AIS-041

AUTOMOTIVE INDUSTRY STANDARDS

Battery Operated Vehicles Measurement of Net Power and the Maximum 30 Minute Power and Speed

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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

September 2003

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 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 document on their website.

This Standard prescribes the requirements for the measurement of range of battery operated vehicle.

Considerable assistance has been taken from ECE R85.

The Committee responsible for preparation of this standard is given in Annexure- 1.

Battery Operated Vehicles - Measurement of Net Power and the Maximum 30-Minute Power and Speed

1.0 SCOPE

1.1. This Standard applies to the representation of the curve as a function of motor speed and the power at full load indicated by the manufacturer for electric drive trains and the maximum 30 minutes power of electric drive trains intended for the propulsion of battery operated vehicles.

1.2 This also applies to measurement of the 30minutes maximum speed of the battery-operated vehicle.

2.0 TERMINOLOGY

Refer Annexure-E of AIS-049 for definitions.

3.0 VEHICLE PREPARATION

3.1 Vehicle preparation shall be as per details given in para 3 of AIS 039.

3.2 In addition, the battery-operated vehicle shall be conditioned at a temperature between 20° C to 40° C for minimum of two hours before start of net power measurement test and for minimum of four hours before start of maximum 30-minute power test.

4.0 TEST CONDITIONS

4.1 The test shall be conducted at temperature between 20° C to 40° C.

4.2 The test for motor power may be conducted by testing the drive train using a bench dynamometer or by testing the vehicle using a chassis dynamometer

4.3 While testing on a bench dynamometer

4.3.1 While testing the motor power train, the auxiliaries necessary for the drive train operation in the intended application as listed in Table-1 shall be installed in the same position as in the vehicle.

Table 1

1	Speed variator and control device
2	LIQUID COOLING Radiator Fan Fan cowl Pump Thermostat
	AIR COOLING Air filter Cowl Blower Temperature adjustment system
3	Electric equipment
4	Bench test auxiliary fan (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 drive train water pump only. Cooling of the liquid may be produced either by the drive train 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 drive train 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 disconnected fan (or blower) disconnected or at maximum slip condition.

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

4.3.2 The electric drive train 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.

4.4 While testing the vehicle on chassis dynamometer

4.4.1 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.

4.4.2 The power supply may be as given in 4.3.2 or may be from the traction battery of the vehicle. In such case, the voltage shall be maintained within the specified limits by supplying energy to the battery.

4.4.3 If the power supply is from the traction battery of the vehicle, the battery 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 para 3.5.1.2.1).

5.0 TEST PROCEDURE FOR THE MOTOR POWER

5.1.1 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.

5.1.2 Torque and speed data shall be recorded simultaneously.

5.1.3 If needed, the cooling liquid temperature recorded at the motor outlet must be maintained at ± 5° C of the thermostat temperature setting specified by the manufacturer.

For air cooling drive trains, the temperature at a point indicated by the manufacturer shall be kept within + 0/ - 20° C of the maximum value specified by the manufacturer.

5.1.4 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.

5.1.5 An auxiliary regulating system may be used, if necessary, to maintain the temperature within the limits specified in Paragraphs 5.1.3. and 5.1.4.

5.2 Accuracy of Measurements

5.2.1 Torque: ± 2% of measured torque.

The torque measuring system shall be calibrated to take friction losses into account.

5.2.2 Vehicle Speed: $\pm$ 1 kmph / Engine speed $\pm$ 1% of measured speed.

5.2.3 Motor Inlet Air Temperature: ± 2° C.

5.3 Determination of net power

5.3.1 The net power test shall consist of a run at full setting of the power controller.

5.3.2 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.

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

5.3.4 The whole test shall be completed within 10 minutes. It may be necessary to recharge the batteries once for completion of the power curve measurement.

5.4 Determination of maximum 30 minute power

5.4.1 The electric drive train /the battery operated 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 para 5.3. This speed shall be recommended by the manufacturer.

5.4.2 Speed and power shall be recorded. The power must be in a range of ± 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.

5.5 Test Results

The net power and the maximum 30 minutes power for battery operated vehicle indicated by the manufacturer shall be accepted if it does not differ by more than ± 5% for maximum power and more than ±10% at the other measurement points on the curve with a tolerance of ± 1 kmph for vehicle speed/ $\pm$ 1.5 % of the motor speed, from the values measured by the Test Agency.

6.0 MEASUREMENT OF 30MINUTES MAXIMUM SPEED OF THE VEHICLE :

6.1 Power setting of the chassis dynamometer shall be as per the details given in para 5.2 of AIS 039.

6.2 At the start of the test the battery shall be charged as per para 3.5 of AIS 039

6.3 The transmission ratio chosen, where applicable, shall be that allows the highest speed of the vehicle. The vehicle shall be run on the chassis dynamometer at speed declared by the manufacturer for a period of 30 minutes.

At the end of thirty minutes the vehicle speed shall be within 5% of the speed declared by the manufacturer.

7.0 TECHNICAL SPECIFICATIONS

The details of technical specification, approvals of changes in specification shall be as per para 6.0 of AIS-049.

Annexure – 1
(See Introduction)
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