

AUTOMOTIVE INDUSTRY STANDARDS

**Electric Power Train Vehicles
Measurement of Net Power and
The Maximum 30 Minute Power**

(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 net power and maximum 30 minute power of Electric Power Train Vehicles.

This standard is formulated based on UN ECE R 85 (Supplement 6 to the original version of the Regulation , Date of entry into force: 15.07.13): Uniform Provisions Concerning the Approval of Internal Combustion engines or Electric Drive Trains intended for the Propulsion of Motor Vehicles of Categories M and N with regard to the measurement of the Net Power and the Maximum 30 Minutes Power of Electric Drive Trains.

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 Net Power and
the Maximum 30 Minute Power**

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**Electric Power Train Vehicles - Measurement of Net Power and
the Maximum 30 Minute Power**

1.0 SCOPE

This standard applies to the representation of the curve as a function of motor speed and the power at full load indicated by the vehicle/motor manufacturer for motors of electric drive trains and the maximum 30 minutes power of electric drive trains intended for the propulsion for L, M and N categories of Electric Power Train Vehicles as defined in Rule 2 (u) of CMVR.

2.0 DEFINITIONS

Refer AIS-049 Rev 1 as amended from time to time for definitions.

3.0 TEST CONDITIONS

3.1 The test for motor power may be conducted by testing the motor using a bench dynamometer or by testing the vehicle using a chassis dynamometer as per manufacturer's option.

3.2 The motor / Vehicle shall have been run-in according to the manufacturer's recommendations

3.3 If the power measurement can be carried out only on a motor with the gear box or a reducer mounted, the efficiency shall be taken into account.

4.0 TESTING PROCEDURE

4.1 Bench Dynamometer Procedure

4.1.1 Auxiliaries

4.1.1.1 Auxiliaries to be fitted

During the test, the auxiliaries necessary for the motor operation in the intended application as listed in Table-1 shall be installed in the same position as in the vehicle.

Table 1
Auxiliaries to be fitted for the Test to Determine Net Power and
the Maximum 30 Minutes Power of Electric Motor

("Standard-production equipment" means equipment provided by the manufacturer for a particular application).

No.	Auxiliaries	Fitted for net power and the maximum 30 minutes power test
1	DC voltage source	Voltage drop during test less than 5 %
2	Speed variator and control device	Yes: Standard-production equipment
3	Liquid-cooling Motor bonnet Bonnet outlet Radiator ^{1,2} Fan Fan cowl Pump Thermostat ³	No Yes: Standard production equipment
	Air cooling Air filter Cowl Blower Temperature adjustment system	Yes: Standard production equipment
4	Electric equipment	Yes: Standard production equipment
5	Bench test auxiliary fan	Yes, if necessary

⁽¹⁾ The radiator, the fan, the fan cowl, the water pump and the thermostat shall be located on the test bench in the same relative position as on the vehicle.

The cooling-liquid circulation shall be activated by the motor liquid pump only. Cooling of the liquid may be produced either by the motor radiator, or by an external circuit, provided that the pressure loss of this circuit and the pressure at the pump inlet remain substantially the same as those of the motor cooling system.

The radiator shutter, if any, shall be in the open position. Where the fan, radiator and fan cowl cannot conveniently be fitted for the bench test, the power absorbed by the fan when separately mounted in its correct position in relation to the radiator and cowl (if used), shall be determined at the speed corresponding to the motor speeds used for measurement of the motor power either by calculation from standard characteristics or by practical tests.

This power, corrected to the standard atmospheric conditions should be deducted from the correct power.

⁽²⁾ Where a dis-connectable or progressive fan or blower is incorporated, the test should be carried out with the fan (or blower) disconnected or at maximum slip condition.

⁽³⁾ The thermostat may be fixed in the fully open position.

4.1.1.2 Auxiliaries to be removed

The auxiliaries necessary for the proper operation of the vehicle, and which may be mounted on the motor shall be removed when performing the test. The following non-exhaustive list is given as an example:

- Air compressor for brakes;
- Power steering compressor;
- Suspension system compressor;
- Air conditioner system, etc.

4.1.1.3 Where accessories cannot be removed, the power they absorb in the unloaded condition may be determined and added to the measured power.

The electric motor shall be supplied from a DC voltage source with a maximum voltage drop of 5% depending on time and current (periods of less than 10 seconds excluded). The supply voltage of the test shall be as specified by the vehicle manufacturer.

4.2 Chassis Dynamometer Procedure

4.2.1 While testing the vehicle on chassis dynamometer, the chassis dynamometer shall be adjusted for canceling the friction losses from the parts of the running vehicle other than the electric power train and the installed accessories. This may be carried out by calibrating the chassis dynamometer by coast down with the vehicle placed on the chassis dynamometer appropriately.

4.2.2 The power supply may be as given in Table 1 or may be from the Rechargeable Energy Storage System (REESS) of the vehicle. In such case, the voltage shall be maintained within the specified limits by supplying energy to the REESS using the power supply given in Table 1.

4.2.3 If the power supply is from the REESS of the vehicle, the REESS shall be charged according to the normal charge procedure for a period not exceeding 12 hour or as per vehicle manufacturer's recommendation. (Refer AIS-039 (Rev 1) para 3.5. 2.1).

4.3 Setting conditions

The setting conditions shall conform to the manufacturers specifications for the production motor and be used without further alteration for the particular application.

4.4 Data to be recorded

- 4.4.1 The test for determining the net power shall be carried out with the speed control set at the maximum position with full setting of the power controller.
- 4.4.2 Torque and speed data shall be recorded simultaneously.
- 4.4.3 If needed, the cooling liquid temperature recorded at the motor outlet must be maintained at $\pm 5^{\circ}$ C of the thermostat temperature setting specified by the manufacturer.
For air cooling motor, the temperature at a point indicated by the manufacturer shall be kept within $+ 0/ - 20^{\circ}$ C of the maximum value specified by the manufacturer.
- 4.4.4 The temperature of the lubricating oil measured in the oil sump or at the outlet from the oil temperature exchanger (if any) shall be maintained within the limits prescribed by the manufacturer.
- 4.4.5 An auxiliary regulating system may be used, if necessary, to maintain the temperature within the limits specified in Paragraphs 4.4.3. and 4.4.4.

4.5 Accuracy of Measurements

- 4.5.1 Torque: $\pm 1\%$ of measured torque.
The torque measuring system shall be calibrated to take friction losses into account. The accuracy in the lower half of the measuring range of the dynamometer bench may be $\pm 2\%$ of measured torque.
- 4.5.2 Motor Speed : 0.5% of measured speed
- 4.5.3 Motor Inlet Air Temperature: $\pm 2^{\circ}$ C.
- 4.5.4 Vehicle Speed: ± 1 kmph

5.0 DETERMINATION OF NET POWER

- 5.1 The motor/vehicle and its entire equipment assembly must be conditioned at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for a minimum of two hours before start of test.
- 5.2 The net power test shall consist of a run at full setting of the power controller.
- 5.3 Just before beginning the test, the vehicle / motor shall be run on the chassis / bench dynamometer for three minutes delivering a power equal to 80% of the rated maximum power at the speed recommended by the manufacturer

5.4 Measurements shall be taken at a sufficient number of motor speeds, (at least four) to define correctly the power curve between lowest and the highest speeds recommended by the manufacturer.

5.5 The whole test shall be completed within 5 minutes. It may be necessary to recharge the batteries once for completion of the power curve measurement.

6.0 DETERMINATION OF MAXIMUM 30 MINUTE POWER

6.1 The motor/vehicle and its entire equipment assembly must be conditioned at a temperature of $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for minimum four hours before the test.

The electric motor / vehicle shall be run on the bench dynamometer/chassis dynamometer at a power, which is declared by manufacturer for the maximum 30 minutes power.

The speed is recommended to be in a range, at which the net power is greater than 90% of the maximum power measured in clause 5.0. This speed shall be recommended by the manufacturer.

6.2 Speed and power shall be recorded. The power must be in a range of $\pm 5\%$ of the power value at the start of the test. The maximum 30 minutes power is the average of the power within the 30 minutes period.

7.0 TEST RESULTS

7.1 The net power and the maximum 30 minutes power for Electric Power Train Vehicles/motor indicated by the manufacturer shall be accepted if it does not differ by more than $\pm 2\%$ for maximum power and more than $\pm 4\%$ at the other measurement points on the curve with a tolerance of ± 1 kmph for vehicle speed/ $\pm 2\%$ of the motor speed or motor speed range ($X1 \text{ min}^{-1} + 2\%$) to ($X2 \text{ min}^{-1} - 2\%$) ($X1 < X2$), from the values measured by the Test Agency.

Note : If the battery limits the maximum 30 minutes power, the maximum 30 minutes power of an electric vehicle can be less than the maximum 30 minutes power of the motor of the vehicle according to this test.

8.0 TECHNICAL SPECIFICATIONS

The details of technical specification, approvals of changes in specification shall be as per para 5.0 of AIS-049 Rev 1.

9.0 TRANSITIONAL PROVISIONS

9.1 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..

9.2 Type approvals issued for compliance to AIS-041 - 2003 shall be extended to approval of AIS-041 (Rev 1) - 2015 however manufacturer may request a retest.

ANNEX A
(See Introduction)

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

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* 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
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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
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General Manager
The Automotive Research Association of India, Pune

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