AUTOMOTIVE INDUSTRY STANDARDS

Electric Power Train Vehicles– Measurement of Electrical Energy Consumption

(Revision 1)

PRINTED BY
THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA
P.B. NO. 832, PUNE 411 004

ON BEHALF OF
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

SET-UP BY
MINISTRY OF ROAD TRANSPORT AND HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT AND HIGHWAYS)
GOVERNMENT OF INDIA

February 2015

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

Sr.	Corrigenda	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 of preparation of 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 erstwhile Ministry of Surface Transport (MOST) has constituted a permanent Automotive Industry Standard Committee (AISC) vide order no. RT-11028/11/97-MVL dated September 15, 1997. The Standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC) after approval, The Automotive Research Association of India, (ARAI), Pune, being the secretariat of the AIS Committee, has published this Standard. For better dissemination of this information, ARAI may publish this standard on their website.

This standard prescribes the requirements for the measurement of electrical energy consumption.

Considerable assistance has been taken from UN R101 Rev 3 (Supplement 1 to the 01 series of amendments - Date of entry into force: 27 January 2013): Uniform Provisions concerning the approval of Passenger Cars powered by an Internal Combustion Engine only, or powered by a Hybrid Electric Power Train with regard to the measurement of the Emission of Carbon Dioxide and Fuel Consumption and/or the measurement of Electric Energy Consumption and Electric Range, and of categories M1 and N1 vehicles powered by an Electric Power Train only with regard to the measurement of Electric Energy Consumption and Electric Range.

The AISC panel and the Automotive Industry Standards Committee (AISC) responsible for preparation of this standard are given in Annex A and Annex B respectively.

Electric Power Train Vehicles - Measurement of Electrical Energy Consumption

Contents

Electric Power Train Vehicles - Measurement of Electrical Energy Consumption

1.0 SCOPE

This standard specifies the method for measurement of electrical energy consumption expressed in Wh/km for L, M & N categories of Electric Power Train Vehicles as defined in Rule 2 (u) of CMVR.

2.0 DEFINITIONS

Refer AIS-049:2003, as amended and revised from time to time, for the definitions.

3.0 VEHICLE PREPARATION

3.1 Condition of the Vehicle

The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer when tyres are at the ambient temperature. The lubricants for the mechanical moving parts shall conform to the specifications of the vehicle manufacturer. The lighting, light – signaling and auxiliary devices shall be off, except those required for testing and usual daytime operation of the vehicle.

3.2 All energy storage systems available for other than traction purpose (electric, hydraulic, pneumatic, etc.) shall be charged up to their maximum level specified by the manufacturer.

3.3 If the Rechargeable Energy Storage System (REESS) is operated above the ambient temperature, the operator shall follow the procedure recommended by the vehicle manufacturer in order to keep the temperature of the REESS in the normal operating range.

The manufacturer's representative shall be in a position to attest that the thermal management system of the REESS is neither disabled nor reduced.

The vehicle must have undergone at least 300 km during the seven days before the test with those REESS that are installed in the test vehicle. The seven days period can be waived on the request of vehicle manufacturer.

3.4 Operation mode

All the tests are conducted at a temperature of between 20 °C and 30 °C.

Note: If the ambient condition cannot be met at the time of the test, then based on mutual agreement between test agency and vehicle manufacturer, requirement of ambient temperature condition can be waived.

The test method includes the four following steps:

(a) Initial charge of the Rechargeable Energy Storage System (REESS);
(b) Application of 34 cycles of IDC (of 108 s duration each) for L category of vehicles

Or

22 Cycles of Part 1 of MIDC (of 195 s duration each) for M1, M2 (with GVW upto 3500 kg) and N category of vehicles.

Or

25 Cycles of Delhi Driving Cycle for M2 (with GVW above 3500 kg) and M3 category of vehicles (refer para 5.1.1 or 5.1.2)

(c) Charging the REESS;
(d) Calculation of the electric energy consumption.

Between the steps, if the vehicle needs to be moved, it is pushed to the following test area (without regenerative recharging).

3.5 Initial charge of the Rechargeable Energy Storage System (REESS)

Charging the REESS consists of the following procedures.

Note: "Initial charge of the REESS" applies to the first charge of the REESS, at the reception of the vehicle. In case of several combined tests or measurements, carried out consecutively, the first charge carried out shall be an "initial charge of the REESS" and the following may be done in accordance with the "normal overnight charge" procedure.

3.5.1 Discharge of the Rechargeable Energy Storage System (REESS)

The procedure starts with the discharge of the battery of the vehicle while driving (on the test track, on a chassis dynamometer etc.) at a steady speed of 70% ± 5% of the maximum thirty minutes speed of the vehicle. Stopping the discharge occurs:

a) When the vehicle is not able to run at 65 % of the maximum thirty minutes speed or

b) When an indication to stop the vehicle is given to the driver by the standard on-board instrumentation or

c) After covering the distance of 100 km.

3.5.2 **Application of a normal overnight charge**

The Rechargeable Energy Storage System (REESS) shall be charged according to the following procedure.

3.5.2.1 Normal overnight charge procedure

The charge is carried out

a) with the on-board charger, if fitted,

b) with an external charger recommended by the manufacturer using the charging pattern prescribed for normal charging,

c) in an ambient temperature comprised between 20 °C and 30 °C.

The procedure excludes all type of special charges that could be automatically or manually initiated like, for instance, the equalization charges or the servicing charges. The vehicle manufacturer shall declare that during the test, a special charge procedure has not occurred.

Note: If the ambient condition cannot be met at the time of the test, then based on mutual agreement between test agency and vehicle manufacturer requirement of ambient temperature condition can be waived.

3.5.2.2 **End of charge criteria**

The end of charge criteria corresponds to a charging time of 12 h except if a clear indication is given to the driver by the standard instrumentation that the REESS is not yet fully charged or as specified by the manufacturer. In this case

The maximum time is =

$$\frac{3 \times \text{Claimed battery capacity (Wh)}}{\text{Mains power supply (W)}}$$

4.0 FULLY CHARGED RECHARGEABLE ENERGY STORAGE SYSTEM (REESS)

REESS having been charged according to overnight charge procedure until the end of charge criteria.

5.0 TEST PROCEDURE

5.1 Test Sequence

5.1.1 The driving cycle shall be the Indian Driving Cycle (IDC) as given in Annexure-II of CMVR for all L category vehicles.

5.1.2 The driving cycle shall be Part-I of the modified Indian driving cycle as given in Annexure-IV B of CMVR for M1, M2 (with GVW upto 3500 kg) and N category of vehicles.

The driving cycle shall be Delhi Driving Cycle as given in AIS-049:2003,as amended and revised from time to time for M2 (with GVW above 3500 kg) and M3 category of vehicles.

5.1.3 In cases where the vehicle does not reach the required acceleration during driving, the accelerator/speed control shall remain fully activated until the reference curve has been reached again.

5.2 Power setting of the chassis dynamometer

The procedure prescribed in the document MoRTH/TAP/CMVR-115/116 as amended from time to time shall be adopted. Reference mass shall be taken as defined in AIS-049:2003 as amended and revised from time to time

5.3 Test Method

5.3.1 Principle

The test method described hereafter permits to measure the electric energy consumption expressed in Wh/km, to be measured:

5.3.2 Parameters, Units and Accuracy of Measurements

Parameter	Unit	Accuracy	Resolution
Time	s	±0.1 s	0.1 s
Distance	m	±0.1 percent	1 m
Temperature	°C	± 1 °C	1 °C
Speed	km/h	±1 percent	0.2 km/h
Mass	kg	±0.5 percent	1 kg
Energy	Wh	±0.2 percent	Class 0.2 s according to IEC 687

IEC: International Electrotechnical Commission.

Where accuracy is specified in %, it is the % of the measured value.

5.4 Application of the Cycle and Measurement of the Distance

5.4.1 The end of charging t_o (plug off) is reported.

5.4.2 The chassis dynamometer shall be set as per the settings in point 5.2 above. Starting within 4 h from t_o, 34 cycles of IDC (of 108 s duration each) or 22 cycles of Part1 of MIDC (of 195 s duration each) or 1 cycle of Delhi Driving Cycle as applicable (refer para 5.1.1 or 5.1.2 above) are run. At the end, the covered distance (D) in km is recorded.

5.4.3 **Charge of the Rechargeable Energy Storage System (REESS):**

The vehicle shall be connected to the mains within 30 minutes after the conclusion of the Driving Cycle. The vehicle shall be charged according to normal overnight charge procedure (Refer clause 3.5.2.1 above). The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy E delivered from the mains as well as its duration. Charging is stopped after 24 h from the previous end of charging time t_o.

Note: In case of any power disruptions during charging, the 24 h period shall be exceeded according to the disruption duration. The maximum total Power disruption of 30 minutes duration is allowed irrespective of the number of failures. Validity of the charge shall be discussed between the Test Agency and the vehicle manufacturer.

5.4.4 **Electric Energy Consumption Calculation**

Energy E in Wh and charging time measurements shall be recorded in the test report. The electric energy consumption is defined by the formula :

$$C = E / D$$

Where C is expressed in Wh/km and rounded off to the nearest whole number, E is Wh and D is the distance covered during the test in km.

5.5 Interpretation of the Results

5.5.1 The electric energy consumption adopted as the type approved value, shall be the value declared by the manufacturer if the value measured during testing does not exceed the declared value by more than 4%. The measured value can be lower without any limitations.

5.5.2 If the measured value of energy consumption exceeds the manufacturers declared value by more than 4% then another test shall be carried out on the same vehicle. When the average of the two test results does not exceed the manufacturer's declared value, by more than 4 % then the value declared by the manufacturer shall be taken as the type approval value.

5.5.3 If the average still exceeds the declared value by more than 4%, a final test shall be run on the same vehicle. The average of the three tests shall be then taken as the type approval value.

5.5.4 **Test Results**

The result of the electric energy consumption shall be expressed in Watt - hour per kilometer (Wh/km) rounded off to the nearest whole number.

6.0 TECHNICAL SPECIFICATIONS

The details of technical specification, approvals of changes in specification shall be as per para 5.0 of AIS-049:2003 as amended and revised from time to time.

7.0 TRANSITIONAL PROVISIONS

7.1 General guidelines for transitional provisions for this standard shall be as per AIS-000, as amended from time to time, as applicable, with the following requirement.

7.2 For L category vehicles type approvals issued for compliance to AIS-039:2003 shall be extended for approval to of AIS-039 (Rev1):2015. A retest may be performed at the request of manufacturer.

7.3 For M and N category vehicles re-testing shall be carried out for compliance to AIS-039 (Rev 1): 2015 from the date of notification. Manufacturers may request testing as per this standard from the date of adoption of this standard in CMVR-TSC.

ANNEX A
(See Introduction)

COMPOSITION OF AISC PANEL ON ELECTRIC POWER TRAIN VEHICLES- CONSTRUCTION AND FUNCTIONAL SAFETY REQUIREMENTS*

Convener	
Mr. A.A. Deshpande	The Automotive Research Association of India (ARAI)
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Mr. P. C. Joshi	Bureau of Indian Standards (BIS)

* At the time of approval of this Automotive Industry Standard (AIS)

ANNEX B
(See Introduction)
COMMITTEE COMPOSITION *
Automotive Industry Standards Committee

Chairperson	
Mrs. Rashmi Urdhwareshe	Director The Automotive Research Association of India, Pune
Members	**Representing**
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Representative from	Ministry of Heavy Industries and Public Enterprises (Department of Heavy Industry), New Delhi
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Shri Shrikant R. Marathe	Former Chairman, AISC
Shri N. K. Sharma	Bureau of Indian Standards, New Delhi
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Shri Uday Harite	Automotive Components Manufacturers Association of India, New Delhi

Member Secretary
Mr. A. S. Bhale
General Manager
The Automotive Research Association of India, Pune

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