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AUTOMOTIVE INDUSTRY STANDARD

**Automotive Vehicles – Interior Noise –
Method of Measurement and
Requirements**

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ON BEHALF OF:

AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER

CENTRAL MOTOR VEHICLE RULES - TECHNICAL STANDING COMMITTEE

SET-UP BY

MINISTRY OF ROAD TRANSPORT & HIGHWAYS

GOVERNMENT OF INDIA

December 2004

Status chart of the Standard to be used by the purchaser
for updating the record

Sr. No.	Corr-igenda.	Amend-Ment	Revision	Date	Remark	Misc.

General remarks:

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the Ministry of Surface Transport (MoST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No. RT-11028/11/97-MVL dated September 15, 1997.

This Standard is prepared to lay down a uniform testing procedure for evaluating Interior Noise of N2 , N3, M2 and M3 category of vehicles.

The Automotive Research Association of India (ARAI), Pune, being the Secretariat of AIS Committee, has printed this Standard .

The Automotive Industry Standards Committee responsible for preparation of this standard is given in Annexure : A

Automotive Vehicles - Interior Noise - Method of Measurement and Requirements

1. SCOPE AND FIELD OF APPLICATION

- 1.1 This standard specifies the method of measurement of interior noise of body built N2, N3, M2 and M3 category of vehicles.

2. REFERENCES

ISO 5128 -1980 (E); Acoustics - Measurement of Noise inside Motor Vehicle.

JASO Z 111 - 83 ; Japanese Automobile Standard - Measurement of Noise inside Motor vehicle.

IS : 9211- 1979 Denominations and definitions of weights of road vehicles.

IS : 9779 - 1981 Sound level meters

IS : 14272 - (Part 1) : 1995 Automotive vehicles - types-terminology : 3 & 4 wheelers

Publication 179 'Precision Sound Level Meters', second edition of the International Electrotechnical Commission (IEC)

3. MEASURED QUANTITIES

- 3.1 All readings of the sound level meter shall be taken with the dynamic characteristic - "fast".
- 3.2 The values to be measured at all microphone positions during the tests are A-weighted sound pressure levels, L_{pA} , expressed in decibels dB(A).

4. MEASURING INSTRUMENTS

4.1 Acoustic measurements

The apparatus used for measuring the noise level must be a precision sound-level meter of the type described in Publication 179 ' Precision sound level meters', second edition, of the International Electrotechnical Commission (IEC). Measurements must be carried out using the 'fast' response of the sound-level meter and the 'A' weighted curve which are also described in that publication. The 'Frontal' mode of operation of the sound level meter shall be used.

At the beginning and end of each series (full set) of measurements, the sound-level meter must be calibrated according to the manufacturer's instructions by means of an appropriate sound source (e.g. a piston phone). The test shall be considered invalid if the sound level meter errors registered during this calibration exceed 1 dB(A).

4.2 **Speed measurements**

The engine speed and vehicle speed shall be determined with an accuracy of $\pm 3\%$ during testing.

5. **ACOUSTICAL ENVIRONMENT, WEATHER CONDITIONS, BACKGROUND NOISE**

5.1. The test site shall be such that the sound radiated by the vehicle to the outside contributes to the inside noise only by reflections from the road surface and not by reflections from buildings, walls or similar large objects outside the vehicle. During the period of measurement, the distance of the vehicle from large objects shall be greater than 20 m.

5.2. **Meteorological conditions**

Measurements shall not be made if wind velocity is > 3 m/s . It shall be ensured that the results are not affected by gusts of wind.

5.3. **Background Noise**

Background noise shall be measured by the microphone located at the driver's seat of stationary vehicle, which shall be lower than the measured test value by 10 dB(A). A suitable windscreen as recommended by sound level meter manufacturer may be fitted to the microphone provided that account is taken of its effect on the sensitivity and directional characteristics of the microphone.

6. **TEST TRACK CONDITIONS**

6.1 Interior sound pressure levels of motor vehicles are greatly influenced in general by the macro texture of surface roughness of the road, with smooth road surfaces producing consistent interior levels. Accordingly, the test road shall be hard and as smooth and level as possible, without gaps or ripples or similar macro-texture of surface roughness which might contribute to the interior sound pressure levels of the motor vehicle.

The surface shall be dry and free from snow, dirt, stones, leaves, etc.

6.2. The test track shall allow a steady speed to be maintained. It shall be in a straight line or form a closed circuit with at least 2000 m length and having a minimum radius of 200 m. The measurement shall not be carried out on Banking Section of Tracks.

7. VEHICLE CONDITIONS

7.1. Engine and tyre conditions

Prior to test, the vehicle shall be run-in as per vehicle manufacturers' recommendation. The vehicle's tyres must be of the type normally fitted to such vehicles by the manufacturer and must be inflated to the appropriate pressure(s) for the unladen vehicle.

Before the measurements are made, the engine must be brought to its normal operating condition as regards temperatures, settings, fuel, spark plugs, carburetor(s), etc. (as appropriate). If the vehicle is fitted with fan(s) having an automatic actuating mechanism, this system must not be interfered with during the measurements.

7.2. Loading of the vehicle

The vehicle shall be tested in unladen condition. Only standard vehicle equipment, measuring equipment and necessary personnel shall occupy the interior of the vehicle. No more than two persons (the driver and observer) shall be present, and in M3 category buses with more than eight seats no more than three persons may be present.

For vehicles with drive-away chassis submitted for test, the compliance to clauses 7.4.3 and 10.0 shall be established based on a prototype model / mock-up sample, representing completely built vehicle submitted by the vehicle manufacturer and adopting the Criterion for Extension of Type Approval given in clause 11.0 and 12.0.

7.3. Openings, windows, auxiliary equipment, adjustable seats.

7.3.1 Openings such as skylights, all windows and ventilating inlets and/ or outlets shall be shut if possible, unless their influence upon the sound level inside the vehicle is to be investigated.

7.3.2 Auxiliary equipment such as windscreen wipers and heating and / or ventilating fans and air-conditioners shall not operate during the tests. If the contribution of the noise of the ventilating system, and of any auxiliary equipment, to the total inside noise is to be investigated, the test should be repeated with this equipment operating. If any auxiliary equipment is automatic in operation, its operating condition shall be stated in the test report.

- 7.3.3. Adjustable seats shall be set in the mid-position of the horizontal and vertical range of adjustments. If the back-rest of the seat is adjustable, it shall be set as near to the vertical position as possible.

Adjustable headrests shall be set at the midposition.

7.4. Vehicle operating conditions

The vehicle operating conditions shall be such as to typify the inside noise under whichever of the following conditions are appropriate for the vehicle under test :

- a) steady speeds (see 7.4.1.);
- b) full throttle acceleration (maximum accelerator position) (see 7.4.2);
- c) vehicle stationary, with engine idling and full throttle (see 7.4.3), as an additional monitoring test for commercial vehicles and buses with diesel engines.

The corresponding operating conditions are specified in 7.4.1, 7.4.2 and 7.4.3.

7.4.1. Steady speed.

7.4.1.1 Test vehicle speed

The test shall be carried out with increments of 20 km/h from 40 km/h to 80 % of max. speed. If the maximum speed of the test vehicle is below 120 km/h, the test speed shall be 80 % of its maximum speed. For a vehicle with the maximum vehicle speed below 40 km/h, the test shall be done at 80 % of its maximum speed. The vehicle speed shall be maintained within $\pm 3\%$ of each test speed.

7.4.1.2 Gear Position of Transmission

The highest possible gear (including that of auxiliary transmission) that allows the stable running of the test vehicle shall be used for each test speed. If the test vehicle is capable of selecting 4-wheel drive or 2-wheel drive the vehicle shall be run with the 2-wheel drive.

“A” weighted sound pressure levels are to be determined at least 3 speeds to cover the range specified above.

7.4.2. Full throttle acceleration (maximum accelerator position)

The procedure for the acceleration test is as follows :-

- the speed of the vehicle and of the engine shall be stabilized at specified initial conditions;
- when stable conditions are attained, the throttle shall be fully opened as quickly as possible and sound recording shall be made until either 90% of the engine speed for maximum power as specified by the manufacturer of the vehicle (in the following test, referred to as “maximum power speed”) or 120 km/h is reached, whichever is lower. Wheel slip shall be avoided.

The initial operating conditions shall be specified as follows:

- the transmission setting shall be the highest position making the test possible without exceeding 120 km/h;
- the setting shall not be changed during the test;
- if, at an engine speed of 90% of maximum power speed, a road speed of 120 km/h is exceeded in top gear, a lower gear shall be selected, but no lower than third for a four-or five-speed gear-box, and no lower than second for a three-speed gear- box. If 120 km/h is still exceeded in this lower gear, the vehicle shall be tested over the speed range 60 to 120 km/h in that gear;
- if possible, kick-down mechanisms shall be made in-operative;
- the initial engine speed shall be the lowest allowing a continuously increasing engine speed during the test, but no lower than 45% of the maximum power speed, unless 120 km/h is exceeded at 90% of maximum power speed in the lowest gear allowed, in which case the initial engine speed shall be that corresponding to a road speed of 60 km/h;
- for vehicle with automatic transmission, the initial engine speed shall be stabilized as near as possible to 45% of the maximum power speed. The corresponding road speed shall be no higher than approximately 60 km/h.

If, for vehicles with automatic transmissions, the setting changes before the final speed of 90% of maximum power speed of 120 km/h is reached the initial speed shall be 50% of that speed where the setting changes.

Note : Since difficulties in controlling engine speeds may be encountered in vehicles fitted with torque converters, the test condition should be adhered to as closely as practicable.

7.4.3. Stationary test

The procedure for the stationary test which shall be carried out in neutral gear is as follows :

- a) the engine shall be operated at the low speed idle;
- b) the throttle shall be fully opened as quickly as possible allowing the engine to accelerate to high idle and shall be held fully open for at least 5 seconds.

8. MICROPHONE POSITIONS

The noise inside a vehicle may vary considerably with location. Therefore, measuring points should be selected in sufficient number and in such a manner that the distribution of the noise in the vehicle is adequately represented with respect to driver and passenger ear locations.

One measuring point shall be at the driver's position. Additional measuring points shall be for the rear passenger seats of vehicle adjacent to the longitudinal axis of the vehicle.

For a vehicle with three or more than three rows of seats the interior noise may be measured with the microphone position at the following three positions:

Driver' s ear as the first position, second position at the middle row of the multiple seat rows and third position at the last row of seats for the seat positions nearest to the longitudinal axis of the vehicle.

Both seated and standing positions shall be included where appropriate. The exact position of the measuring points shall be indicated on a plan. During the measurement no person shall occupy the selected position with the exception of the driver's seat.

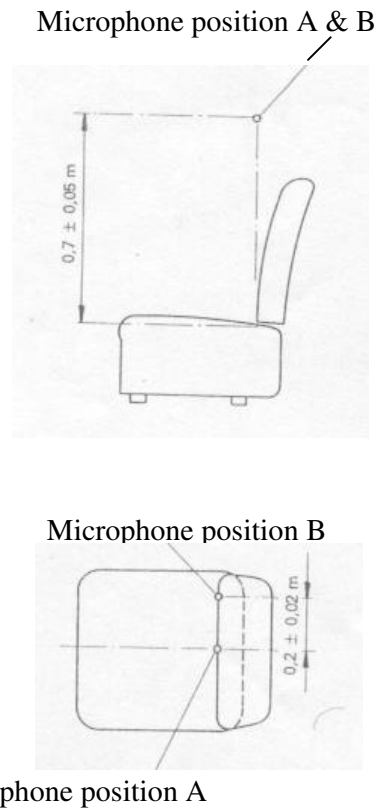
The microphone shall be no closer than 0.15 m to walls or upholstery.

The microphone shall be oriented horizontally, with the direction of maximum sensitivity specified by the manufacturer of the microphone pointing in the direction in which a person occupying the seat or standing position would be looking or, if such direction is not defined, in the driving direction.

The microphone used during the tests shall be mounted in such a way that it is not affected by vibrations of the vehicle. The mounting shall prevent excessive (more than about 20 mm) amplitudes relative to the vehicle.

If not stated otherwise by the manufacturer of the sound level meter the direction of maximum sensitivity shall coincide with the reference direction.

8.1. Microphone position with respect to a seat (see the figure 1 below):



A: Unoccupied seat, B: Driver's seat

Figure 1 – Microphone position with respect to a seat

The vertical coordinate of the microphone shall be $0.7 \pm 0.05\text{m}$ above the intersection of the occupied seat surface and the surface of the back of the seat (see the figure 1).

The horizontal co-ordinate shall be the middle plane (or plane of symmetry) of the unoccupied seat. At the driver's seat, with the driver present, the horizontal co-ordinate shall be $0.2 \pm 0.02\text{m}$ to the right (to the left for right-hand driven vehicles) from the middle plane of the seat. Adjustable seats shall be set according to 7.3.

8.2. Microphone position for standing locations

The vertical co-ordinate shall be 1.6 ± 0.1 m above the floor. The horizontal co-ordinates shall correspond to a person standing at selected points.

8.3. Microphone position in sleeping -berths

In sleeping-berths, such as in sleeper trucks or buses the microphone shall be placed 0.15 ± 0.02 m above the middle of the unoccupied pillow.

9. TEST PROCEDURE

9.1. At the steady speeds, the values of the A-weighted sound pressure level are recorded for at least 3 speeds as specified in 7.4.1

9.2. At full throttle acceleration (see 7.4.2), the maximum value of the A-weighted sound pressure level occurring in the specified acceleration range is retained and stated in the test report.

9.3. In the stationary test, the maximum value of the A-weighted sound pressure level shall be recorded when the testing is carried out as specified in 7.4.3.

9.4. At least two measurements shall be made at each microphone position and for each operating condition. If the spread of results of the A-weighted sound pressure levels obtained under any measuring condition exceeds 3 dB(A), further measurements shall be made until the readings of two independent successive measurements fall within a range of 3 dB(A); the mean value of these two readings shall be recorded as the test result.

The values stated in the test report shall be rounded to the nearest integral decibel.

Any peak which is obviously out of character with the general sound pressure level being read should be ignored.

9.5. Whenever the sound level meter reading fluctuates, the mean value of the readings shall be determined. Occasional extreme peaks should be disregarded.

10. REQUIREMENTS

When tested as per Clause 7.4.3, the sound pressure level shall not exceed 90 dB(A) for the Type Approval of the vehicle and for Conformation of Production.

11.0 CRITERION FOR EXTENSION OF APPROVAL (CEA)

This para gives the factors to be considered while selection a vehicle to represent a range of variants for establishing compliance of a model for Type Approval to meet the test requirements of Clause 10 for test conducted as per Clause 7.4.3 on Stationary Noise. This also applies to

- Extension of Type Approval for changes in Technical Specifications of an already Type Approved model
- Establishing compliance of new model/variant(s) based on already Type Approved model

Extension may be granted based on guidelines given in clause 12.

11.1 Changes to the Technical Specifications of an already Type Approved Vehicle:

11.1.1 every modification pertaining to the information declared in accordance with Clause 12. shall be intimated by the manufacturer to the certifying agency.

11.1.2 if the changes in parameters are not related to the provisions, no further action need to be taken.

If the changes in parameters are related to the provisions, the Testing Agency may then consider whether,

- a) The model with the changed specifications still complies with provisions or
- b) Any further verification is required to establish compliance.

For considering whether any further verification is required or not, guidelines given in clause **12.0** (Criteria for Extension of Approval) shall be used.

11.1.3 In case of 11.1.2(b), verification for only those parameters, which are affected by the modifications, need to be carried out.

11.1.4 In case of fulfilment of criteria of clause 11.1.2 (a), or after results of further verification as per clause of 11.1.2 (b) are successful, the Type Approval of compliance shall be extended for the changes carried out.

12.0 GUIDELINES FOR CRITERIA FOR EXTENSION OF APPROVAL (CEA) – APPLICABLE ONLY FOR CLAUSE 7.4.3

12.1 In case of following changes, the verification shall be carried out for establishing compliance of the changed parameters to the requirements specified in this standard.

- 12.1.1. In case of change in Engine Type, capacity, number & arrangement of cylinders, **test needs to be conducted for compliance.**
- 12.1.1.1 In case of change in base diesel engine to Petrol, CNG or LPG or base petrol engine to CNG or LPG keeping the power within the tolerance specified in clause 12.1.2 below, no test needs to be conducted for compliance.
- 12.1.2 In case of increase in maximum engine power upto 10 % or any decrease of maximum engine power, **no test needs to be conducted for compliance.**
- 12.1.3 In case of increase in maximum engine speed upto 10 % or any decrease of maximum engine speed, **no test needs to be conducted for compliance.**
- 12.1.4 In case of any changes in transmission ratios, axle ratios and type, size and ply rating of tyres, **no test needs to be conducted for compliance.**
- 12.1.5. In case of any increase in the interior length or a decrease in interior length by less than 10 %, **no test needs to be conducted for compliance.**
- 12.1.6 In case of any decrease in the fan tip speed or an increase in the fan tip speed up to 10 %, **no test needs to be conducted for compliance.**
- 12.1.7 In case of any decrease in the blades or an increase in the number of blades up to 30 % (rounded off to nearest whole number, as per Indian Standard procedure), **no test needs to be conducted for compliance.**
- 12.1.8 In case of change in the fan drive from mechanical to either viscous or electrical or from viscous to electrical, **no test needs to be conducted for compliance.**
- 12.1.8.1 In case of any change in fan shroud, blade material, thickness, profile and design details, **no test needs to be conducted for compliance.**
- 12.2** Changes other than the above are considered as not affecting compliance and do not call for any test.

13. TEST REPORT

The test report shall include the following information :

Sr. No.	Parameters to be Included in Test Report
01.	Nature of Tests
02.	Test Site
03.	Weather Conditions including Speed & Direction of Wind
04.	Measuring Equipment
05.	Background Noise and Corrections applied to the date (if any)
06.	Vehicle details, including <ul style="list-style-type: none"> - its engine - settings of gearbox - speed during tests - tyre sizes - tyre pressures - radiator-flaps (blinds) - cooling fan - noise shield
07.	Position of Openings with reference to Clause 7.3.1
08.	Auxiliary equipment and its operating conditions with reference to Clause 7.3.2.
09.	Adjustable Seats with reference to Clause 7.3.3
10.	Unladen weight of the vehicle
11.	No. of persons in the vehicle.
12.	Microphone positions (indicated in Plan)
13.	“A” weighted sound pressure levels at specified microphone positions.

14. TECHNICAL SPECIFICATIONS TO BE SUBMITTED BY THE VEHICLE MANUFACTURER

- 1. Vehicle details including**
 - 1.1 Model name / Variant(s)
 - 1.2 Category of Vehicle
 - 1.3 Unladen Weight
 - 1.4 Fully built or partially built or only with cabin
 - 1.5 Setting of gear box
 - 1.5.1 Type of Gear box – MT / AT
 - 1.5.2 No. of Forward Gears
 - 1.5.3 Speeds in different gear
 - 1.6 Design & material used inside the cabin
 - 1.7 Radiator-flaps (blinds)

- 1.8 Cooling fan details
 - 1.8.1 Type – Fixed / Viscous / Electrical
 - 1.8.2 Fan Diameter
 - 1.8.3 No. of Fan blades
 - 1.8.4 Max. speed of fan
 - 1.8.5 Fan Drive Ratio
- 1.9 Noise shield
- 1.10 Engine : power-torque characteristics
 - 1.10.1 Engine type
- 1.11 Tyre sizes & tyre pressures.

Annexure: A
(See Introduction)
COMMITTEE COMPOSITION
Automotive Industry Standards Committee

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