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U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
LABORATORY TEST PROCEDURE
FOR
FMVSS 141

Minimum Sound Requirements for Hybrid and Electric Vehicles

DRAFT



ENFORCEMENT
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OVSC LABORATORY TEST PROCEDURE NO. 141
TABLE OF CONTENTS

	PAGE
PREFACE.....	ii
1. PURPOSE AND APPLICATION	1
2. GENERAL REQUIREMENTS	2
3. SECURITY	3
4. GOOD HOUSEKEEPING.....	3
5. TEST SCHEDULING AND MONITORING.....	4
6. TEST DATA DISPOSITION	4
7. GOVERNMENT FURNISHED PROPERTY (GFP)	6
8. CALIBRATION OF TEST INSTRUMENTS	7
9. SUGGESTED TEST EQUIPMENT	8
10. PHOTOGRAPHIC DOCUMENTATION.....	9
11. DEFINITIONS	10
12. PRETEST REQUIREMENTS	12
13. COMPLIANCE TEST EXECUTION.....	16
14. POST TEST REQUIREMENTS.....	32
15. REPORTS	32
15.1 MONTHLY STATUS REPORTS	32
15.2 APPARENT NONCOMPLIANCE.....	33
15.3 FINAL TEST REPORTS.....	33
15.3.1 COPIES.....	33
15.3.2 REQUIREMENTS.....	34
15.3.3 FIRST THREE PAGES	35
15.3.4 TABLE OF CONTENTS.....	39
16. DATA SHEETS	41
17. FORMS.....	71
18. APPENDIX A - Compliance Tool Instruction Manual	
19. APPENDIX B - MATLAB Source Code	
20. APPENDIX C - Executable MATLAB File	

PREFACE

On December 14, 2016, NHTSA published a final rule establishing a new Federal motor vehicle safety standard (FMVSS) No. 141, *Minimum Sound Requirements for Hybrid and Electric Vehicles*. To reduce the risk of pedestrian crashes, especially for the blind and visually impaired, and to satisfy the mandate in the Pedestrian Safety Enhancement Act (PSEA) of 2010, FMVSS No. 141 establishes minimum sound requirements for hybrid and electric vehicles. This standard requires hybrid and electric passenger cars, multipurpose passenger vehicles, trucks, buses, with gross vehicle weight ratings (GVWRs) of 4,536 Kg or less, and low speed vehicles (LSVs), to produce sounds meeting the requirements of this standard.

**REVISION CONTROL LOG
FOR OVSC LABORATORY
TEST PROCEDURES**

TP-141

Minimum Sound Requirements for Hybrid and Electric Vehicles

TEST PROCEDURE		FMVSS 141		DESCRIPTION
REV. No.	DATE	AMENDMENT	EFFECTIVE DATE	
00	Draft 11/19/18	81FR90416 and 83FR8182	02/13/2017 and 04/27/2018	Final Rules
01				
02				
03				
04				
05				
06				

1. PURPOSE AND APPLICATION

This document is a laboratory test procedure provided by the National Highway Traffic Safety Administration (NHTSA), Office of Vehicle Safety Compliance (OVSC) for the purpose of presenting guidelines for a uniform testing data and information recording format, and providing suggestions for the use of specific equipment and procedures for contracted testing laboratories. The data correspond to specific requirements of the Federal Motor Vehicle Safety Standard(s) (FMVSS). The OVSC test procedures include requirements that are general in scope to provide flexibility for contracted laboratories to perform compliance testing and are not intended to limit or restrain a contractor from developing or utilizing any testing techniques or equipment which will assist in procuring the required compliance test data. These test procedures do not constitute an endorsement or recommendation for use of any particular product or testing method.

Prior to conducting compliance testing, contracted laboratories are required to submit a detailed test procedure to the COR to demonstrate concurrence with the OVSC laboratory test procedure and the applicable FMVSS. If any contractor views any part of an OVSC laboratory test procedure to conflict with a FMVSS or observes deficiencies in a laboratory test procedure, the contractor is required to advise the Contracting Officer's Technical Representative (COR) and resolve the discrepancy prior to the start of compliance testing or as soon as practicable. The contractor's test procedures must include a step-by-step description of the methodology and detailed check-off sheets. Detailed check-off sheets shall also be provided for the testing instrumentation including a complete listing of the test equipment with make and model numbers. The list of test equipment shall include instrument accuracy and calibration dates. All equipment shall be calibrated in accordance with the manufacturer's instructions. There shall be no contradictions between the laboratory test procedures and the contractor's in-house test procedure. Written approval of the in-house test procedures shall be obtained from the COR before initiating the compliance test program.

NOTE: The OVSC Laboratory Test Procedures, prepared for the limited purpose of use by independent laboratories under contract to conduct compliance tests for the OVSC, are not rules, regulations or NHTSA interpretations regarding the meaning of a FMVSS. The laboratory test procedures are not intended to limit the requirements of the applicable FMVSS(s). In some cases, the OVSC laboratory test procedures do not include all of the various FMVSS minimum performance requirements. Recognizing applicable test tolerances, the laboratory test procedures may specify test conditions that are less severe than the minimum requirements of the standard. In addition, the laboratory test procedures may be modified by the OVSC at any time without notice, and the COR may direct or authorize contractors to deviate from these procedures, as long as the tests are performed in a manner consistent with the standard itself and within the scope of the contract.

1. PURPOSE AND APPLICATION....Continued

Laboratory test procedures may not be relied upon to create any right or benefit in any person. Therefore, compliance of a vehicle or item of motor vehicle equipment is not necessarily guaranteed if the manufacturer limits its certification tests to those described in the OVSC laboratory test procedures.

2. GENERAL REQUIREMENTS

To reduce the risk of pedestrian crashes, especially for the blind and visually impaired, and to satisfy the mandate in the Pedestrian Safety Enhancement Act (PSEA) of 2010, FMVSS No. 141, *Minimum Sound Requirements for Hybrid and Electric Vehicles*, establishes minimum sound requirements for hybrid and electric vehicles. This standard requires hybrid and electric passenger cars, multipurpose passenger vehicles, trucks, buses, with gross vehicle weight ratings (GVWRs) of 4,536 Kg or less, and low speed vehicles (LSVs), to produce sounds meeting the requirements of this standard, according to the phase-in schedule shown below.

Manufacturer Type	Percentage Complying	Period of Production Vehicle Manufactured
Large Volume	$\geq 50\%$	On or after September 1, 2019, and before September 1, 2020
Large & Small Volume	100%	On or after September 1, 2020

FMVSS No. 141 applies to electric vehicles (EVs) and to those hybrid vehicles (HVs) that are capable of propulsion in any forward or reverse gear without the vehicle's internal combustion engine operating. Applicable vehicles must meet specified audible alert requirements for detection and directivity during critical operating scenarios including: stationary, reverse, and constant speeds up to 30 km/h. Applicable vehicles must also meet relative volume change requirements that signify vehicle acceleration and deceleration. Furthermore, any two vehicles of the same make, model, model year, body type, and trim level must use the same pedestrian alert system and sound.

METRIC SYSTEM OF MEASUREMENT

Section 5164 of the Omnibus Trade and Competitiveness Act (Pub. L. 100-418) establishes that the metric system of measurement is the preferred system of weights and measures for trade and commerce in the United States. Executive order 12770 directs Federal agencies to comply with the Act by converting regulatory standards to the metric system after September 30, 1992. In a final rule published on March 15, 1990 (60 FR 13639), NHTSA completed the first phase of metrication, converting English measurement in several regulatory standards to the metric system. Since then, metrication has been applied to other regulatory standards (63 FR 28912).

2. GENERAL REQUIREMENTS....Continued

Accordingly, the OVSC laboratory test procedures include revisions to comply with governmental directives in using the metric system. Regulatory standards converted to metric units are required to use metric measurement in the test procedures. For any testing equipment that is not available for direct measurement in metric units, the test laboratory shall calculate the exact metric equivalent by means of a conversion factor carried out to at least five significant digits before rounding, consistent with the specified metric requirement.

All final compliance test reports are required to include metric measurements for standards using metrication.

NOTE: The methodology for rounding measurement in the test reports shall be made in accordance with ASTM E29-06b, "Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications."

3. SECURITY

The contractor shall provide appropriate security measures to protect the OVSC test vehicles and Government Furnished Property (GFP) from unauthorized personnel during the entire compliance testing program. The contractor is financially responsible for any acts of theft and/or vandalism which occur during the storage of test vehicles and GFP. Any security problems which arise shall be reported by telephone to the Industrial Property Manager (IPM), Office of Acquisition Management, within two working days after the incident. A letter containing specific details of the security problem shall be sent to the IPM (with copy to the COR) within 48 hours.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each vehicle test. No information concerning the vehicle safety compliance testing program shall be released to anyone except the COR, unless specifically authorized by the COR or the COR's Division Chief.

NOTE: No individuals, other than contractor personnel directly involved in the compliance testing program or OVSC personnel, shall be allowed to witness any vehicle or equipment item compliance test or test dummy calibration unless specifically authorized by the COR.

4. GOOD HOUSEKEEPING

Contractors shall maintain the entire vehicle compliance testing area, test fixtures and instrumentation in a neat, clean and painted condition with test instruments arranged in an orderly manner consistent with good test laboratory housekeeping practices.

5. TEST SCHEDULING AND MONITORING

The contractor shall submit a test schedule to the COR prior to conducting the first compliance test. Tests shall be completed at intervals as required in the contract. If not specified, the first test shall be conducted within 6 weeks after receiving the first delivered unit. Subsequent tests shall be completed in no longer than 1 week intervals unless otherwise specified by the COR.

Scheduling of tests shall be adjusted to permit vehicles (or equipment, whichever applies) to be tested to other FMVSSs as may be required by the OVSC. All compliance testing shall be coordinated with the COR in order to allow monitoring by the COR and/or other OVSC personnel if desired. The contractor shall submit a monthly test status report and a vehicle status report (if applicable) to the COR. The vehicle status report shall be submitted until all vehicles are disposed of. The status report forms are provided in the forms section.

6. TEST DATA DISPOSITION

The Contractor shall make all preliminary compliance test data available to the COR on location within 30 minutes after the test. Final test data, including digital printouts and computer generated plots, shall be available to the COR in accordance with the contract schedule or if not specified within two working days. Additionally, the Contractor shall analyze the preliminary test results as directed by the COR.

All backup data sheets, strip charts, recordings, plots, technicians' notes, etc., shall be either sent to the COR or destroyed at the conclusion of each delivery order, purchase order, etc.

The contractor shall protect and segregate the data that evolves from compliance testing before and after each test.

TEST DATA LOSS

A. INVALID TEST DESCRIPTION

An invalid compliance test is one, which does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedures and Statement of Work applicable to the test.

B. INVALID TEST NOTIFICATION

The Contractor shall notify NHTSA of any test not meeting all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test, by telephone, within 24 hours of the test and send written notice to the COR within 48 hours of the test completion.

C. RETEST NOTIFICATION

6. TEST DATA DISPOSITION....Continued

The Contracting Officer of NHTSA is the only NHTSA official authorized to notify the Contractor that a retest is required. The retest shall be completed within 2 weeks after receipt of notification by the Contracting Officer that a retest is required.

D. WAIVER OF RETEST

NHTSA, in its sole discretion, reserves the right to waive the retest requirement. This provision shall not constitute a basis for dispute over the NHTSA's waiving or not waiving any requirement.

E. TEST VEHICLE

NHTSA shall furnish only one vehicle for each test ordered. The Contractor shall furnish the test vehicle required for the retest. The retest vehicle shall be equipped as the original vehicle. The original vehicle used in the invalid test shall remain the property of NHTSA, and the retest vehicle shall remain the property of the Contractor. The Contractor shall retain the retest vehicle for a period not exceeding 180 days if it fails the test. If the retest vehicle passes the test, the Contractor may dispose of it upon notification from the COR that the test report has been accepted.

F. TEST REPORT

No test report is required for any test that is determined to be invalid unless NHTSA specifically decides, in writing, to require the Contractor to submit such report. The test data from the invalid test must be safeguarded until the data from the retest has been accepted by the COR. The electronic data, draft final test report, dummy calibration report, and video shall be submitted within 14 days of the final test. The final test report, dummy calibration report, and video shall be submitted 7 days after receiving comments from the COR.

G. DEFAULT

The Contractor is subject to the default and subsequent procurement costs for nondelivery of valid or conforming test (pursuant to the Termination For Default clause in the contract).

H. NHTSA'S RIGHTS

None of the requirements herein stated shall diminish or modify the rights of NHTSA to determine that any test submitted by the Contractor does not conform precisely to all requirements/specifications of the OVSC Laboratory Test Procedure and Statement of Work applicable to the test.

7. GOVERNMENT FURNISHED PROPERTY (GFP)

A. ACCEPTANCE OF TEST VEHICLES

The contractor has the responsibility of accepting each GFP test vehicle whether delivered by a new vehicle dealership or another vehicle transporter. In both instances, the Contractor acts on behalf of the OVSC when signing an acceptance of the GFP test vehicle delivery order. When a GFP vehicle is delivered, the contractor must verify:

- 1) All options listed on the “window sticker” are present on the test vehicle.
- 2) Tires and wheel rims are new and the same as listed.
- 3) There are no dents or other interior or exterior flaws in the vehicle body.
- 4) The vehicle has been properly prepared and is in running condition.
- 5) The glove box contains an owner’s manual, warranty document, consumer information, and extra set of keys.
- 6) Proper fuel filler cap is supplied on the test vehicle.
- 7) Spare tire, jack, lug wrench and tool kit (If applicable) is located in the vehicle cargo area.
- 8) The VIN (vehicle identification number) on the vehicle condition report matches the VIN on the vehicle.
- 9) The vehicle is equipped as specified by the COR.

A Vehicle Condition form will be supplied to the Contractor by the COR when the test vehicle is transferred from a new vehicle dealership or between test contracts. The upper half of the form is used to describe the vehicle as initially accepted. The lower half of the Vehicle Condition form provides space for detailed description of the post-test condition. The contractor must complete a Vehicle Condition form for each vehicle and deliver it to the COR with the Final Test Report or the report will NOT be accepted for payment.

If the test vehicle is delivered by a government contracted transporter, the contractor should check for damage which may have occurred during transit.

GFP vehicle(s) shall not be driven by the contractor on public roadways unless authorized by the COR.

B. NOTIFICATION OF COR

7. GOVERNMENT FURNISHED PROPERTY (GFP)....Continued

The COR must be notified within 24 hours after a vehicle (and/or equipment item) has been delivered. In addition, if any discrepancy or damage is found at the time of delivery, a copy of the Vehicle Condition form shall be sent to the COR immediately.

8. CALIBRATION OF TEST INSTRUMENTS

Before the Contractor initiates the vehicle safety compliance test program, a test instrumentation calibration system must be implemented and maintained in accordance with established calibration practices. The calibration system shall include the following as a minimum:

- A. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.
- B. All measuring instruments and standards shall be calibrated by the Contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 12 months for instruments and 12 months for the calibration standards except for static types of measuring devices such as rulers, weights, etc., which shall be calibrated at periodic intervals not to exceed two years. Records, showing the calibration traceability to the National Institute of Standards and Technology (NIST), shall be maintained for all measuring and test equipment.

Accelerometers shall be calibrated every 12 months or after a test failure or after any indication from calibration checks that there may be a problem with the accelerometer whichever occurs sooner.

- C. All measuring and test equipment and measuring standards shall be labeled with the following information:
 - 1) Date of calibration
 - 2) Date of next scheduled calibration
 - 3) Name of the technician who calibrated the equipment
- D. A written calibration procedure shall be provided by the Contractor, which includes as a minimum the following information for all measurement and test equipment:
 - 1) Type of equipment, manufacturer, model number, etc.
 - 2) Measurement range
 - 3) Accuracy

8. CALIBRATION OF TEST INSTRUMENTS....Continued

- 4) Calibration interval
- 5) Type of standard used to calibrate the equipment (calibration traceability of the standard must be evident)
- 6) The actual procedures and the forms used to perform the calibrations
- E. Records of calibration for all test instrumentation shall be kept by the Contractor in a manner that assures the maintenance of established calibration schedules.
- F. All such records shall be readily available for inspection when requested by the COR. The calibration system shall need the acceptance of the COR before vehicle safety compliance testing commences.
- G. Test equipment shall receive a system functional check out using a known test input immediately before and after the test. This check shall be recorded by the test technician(s) and submitted with the final report.
- H. The Contractor may be directed by NHTSA to evaluate its data acquisition system.

Further guidance is provided in the International Standard ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment" and American National Standard ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment General Requirements."

NOTE: In the event of a failure to meet the standard's minimum performance requirements additional calibration checks of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration will be at the COR's discretion and shall be performed without additional cost.

9. SUGGESTED TEST EQUIPMENT

- A. Acoustic sound measurement system for measuring the sound pressure level must be a sound level meter or equivalent measurement system meeting the requirements of Class 1 instruments per IEC 61672-1 (Bruel & Kjaer North America "B&K" Pass-by System).
- B. Acoustic sound measurement system sound calibrator that fulfills the requirements of Class 1 sound calibrators per IEC 60942.
- C. Post-Processing Compliance Tool (sound analysis code) to conduct the analysis of the valid sound files, including ambient sound files, for compliance to FMVSS No. 141. The sound analysis code is a government supplied MATLAB based source code with parameters set in accordance with the following table:

9. SUGGESTED TEST EQUIPMENT....Continued

Parameter	Settings
General Settings:	
Re-Sampling Frequency*	44.1 kHz.
Processing Window	Test Scenario Dependent.
Acoustic Weighting	A.
Overall Sound Pressure Level Settings:	
Frequency span	24000 Hz.
Overall Averaging	None.
Averaging time	None.
One-Third Octave Band Analysis Settings:	
Bandwidth (Fractional Octave)	$\frac{1}{3}$ —Base 10 Exact.
Upper Nominal Center Frequency	5000 Hz.
Lower Nominal Center Frequency	315 Hz.
Type of Octave Band Averaging	Exponential.
Type of Time Weighting	Fast.
Averaging Time	$\frac{1}{4}$ seconds.
Tau (Time Constant)	$\frac{1}{8}$ seconds (Fast).

*The compliance tool is designed to sample at a rate of 65,536 Hz, but re-samples signals at 44.1 kHz to allow for the use of lower sampling frequencies.

- D. Speed measurement device to measure vehicle speed during the constant speed pass-by tests must be capable of continuous measurement of speed within ± 0.5 km/ h over the entire measurement zone (which is defined as the portion of the test track between lines AA' and BB').
- E. Meteorological instrumentation meeting the following specifications: ± 1 °C or less for a temperature measuring device; ± 1.0 m/s for a wind speed-measuring device; ± 5 hPa for a barometric pressure measuring device; ± 5 % for a relative humidity measuring device.

10. PHOTOGRAPHIC DOCUMENTATION

DIGITAL PHOTOGRAPHS

The contractor shall take digital photographs of the test execution procedures. Photographs shall be taken in color and contain clear images. A tag, label or placard identifying the test item, NHTSA number (if applicable) and date shall appear in each photograph and must be legible. Each photograph shall be labeled as to the subject matter. The required resolution for digital photographs is a minimum of 1,600 x 1,200 pixels. Digital photographs are required to be created in color and in a JPG format. Glare or light from any illuminated or reflective surface should be minimized while taking photographs.

The test reports should include enough photographs to describe the testing in detail and should be organized in a logical succession of consecutive pictures. The digital photographs should be included in the test report as 203 mm x 254 mm or 215.9 mm x 279 mm (8 x 10 or 8 ½ x 11 inch) pictures. All photographs are required to be included in the

10. PHOTOGRAPHIC DOCUMENTATION....Continued

test report in the event of a test failure. Any failure must be photographed at various angles to assure complete coverage. Upon request, the photographs should be sent to the COR on a CD or DVD and saved in a “read only” format to ensure that the digital photographs are the exact pictures taken during testing and have not been altered from the original condition.

Photographic Views

As a minimum the following test photographs shall be included in each vehicle final test report, submitted by the contractor:

- A. $\frac{3}{4}$ Frontal – left side view of the test vehicle
- B. $\frac{3}{4}$ Rear – right side view of the test vehicle
- C. Vehicle certification label
- D. Vehicle placard (titled, “Tire and Loading Information”)
- E. Tire inflation pressure label, if provided (optional label)
- F. Close-up view(s) of test instrumentation mounted on the outside of the vehicle
- G. Close-up view(s) of test instrumentation mounted on the inside of the vehicle
- H. View(s) of microphone setup for stationary testing
- I. View(s) of microphone setup for pass-by testing
- J. Any damage or apparent test failure that cannot be seen in the above photographs

11. DEFINITIONS

BAND OR ONE-THIRD OCTAVE BAND

One of thirteen one-third octave bands having nominal center frequencies ranging from 315 to 5000 Hz. These are Bands 25 through 37 as defined in Table A1, Mid-Band Frequencies for One-Third-Octave-Band and Octave-Band Filters in the Audio Range, of ANSI S1.11-2004: “Specification for Octave-Band and Fractional-Octave Band Analog and Digital Filters”.

11. DEFINITIONS....Continued

BAND SUM

The combination of Sound Pressure Levels (SPLs) from selected bands that produce an SPL representing the sound in all of these bands. Band sum is calculated with the following equation (where SPL_i is the sound pressure level in each selected band):

$$Band\ Sum = 10 \times \log_{10} \sum_{i=1}^n 10^{(SPL_i/10)}$$

BODY TYPE

The general configuration or shape of a vehicle distinguished by such characteristics as the number of doors or windows, cargo-carrying features and the roofline (e.g., sedan, fastback, hatchback).

ELECTRIC VEHICLE

A motor vehicle with an electric motor as its sole means of propulsion.

FRONT PLANE

A vertical plane tangent to the leading edge of the vehicle during forward operation.

HYBRID VEHICLE

A motor vehicle which has more than one means of propulsion for which the vehicle's propulsion system can propel the vehicle in the normal travel mode in at least one forward drive gear or reverse without the internal combustion engine operating.

REAR PLANE

A vertical plane tangent the leading edge of the rear of the vehicle during operation in reverse.

SOUND PRESSURE LEVEL (SPL)

Logarithm of the ratio of a given sound pressure (P) to the reference sound pressure P_o .

$SPL = 20 * \log_{10} (P / P_o)$, in dB

TRIM LEVEL

A subset of vehicles within the same model designation with the same body type which are alike in their general level of standard equipment, such as a "base" trim level of a vehicle model. Vehicles with only minor trim differences that are unlikely to affect vehicle-emitted sound are not considered different for the purposes of this safety standard.

REFERENCE SOUND PRESSURE LEVEL (P_o) = 20 micro-Pascals = 20 N/m².

Logarithm of the ratio of a given sound pressure to the reference sound pressure.

12. PRETEST REQUIREMENTS

12.1 GENERAL TEST PREPARATION

- A. Verify COR approval of Contractor's in-house test procedure.
- B. Verify the training of technicians for performance of this test.
- C. Verify the calibration status of all test equipment.
- D. Verify availability of document that indicates sound pad test surface meets the requirements of ISO 10844:1994, ISO 10844:2011, or ISO 10844:2014.
- E. Review applicable revision of FMVSS 141.
- F. Review vehicle Owner's Manual (or equipment mfg. instructions).

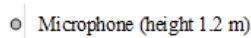


Figure 1. Test Site Dimensions

A. Facility Layout

- 1) The test track and microphone positions must be configured as shown in the Figure 1, “Test Site Dimensions.”
- 2) The distance from the microphone positions of microphones 1 and 2 on the microphone line PP’ to the perpendicular reference line CC’ on the test track shall be $2.0\text{m} \pm 0.05\text{m}$.
- 3) Each microphone shall be located $1.2\text{m} \pm 0.02\text{m}$ above the ground level. For microphones 1 and 2, the reference direction for free field conditions as specified in IEC 61672-1 shall be horizontal and directed perpendicularly towards the path of the vehicle line CC’.

12. PRETEST REQUIREMENTS....Continued

- 4) Test set up for directivity measurement shall include the addition of one microphone (microphone 3) placed on the line CC', $2\text{m} \pm 0.05\text{m}$ forward of the line PP' at a height of $1.2\text{m} \pm 0.02\text{m}$ above ground level. For microphone 3, the reference direction for free field conditions shall be horizontal and directed parallel along the path of the vehicle line CC'.
- 5) The test surface shall meet the requirements of ISO 10844:1994, ISO 10844:2011, or ISO 10844:2014.
- 6) The area within a 50m radius around the sound pad should be free of large reflecting objects (e.g., trees or buildings).

B. Facility Conditions

- 1) The ambient temperature shall be between $5\text{ }^{\circ}\text{C}$ ($41\text{ }^{\circ}\text{F}$) and $40\text{ }^{\circ}\text{C}$ ($104\text{ }^{\circ}\text{F}$).
- 2) The maximum wind speed at the microphone height shall be no greater than 5 m/s (11 mph), including gusts.
- 3) The test track surface shall be dry.
- 4) The test track shall be clean of rocks and other debris.

12.3 TEST VEHICLE INSPECTION AND TEST PREPARATION (DATA SHEET 1)

- A. Inspect test vehicle. Document all required test vehicle information.
- B. Check vehicle fluids and adjust to the proper levels for operation.
- C. Document vehicle installed tire size including make and model. All tires must be new. The vehicle must be tested with the tires installed on the vehicle at the time of initial vehicle sale. From the vehicle's Placard or optional Tire Inflation Pressure Label, identify the vehicle's designated tire size(s). Notify COR if any tire size installed on the vehicle is different from the manufacturers recommended tire size specified on the vehicle labels and request further guidance before proceeding.
- D. Ensure the vehicle does not make any unintended sounds while stationary or in motion (e.g. squeaky brakes). Notify COR if anything out of the ordinary is identified.

12. PRETEST REQUIREMENTS....Continued

- E. Measure vehicle curb weight and vehicle test weight. Test weight, including the driver and instrumentation, shall be evenly distributed between the left and right side of the vehicle and will not exceed the vehicle's GVWR or GAWR: (1) For passenger cars, and MPVs, trucks, and buses with a GVWR of 4,536 kg (10,000 pounds) or less, the vehicle test weight is the unloaded vehicle weight plus 180 kg (396 pounds); (2) For LSVs, the test weight is the unloaded vehicle weight plus 78 kg (170 pounds).
- F. Tires are conditioned by driving the test vehicle around a circle 30 meters (100 feet) in diameter at a speed that produces a lateral acceleration of 0.5 to 0.6 g for three clockwise laps followed by three counterclockwise laps.
- G. Vehicle's electric propulsion batteries, if any, shall have a state of charge sufficiently high to enable all key functionalities per the manufacturer's specifications. Propulsion batteries shall be within their component-temperature window to enable all key functionalities that could reduce vehicle noise emissions. Any other type of rechargeable energy storage system shall be ready to operate during the test. If propulsion batteries must be recharged during testing to ensure internal combustion engine does not activate, manufacturer instructions will be followed.

12.4 TEST INSTRUMENTATION SETUP AND CHECK

- A. Instrument vehicle and configure test track equipment.
- B. Ensure test equipment is secured so as not to shift position during tests, and any associated wires or cables must be secured inside of the test vehicle.
- C. Check test track instrumentation functionality and positioning.
- D. Check vehicle onboard instrumentation functionality and positioning.
- E. Calibrate acoustical measurement equipment and document calibration.

12. PRETEST REQUIREMENTS....Continued

12.5 PRE-TEST CHECKLIST (DATA SHEETS 2, 3, 4, 5 and 6)

Document each of the following items before each test series (i.e., stationary, reverse, 10, 20 and 30 km/h pass-by tests):

- A. Document environmental conditions (i.e., ambient temperature, wind speed and track surface conditions).
- B. Verify all vehicle's doors are shut and locked and windows and roof openings are shut.
- C. Verify all accessory equipment (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) that can be shut down, are shut off. Propulsion battery cooling fans and pumps and other components of the vehicle's propulsion battery thermal management system are not considered accessory equipment. During night time testing test vehicle headlights may be activated.
- D. Verify all tires are free of all debris and each tire's cold tire inflation pressure set to: (1) For passenger cars, and MPVs, trucks, and buses with a GVWR of 4,536 kg (10,000 pounds) or less, the inflation pressure specified on the vehicle placard in FMVSS No. 110; (2) For LSVs, the inflation pressure recommended by the manufacturer for GVWR; if none is specified, the maximum inflation pressure listed on the sidewall of the tires.

13. COMPLIANCE TEST EXECUTION

Personnel supervising and/or performing the compliance test program shall be thoroughly familiar with the requirements, test conditions, and equipment for the test to be conducted. Testing will be accomplished as indicated below. Test personnel shall make note of all discrepancies and deviations from the applicable FMVSS and this Laboratory Test Procedure.

13.1 STATIONARY TEST (DATA SHEET 2)

- A. Document ambient environment conditions (i.e., temperature, wind speed, dry track).
- B. Verify all tires are inflated to the manufacturer recommended inflation pressure.
- C. Verify that there are no external environmental sounds that can interfere with collection of acoustic sound files. Ready driver, test personnel, vehicle onboard equipment, and test site instrumentation for the commencement of audio collection.

13. COMPLIANCE TEST EXECUTION....Continued

- D. Immediately before beginning the first stationary test, use acoustic sound measurement system to measure the ambient noise for at least 30 seconds. Collect separate ambient sounds files from the left, right, and front microphones.
- E. Position test vehicle with the front plane at the line PP', the vehicle centerline on the line CC'. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake.
- F. Place and secure wheel chocks in front of both front wheels to secure vehicle against forward movement.
- G. Activate the test vehicle's propulsion system. Power-off all auxiliary electrical systems (e.g., air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.). These systems should remain off during compliance testing.
- H. For vehicles equipped with a Park position for the gear selector, after activating the starting system to energize the vehicle's propulsion system, apply and maintain a full application of the service brake, disengage the vehicle parking brake and then place the vehicle's gear selector in "Drive," or any forward gear. For vehicles not equipped with a Park position for the gear selector, after activating the starting system to energize the vehicle's propulsion system, apply and maintain a full application of the service brake, disengage the vehicle parking brake, disengage the manual clutch (fully depress and hold the clutch pedal), and place the vehicle's gear selector in any forward gear.
- I. Using the acoustic sound measurement system, record sound levels for a duration of 10 seconds using all three microphones. During the test, the test technician should closely observe real-time the SPL values versus time plot of the acoustic sound file and make note of any extraneous unwanted noises (e.g. chirping birds, overhead planes, trains, car doors being closed, etc.) that were measured and recorded along with the vehicle's alert sound. If the test technician believes the sound file collected has been contaminated, that sound recording should be discarded and the test should be repeated. Each set of sound files measured and recorded that the test technician believes are not contaminated are considered valid and should be saved.
- J. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake. Deactivate the vehicle's propulsion system.
- K. Save the recorded sound file collected in step G. (one sound file corresponding to each of the three microphones used during the test). Valid sound files should be properly identified by microphone position and in chronological order as collected.

13. COMPLIANCE TEST EXECUTION....Continued

- L. Repeat steps “G” through “K” seven times, identifying each completed test sequentially (e.g. Test 1 – Test 8).
- M. Verify that at least four valid test results within 2.0 dBA have been collected using acoustic sound measurement system. If at least four of the eight tests yield valid test results within 2.0 dB, proceed to step “N”. If not, repeat steps “G” through “L” until a total of at least four valid test results have been acquired (continue numbering tests sequentially- e.g. Test 9 – Test ##).
- N. Remove vehicle from the test area bounded by the lines AA’ and BB’. Using the acoustic sound measurement system, measure the ambient noise for at least 30 seconds immediately following the completion of the last test of the stationary test series. Collect separate ambient sounds files from the left, right, and front microphones.
- O. Save the three ambient sound files to appropriate computer based data file for the Test Series.
- P. Using the computer based “Post Processing Compliance Tool” (refer to section 13.7.A.) verify if the stationary test condition alert sound meets either the 2-band or 4-band 1/3 octave band requirements of FMVSS No. 141.

13.2 REVERSE TEST (DATA SHEET 3)

- A. Document ambient environment conditions (i.e., temperature, wind speed, dry track).
- B. Verify all tires are inflated to the manufacturer recommended inflation pressure.
- C. Verify that there are no external environmental sounds that can interfere with collection of acoustic sound files. Ready driver, test personnel, vehicle onboard equipment, and test site instrumentation for the commencement of audio collection.
- D. Immediately before beginning the first reverse test, use acoustic sound measurement system to measure the ambient noise for at least 30 seconds. Collect separate ambient sounds files from the left and right microphones.
- E. Position test vehicle with the rear plane at the line PP’, the vehicle centerline on the line CC’. For vehicles equipped with a Park position, place the vehicle’s gear selector in “Park” and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle’s gear selector in “Neutral” and engage the parking brake.
- F. Place and secure wheel chocks behind both rear wheels to secure vehicle against rearward movement.

13. COMPLIANCE TEST EXECUTION....Continued

- G. Activate the test vehicle's propulsion system. Power-off all auxiliary vehicle electrical systems (e.g., air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.). These systems should remain off during compliance testing.
- H. For vehicles equipped with a Park position for the gear selector, after activating the starting system to energize the vehicle's propulsion system, apply and maintain a full application of the service brake, disengage the vehicle parking brake and then place the vehicle's gear selector in "Reverse". For vehicles not equipped with a Park position for the gear selector, after activating the starting system to energize the vehicle's propulsion system, apply and maintain a full application of the service brake, disengage the vehicle parking brake, disengage the manual clutch (fully depress and hold the clutch pedal), and place the vehicle's gear selector in Reverse.
- I. Using the acoustic sound measurement system record sound levels for a duration of 10 seconds using both microphones. During the test, the test technician should closely observe real-time the SPL values versus time plot of the acoustic sound file and make note of any extraneous unwanted noises (e.g. chirping birds, overhead planes, trains, car doors being closed, etc.) that were measured and recorded along with the vehicle's alert sound. If the test technician believes the sound file collected has been contaminated that sound recording should be discarded and the test should be repeated. Each set of sound files measured and recorded that the test technician believes are not contaminated are considered valid and should be saved.
- J. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake. Deactivate the vehicle's propulsion system.
- K. Save the recorded sound file collected in step I. (one sound file corresponding to each of the two microphones used during the test). Valid sound files should be properly identified by microphone position and in chronological order as collected.
- L. Repeat steps "G" through "K" seven times, identifying each completed test sequentially (e.g. Test 1 – Test 8).
- M. Verify that at least four valid test results within 2.0 dBA have been collected using acoustic sound measurement system. If at least four of the eight tests yield valid test results within 2.0 dB, proceed to step "N". If not, repeat steps "G" through "L" until a total of at least four valid test results have been acquired (continue numbering tests sequentially- e.g. Test 9 – Test ##).

13. COMPLIANCE TEST EXECUTION....Continued

- N. Remove vehicle from the test area bounded by the lines AA' and BB'. Using the acoustic sound measurement system measure the ambient noise for at least 30 seconds immediately following the completion of the last test of the reverse test series. Collect separate ambient sounds files from the left and right microphones.
- O. Save the two ambient sound files to appropriate computer based data file for the Test Series.
- P. Using the computer based "Post Processing Compliance Tool" (refer to section 13.7.A.) verify if the reverse test condition alert sound meets either the 2-band or 4-band 1/3 octave band requirements of FMVSS No. 141.

13.3 CONSTANT SPEED PASS-BY TEST- GREATER THAN 0 km/h BUT LESS THAN 20 km/h (DATA SHEET 4)

- A. Position test vehicle with the front plane at least 10m in front of the line AA', the vehicle centerline on the line CC'. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake.
- B. Power-off all auxiliary vehicle electrical systems (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) and deactivate vehicle propulsion system.
- C. Document ambient environment conditions (i.e., temperature, wind speed, dry track).
- D. Verify all tires are free of all debris and inflated to the manufacturer recommended inflation pressure.
- E. Verify that there are no external environmental sounds that can interfere with collection of acoustic sound files. Ready driver, test personnel, vehicle onboard equipment, and test site instrumentation for the commencement of audio collection.
- F. Immediately before beginning the first constant-speed pass-by test, use acoustic sound measurement system to measure the ambient noise for at least 30 seconds. Collect separate ambient sounds files from the left and right microphones.
- G. Activate the test vehicle's propulsion system. Electrical systems (e.g., air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) not being utilized for compliance test are to remain powered off.
- H. For vehicles equipped with a Park position for the gear selector, while the starting system is active, apply and maintain a full application of the service brake, disengage the vehicle parking brake and then place the vehicle's gear selector in "Drive". For vehicles not

13. COMPLIANCE TEST EXECUTION....Continued

equipped with a Park position for the gear selector, while the starting system is active, apply and maintain a full application of the service brake, disengage the vehicle parking brake, disengage the manual clutch (fully depress and hold the clutch pedal), and place the vehicle's gear selector in any forward gear.

- I. *Execute pass-by tests at a target speed of 11km/h (+/- 1 km/h) and collect acoustic sound files.* Drive the vehicle forward, accelerating towards the target speed, crossing line AA' at the target speed while maintaining vehicle centerline along the line CC'. Using acoustic sound measurement system and data acquisition system, measure and record the sound emitted by the test vehicle while at a constant speed of 11km/h (+/- 1 km/h) throughout the measurement zone between lines AA' and BB' (sound collected between AA' and PP' will be evaluated for compliance).
- J. The target speed must be maintained constant, within the tolerance stated in step "I", from the line AA' to the line BB'. Bring the vehicle to a complete stop after the rear plane of the vehicle has crossed the line BB'. End sound collection.
- K. Return vehicle to starting position as designated in "A" above. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake.
- L. Save the recorded sound file collected in step I. (one sound file corresponding to each of the two microphones used during the test). Valid sound files should be properly identified by microphone position and in chronological order as collected.
- M. Repeat steps "H" through "L" seven times, identifying each completed test sequentially (e.g. Test 1 – Test 8).
- N. Verify that at least four valid test results within 2.0 dBA have been collected using acoustic sound measurement system. If at least four of the eight tests yield valid test results within 2.0 dB, proceed to step "O". If not, repeat steps "H" through "L" until a total of at least four valid test results have been acquired (continue numbering tests sequentially- e.g. Test 9 – Test ##).
- O. Using the acoustic sound measurement system measure the ambient noise for at least 30 seconds immediately following the completion of the constant speed pass-by test series. Collect separate ambient sounds files from the left and right microphones.
- P. Save the two ambient sound files to appropriate computer based data file for the Test Series.
- Q. Using the computer based "Post Processing Compliance Tool" (refer to section 13.7.A.) verify if the pass-by test condition alert sound meets either the 2-band or 4-band 1/3 octave band requirements of FMVSS No. 141.

13. COMPLIANCE TEST EXECUTION....Continued

- R. Repeat steps A. – Q. for other constant test speeds between 0 km/h and 20 km/h (+/- 1 km/h), as directed by COR.

13.4 CONSTANT SPEED PASS-BY TEST- EQUAL TO OR GREATER THAN 20 km/h BUT LESS THAN 30 km/h (DATA SHEET 5)

- A. Position test vehicle with the front plane at least 10m in front of the line AA', the vehicle centerline on the line CC'. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake.
- B. Power-off all auxiliary vehicle electrical systems (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) and deactivate vehicle propulsion system.
- C. Document ambient environment conditions (i.e., temperature, wind speed, dry track).
- D. Verify all tires are free of all debris and inflated to the manufacturer recommended inflation pressure.
- E. Verify that there are no external environmental sounds that can interfere with collection of acoustic sound files. Ready driver, test personnel, vehicle onboard equipment, and test site instrumentation for the commencement of audio collection.
- F. Immediately before beginning the first constant-speed pass-by test, use acoustic sound measurement system to measure the ambient noise for at least 30 seconds. Collect separate ambient sounds files from the left and right microphones.
- G. Activate the test vehicle's propulsion system. . Electrical systems (e.g., air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) not being utilized for compliance test are to remain powered off.
- H. For vehicles equipped with a Park position for the gear selector, while the starting system is active, apply and maintain a full application of the service brake, disengage the vehicle parking brake and then place the vehicle's gear selector in "Drive". For vehicles not equipped with a Park position for the gear selector, while the starting system is active, apply and maintain a full application of the service brake, disengage the vehicle parking brake, disengage the manual clutch (fully depress and hold the clutch pedal), and place the vehicle's gear selector in any forward gear.
- I. *Execute pass-by tests at a target speed of 21km/h (+/- 1 km/h) and collect acoustic sound files.* Drive the vehicle forward, accelerating towards the target speed, crossing line AA'

13. COMPLIANCE TEST EXECUTION....Continued

at the target speed while maintaining vehicle centerline along the line CC'. Using acoustic sound measurement system and data acquisition system, measure and record the sound emitted by the test vehicle while at a constant speed of 21km/h (+/- 1 km/h) throughout the measurement zone between lines AA' and BB' (sound collected between AA' and PP' will be evaluated for compliance).

- J. The target speed must be maintained constant, within the tolerance stated in step "I", from the line AA' to the line BB'. Bring the vehicle to a complete stop after the rear plane of the vehicle has crossed the line BB'. End sound collection.
- K. Return vehicle to starting position as designated in "A" above. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake.
- L. Save the recorded sound file collected in step I. (one sound file corresponding to each of the two microphones used during the test). Valid sound files should be properly identified by microphone position and in chronological order as collected.
- M. Repeat steps "H" through "L" seven times, identifying each completed test sequentially (e.g. Test 1 – Test 8).
- N. Verify that at least four valid test results within 2.0 dBA have been collected using acoustic sound measurement system. If at least four of the eight tests yield valid test results within 2.0 dB, proceed to step "O". If not, repeat steps "H" through "L" until a total of at least four valid test results have been acquired (continue numbering tests sequentially- e.g. Test 9 – Test ##).
- O. Using the acoustic sound measurement system measure the ambient noise for at least 30 seconds immediately following the completion of the constant speed pass-by test series. Collect separate ambient sounds files from the left and right microphones.
- P. Save the two ambient sound files to appropriate computer based data file for the Test Series.
- Q. Using the computer based "Post Processing Compliance Tool" (refer to section 13.7.A.) verify if the pass-by test condition alert sound meets either the 2-band or 4-band 1/3 octave band requirements of FMVSS No. 141.
- R. Repeat steps A. – Q. for other constant test speeds equal to or greater than 20 km/h but less than 30 km/h (+/- 1 km/h), as directed by COR.

13. COMPLIANCE TEST EXECUTION....Continued

13.5 CONSTANT SPEED PASS-BY TEST- AT 30 km/h (DATA SHEET 6)

- A. Position test vehicle with the front plane at least 10m in front of the line AA', the vehicle centerline on the line CC'. For vehicles equipped with a Park position, place the vehicle's gear selector in "Park" and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle's gear selector in "Neutral" and engage the parking brake.
- B. Power-off all auxiliary vehicle electrical systems (air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) and deactivate vehicle propulsion system.
- C. Document ambient environment conditions (i.e., temperature, wind speed, dry track).
- D. Verify all tires are free of all debris and inflated to the manufacturer recommended inflation pressure.
- E. Verify that there are no external environmental sounds that can interfere with collection of acoustic sound files. Ready driver, test personnel, vehicle onboard equipment, and test site instrumentation for the commencement of audio collection.
- F. Immediately before beginning the first constant-speed pass-by test, use acoustic sound measurement system to measure the ambient noise for at least 30 seconds. Collect separate ambient sounds files from the left and right microphones.
- G. Activate the test vehicle's propulsion system. Electrical systems (e.g., air conditioner, wipers, heat, HVAC fan, audio/video systems, etc.) not being utilized for compliance test are to remain powered off.
- H. For vehicles equipped with a Park position for the gear selector, while the starting system is active, apply and maintain a full application of the service brake, disengage the vehicle parking brake and then place the vehicle's gear selector in "Drive". For vehicles not equipped with a Park position for the gear selector, while the starting system is active, apply and maintain a full application of the service brake, disengage the vehicle parking brake, disengage the manual clutch (fully depress and hold the clutch pedal), and place the vehicle's gear selector in any forward gear.
- I. *Execute pass-by tests at a target speed of 31km/h (+/- 1 km/h) and collect acoustic sound files.* Drive the vehicle forward, accelerating towards the target speed, crossing line AA' at the target speed while maintaining vehicle centerline along the line CC'. Using acoustic sound measurement system and data acquisition system, measure and record the sound emitted by the test vehicle while at a constant speed of 31km/h (+/- 1 km/h) throughout the measurement zone between lines AA' and BB' (sound collected between AA' and PP' will be evaluated for compliance).

13. COMPLIANCE TEST EXECUTION....Continued

- J. The target speed must be maintained constant, within the tolerance stated in step “I”, from the line AA’ to the line BB’. Bring the vehicle to a complete stop after the rear plane of the vehicle has crossed the line BB’. End sound collection.
- K. Return vehicle to starting position as designated in “A” above. For vehicles equipped with a Park position, place the vehicle’s gear selector in “Park” and engage the parking brake. For vehicles not equipped with a Park position, place the vehicle’s gear selector in “Neutral” and engage the parking brake.
- L. Save the recorded sound file collected in step I. (one sound file corresponding to each of the two microphones used during the test). Valid sound files should be properly identified by microphone position and in chronological order as collected.
- M. Repeat steps “H” through “L” seven times, identifying each completed test sequentially (e.g. Test 1 – Test 8).
- N. Verify that at least four valid test results within 2.0 dBA have been collected using acoustic sound measurement system. If at least four of the eight tests yield valid test results within 2.0 dB, proceed to step “O”. If not, repeat steps “H” through “L” until a total of at least four valid test results have been acquired (continue numbering tests sequentially- e.g. Test 9 – Test ##).
- O. Using the acoustic sound measurement system measure the ambient noise for at least 30 seconds immediately following the completion of the constant speed pass-by test series. Collect separate ambient sounds files from the left and right microphones.
- P. Save the two ambient sound files to appropriate computer based data file for the Test Series.
- Q. Using the computer based “Post Processing Compliance Tool” (refer to section 13.7.A.) verify if the pass-by test condition alert sound meets either the 2-band or 4-band 1/3 octave band requirements of FMVSS No. 141.

13.6 RELATIVE VOLUME CHANGE (DATA SHEET 7)

- R. Using the computer based “Post Processing Compliance Tool” (refer to section 13.7.A steps 8-10) verify if the test vehicle alert sound meets the relative volume change requirements of FMVSS No. 141.

13. COMPLIANCE TEST EXECUTION....Continued

13.7 ACOUSTIC SOUND FILE PROCESSING

Data collected in sections 13.1 – 13.5 will be post-processed utilizing the NHTSA QV Compliance Tool to determine compliance with the 2 and/or 4 band alert and relative volume change requirements. This tool was developed using MATLAB code and is made available to our contracted test laboratory, and the public, as an executable file. Refer to Appendices A-C for related documentation.

- A. **Post Processing Compliance Tool** – This tool was developed to be used by the test technician after execution of all test series (i.e., stationary, reverse, and pass-by tests) have been completed.

Figure 2 is a flow diagram depicting the process used by the tool to determine if four valid test runs within 2.0 dB have been completed.

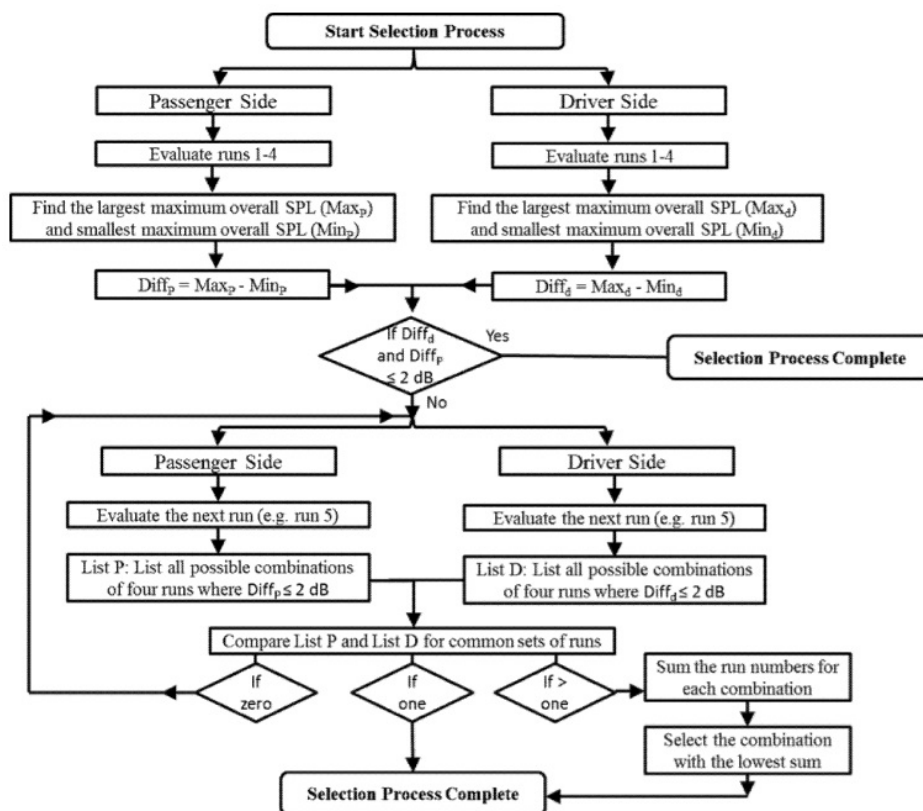


Figure 2. Selection process to determine “first four valid test run sound files within 2.0 dBA”

13. COMPLIANCE TEST EXECUTION....Continued

For each test run, a valid left (driver's side) and a valid right (passenger side) sound file must exist. For each sound file the maximum overall SPL must be determined.

Ultimately, the four test runs to be used for the compliance evaluation must be sequentially the first four valid test runs that have four left side files within 2.0 dBA overall SPL and four right side files within 2.0 dBA overall SPL. The left and right side files must come from the same set of four test runs. This test run selection process as depicted in Figure 2 is as follows:

Step 1: Number each valid sound measurement test run sequentially in the chronological order it was completed on the test track— e.g., Run 1, Run 2, Run 3, ... Run N. Each test run must have a corresponding left (driver's side) and right (passenger side) acoustic sound file.

Step 2: Determine the maximum overall SPL value for the left and right side sound files from each of the first 4 test runs.

Step 3: Compare the four left side (driver's side) maximum overall SPL values. Calculate the difference between the largest and smallest of the four values. Use the same process to determine the difference between the largest and smallest of the four right side (passenger side) maximum overall SPL values. If the difference is less than or equal to 2.0 dBA on both the left and right sides, then these four test runs will be used for the compliance evaluation, and the test run selection process for the given operating condition is complete. The selected runs will be considered the "first four valid test runs within 2.0 dBA." Otherwise, continue to Step 4.

Step 4: Add data from a fifth test run to the analysis.

Step 5: For the driver-side microphone, list all possible combinations of four runs for which the largest overall SPL from any of the four runs minus the smallest overall SPL from any of the four runs is less than or equal to 2.0 dBA.

Step 6: For the passenger-side microphone, list all possible combinations of four runs for which the largest overall SPL from any of the four runs minus the smallest overall SPL from any of the four runs is less than or equal to 2.0 dBA.

Step 7: Examine the list of runs developed in both Step 5 and Step 6. If a set of four runs (e.g., Run 1, Run 2, Run 4, and Run 5) appears in both the Step 5 and Step 6 lists, enter it into a new list (the Step 7 List).

13. COMPLIANCE TEST EXECUTION....Continued

Step 8: The Step 7 list can possibly contain zero, one, or two entries. If the Step 7 list has zero entries, skip to Step 10. If the Step 7 list contains exactly one entry, then that entry is the list of runs for which final data will be analyzed. For this case, terminate the run selection procedure. This list of runs will be considered the “first four valid test run sound files within 2.0 dBA.” If the Step 7 list contains more than one entry, go on to Step 9.

Step 9: Case for which the Step 7 list contains more than one entry. Sum the run numbers for each entry in the Step 7 list. For example, if an entry contains Run 1, Run 2, Run 4, and Run 5, then the sum of its run numbers would be 12 ($1+2+4+5$). Select the entry with the lowest sum of its run numbers. This set of runs is the set for which final data will be analyzed for compliance. At this point, terminate the run selection procedure. This set of runs will be considered the “first four valid test run sound files within 2.0 dBA.” [Note: When there are five runs being considered, it is mathematically impossible for the sums of the run numbers for the two entries in the Step 7 list to be exactly the same. One entry will always have a lower value. However, NHTSA has seen cases in which six or seven test runs are needed to find a set of four shared by the driver’s and passenger’s sides that have Overall SPL’s within 2.0 dBA. It might be possible in these situations for the sums of the run numbers for the two entries in the Step 7 list to be exactly the same. If this condition occurs, our procedure will be to eliminate the combination of four runs containing the highest run number. If the highest run number is the same in both four-run combinations, we then will eliminate the combination of four runs with the second highest run number, and so on.

Step 10: Case for which the Step 7 list contains zero entries. In this situation, add data from another test run to the analysis and return to Step 5. [Note:

In NHTSA’s experience, there have been instances in which it was necessary to examine data from as many as seven runs to find a set of four that are shared by the driver’s and passenger’s sides that have Overall SPL’s that are within 2.0 dBA.]

Note that, although data recorded by the front microphone are not considered when determining the “first four valid test runs within 2.0 dB(A),” those data are used when evaluating compliance with the directivity requirement. The front microphone data to be used for directivity are the data recorded during the “first four valid test runs within 2 dBA” determined according to the procedure above.

Step 11: After the “first four valid test runs within 2.0 dBA” have been identified for each test series, the four acoustic sound files from each side of the vehicle recorded during those four runs are analyzed to determine which side of the vehicle was the quietest during test execution (see figure 3). For each of the eight acoustic sound data

13. COMPLIANCE TEST EXECUTION....Continued

files (four left side files and four right side files) the maximum overall SPL value is determined (i.e., For the stationary tests the maximum overall SPL value measured any time during each 10 sec sound file. For the pass-by tests the maximum overall SPL value recorded any time between AA' and PP', up to and including PP', during each sound file.)

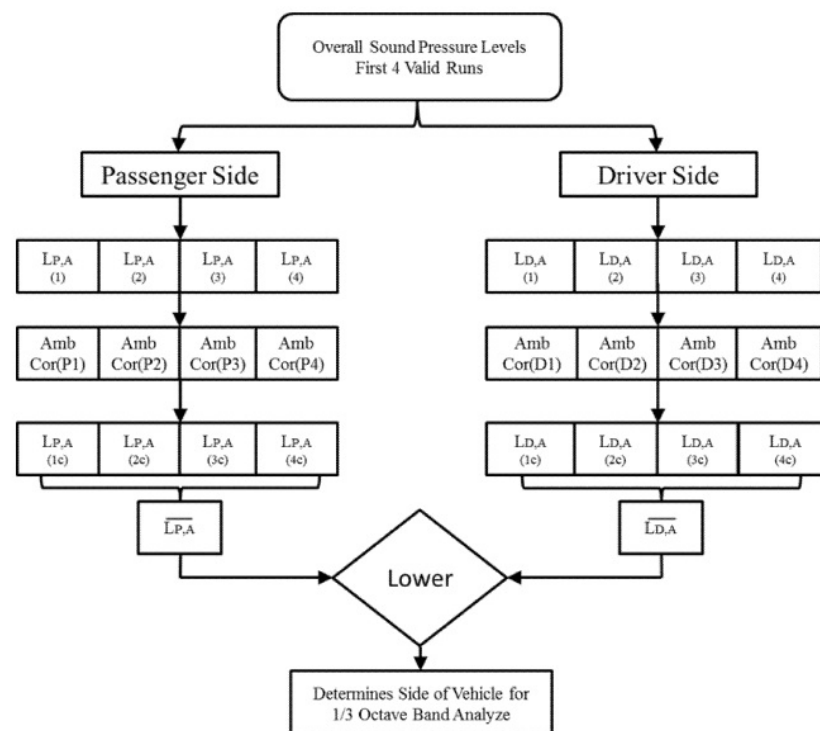


Figure 3. Flow diagram for identification of quietest side of test vehicle to be used for one-third octave analysis

Step 12: Each of the eight acoustic data file maximum overall SPL values are then corrected for the recorded ambient conditions as specified in the standard (see FMVSS 141, S6.7).

Step 13: Finally, the four ambient-corrected maximum overall SPL values on each side of the vehicle are linearly averaged together for one comprehensive ambient-corrected value for each side of the vehicle.

Step 14: The side of the vehicle with the lowest average ambient-corrected maximum overall

13. COMPLIANCE TEST EXECUTION....Continued

SPL value is the side of the vehicle that is further evaluated for compliance at the one-third octave band level. Each of the four acoustic data files on the side of the vehicle with the lowest average ambient-corrected maximum overall SPL value are then used for the one-third octave band evaluation as depicted in the flow diagram in Figure 4. Note: In the event that the average corrected maximum overall SPL values for the driver's and passenger's sides are exactly equal, then the sound from the passenger's side will be analyzed.

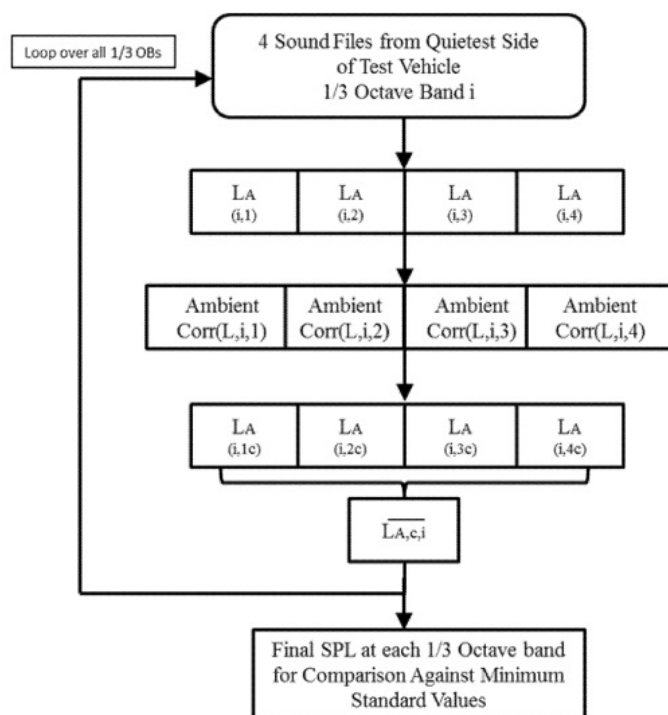


Figure 4. Flow diagram for processing sound files at one-third octave band levels

Step 15: Figure 4 indicates the flow process for analyzing the selected four acoustic data files for the one-third octave band analysis. As shown in Figure 3, the side of the vehicle found to have the lowest overall SPL value, corrected for ambient and averaged over four runs, is the side of the vehicle that is further evaluated for compliance verification. The side selected has four individual acoustic data files. Each file is broken down into one-third octave band levels.

NOTE: The one-third octave band levels to be used for compliance are the levels at the point in time of the maximum overall sound pressure level of a vehicle measurement. To clarify, for NHTSA's compliance evaluations, the agency will not use the maximum sound pressure level in each one-third octave band if the maximum occurs at any other point over the measurement time interval.

13. COMPLIANCE TEST EXECUTION....Continued

Step 16: The identified one-third octave band levels in each of the four files are then corrected for the measured ambient levels as specified in the standard (see FMVSS 141, S6.7). **NOTE: For ambient correction purposes, the ambient one-third octave band levels are the levels at the point in time of the minimum overall ambient sound pressure level.**

Step 17: The four corrected values in each one-third octave band are then averaged together to get the average corrected sound pressure level in each one-third octave band. The averaged corrected values in each one-third octave band are then compared directly to the minimum standards specified in the standard to determine compliance. For the stationary test condition, “first four valid test runs within 2.0 dBA” also has front microphone acoustic data. Each sound file for the front microphone is broken down into its one-third octave band levels. The identified one-third octave band levels in each of the four files are then corrected for the measured ambient levels as specified in the standard. The four values calculated in each one-third octave band are then averaged together to get the average ambient-corrected sound pressure level in each one-third octave band. The averaged, corrected values in each one-third octave band are then compared directly to the minimum standards specified in this standard to determine compliance.

Step 18: Utilizing the average corrected one third octave band levels in each of the 13 one-third octave bands from the side of the vehicle with the lowest maximum overall sound pressure level averaged over the four runs for each operating scenario (i.e., stationary, 10 km/h (11+/- 1km/h), 20 km/h (21+/- 1km/h), and 30 km/h (31+/- 1km/h)), calculate the normalized values for each of the 13 one-third octave bands for each of the operating scenarios, relative to the minimum SPL requirements specified for the stationary operating scenario. The normalized values are calculated by subtracting the minimum SPL values specified for the stationary operating condition from each of the one-third octave band averages calculated for each operating scenario (stationary, 10 km/h (11+/- 1km/h), 20 km/h (21+/- 1km/h), and 30 km/h (31+/- 1km/h)).

Step 19: Calculate the BAND SUM for each critical operating scenario (stationary, 10 km/h (11+/- 1km/h), 20 km/h (21+/- 1km/h), and 30 km/h (31+/- 1km/h)) as follows:

13. COMPLIANCE TEST EXECUTION....Continued

$$\text{Normalized Band Sum} = 10 \times \log_{10} \left(\sum_{i=1}^{13} 10^{\frac{\text{Normalized Band Level}_i}{10}} \right)$$

Where: i represents each of the 13 one-third octave bands and Normalized Band Level_i is the calculated normalized value for each of the 13 one-third octave bands.

Step 20: Calculate the relative volume change between each operating scenario (stationary to 10 km/h; 10 km/h to 20 km/h; 20 km/h to 30 km/h) by subtracting the BAND SUM of the lower speed test case from the BAND SUM of the next higher speed test case.

14. POST TEST REQUIREMENTS

After the required tests are completed, the contractor shall:

- A. Restore vehicle to original condition
- B. Verify all instrumentation, data sheets and photographs
- C. Complete the Vehicle Condition report form including a word description of its post test condition
- D. Copy applicable pages of the vehicle Owner's Manual for attachment to the final test report
- E. Move the test vehicle to a secure area, and
- F. Place all original records in a secure and organized file awaiting test data disposition.

15. REPORTS

15.1 MONTHLY STATUS REPORTS

The contractor shall submit a monthly Test Status Report and a Vehicle Status Report to the COR. The Vehicle Status Report shall be submitted until all vehicles are disposed of. Samples of the required Monthly Status Reports are contained in the report forms section.

15. REPORTS....Continued

15.2 APPARENT NONCOMPLIANCE

Any indication of a test failure shall be communicated by telephone to the COR within 24 hours with written notification mailed within 48 hours (Saturdays and Sundays excluded). A Notice of Test Failure (see report forms section) with a copy of the particular compliance test data sheet(s) and preliminary data plot(s) shall be included.

In the event of a test failure, a post test calibration check of some critically sensitive test equipment and instrumentation may be required for verification of accuracy. The necessity for the calibration shall be at the COR's discretion and shall be performed without additional costs to the OVSC.

15.3 FINAL TEST REPORTS

15.3.1 COPIES

An electronic draft test report is required after completion of each test. The test report and content shall comply with the TP. The organization and content of test data sheets in the report shall be consistent with the applicable TP.

Within seven (7) days of receiving the COR's comments on the draft test report, the Contractor shall submit up to seven (7) compact discs (at discretion of the COR) of the final report for which the test items failed to meet the requirements of the test or the test was a retest (another test of a vehicle that previously exceeded the performance requirements). Four (4) compact discs of the final report shall be submitted for tests for which there were no failures.

NOTE: Prior to submission of the compact discs of the final report, the final report shall be electronically transmitted to the COR to facilitate electronic signature for acceptance. The COR shall sign the report then send the electronic file, containing the signature back to the contractor for the purposes of placing the file on compact disc. The final report shall be in PDF format.

The Final Test Report format to be used by all contractors can be found in Section 14.3.2: "REQUIREMENTS".

Payment of contractor's invoices for completed compliance tests may be withheld until the Final Test Report is accepted by the COR. Contractors are requested to NOT submit invoices before the COR is provided copies of the Final Test Report.

Contractors are required to PROOF READ all Final Tet Reports before submittal to the COR. The OVSC will not act as a report quality control office for contractors. Reports containing a significant number of errors will be returned to the contractor for correction, and a "hold" will be placed on invoice payment for the particular test.

15. REPORTS....Continued

Electric file copies of the Final Test Report shall be provided in accordance with the following:

- a. Electronic Master File:
An electronic version of the final report shall be used as the “Master” report copy. The hard-copy and electronic reports shall be generated from this electronic master file. A copy of the electronic master file shall be provided to NHTSA as required.
- b. System Compatibility:
 - 1. All electronically submitted report copies shall be stored on compact discs (CD) in PDF format.
 - 2. The software application used to store the electronic file version (Master copy) of the final report shall be compatible with Microsoft Word, i.e., the file must be able to be opened, viewed and edited using Microsoft Word.
 - 3. All test report images (photographs, charts, graphs, etc.) shall be imbedded as part of a Microsoft Word file and shall be JPEG or TIFF file format.
- c. For any of the option periods exercised under this contract, NHTSA reserves the right to change the hardware and software requirements stated above, such that submitted electronic files continue to be compatible with computer systems utilized by the Office of Vehicle Safety Compliance.

If a Final Test Report is returned to the laboratory for correction, the report date shall be changed to the date of re-submission. Delivery of an unacceptable Final Test Report will not be construed as meeting the due date specified.

The data tapes recorded from the sensors during the test shall be provided on a compact disc or other acceptable media. The data shall be developed and formatted as specified by the Office of Crashworthiness Research Data References Guides. The guides can be located at NHTSA address:

<http://www-nrd.nhtsa.dot.gov/software/test-reference-guides/test-reference-guides.html>

15.3.2 REQUIREMENTS

The Final Test Report and associated documentation (including photographs) are relied upon as the chronicle of the compliance test. The Final Test Report will be released to the public domain after review and acceptance by the COR. For these reasons, each final report must be a complete document capable of standing by itself.

15. REPORTS....Continued

The contractor should use **detailed** descriptions of all compliance test events. Any events that are not directly associated with the standard but are of technical interest should also be included. The contractor should include as much **detail** as possible in the report.

Instructions for the preparation of the first three pages of the final test report are provided below for the purpose of standardization.

15.3.3 FIRST THREE PAGES

A. FRONT COVER

A heavy paperback cover (or transparency) shall be provided for the protection of the final report. The information required on the cover is as follows:

- (1) Final Report Number such as 141-ABC-XX-01 where

141 is the FMVSS tested
ABC are the initials for the laboratory
XX is the Fiscal Year of the test program
001 is the Group Number (001 for the 1st test, 002 for the 2nd test, etc.)

- (2) Final Report Title and Subtitle such as

SAFETY COMPLIANCE TESTING FOR FMVSS 141
Minimum Sound Requirements for Hybrid and Electric Vehicles
* * * * *
XYZ Car Manufacturer
Make and Model
NHTSA No. CX1401

- (3) Contractor's Name and Address such as

COMPLIANCE TESTING LABORATORIES, INC.
4335 West Dearborn Street
Detroit, Michigan 48090

NOTE: DOT SYMBOL WILL BE PLACED BETWEEN ITEMS (3) AND (4)

- (4) Date of Final Report completion

- (5) The words "FINAL REPORT"

- (6) The sponsoring agency's name and address as follows

15. REPORTS....Continued

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NEF-210
1200 New Jersey Ave., SE
Washington, DC 20590

B. FIRST PAGE AFTER FRONT COVER

When a contract test laboratory is reporting, a disclaimer statement and an acceptance signature block for the COR shall be provided as follows:

This publication is distributed by the National Highway Traffic Safety Administration in the interest of information exchange. Options, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof.

If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be constructed as an endorsement.

Prepared By: _____

Approved By: _____*

Approval Date: _____*

FINAL REPORT ACCEPTANCE BY OVSC:*

Accepted By: _____

Acceptance Date: _____

* These lines not required when OVSC staff writes the Test Report

15. REPORTS....Continued

C. SECOND PAGE AFTER FRONT COVER

A completed Technical Report Documentation Page (Form DOT F1700.7) shall be completed for those items that are applicable with the other spaces left blank. Sample data for the applicable block numbers of the title page follows.

Block 1 – REPORT NUMBER

141-ABC-XX-001

Block 2 – GOVERNMENT ACCESSION NUMBER

Leave blank

Block 3 – RECIPIENT'S CATALOG NUMBER

Leave blank

Block 4 – TITLE AND SUBTITLE

Final Report of FMVSS 141 Compliance Testing of 20XX XYZ, NHTSA No. CX1401

Block 5 – REPORT DATE

March 1, 20XX

Block 6 – PERFORMING ORGANIZATION CODE

ABC

Block 7 – AUTHOR(S)

John Smith, Project Manager / Bill Doe, Project Engineer

Block 8 – PERFORMING ORGANIZATION REPORT NUMBER

ABC-DOT-XXX-001

Block 9 – PERFORMING ORGANIZATION NAME AND ADDRESS

ABC Laboratories
405 Main Street
Detroit, MI 48070

15. REPORTS....Continued

Block 10 – WORK UNIT NUMBER

Leave blank

Block 11 – CONTRACT GRANT NUMBER

DTNH22-XX-D-XXXXX

Block 12 – SPONSORING AGENCY NAME AND ADDRESS

U.S. Department of Transportation
National Highway Traffic Safety Administration
Enforcement
Office of Vehicle Safety Compliance
Mail Code: NEF-210
1200 New Jersey Ave., SE
Washington, DC 20590

Block 13 – TYPE OF REPORT AND PERIOD COVERED

Final Test Report
Month Day to Month Day, 20XX

Block 14 – SPONSORING AGENCY CODE

NEF-210

Block 15 – SUPPLEMENTARY NOTES

Leave blank

Block 16 – ABSTRACT

Compliance tests were conducted on the subject 20XX XYZ Carrier in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-141-XX for the determination of FMVSS 141 compliance.

Test failures identified were as follows:

None

NONE: Above wording must be shown with appropriate changes made for a particular compliance test. Any questions should be resolved with the COR.

15. REPORTS....Continued

Block 17 – KEY WORDS

Compliance Testing
Safety Engineering
FMVSS 141

Block 18 – DISTRIBUTION STATEMENT

Copies of this report are available from the following:

National Highway Traffic Safety Administration
Technical Information Services Division, NPO-411
1200 New Jersey Avenue SE (Room E12-100)
Washington DC 20590

e-mail: tis@nhtsa.dot.gov
FAX: 202-493-2833

Block 19 – SECURITY CLASSIFICATION OF REPORT

Unclassified

Block 20 – SECURITY CLASSIFICATION OF PAGE

Unclassified

Block 21 – NUMBER OF PAGES

Add appropriate number

Block 22 – PRICE

Leave blank

15.3.4 TABLE OF CONTENTS

The final test report Table of Contents shall include the following as a minimum:

Section 1 – Purpose of Compliance Test

Section 2 – Test Procedure and Discussion of Results

Section 3 – Compliance Test Data

15. REPORTS....Continued

Section 4 – Test Equipment List and Calibration Information

Section 5 – Photographs

Section 6 – Notice of Test Failure (if applicable)

Section 7 – Vehicle Owner's Manual (applicable pages)

16. DATA SHEETS

DATA SUMMARY SHEET

VEHICLE MAKE/MODEL/BODY STYLE: _____

VEHICLE NHTSA NO.: _____ VIN: _____

VEHICLE TYPE: _____ DATE OF MANUFACTURE: _____

LABORATORY: _____

REQUIREMENTS

PASS/FAIL

Vehicle Stationary (Data Sheet 2)

Requirement for stationary AND directivity conditions; four-band OR two-band alert sounds (S5.1.1, S5.1.1.2, S5.2)

Reverse (Data Sheet 3)

Requirement for reverse condition; four-band OR two-band alert sounds (S5.1.2, S5.2)

Constant Pass-By Speeds Greater Than 0 km/h but Less Than 20 km/h
(Data Sheet 4)

Requirement for constant speed pass-by conditions; four-band OR two-band alert sounds. (S5.1.3, S5.2)

Constant Pass-By Speeds Greater Than or Equal to 20 km/h but Less Than 30 km/h (Data Sheet 5)

Requirement for constant speed pass-by conditions; four-band OR two-band alert sounds. (S5.1.4, S5.2)

Constant Pass-By Speed at 30 km/h (Data Sheet 6)

Requirement for constant speed pass-by conditions; four-band OR two-band alert sounds. (S5.1.5, S5.2)

Relative Volume Change (Data Sheet 7)

Requirement for minimum change in volume from one critical operating condition to the next; four-band OR two-band alert sounds (S5.4, Table 7)

16. DATA SHEETS....continued

DATA SHEET 1 (Sheet 1 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

VEHICLE MAKE/MODEL/BODY STYLE: _____

NHTSA No.: _____ TEST DATE: _____

VIN: _____ MANUFACTURE DATE: _____

GVWR: _____ KG FRONT GAWR: _____ KG REAR GAWR _____ KG

SEATING POSITIONS: FRONT _____ MID _____ REAR _____

ODOMETER READING AT START OF TEST: _____ Miles (Kilometers)

FULL FLUID LEVELS Fuel _____ Coolant _____ Other Fluids _____ (specify)

DESIGNATED TIRE SIZE(S) FROM VEHICLE LABELING:

Front Axle _____ Rear Axle _____
Inflation Pressure (kPa) _____ Inflation Pressure (kPa) _____

INSTALLED TIRE SIZE(S) ON VEHICLE:

<u>From Tire Sidewall</u>	<u>Front Axle</u>	<u>Rear Axle</u>
Manufacturer & Tire Name	_____	_____
Tire Size Designation	_____	_____

Are installed tire sizes same as labeled tire sizes? _____ Yes _____ No

If no, contact COR for further guidance.

PROPULSION SYSTEM(S):

Electric _____ Hybrid Electric _____ Plug-In Hybrid Electric _____
Other _____ (describe: _____)

ENGINE LOCATION:

Front _____ Rear _____ Mid _____ None _____
Other _____ (describe: _____)

TRANSMISSION TYPE:

Automatic _____ Manual _____
Other _____ (describe: _____)

16. DATA SHEETS....continued

DATA SHEET 1 (Sheet 2 of 2)
TEST VEHICLE INSPECTION AND TEST PREPARATION

VEHICLE CURB WEIGHT (Kg):

Front axle _____
Rear Axle _____
Total Vehicle _____

VEHICLE TEST WEIGHT with Driver and Instrumentation (Kg):

Front axle _____
Rear Axle _____
Total Vehicle _____

Test Weight exceeds vehicle ratings (GAWRs and GVWR)?

Yes _____ No _____

If yes contact COR for guidance.

TIRE CONDITIONING:

Tires are set to manufacturer recommended cold inflation pressure.

Front Axle (kPa)

Rear Axle (kPa)

Right Front _____

Right Rear _____

Left Front _____

Left Rear _____

Tires have been conditioned as required?

Yes _____ No _____

REMARKS:

RECORDED BY: _____

DATE: _____

APPROVED BY: _____

DATE: _____

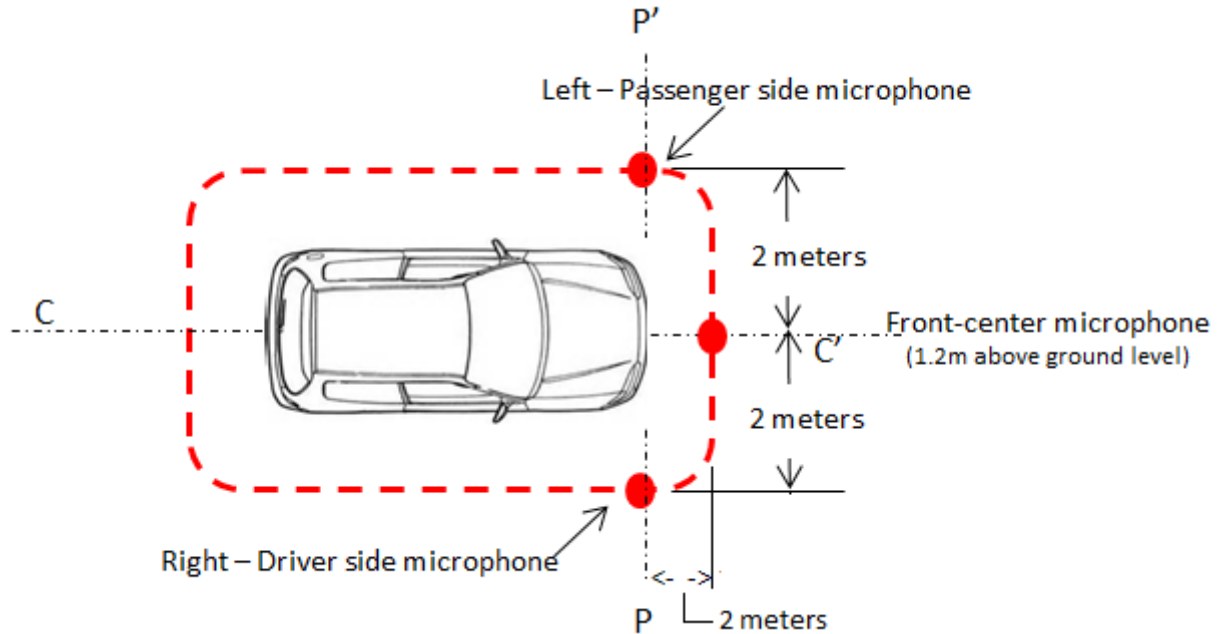
16. DATA SHEETS....continued

DATA SHEET 2 (Sheet 1 of 6)

STATIONARY TEST

VEHICLE MAKE/MODEL/BODY STYLE: _____

NHTSA No.: _____ TEST DATE: _____



TEST CONDITIONS:

Measured Tire Pressures (KPA):

LF _____	LR _____
RF _____	RR _____

Tires treads are free and clear of rocks and debris? **Yes**

Wind Speed _____ m/sec (less than 5m/sec)

Ambient Temperature _____ C° (between 5C° and 40C°)

Test Surface is dry and free of cracks and debris? **Yes** _____

Test vehicle windows and doors are closed? **Yes**

All electrical accessories are turned off? **Yes**

16. DATA SHEETS....continued

DATA SHEET 2 (Sheet 2 of 6)
STATIONARY TEST

FIRST FOUR VALID TESTS WITHIN 2.0 dBA OVERALL SPL

Microphone Maximum SPL dB(A)				
	Sequence #	Left, Driver	Right, Passenger	Front, Center
Valid Test 1				
Valid Test 2				
Valid Test 3				
Valid Test 4				
Difference between max and min SPL for each microphone				

Is the difference between the maximum and minimum SPL values on each the left side and right side of the vehicle less than or equal to 2.0 dBA? Must be "Yes" or discuss situation with the COR before proceeding.

_____ YES _____ NO

IDENTIFICATION OF THE QUIETEST SIDE OF TEST VEHICLE

LEFT/DRIVER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Left side average overall ambient-corrected SPL = _____ dB

RIGHT/PASSENGER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Right side average overall ambient-corrected SPL = _____ dB

Quietest side of vehicle? Left/ Driver Side _____ Right/ Passenger Side _____

16. DATA SHEETS....continued

**DATA SHEET 2 (Sheet 3 of 6)
STATIONARY TEST**

**QUIETEST SIDE 1/3 OCTAVE BAND SPLs FOR FOUR VALID TEST RUNS
(AMBIENT CORRECTED)**

1/3 octave band center frequency, Hz	Valid Test 1 corrected SPL, dB	Valid Test 2 corrected SPL, dB	Valid Test 3 corrected SPL, dB	Valid Test 4 corrected SPL, dB	Average corrected SPL, dB	Minimum Required SPL	Is Avg > Min Req?
315						39	
400						39	
500						40	
630						40	
800						41	
1000						41	
1250						42	
1600						39	
2000						39	
2500						37	
3150						34	
4000						32	
5000						31	

FOUR-BAND STATIONARY COMPLIANCE

Compare the average corrected SPL values against the minimum SPL requirement for each one-third octave band. Determine if any four one-third octave bands meeting the required standard are non-adjacent to each other AND that span a range of at least nine one-third octave bands in the range of 315 Hz to 5000 Hz. Complete following table with one set of four one-third octave bands that meet these requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard

Stationary Test (Four-Band) PASS/FAIL _____

16. DATA SHEETS....continued

DATA SHEET 2 (Sheet 4 of 6)
STATIONARY TEST

TWO-BAND STATIONARY COMPLIANCE

Compare the average corrected SPL values and identify which one-third octave bands meet the minimum SPL requirement. Select the band with the highest SPL of the 315 to 800 Hz bands, and select the band with the highest SPL of the 1000 to 3150 Hz bands. The selected bands must be non-adjacent AND span no fewer than three one-third octave bands in the range of 315 Hz to 3150 Hz. Complete following table with one set of two one-third octave bands that meet these requirements and each meet the minimum requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard
	40		
	40		

Calculate the Band sum of the one-third octave bands selected.

$$Band\ Sum = 10 \times \log_{10} \sum_{i=1}^2 10^{(SPL_i/10)}$$

BAND SUM = _____ (Must be at least 44 dBA)

Stationary Test (Two-Band) PASS/FAIL _____

16. DATA SHEETS....continued

**DATA SHEET 2 (Sheet 5 of 6)
DIRECTIVITY TEST**

**FRONT MICROPHONE 1/3 OCTAVE BAND SPLs FOR FOUR VALID TEST RUNS
(AMBIENT CORRECTED)**

1/3 octave band center frequency, Hz	Valid Test 1 corrected SPL, dB	Valid Test 2 corrected SPL, dB	Valid Test 3 corrected SPL, dB	Valid Test 4 corrected SPL, dB	Average corrected SPL, dB	Minimum Required SPL	Is Avg > Min Req?
315						39	
400						39	
500						40	
630						40	
800						41	
1000						41	
1250						42	
1600						39	
2000						39	
2500						37	
3150						34	
4000						32	
5000						31	

FOUR-BAND DIRECTIVITY COMPLIANCE

Compare the average corrected SPL values against the minimum SPL requirement for each one-third octave band. Determine if any four one-third octave bands meeting the required standard are non-adjacent to each other AND that span a range of at least nine one-third octave bands in the range of 315 Hz to 5000 Hz. Complete following table with one set of four one-third octave bands that meet these requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard

Stationary Test (Four-Band Directivity) PASS/FAIL _____

16. DATA SHEETS....continued

DATA SHEET 2 (Sheet 6 of 6)
DIRECTIVITY TEST

TWO-BAND DIRECTIVITY COMPLIANCE

Compare the average corrected SPL values and identify which one-third octave bands meet the minimum SPL requirement. Select the band with the highest SPL of the 315 to 800 Hz bands, and select the band with the highest SPL of the 1000 to 3150 Hz bands. The selected bands must be non-adjacent AND span no fewer than three one-third octave bands in the range of 315 Hz to 3150 Hz. Complete following table with one set of two one-third octave bands that meet these requirements and each meet the minimum requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard
	40		
	40		

Calculate the Band sum of the one-third octave bands selected.

$$Band\ Sum = 10 \times \log_{10} \sum_{i=1}^2 10^{(SPL_i/10)}$$

BAND SUM = _____ (Must be at least 44 dBA)

Stationary Test (Two-Band Directivity) PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE: _____

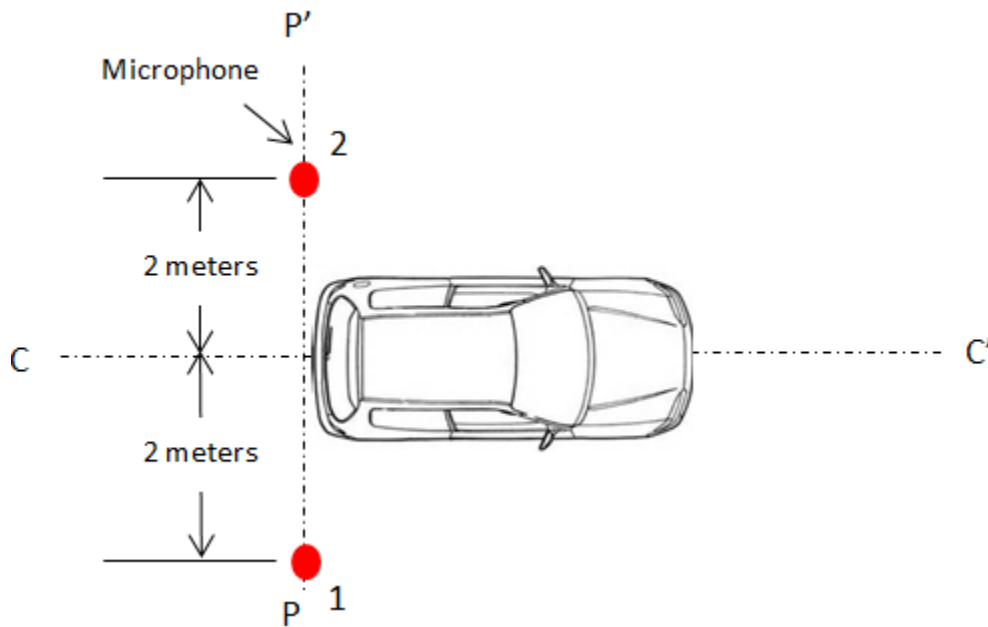
APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 3 (Sheet 1 of 4)
REVERSE TEST

VEHICLE MAKE/MODEL/BODY STYLE: _____

NHTSA No.: _____ TEST DATE: _____



TEST CONDITIONS:

Measured Tire Pressures (KPA):

LF _____	LR _____
RF _____	RR _____

Tires treads are free and clear of rocks and debris? Yes_____

Wind Speed _____m/sec (less than 5m/sec)

Ambient Temperature _____ C° (between 5C° and 40C°)

Test Surface is dry and free of cracks and debris? Yes _____

Test vehicle windows and doors are closed? Yes _____

All electrical accessories are turned off? **Yes**

16. DATA SHEETS....continued

DATA SHEET 3 (Sheet 2 of 4)
REVERSE TEST

FIRST FOUR VALID TESTS WITHIN 2.0 dBA OVERALL SPL

Microphone Maximum SPL dB(A)			
	Sequence #	Left, Driver	Right, Passenger
Valid Test 1			
Valid Test 2			
Valid Test 3			
Valid Test 4			
Difference between max and min SPL for each microphone			

Is the difference between the maximum and minimum SPL values on each the left side and right side of the vehicle less than or equal to 2.0 dBA? Must be "Yes" or discuss situation with the COR before proceeding.

_____ YES _____ NO

IDENTIFICATION OF THE QUIETEST SIDE OF TEST VEHICLE

LEFT/DRIVER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Left side average overall ambient-corrected SPL = _____ dB

RIGHT/PASSENGER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Right side average overall ambient-corrected SPL = _____ dB

Quietest side of vehicle? Left/ Driver Side _____ Right/ Passenger Side _____

16. DATA SHEETS....continued

**DATA SHEET 3 (Sheet 3 of 4)
REVERSE TEST**

**QUIETEST SIDE 1/3 OCTAVE BAND SPLs FOR FOUR VALID TEST RUNS
(AMBIENT CORRECTED)**

1/3 octave band center frequency, Hz	Valid Test 1 corrected SPL, dB	Valid Test 2 corrected SPL, dB	Valid Test 3 corrected SPL, dB	Valid Test 4 corrected SPL, dB	Average corrected SPL, dB	Minimum Required SPL	Is Avg > Min Req?
315						42	
400						41	
500						43	
630						43	
800						44	
1000						44	
1250						45	
1600						41	
2000						42	
2500						40	
3150						37	
4000						35	
5000						33	

FOUR-BAND REVERSE COMPLIANCE

Compare the average corrected SPL values against the minimum SPL requirement for each one-third octave band. Determine if any four one-third octave bands meeting the required standard are non-adjacent to each other AND that span a range of at least nine one-third octave bands in the range of 315 Hz to 5000 Hz. Complete following table with one set of four one-third octave bands that meet these requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard

Reverse Test (Four-Band) PASS/FAIL _____

16. DATA SHEETS....continued

DATA SHEET 3 (Sheet 4 of 4)
REVERSE TEST

TWO-BAND REVERSE COMPLIANCE

Compare the average corrected SPL values and identify which one-third octave bands meet the minimum SPL requirement. Select the band with the highest SPL of the 315 to 800 Hz bands, and select the band with the highest SPL of the 1000 to 3150 Hz bands. The selected bands must be non-adjacent AND span no fewer than three one-third octave bands in the range of 315 Hz to 3150 Hz. Complete following table with one set of two one-third octave bands that meet these requirements and each meets the minimum requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard
	40		
	40		

Calculate the Band sum of the one-third octave bands selected.

$$Band\ Sum = 10 \times \log_{10} \sum_{i=1}^2 10^{(SPL_i/10)}$$

BAND SUM = _____ (Must be at least 48 dBA)

Reverse Test (Two-Band) PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 1 of 4)
CONSTANT SPEED PASS-BY TEST (11 ± 1 km/h)

VEHICLE MAKE/MODEL/BODY STYLE: _____

NHTSA No.: _____ TEST DATE: _____

TEST CONDITIONS:

Measured Tire Pressures (KPA):

LF _____	LR _____
RF _____	RR _____

Tires treads are free and clear of rocks and debris? Yes_____

Wind Speed _____m/sec (less than 5m/sec)

Ambient Temperature _____ C° (between 5C° and 40C°)

Test Surface is dry and free of cracks and debris? Yes _____

Test vehicle windows and doors are closed? Yes _____

All electrical accessories are turned off? Yes_____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 2 of 4)
CONSTANT SPEED PASS-BY TEST (11 ± 1 km/h)

FIRST FOUR VALID TESTS WITHIN 2.0 dBA OVERALL SPL

	Microphone Maximum SPL dB(A)			
	Sequence #	Test Speed	Left, Driver	Right, Passenger
Valid Test 1				
Valid Test 2				
Valid Test 3				
Valid Test 4				
Difference between max and min SPL for each microphone				

Is the difference between the maximum and minimum SPL values on each the left side and right side of the vehicle less than or equal to 2.0 dBA? Must be "Yes" or discuss situation with the COR before proceeding.

_____ YES _____ NO

IDENTIFICATION OF THE QUIETEST SIDE OF TEST VEHICLE

LEFT/DRIVER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Left side average overall ambient-corrected SPL = _____ dB

RIGHT/PASSENGER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Right side average overall ambient-corrected SPL = _____ dB

Quietest side of vehicle? Left/ Driver Side _____ Right/ Passenger Side _____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 3 of 4)
CONSTANT SPEED PASS-BY TEST (11 ± 1 km/h)

**QUIETEST SIDE 1/3 OCTAVE BAND SPLs FOR FOUR VALID TEST RUNS
 (AMBIENT CORRECTED)**

1/3 octave band center frequency, Hz	Valid Test 1 corrected SPL, dB	Valid Test 2 corrected SPL, dB	Valid Test 3 corrected SPL, dB	Valid Test 4 corrected SPL, dB	Average corrected SPL, dB	Minimum Required SPL	Is Avg > Min Req?
315						45	
400						44	
500						46	
630						46	
800						47	
1000						47	
1250						48	
1600						44	
2000						45	
2500						43	
3150						40	
4000						38	
5000						36	

FOUR-BAND PASS-BY COMPLIANCE

Compare the average corrected SPL values against the minimum SPL requirement for each one-third octave band. Determine if any four one-third octave bands meeting the required standard are non-adjacent to each other AND that span a range of at least nine one-third octave bands in the range of 315 Hz to 5000 Hz. Complete following table with one set of four one-third octave bands that meet these requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard

11 ± 1 km/h Pass-By (Four-Band) PASS/FAIL _____

16. DATA SHEETS....continued

DATA SHEET 4 (Sheet 4 of 4)
CONSTANT SPEED PASS-BY TEST (11 ± 1 km/h)

TWO-BAND PASS-BY COMPLIANCE

Compare the average corrected SPL values and identify which one-third octave bands meet the minimum SPL requirement. Select the band with the highest SPL of the 315 to 800 Hz bands, and select the band with the highest SPL of the 1000 to 3150 Hz bands. The selected bands must be non-adjacent AND span no fewer than three one-third octave bands in the range of 315 Hz to 3150 Hz. Complete following table with one set of two one-third octave bands that meet these requirements and each meets the minimum requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard
	42		
	42		

Calculate the Band sum of the one-third octave bands selected.

$$\text{Band Sum} = 10 \times \log_{10} \sum_{i=1}^2 10^{(SPL_i/10)}$$

BAND SUM = _____ (Must be at least 51 dBA)

11 ± 1 km/h Pass-By Test (Two-Band) PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 1 of 4)
CONSTANT SPEED PASS-BY TEST (21 ± 1 km/h)

VEHICLE MAKE/MODEL/BODY STYLE: _____

NHTSA No.: _____ TEST DATE: _____

TEST CONDITIONS:

Measured Tire Pressures (KPA):

LF _____	LR _____
RF _____	RR _____

Tires treads are free and clear of rocks and debris? Yes_____

Wind Speed _____m/sec (less than 5m/sec)

Ambient Temperature _____ C° (between 5C° and 40C°)

Test Surface is dry and free of cracks and debris? Yes _____

Test vehicle windows and doors are closed? Yes _____

All electrical accessories are turned off? Yes_____

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 2 of 4)
CONSTANT SPEED PASS-BY TEST (21 ± 1 km/h)

FIRST FOUR VALID TESTS WITHIN 2.0 dBA OVERALL SPL

	Microphone Maximum SPL dB(A)			
	Sequence #	Test Speed	Left, Driver	Right, Passenger
Valid Test 1				
Valid Test 2				
Valid Test 3				
Valid Test 4				
Difference between max and min SPL for each microphone				

Is the difference between the maximum and minimum SPL values on each the left side and right side of the vehicle less than or equal to 2.0 dBA? Must be "Yes" or discuss situation with the COR before proceeding.

_____ YES _____ NO

IDENTIFICATION OF THE QUIETEST SIDE OF TEST VEHICLE

LEFT/DRIVER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Left side average overall ambient-corrected SPL = _____ dB

RIGHT/PASSENGER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Right side average overall ambient-corrected SPL = _____ dB

Quietest side of vehicle? Left/ Driver Side _____ Right/ Passenger Side _____

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 3 of 4)
CONSTANT SPEED PASS-BY TEST (21 ± 1 km/h)

**QUIETEST SIDE 1/3 OCTAVE BAND SPLs FOR FOUR VALID TEST RUNS
 (AMBIENT CORRECTED)**

1/3 octave band center frequency, Hz	Valid Test 1 corrected SPL, dB	Valid Test 2 corrected SPL, dB	Valid Test 3 corrected SPL, dB	Valid Test 4 corrected SPL, dB	Average corrected SPL, dB	Minimum Required SPL	Is Avg > Min Req?
315						52	
400						51	
500						52	
630						53	
800						53	
1000						54	
1250						54	
1600						51	
2000						51	
2500						50	
3150						47	
4000						45	
5000						43	

FOUR-BAND PASS-BY COMPLIANCE

Compare the average corrected SPL values against the minimum SPL requirement for each one-third octave band. Determine if any four one-third octave bands meeting the required standard are non-adjacent to each other AND that span a range of at least nine one-third octave bands in the range of 315 Hz to 5000 Hz. Complete following table with one set of four one-third octave bands that meet these requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard

21 ± 1 km/h Pass-By (Four-Band) PASS/FAIL _____

16. DATA SHEETS....continued

DATA SHEET 5 (Sheet 4 of 4)
CONSTANT SPEED PASS-BY TEST (21 ± 1 km/h)

TWO-BAND PASS-BY COMPLIANCE

Compare the average corrected SPL values and identify which one-third octave bands meet the minimum SPL requirement. Select the band with the highest SPL of the 315 to 800 Hz bands, and select the band with the highest SPL of the 1000 to 3150 Hz bands. The selected bands must be non-adjacent AND span no fewer than three one-third octave bands in the range of 315 Hz to 3150 Hz. Complete following table with one set of two one-third octave bands that meet these requirements and each meet the minimum requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard
	47		
	47		

Calculate the Band sum of the one-third octave bands selected.

$$\text{Band Sum} = 10 \times \log_{10} \sum_{i=1}^2 10^{(SPL_i/10)}$$

BAND SUM = _____ (Must be at least 57 dBA)

21 ± 1 km/h Pass-By Test (Two-Band) PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 1 of 4)
CONSTANT SPEED PASS-BY TEST (31 ± 1 km/h)

VEHICLE MAKE/MODEL/BODY STYLE:_____

NHTSA No.: _____ TEST DATE: _____

TEST CONDITIONS:

Measured Tire Pressures (KPA):

LF _____	LR _____
RF _____	RR _____

Tires treads are free and clear of rocks and debris? Yes_____

Wind Speed _____m/sec (less than 5m/sec)

Ambient Temperature _____ C° (between 5C° and 40C°)

Test Surface is dry and free of cracks and debris? Yes_____

Test vehicle windows and doors are closed? Yes _____

All electrical accessories are turned off? Yes_____

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 2 of 4)
CONSTANT SPEED PASS-BY TEST (31 ± 1 km/h)

FIRST FOUR VALID TESTS WITHIN 2.0 dB(A) OVERALL SPL

	Microphone Maximum SPL dB(A)			
	Sequence #	Test Speed	Left, Driver	Right, Passenger
Valid Test 1				
Valid Test 2				
Valid Test 3				
Valid Test 4				
Difference between max and min SPL for each microphone				

Is the difference between the maximum and minimum SPL values on each the left side and right side of the vehicle less than or equal to 2.0 dBA? Must be "Yes" or discuss situation with the COR before proceeding.

_____ YES _____ NO

IDENTIFICATION OF THE QUIETEST SIDE OF TEST VEHICLE

LEFT/DRIVER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Left side average overall ambient-corrected SPL = _____ dB

RIGHT/PASSENGER SIDE

Valid Test 1 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 2 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 3 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB
 Valid Test 4 – MAX overall SPL _____ dB; Ambient corrected value: _____ dB

Right side average overall ambient-corrected SPL = _____ dB

Quietest side of vehicle? Left/ Driver Side _____ Right/ Passenger Side _____

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 3 of 4)
CONSTANT SPEED PASS-BY TEST (31 ± 1 km/h)

**QUIETEST SIDE 1/3 OCTAVE BAND SPLs FOR FOUR VALID TEST RUNS
 (AMBIENT CORRECTED)**

1/3 octave band center frequency, Hz	Valid Test 1 corrected SPL, dB	Valid Test 2 corrected SPL, dB	Valid Test 3 corrected SPL, dB	Valid Test 4 corrected SPL, dB	Average corrected SPL, dB	Minimum Required SPL	Is Avg > Min Req?
315						56	
400						55	
500						57	
630						57	
800						58	
1000						58	
1250						59	
1600						55	
2000						55	
2500						54	
3150						51	
4000						49	
5000						47	

FOUR-BAND PASS-BY COMPLIANCE

Compare the average corrected SPL values against the minimum SPL requirement for each one-third octave band. Determine if any four one-third octave bands meeting the required standard are non-adjacent to each other AND that span a range of at least nine one-third octave bands in the range of 315 Hz to 5000 Hz. Complete following table with one set of four one-third octave bands that meet these requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard

31 ± 1 km/h Pass-By (Four-Band) PASS/FAIL _____

16. DATA SHEETS....continued

DATA SHEET 6 (Sheet 4 of 4)
CONSTANT SPEED PASS-BY TEST (31 ± 1 km/h)

TWO-BAND PASS-BY COMPLIANCE

Compare the average corrected SPL values and identify which one-third octave bands meet the minimum SPL requirement. Select the band with the highest SPL of the 315 to 800 Hz bands, and select the band with the highest SPL of the 1000 to 3150 Hz bands. The selected bands must be non-adjacent AND span no fewer than three one-third octave bands in the range of 315 Hz to 3150 Hz. Complete following table with one set of two one-third octave bands that meet these requirements and each meet the minimum requirements.

1/3 octave band center frequency, Hz	Minimum required SPL, dB, for selected band	Average corrected SPL, dB	Exceeds Standard
	52		
	52		

Calculate the Band sum of the one-third octave bands selected.

$$\text{Band Sum} = 10 \times \log_{10} \sum_{i=1}^2 10^{(SPL_i/10)}$$

BAND SUM = _____ (Must be at least 62 dBA)

31 ± 1 km/h Pass-By Test (Two-Band) PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

16. DATA SHEETS....continued

DATA SHEET 7 (Sheet 1 of 5) RELATIVE VOLUME CHANGE REQUIREMENT

Stationary Test Data

Normalize the levels of the 13 one-third octave bands, and use these values to calculate the normalized band sum.

Normalizing averaged values

1/3 octave band center frequency, Hz	Average corrected SPL, dB (Data Sheet 2)		Minimum SPL, dB		Normalized Band Level, dB
315		-	39	=	
400		-	39	=	
500		-	40	=	
630		-	40	=	
800		-	41	=	
1000		-	41	=	
1250		-	42	=	
1600		-	39	=	
2000		-	39	=	
2500		-	37	=	
3150		-	34	=	
4000		-	32	=	
5000		-	31	=	

Use the following equation to calculate the Normalized Band Sum:

$$\text{Normalized Band Sum} = 10 \times \log_{10} \left(\sum_{i=1}^{13} 10^{\frac{\text{Normalized Band Level}_i}{10}} \right)$$

Normalized Band Sum (Stationary Operating Scenario): _____ **dB**

16. DATA SHEETS....continued

DATA SHEET 7 (Sheet 2 of 5)
RELATIVE VOLUME CHANGE REQUIREMENT

11 ± 1 km/h Test Data

Normalize the levels of the 13 one-third octave bands, and use these values to calculate the normalized band sum.

Normalizing averaged values

1/3 octave band center frequency, Hz	Average corrected SPL, dB (Data Sheet 4)		Minimum SPL, dB		Normalized Band Level, dB
315		-	39	=	
400		-	39	=	
500		-	40	=	
630		-	40	=	
800		-	41	=	
1000		-	41	=	
1250		-	42	=	
1600		-	39	=	
2000		-	39	=	
2500		-	37	=	
3150		-	34	=	
4000		-	32	=	
5000		-	31	=	

Use the following equation to calculate the Normalized Band Sum:

$$\text{Normalized Band Sum} = 10 \times \log_{10} \left(\sum_{i=1}^{13} 10^{\frac{\text{Normalized Band Level}_i}{10}} \right)$$

Normalized Band Sum (11 ± 1 km/h Operating Scenario): _____ dB

16. DATA SHEETS....continued

DATA SHEET 7 (Sheet 3 of 5)
RELATIVE VOLUME CHANGE REQUIREMENT

21 ± 1 km/h Test Data

Normalize the levels of the 13 one-third octave bands, and use these values to calculate the normalized band sum.

Normalizing averaged values

1/3 octave band center frequency, Hz	Average corrected SPL, dB (Data Sheet 5)		Minimum SPL, dB		Normalized Band Level, dB
315		-	39	=	
400		-	39	=	
500		-	40	=	
630		-	40	=	
800		-	41	=	
1000		-	41	=	
1250		-	42	=	
1600		-	39	=	
2000		-	39	=	
2500		-	37	=	
3150		-	34	=	
4000		-	32	=	
5000		-	31	=	

Use the following equation to calculate the Normalized Band Sum:

$$\text{Normalized Band Sum} = 10 \times \log_{10} \left(\sum_{i=1}^{13} 10^{\frac{\text{Normalized Band Level}_i}{10}} \right)$$

Normalized Band Sum (21 ± 1 km/h Operating Scenario): _____ dB

16. DATA SHEETS....continued

DATA SHEET 7 (Sheet 4 of 5)
RELATIVE VOLUME CHANGE REQUIREMENT

31 ± 1 km/h Test Data

Normalize the levels of the 13 one-third octave bands, and use these values to calculate the normalized band sum.

Normalizing averaged values

1/3 octave band center frequency, Hz	Average corrected SPL, dB (Data Sheet 6)		Minimum SPL, dB		Normalized Band Level, dB
315		-	39	=	
400		-	39	=	
500		-	40	=	
630		-	40	=	
800		-	41	=	
1000		-	41	=	
1250		-	42	=	
1600		-	39	=	
2000		-	39	=	
2500		-	37	=	
3150		-	34	=	
4000		-	32	=	
5000		-	31	=	

Use the following equation to calculate the Normalized Band Sum:

$$\text{Normalized Band Sum} = 10 \times \log_{10} \left(\sum_{i=1}^{13} 10^{\frac{\text{Normalized Band Level}_i}{10}} \right)$$

Normalized Band Sum (31 ± 1 km/h H Operating Scenario): _____ **dB**

16. DATA SHEETS....continued

DATA SHEET 7 (Sheet 5 of 5)
RELATIVE VOLUME CHANGE REQUIREMENT

Critical Operating Speed Intervals

Between:

Stationary and 10 km/h

Normalized Band Sum 10 KM/H _____ dB – Normalized Band Sum Stationary _____ dB

= Relative Volume Change _____ dB

Relative Volume Change ≥ 3 dB **YES / NO** _____

10 km/h and 20 km/h

Normalized Band Sum 20 KM/H _____ dB – Normalized Band Sum 10 KM/H _____ dB

= Relative Volume Change _____ dB

Relative Volume Change ≥ 3 dB **YES / NO** _____

20 km/h and 30 km/h

Normalized Band Sum 30 KM/H _____ dB – Normalized Band Sum 20 KM/H _____ dB

= Relative Volume Change _____ dB

Relative Volume Change ≥ 3 dB **YES / NO** _____

Relative Volume Change Requirement PASS/FAIL _____

REMARKS:

RECORDED BY: _____ DATE: _____

APPROVED BY: _____ DATE: _____

17. FORMS

LABORATORY NOTICE OF TEST FAILURE TO OVSC

FMVSS NO.:141 TEST DATE:_____

LABORATORY: _____

CONTRACT NO.: _____ DELV. ORDER NO: _____

LAB. PROJECT ENGINEER'S NAME: _____

TEST SPECIMEN DESCRIPTION:

VEHICLE NHTSA NO.: _____ VIN: _____

PART NO.: _____ MFR: _____

TEST FAILURE DESCRIPTION:

FMVSS REQUIREMENT, PARAGRAPH § _____:

NOTIFICATION TO NHTSA (COR): _____

DATE: _____ BY: _____

REMARKS:

17. FORMS....Continued

MONTHLY TEST STATUS REPORT FMVSS 141

DATE OF REPORT: _____

NO.	VEHICLE NHTSA NO., MAKE & MODEL	COMPLIANCE TEST DATE	PASS/ FAIL	DATE REPORT SUBMITTED	DATE INVOICE SUBMITTED	INVOICE PAYMENT DATE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

17. FORMS....Continued

MONTHLY VEHICLE STATUS REPORT FMVSS 141

DATE OF REPORT: _____

NO.	VEHICLE NHTSA NO., MAKE & MODEL	DATE OF DELIVERY	ODOM. READING	TEST COMPLETE DATE	VEHICLE SHIPMENT DATE	ODOM. READING
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						