102-104	0.0	0.1
104-106	0.0	0.0

2.22.4 Gear Shifts

Most of the current vehicle fleet is fitted with a 4-speed automatic transmission. During its 5-year life, a current taxi will change gear approximately **11.5 million** times.

Gear Shift	1st Shift Average *# of events per hour*	2nd Shift Average *# of events per hour*	Vehicle Life *# of events*
1st to 2nd	67	63	**2,808,421**
2nd to 3rd	55	67	**2,637,180**
3rd to 4th	5	6	**221,948**
2nd to 1st	68	63	**2,822,577**
3rd to 2nd	56	67	**2,655,938**
4th to 3rd	5	6	**223,948**

2.22.5 Brake Events

State	Brake Events / Hour
Brake Pedal Operation	387

The total number of brake pedal operations over the life of the taxi is expected to be in excess of **14,500,000.**

2.22.6 Time Spent Accelerating and Decelerating

state	1st Shift Average % of Time	2nd Shift Average % of Time
Decelerating	30.5	30.0
Stopped	40.2	37.9
Constant velocity	0.9	1.4
Accelerating	28.4	30.7

2.22.7 Acceleration Profile

The drive cycle depends on traffic conditions, but typically includes approximately **8,600** discrete accel to decel and decel to accel transitions per shift.

% of total time	**Accel** **29.5%**	**Decel** **30.3%**
Time (s)	**% of time**	**% of time**
0-0.2	69.3	69.0
0.2-0.4	6.3	7.0
0.4-0.6	4.1	5.0
0.6-0.8	1.7	2.4
0.8-1	1.6	1.7
1-1.2	1.5	1.5
1.2-1.4	1.4	1.2
1.4-1.6	1.3	1.0
1.6-1.8	1.1	1.0
1.8-2	0.9	0.8
2-2.2	0.8	0.8
2.2-2.4	0.8	0.7
6.2-6.4	0.2	0.2
6.4-6.6	0.1	0.2
6.6-6.8	0.1	0.1
6.8-7	0.1	0.1
7-7.2	0.1	0.1
7.2-7.4	0.1	0.1
7.4-7.6	0.1	0.1
7.6-7.8	0.1	0.1
7.8-8	0.1	0.1
8-8.2	0.1	0.1
8.2-8.4	0.1	0.1
8.4-8.6	0.1	0.1
8.6-8.8	0.1	0.1
8.8-9	0.1	0.1
9-9.2	0.0	0.1
9.2-9.4	0.0	0.1
9.4-9.6	0.0	0.0
9.6-9.8	0.0	0.1
9.8-10	0.0	0.0
10-10.2	0.0	0.0

2.23 Durability

The vehicle and all its sub-systems shall function correctly when fitted with all taxi-specific equipment and operated in a NYC taxi environment for target vehicle life of **400,000 miles** over a period of **60 months**.

Manufacturers must identify any components that are expected to require major rebuild or replacement within this operating period, and specify the expected life of the component and the extent of any rebuild or repair work.

Specific non-powertrain events that are expected to occur with greater frequency than in a normal passenger vehicle are indicated below:

Item	Expected Life (Operating cycles)	Comments
Rear Door Operation	225,000	2 operating cycles per fare.
Trunk Operation	60,000	1 operation every 4th fare.
Door Lock Operation	120,000	1 cycle per fare.
Rear Seat Occupant Arrival and Departure	225,000	1 cycle per fare.
Throttle Pedal Operation	750,000	
Key-on and Key-off	15,000	3 cycles per shift (2 stops /shift).
Brake Pedal Operation	750,000	
Rear HVAC Blower Cycling	15,000	1 cycle = 1 sweep up and down through all speeds – 5 min at each speed.
Passenger Entry and Exit Support Controls (Grab Bars or Straps)	225,000	5-second operating cycle with an applied load of **500N** or an equivalent cycle to be determined by the manufacturer.
Parking Brake Operation	10,000	
Automated Car Wash	4,000	

2.23.1 Cosmetic Corrosion Resistance

The vehicle corrosion resistance performance shall not be reduced by the addition of any taxi-specific content.

Taxi-specific content shall meet the same corrosion resistance requirements as the rest of the vehicle when tested to the vehicle manufacturers specifications.

Taxi-specific equipment that is classified as ‘high visibility’ – i.e. items easily seen by a driver or passenger while walking around, seated in, entering or exiting the vehicle shall not display any cosmetic corrosion artifacts during the period of taxi service (5 years) when exposed to the manufacturer-defined high-corrosion environment.

This standard also covers corrosion on areas exposed to damage from normal vehicle operation such as stone damage, normal wear, panel-to-panel contact, etc.

The vehicle's cosmetic corrosion resistance target is 10 years of environmental exposure and 400,000 miles of customer usage. This applies to all parts except as noted for wearout items in 2.23.

2.24 Service Intervals and Consumable Components

Vehicles that spend less time in the shop earn more money – service time and part cost are key components of the vehicle cost of ownership.

Mileage dependent operating events can be specified by the manufacturer, bearing in mind the low speed nature of the drive cycle and the specific requirements of their own vehicle. However, a target oil change and minor service interval of no less than **5,000 miles** is desired.

The manufacturer shall provide information on the following fluids change and component service intervals:

Service item	Change interval (miles)	Estimated service time (hours)	Estimated component cost ($)
Engine Oil and Filter			
Transmission Oil and Filter			
Axle / Differential Oil			
PAS Fluid			
Brake Fluid			
Coolant			
A/C Refrigerant			
Engine Air Filter			
Cabin Air Filter			
Wiper Blades			
Suspension Grease Points			
Front Brake Pads			
Rear Brake Pads			
Front Rotors			
Engine			
Transmission / Driveline (FWD)			
Prop-shaft / Rear axle (RWD)			
Transfer case / Center diff (AWD)			
Rear Axle			
Rear Rotors			
Exhaust / Aftertreatment System			

2.24.1 Other Service Provisions

The vehicle hood must be self-supporting when open, and shall not require the use of a stay to hold it in the open position.

Fluid fill locations shall be clearly identified, preferably by color-coded caps.

2.24.2 Brake Pad / Lining and rotor life

- Lining life: minimum **5,000 miles**, target **10,000 miles.**
- Rotor life: minimum **2 x lining life**; **target 3 x lining life.**

2.25 Collision Repair

Modern unibody vehicles present a greater challenge than previous body-on-frame taxis. While still inherently repairable, the work required to repair a body can easily exceed the value of a replacement shell. However, the part itself is usually more expensive than the equivalent non-structural panels of a body-on-frame vehicle.

The Taxi of Tomorrow shall be designed in such a way that **wherever possible** replaceable panels will be **sacrificial** in order to limit damage to the unibody structure.

2.25.1 Supply of Service and Repair Parts

A readily available and cost-effective supply of both service and repair parts will be required from day 1 to ensure that vehicles can be repaired and put back on the road expediently. Manufacturers shall provide a list of any repair parts that are expected to have limited availability with the quantities that are currently expected to be available annually.

Typical repair components that will need to be available in larger quantities than for a standard vehicle include:

- Front and Rear Bumpers, Grilles, etc
- Front Wings
- Rear Wings (if removable)
- Door Mirrors
- Trim and Protection Strips
- Headlamps
- Tail lamps
- Door Assemblies

2.25.2 Damage Assessment

Access to dimensional locations of datums & critical component features should be provided as means of assessing severity of damage to vehicle chassis and body components. Appropriate jigs and fixtures will also be required to ensure that repair downtime is minimized.

2.26 Road Safety

The vehicle must meet all current federal, New York State and New York City / TLC regulations for occupant protection.

2.26.1 Improved Safety for Drivers

The Taxi of Tomorrow must provide an environment suitable for spending 12 hours per day, 6 days per week while minimizing fatigue and maximizing peripheral vision. Manufacturers will be expected to provide evidence of improvements in driver comfort and safety over the base vehicle. Of particular concern are seat adjustability and back support, ergonomic positions for all controls (including taxi-specific content), glare-free illumination of all controls and passenger compartment and the ability to communicate with the passenger.

2.26.2 Improved Safety for Passengers

The TLC would like to invite comment from potential suppliers on the feasibility of providing improved rear seat passenger impact safety requirements, particularly for front impacts where the likelihood of contact with the partition (if fitted) is increased.

The integration of a partition to the vehicle structure is likely to provide additional benefits in the roof crush tests, but may require modification to existing side curtain airbags and affect the results of side impact tests.

The provision of safety aids (active or passive) for use by passengers while exiting the vehicle helps both passengers and other road users. These features can be as simple as an external mirror (with appropriate break-away capability) or as complex as a peripheral camera system or ultrasonic detectors (See **Appendix 2**).

2.26.3 Child Seat Mounts and Booster Seats

Rear seats shall be fitted with ‘Latch’ child seat attachment points and a clear indication of their location on the rear seat.

Integrated child booster cushions shall be provided in two of the rear seat locations for older children. Instructions for height and weight criteria for the use of the booster cushions shall be provided in the rear passenger compartment.

2.26.4 ADA Accessible Vehicles

The vehicle manufacturer shall demonstrate that the provisions for wheelchair access in the vehicle afford the same level of impact protection to a passenger in a wheelchair as a passenger seated in the rear of the original vehicle.

2.26.5 Improved Safety for Other Road Users

The vehicle shall be designed such that it minimizes the potential for injury to other road users in the event of an impact.

Design of the front of the vehicle shall be based on EC/2003/102 or EuroNCAP pedestrian safety guidelines. These require that potential head impact areas at the front of the vehicle are (a) deformable and (b) have clearance to rigid components behind them to reduce the head injury to pedestrians. The front bumper of the vehicle also needs to be deformable, with a lower leg contact point as low as possible. The European specifications for pedestrian safety are also being linked to an emergency brake assist function, which detects rate of brake application and increases pedal assistance if a certain threshold is exceeded.

Although existing vehicles typically have 1-2 star ratings for pedestrian impact, the goal for the Taxi of Tomorrow is a 4 star rating. However, it is realized that this may not be practical as a short-term goal.

When reviewing the iconic content of the taxi, manufacturers should take every opportunity to review how the design of the fascia and front end of existing vehicles can integrate pedestrian-friendly content.

Drivers need good peripheral visibility in order to detect pedestrians at intersections as well as other vehicles approaching on either side. The elimination or at least significant reduction in the driver's 'blind spots' by improved mirror location or vision systems is required.

Manufacturers shall provide details of driver vision ranges in accordance with FMVSS 103 for evaluation as part of the RFI submission.

2.27 Recycling and Sustainability

2.27.1 Material Requirements for Recycling

All vehicle systems must conform to the current regulatory (governmental) requirements regarding regulated substances and recycleability.
In order to meet the requirements for the Taxi of Tomorrow, it will be necessary to demonstrate the total environmental cost of ownership of the vehicle from manufacture to final disposal. This will be considered carefully during the initial choice of platform vehicles. As the time window for initial vehicle availability is narrow, there is some expectation that not all aspects of the vehicle will be optimized for recycleability or use of recycled content when the vehicle is launched.. However, there is an expectation that, over time, the vehicle will show significant additional improvements to its environmental impact in line with the long-term goals of plaNYC. This can take the form of not only improved fuel economy (which has already been mandated) but also improvements to other emissions as well as recycled content. Particular attention will be paid to high-impact pollution sources such as batteries and the heavy metals from after-treatment systems.

While the final scope for an environmental vehicle will be based on the target vehicle and mfr capabilities, several items will be requested as part of the industry outreach effort that will follow the RFI:

- The manufacturer should consider dismantling recycling & re-use of materials during the design process.
- The manufacturer should provide a document outlining clear guidelines to ensure vehicle collectors dismantlers & shredders meet the above targets for reuse, recycling and recovery.
- Environmental Health and Occupational Safety requirements for regulated substances or processes and product recycling reporting requirements must be followed.
- Targets for the percentage of reusable recyclable and recoverable components will be continually updated to match or exceed latest international standards.

2.27.2 Design for the Avoidance of Pollution

Provision should be made for the removal of all operating fluids (lubricant, fuel, cooling, and hydraulic) from the vehicle during service and the dismantling/recycling process.

The vehicle should be designed to minimize its effect on the environment from manufacture to disposal. Factors such as the manufacture of components and sub-assemblies local to the vehicle assembly area to reduce shipping energy, assembly of the vehicle itself close to New York, and final disposition of materials at vehicle disposal all add to the energy burden for the vehicle.

Manufacturers shall provide expected manufacturing locations for the vehicle itself as well as all major components and sub-assemblies to enable the TLC to rate the potential environmental impact of the manufacturing and shipping process.

2.27.3 Materials to be avoided

- Toxic substances including but not limited to lead, mercury, cadmium, hexavalent chromium, whether used in the vehicle or as part of the manufacturing process.
- Non-recyclable plastics or over molded matrix components that cannot be readily broken down to their individual components.
- Ethylene Glycol and blends.
- Any other materials or fluids that are not currently considered recyclable. All materials must meet labeling requirements of Occupational Health and Safety (OSHA) Standard 29 CFR 1910.

2.27.4 Restricted and Reportable Substances for Parts

The aim of this specification is to restrict/stop the usage of the substances listed to facilitate compliance with current and future regulations.

Material Safety Data Sheets - Complete material safety data sheets shall be provided for all materials that present a risk during fire, disassembly, disposal or re-manufacture.