AIS-123

AUTOMOTIVE INDUSTRY STANDARD

CMVR Type Approval of Vehicles Retrofitted with Hybrid Electric System

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AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

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

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

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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 Standards 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 CMVR Type Approval requirements for in-use vehicles retrofitted with Hybrid Electric System.

Considerable assistance has been taken from the following UN regulations:

1.	UN R 100 :	Uniform provisions concerning the approval of REESS electric vehicles with regard to specific requirements for the construction and functional safety.
2.	UN R 101:	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 Annexure I and Annexure J respectively.

CMVR Type Approval of Vehicles Retrofitted with Hybrid Electric System

CMVR Type Approval of Vehicles Retrofitted with Hybrid Electric System

1.0 SCOPE

This standard lays down the requirements specific to vehicles retrofitted with Hybrid Electric System (HES) of M1, M2 and N1 category of vehicles, which

i) Comply to BS-II or subsequent emission norms,

ii) Operate on either petrol or diesel fuel only,

iii) Have GVW not exceeding 3500 kg,

iv) Have not been retrofitted earlier or are not operating on any other alternate fuel.

2.0 REFERENCES

2.1	AIS-049	Electric power train vehicles - CMVR type approval for REESS operated vehicles
2.2	IS:11825-1986	Method of weighment of automotive vehicles
2.3	AIS-071 (Part1):2009	Automotive Vehicles - Identification of Controls Tell-Tales and Indicators
2.4	AIS-003-1999	Automotive vehicles - Starting gradeability method of measurement and requirements
2.5	AIS-041	Electric power train vehicles-Measurement of net power and the maximum 30 minute power and speed
2.6	IS:11852: 2001	Automotive vehicles - Brakes and braking systems
2.7	AIS-038	Electric power train vehicles – Requirements for construction and functional safety
2.8	AIS-039	Electric power train vehicles – Measurement of electrical energy consumption
2.9	IS:3028-1998	Automotive vehicles – Noise emitted by moving vehicles- Method of measurement
2.10	IS:3141-2007	Starter Motors for Internal Combustion Engines Used for Automotive and other Applications – Specification
2.11	IS 9000 (Part 7) (Sec 1)	IEC 60068-2-27 : 1987 Basic Environmental Testing Procedures for Electronic and Electrical Items Part 7 Impact Test Section 1 Shock (Test Ea)
2.12	IS:8925-1978	Specification for Alternators for Automobiles
2.13	AIS-004 (Part 1):1999	Electromagnetic radiation from automotive vehicle – Permissible levels and methods of tests
2.14	AIS-004 (Part 3):2009	Automotive vehicles – Requirements for electromagnetic compatibility

2.15	AIS-008 (Rev. 1)	Installation Requirements of Lighting and Light-Signalling Devices for Motor Vehicle having more than Three Wheels, Trailer and Semi-Trailer excluding Agricultural Tractor and Special Purpose Vehicle
2.16	AIS-102 (Part 1)	CMVR Type Approval for Hybrid Electric Vehicles
2.17	AIS-048:2009	Battery Operated Vehicles - Safety Requirements of Traction Batteries
2.18	ISO:6722-2006	Road vehicles – 60v and 600v single core cables – Dimensions, test method and requirements.
2.19	JASO D 616:2011	Automotive parts – Test method and general performance requirements for wiring harness connectors.
2.20	TAP 115/116	Emission testing procedures
2.21	IS 2-1960	Rules for rounding off numerical values

3.0 DEFINITION

For the purpose of this draft the following definitions shall apply

3.1 **Hybrid Electric System (HES)**

Means aggregate of components added by manufacturer/ supplier to the base vehicle for hybrid electric operation without modification/change/fuel type of base vehicle power train and base vehicle configuration.

3.2 **Off Vehicle Charging (OVC) range**

The total distance covered during complete combined cycles run until the energy imparted by external charging of the Rechargeable Energy Storage System (REESS) or other electric REESS device is depleted, as measured according to the procedure described in Appendix-2 of Annexure A.

3.3 Where necessary, the definitions given in Annexure E of AIS-049 shall apply.

4.0 VEHICLE WEIGHTMENT

4.1 Vehicle weightment shall be done as per IS 11825-1986 with retrofitted Hybrid Electric System (HES). Permissible increase in vehicle unladen weight due to Hybrid Electric System (HES) shall be as follows:

Vehicle Category	ULW (kg)	Permissible increase in ULW (%)	Remarks
M1/M2	<= 1100	21	--
M1/M2	> 1100	17	--
N1	--	Equal to weight of HES	Payload shall be reduced to the extent of HES weight

5.0 COAST DOWN TEST

Coast down test shall be done at the choice of HES manufacture/supplier to find out vehicle coefficient for exhaust emission test. Otherwise power table method shall be used.

6.0 VISUAL INDICATION

HES manufacturer/supplier shall provide minimum following indications.

- Rechargeable Energy Storage System State of Charge (REESS SOC)
- Motor temperature
- Hybrid Electric System (HES) fault

These indications shall be as per the guidelines of AIS-071 (Part 1).

7.0 GRADEABILITY TEST

7.1 Test shall be carried out as per AIS-003-1999 with increased weight of Hybrid Electric System (HES) as declared by HES manufacturer / supplier.

8.0 MASS EMISSION TEST PROCEDURE

8.1 The emission test procedure shall be as per MoRTH/CMVR/TAP-115/116 with changes as given in Annexure A. The Hybrid Electric System (HES) retrofitted vehicle shall meet base vehicle model year exhaust emission norm. The existing OBD system of the base vehicle if any, shall not be modified/ altered during Hybrid Electric System (HES) kit installation. The HES manufacturer shall provide separate dashboard indication for displaying any fault in the Hybrid Electric System (HES) kit system.

9.0 BRAKE PERFORMANCE

9.1 Brake performance test for vehicles retrofitted with Hybrid Electric System (HES) shall be carried out with increased weight of Hybrid Electric System (HES) as declared by HES manufacturer / supplier.

The brake performance shall be evaluated as per IS 11852-2001 (Part 3 to Part 9) and Annexure B.

10.0 MEASUREMENT OF PASS BY NOISE LEVEL

Test shall be carried out as per IS 3028-1998.

10.1 Test shall be conducted on vehicle retrofitted with Hybrid Electric System (HES) in following two different modes;

1) Without powering Hybrid Electric System and result shall be recorded.

2) With powering Hybrid Electric System and result shall be recorded.

10.2 Test result verification method

Values of results with powering Hybrid Electric System (HES) shall not be more by 2 dB than the values of results without powering Hybrid Electric System (HES).

11.0 TRACTION MOTOR TEST

Following test shall be carried out on traction motor.

11.1 Motor Power Test**:** Test shall be carried out as per AIS-041:2003

11.2 Environmental validation tests for traction motor:

Manufacturer/supplier of Hybrid Electric System (HES) should provide the test reports of the following tests conducted on traction motor

a)	Thermal Shock test	Test shall be carried out as per IS:3141:2007
b)	Media resistance test	Test shall be carried out as per IS:3141:2007
c)	Impact test	Test shall be carried out as per IS:9000 Part 7/Sec1:2006
d)	Dust Test	Test shall be carried out as per IS: 3141:2007
e)	Water immerse test	Test shall be carried out as per IS: 8925:1978.

12.0 EMI TEST

12.1 Test shall be carried out on component level as per AIS-004 (Part 1):1999. REESS charger shall be excluded from the test as it utilized when vehicle is in off condition.

13.0 EMC TEST

13.1 Test shall be carried out on component level as per AIS-004 (Part 3):2009 as and when it becomes applicable.

14.0 VERTICAL ORIENTATION OF DIPPED BEAM – HEAD LAMP

14.1 HES manufacturer / supplier shall carry out head lamp leveling adjustment on retrofitted vehicle at the time of submission of the vehicle for type approval. For such adjustment, refer procedure given in AIS-008 (Rev.1): 2010. Declaration to this effect shall be provided by HES manufacturer/supplier to the Type Approval test agency.

15.0 REQUIREMENTS FOR CONSTRUCTIONAL AND FUNCTIONAL SAFETY

Requirements for constructional and functional safety shall be as per requirements laid down in para. 11.0 of AIS-102 (Part 1):2009.

16.0 REQUIREMENTS FOR RECHARGEABLE ENERGY STORAGE SYSTEM (REESS)

16.1 Requirements for REESS shall be applicable as per AIS-048:2009.

For Hybrid Electric System (HES) component level testing will be done. The test reports provided by HES manufacturer/supplier shall also be considered as compliance to this requirement.

17.0 WIRING HARNESS / CABLES / CONNECTORS

17.1 Manufacturer/supplier of Hybrid Electric System should comply with the following standards and guidelines for control, power harness and all connectors used in harness.

OR

Manufacturer/supplier of Hybrid Electric System should provide the test reports of the following tests conducted on control, power harness and all connectors used in harness as given in 17.2 and 17.3

17.2 The cables used in the harness shall comply with following tests as mentioned in ISO 6722-2006.

a)	Electrical characteristics- Withstand Voltage	Test shall be carried out as per para. 6.2 of ISO 6722-2006
b)	Low temperature characteristics	Test shall be carried out as per para. 8 of ISO 6722-2006
c)	Heat ageing – Thermal Overload	Test shall be carried out as per para. 10.3 of ISO 6722-2006
d)	Resistance to chemicals fluid compatibility	Test shall be carried out as per para. 11.2.2 and 11.2.3 of ISO 6722-2006
e)	Resistance to flame propagation	Test shall be carried out as per para. 12 of ISO 6722-2006.

17.3 General guidelines for performance and reliability of single pole and multi pole connectors for wiring harness. Counter mating connector shall be used to pig tail any existing connector. The mating connector shall meet the following requirements. JASO D 616:2011 standard can be referred.

a) Water ingress protection when water is splashed during driving or the vehicle is washed

b) Sufficient tensile strength of crimped connections.

c) Connector housing lock strength and terminal retention

d) Connection resistance shall be < 10 mOhms

e) Leakage current shall not exceed 1 mA for non-water proof connector and 50 μA for water proof connector.

f) Insulation resistance shall be > 100 MOhms.

18.0 TECHNICAL SPECIFICATION

18.1 Technical specification for Hybrid Electric System and vehicles retrofitted with Hybrid Electric System (HES) shall be as per Annexure E and F respectively.

19.0 CODE OF PRACTICE

19.1 HES manufacture/supplier/authorized retrofitter shall comply code of practice as per Annexure G. Documentary evidence shall be provided at the time of Type Approval along with technical specification. Annual check-up of Type Approved vehicle shall be verified as per code of practice Annexure G

20.0 CHANGE IN THE TECHNICAL SPECIFICATIONS ALREADY TYPE APPROVED

20.1 Every modification pertaining to the information declared in accordance with para. 18 shall be intimated by the HES manufacturer/supplier to the testing agency.

20.2 If the changes are in parameters not related to the provisions of this standard, no further action need be taken.

If the changes are in parameters related to the provisions of this standard, the testing agency shall then consider, whether,

a) The model with the changed specifications still complies with provisions of this standard; or,

b) Any further verification / testing is required to establish compliance.

For considering whether any further verification / testing is required or not, guidelines given in Annexure H shall be used for the electrical requirements. For other cases, the guide lines given in the individual standard shall be applicable.

20.3 In case of para. 20.2 b), verification for only those parameters which are affected by the modifications needs to be carried out.

20.4 In case of fulfillment of criterion of para. 20.2 a) or after results of further verification as per para. of 20.2 b) are successful, the approval of compliance shall be extended for the changes carried out.

20.5 Tests such as evaporative emission, crankcase emission, idling emission, full load smoke (for diesel engine vehicles) etc. need not be carried out, if the related technical specification is same as those of a model already type approved.

21.0 VALIDITY OF ANNEXURES

It is expected that in due course of time the details given in Annexures A and C would be incorporated in CMVR AIS-102 (Part1) and other related documents referred in this draft. Once, such an incorporation takes place, the details given in these annexures would be automatically defunct.

22.0 VALIDITY OF TYPE APPROVAL CERTIFICATE

22.1 Testing agency shall issue Type Approval certificate only by model basis.

22.2 Validity of such TA certificate shall be 3 years and needs to be revalidated thereafter. During revalidation of Hybrid Electric System (HES) installed vehicle will be subjected to only mass emission test and physical verification of the vehicle as per the layout submitted by HES manufacturer/supplier during initial type approval.

ANNEXURE A
(See 8.1)

TEST PROCEDURE FOR MEASUREMENT OF MASS EMISSIONS, FUEL CONSUMPTION AND HYBRID RANGE OF VEHICLES RETROFITTED WITH HYBRID ELECTRIC SYSTEM

A-1.0 Categories of Vehicles Retrofitted with Hybrid Electric System (HES) are mentioned below

Vehicle charging	**Off Vehicle Charging (OVC) [1/]**		**Not Off Vehicle Charging (NOVC) [2/]**	
Operating mode switch	without	with	without	with
[1/] also known as "externally chargeable" [2/] also known as "not externally chargeable"				

A-2.0 Vehicles Retrofitted with Hybrid Electric System (Externally Chargeable) without an Operating Mode Switch.

Two tests shall be performed under the following conditions

(a) **Condition A**: test shall be carried out with a fully charged electrical energy / power storage device.

(b) **Condition B**: test shall be carried out with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity).

(c) The profile of the state of charge (SOC) of the electrical energy/power storage device during different stages of the Type I test is given in Appendix 1 of this Annexure**.**

A-2.1. **Condition A**

A-2.1.1. Discharge of REESS

The procedure shall start with the discharge of the electrical energy/power storage device as described in para. 2.1.1.1 below

A-2.1.1.1 Discharge of the electrical energy/power storage device

The electrical energy/power storage device of the vehicle is discharged while driving (on the test track, on a chassis dynamometer, etc.)

a) At a steady speed of 50 km/h until the fuel consuming engine starts up

b) Or, if a vehicle cannot reach a steady speed of 50 km/h without starting up the fuel consuming engine or for other reasons, the speed shall be reduced until the vehicle can run at a lower steady speed where the fuel consuming engine just does not start up for a defined time/distance (to be specified between testing agency and HES manufacturer/supplier).

c) Or with HES manufacturer/supplier's recommendation.

The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.

A-2.1.2 Conditioning of vehicle

A-2.1.2.1 Vehicle with compression ignition engine

For conditioning compression-ignition engined vehicles, the Part Two cycle of the applicable driving cycle shall be used in combination with the applicable gear shifting prescriptions as defined in para. A-2.1.4.2 of this Annexure. Three consecutive cycles shall be driven.

A-2.1.2.2 Vehicle with positive ignition engine

Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two cycles of the applicable driving cycle in combination with the applicable gear shifting prescriptions as defined in para. A-2.1.4.2 of this Annexure

A-2.1.3 Soak

A-2.1.3.1 After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within +/-2 K of the temperature of the room, and the electrical energy/power storage device is fully charged as a result of the charging prescribed in para. A-2.1.3.2 below

A-2.1.3.2 During soak, the electrical energy/power storage device shall be charged:

(a) with the on board charger if fitted, or

(b) with an external charger recommended by the HES manufacturer/supplier, using the normal overnight charging procedure (see para. C-4.1.2.1). This procedure excludes all types of special charges that could be automatically or manually initiated like, for instance, the equalization charges or the servicing charges. The HES manufacturer/supplier shall declare that during the test, a special charge procedure has not occurred

(c) For details of end of charge, see para. C-4.1.3.

A-2.1.4 **Mass emission test**

A-2.1.4.1 Mass emission test shall be carried out, as prescribed for corresponding IC engine vehicle

A-2.1.4.2 However, in case of special gear shifting strategy according to the HES manufacturer/supplier's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information) shall be followed. For these vehicles the gear shifting points prescribed in MORTH/CMVR/TAP-115/116 are not applied.

A-2.1.4.4 **Measurement of energy**

The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.

The test procedures defined in either para. A-2.1.4.4.1 or A-2.1.4.4.2 may be used.

A-2.1.4.4.1 Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the respective driving cycle (end of sampling (ES)).

A-2.1.4.4.2 Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and continue over a number of repeat test cycles. It shall end on conclusion of the final idling period in the first extra-urban (Part Two) cycle during which the REESS reached the minimum state of charge according to the criterion defined below (end of sampling (ES)).

The electricity balance Q [Ah] is measured over each combined cycle, using the procedure specified in Appendix 2 to this Annexure, and used to determine when the REESS minimum state of charge has been reached.

The REESS minimum state of charge is considered to have been reached in combined cycle N if the electricity balance measured during combined cycle N+1 is not more than 3 per cent discharge, expressed as a percentage of the nominal capacity of the REESS (in Ah) in its maximum state of charge, as declared by the HES manufacturer/supplier.

At the HES manufacturer/supplier request additional test cycles may be run and their results included in the calculations in para. below, provided that the electricity balance for each additional test cycle shows less discharge of the REESS than over the previous cycle.

In between each of the cycles a hot soak period of up to ten minutes is allowed. The powertrain shall be switched off during this period.

A-2.1.4.4.3 The test results on the combined cycle (mass emission) for Condition A shall be recorded (m1 [gms/km]). In the case of testing according to para. A-2.1.4.4.1., m1 is simply the results of the single combined cycle run. In the case of testing according to para. A-2.1.4.4.2., m1 is the sums of the results of the N combined cycles run.

$$m1 = \sum_{1}^{N} m\,i$$

A-2.1.4.4.4 Within the 30 minutes after the conclusion of the cycle, of the electrical energy/power storage device shall be charged according to para. C-4.1.2 and C-4.1.3.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e1 [Wh] delivered from the mains.

The electric energy consumption for condition A is e_1 [Wh].

A-2.2 **Condition B**

A-2.2.1 Conditioning of vehicle: shall be as per para. A-2.1.2

A-2.2.2 Discharge of REESS shall be as per para. A-2.1.1

A-2.2.3 After this discharge of the REESS and before testing, the vehicle shall be soaked as per para. A-2.1.3

A-2.2.4 Mass emission test shall be as per A-2.1.4

A-2.2.5 Measurement of Energy

A-2.2.5.1 Within the 30 minutes after the conclusion of the cycle, the electrical energy/power storage device shall be charged according to para. C-4.1.2 and C-4.1.3.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_2 [Wh] delivered from the mains.

A-2.2.5.2 The electrical energy/power storage device of the vehicle shall be discharged in accordance with para. A-2.1.1.

A-2.2.5.3 Within the 30 minutes after discharge, the electrical energy/power storage device shall be charged according to para. C-4.1.2 and C-4.1.3.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_3 [Wh] delivered from the mains.

A-2.2.5.4 The electric energy consumption e_4 [Wh] for condition B is:

$$e_4 = e_2 - e_3$$

A-2.3 Final test results

A-2.3.1 In the case of testing according to para. A-2.1.4.4.1.

The final results of pollutants for deciding on compliance and for CO_2 shall be:

$$Mi = (De \times M1i + Dav \times M2i) / (De + Dav)$$

where

Mi = mass emission of the pollutant i in grams per kilometer

M1i = average mass emission of the pollutant i in grams per kilometre with a fully charged electrical energy/power storage device, determined as per para. A-2.1.4

M2i = average mass emission of the pollutant i in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity) determined as per para. A-2.2.4

De = Vehicle electric range, according to the procedure described in Annexure C., where HES manufacturer/ supplier must provide the means for performing the measurement with the vehicle running in pure electric operating state.

Dav = 25 km (average distance between two REESS recharges)

A-2.3.2 In the case of testing according to para. A-2.1.4.4.2.

The final results of pollutants for deciding on compliance and for CO_2 shall be

$$Mi = (Dovc \cdot M1i + Dav \cdot M2i)/(Dovc + Dav)$$

Where:

Mi = mass emission of the pollutant i in grams per kilometre

M1i = average mass emission of the pollutant i in grams per kilometre with a fully charged electrical energy/power storage device, determined as per para. A-2.1.4

M2i = average mass emission of the pollutant i in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity) determined as per para. A-2.2.4

Dovc = OVC range according to the procedure described in Annexure C.

Dav = 25 km (average distance between two REESS recharges).

A-2.3.3 **Fuel Consumption**

Reported fuel consumption shall be calculated by carbon balance method, as per procedure prescribed in MORTH/CMVR/ TAP-115/116, except that the values of HC, CO and CO_2 for calculation of fuel consumption shall be based on figures arrived at, as per para. A-2.3.1. or A-2.3.2

A-2.3.4 $E_1 = e_1/D_{test1}$ [Wh/km] for condition A, and

$E_4 = e_4/D_{test2}$ [Wh/km] for condition B

A-2.3.4.1 with D_{test1} and D_{test2} are the actual driven distances in the tests performed under conditions A (Refer para. A-2.1.4.) and B (Refer para. A-2.2.4) respectively, and e_1 and e_4 determined in para. A-2.1.4.4. and A-2.2.5.4 respectively.

A-2.3.4.2 The weighted values of electric energy consumption shall be calculated as below

A-2.3.4.2.1 In the case of testing according to para. A-2.1.4.4.1.

$$E = ((D_e \times E_1) + (D_{av} \times E_4)) / (D_e + D_{av})$$

Where

E = Electric consumption Wh/km

E_1 = Electric consumption Wh/km with a fully charged electrical energy/power storage device calculated as per para. A-2.3.4.1**.**

D_e = Vehicle electric range, according to the procedure described in Annexure D., where HES manufacturer/ supplier must provide the means for performing the measurement with the vehicle running in pure electric operating state.

D_{av} = 25 km (assumed average distance between two REESS recharges)

A-2.3.4.2.2 In the case of testing according to para. A-2.1.4.4.2.

$$E = (Dovc \cdot E1 + Dav \cdot E4) / (Dovc + Dav)$$

Where

E = Electric consumption Wh/km.

E1 = Electric consumption Wh/km with a fully charged electrical energy/power storage device calculated as per para. A-2.3.4.1**.**

E4 = Electric consumption Wh/km with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity) as per para. A-2.3.4.1.

D_{ovc} = OVC range according to the procedure described in Annexure D.

D_{av} = 25 km (assumed average distance between two REESS recharges).

A-3.0 Vehicles Retrofitted with Hybrid Electric System (Externally Chargeable) with an Operating Mode Switch.

Two tests shall be performed under the following conditions

Condition A: Test shall be carried out with a fully charged electrical energy/power storage device.

Condition B: Test shall be carried out with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity)

A-3.1 The operating mode switch shall be positioned according the table below

Hybrid-modes / REESS State of charge	- Pure electric - Hybrid Switch in position	- Pure fuel consuming - Hybrid Switch in position	- Pure electric - Pure fuel consuming - Hybrid Switch in position	- Hybrid mode n [1/] - Hybrid mode m [1/] Switch in position
Condition A Fully charged	Hybrid	Hybrid	Hybrid	Most electric hybrid mode [2/]
Condition B Min. state of charge	Hybrid	Fuel consuming	Fuel consuming	Most fuel consuming mode [3/]

[1/]	For instance: sport, economic, urban, extra urban position
[2/]	Most electric hybrid mode:
	The hybrid mode which can be proven to have the highest electricity consumption of all selectable hybrid modes when tested in accordance with Condition A of Annexure B, to be established based on information/test reports provided by the HES manufacturer/supplier and in agreement with the testing agency.
[3/]	Most fuel consuming mode:
	The hybrid mode which can be proven to have the highest fuel consumption of all selectable hybrid modes when tested in accordance with Condition B of Annexure B, to be established based on information/test reports provided by the HES manufacturer/supplier and in agreement with the testing agency.

A-3.2 Two tests shall be performed one under Condition A and the other under Condition B as defined in para. A-2.0. The test procedures for Condition A and Condition B shall be same as those given in para. A-2.1 and A-2.2 respectively, except that the switching modes shall be as given in para. A-3.1, A-3.2.1 and A-3.3.

A-3.2.1 However, if the pure electric range of the vehicle measured in accordance with Annexure-C is higher than one full emission test cycle, on the request of the HES manufacturer/supplier, the Type I test for condition A may not be carried out.

In such cases, the value of M1i shall be taken as zero for calculation of final results. (Refer para. A-2.3.1 and A-2.3.2).

In this case, vehicle preconditioning prescribed in para. A-2.1.2 can be omitted at the request of HES manufacturer/supplier.

A-3.3 **Discharge of REESS**

A-3.3.1 In the case of OVC HEV's equipped with a pure electric mode, the procedure shall start with the discharge of the electrical energy/power storage device of the vehicle while driving with the switch in pure electric position (on the test track, on a chassis dynamometer, etc.) at a steady speed of 70 per cent ± 5 per cent of the maximum thirty minutes speed of the vehicle (determined according to para. 6.0 of AIS-041:2003).

Stopping the discharge occurs when any of the following conditions happens, earliest :

1) when the vehicle is not able to run at 65 per cent of the maximum thirty minutes speed; or

2) when an indication to stop the vehicle is given to the driver by the standard onboard instrumentation, or

3) after covering the distance of 100 km.

A-3.3.2 In case of Hybrid Electric Vehicle (HEV) is not equipped with "pure electric" mode, the discharge procedure shall be as per para. A-2.1.1.

A-3.4 Final test results shall be obtained using procedure given in para. A-2.3.

A-4.0 Vehicles Retrofitted With Hybrid Electric System (HES) (Not Externally Chargeable) without an Operating Mode Switch

A-4.1 These vehicles shall be tested according to MORTH/CMVR/ TAP-115/116

A-4.2 In the case of M and N category vehicles, for preconditioning, at least two consecutive complete driving cycles (one according to Part One and one according to Part Two) are carried out without soak.

A-4.3 The vehicle shall be driven according to driving cycles prescribed, taking into account requirements given in para. A-2.1.4.2 in case of special gear shifting strategy.

A-4.4 Special requirements for measurement and correction of the test results for CO_2 and fuel consumption are given in Annexure D.

A-5.0 Vehicles Retrofitted with Hybrid Electric System (Not Externally Chargeable) with an Operating Mode Switch

A-5.1 These vehicles shall be tested in Hybrid mode, according to MORTH/CMVR/TAP-115/116. If several hybrid modes are available, the test shall be carried out in the mode that is automatically set after turn on of the ignition key (normal mode). On the basis of information provided by the HES manufacturer/supplier, the testing agency will make sure that the limit values are met in all hybrid modes.

A-5.2 Preconditioning of vehicle shall be as per para.A-4.2.

A-5.3 The vehicle shall be driven according to driving cycles prescribed, taking into account requirements given in para. A-2.1.4.2 in case of special gear shifting strategy.

A-5.4 Special requirements for measurement and correction of the test results for CO_2 and fuel consumption are given in Annexure D.

A-6.0 Type II Test Methods (Idling Emissions) for SI Engines

A-6.1 The vehicles shall be tested according to MoRTH/CMVR/TAP-115/116 with the fuel consuming engine running.

A-6.2 If applicable, the HES manufacturer/supplier shall provide a "service mode" that makes execution of this test possible, However for HEV's using constant speed engine for charging of batteries, above test shall be exempted.

A-6.3 If necessary, the special procedure provided for in para. A-6.4. shall be used.

A-6.4 It shall be possible to inspect the vehicle for roadworthiness test in order to determine its performance in relation to the data collected in accordance with the procedure prescribed in MORTH/CMVR/ TAP-115/116. If this inspection requires a special procedure, this shall be detailed in the service manual (or equivalent media). This special procedure shall not require the use of special equipment other than that provided with the vehicle.

ANNEXURE A

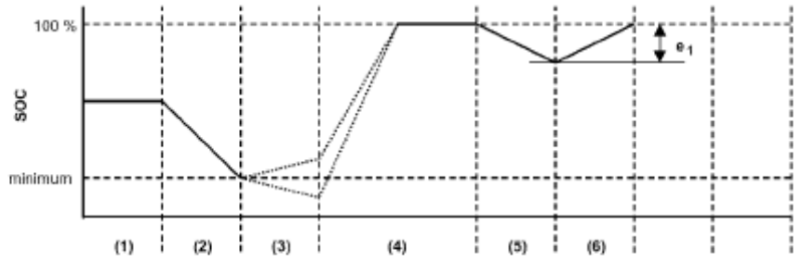
APPENDIX 1

(See A-2.0(c))

ELECTRICAL ENERGY/POWER STORAGE DEVICE STATE OF CHARGE (SOC) PROFILE FOR OVC-HEV'S.

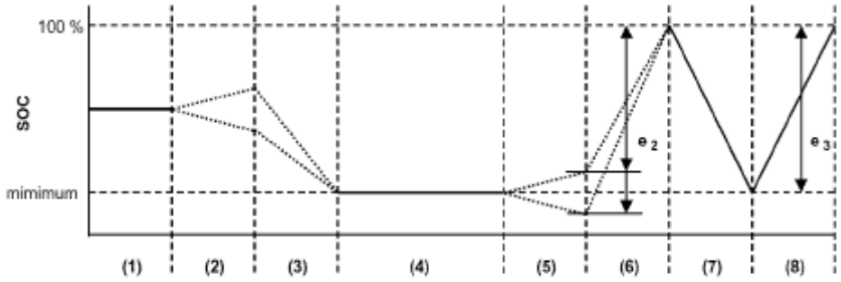
The SOC profiles for OVC-HEV's tested under conditions A and B are

Condition A



(1)	initial state of charge of the electrical energy/power storage device
(2)	discharge according to para. A-2.1.1 or A-3.3 of Annexure-A
(3)	vehicle conditioning according to para. A-2.1.2 of Annexure-A
(4)	charge during soak according to para. A-2.1.3.2 of Annexure-A
(5)	test according to para. A-2.1.4 of Annexure-A
(6)	charging (A-2.1.4.4)

Condition B



(1)	Initial state of charge
(2)	Vehicle conditioning according to para. A-2.2.1 of Annexure-A
(3)	Discharge according to para. A-2.2.2 of Annexure-A
(4)	Soak according to para. A-2.2.3 of Annexure-A
(5)	Test according to para. A-2.2.4 of Annexure-A
(6)	Charging according to para. A-2.2.5.1
(7)	Discharging according to para. A-2.2.5.2.
(8)	Charging according to para. A-2.2.5.3.

ANNEXURE A

APPENDIX-2

(See A- 2.1.4.4.2)

METHOD FOR MEASURING THE ELECTRICITY BALANCE OF THE REESS OF OVC AND NOVC HEVS

1.0 Introduction

1.1 The purpose of this appendix is to define the method and required instrumentation for measuring the electricity balance of Off Vehicle Charging Hybrid Electric Vehicles (OVC HEV) and Not Off Vehicle Charging Hybrid Electric Vehicles (NOVC HEVs). Measurement of the electricity balance is necessary

(a) To determine when the minimum state of charge of the REESS has been reached during the test procedure defined in para. A-2.0. and A-3.0. of Annexure A; and

(b) To correct the measured fuel consumption and CO_2-emissions for the change in REESS energy content occurring during the test, using the method defined in para. A-5.0 and A-6.0 of Annexure A.

1.2 The method described in this Annexure shall be used by the HES manufacturer/supplier for the measurements that are performed to determine the correction factors K fuel and KCO_2, as defined in para. A-4.0, and A-5.0 of this Annexure A.

The Testing Agency shall check whether these measurements have been performed in accordance with the procedure described in this Annexure A and Annexure D

1.3 The method described in this annex shall be used by the Testing Agency for the measurement of the electricity balance Q, as defined in para. A-2.1.4.4.2, A-4.0., and A-5.0. of this Annexure A and Annexure D

2.0 Measurement Equipment and Instrumentation

2.1 During the tests as described in para. A-2.0, A-3.0, A-4.0, and A-5.0. of this Annexure A, the REESS current shall be measured using a current transducer of the clamp-on type or the closed type. The current transducer (i.e. the current sensor without connecting to data acquisition equipment) shall have a minimum accuracy of 0.5 per cent of the measured value (in A) or 0.1 per cent of the maximum value of the scale. HES manufacturer/supplier diagnostic testers are not to be used for the purpose of this test.

2.1.1 The current transducer shall be fitted on one of the wires directly connected to the REESS. In order to easily measure REESS current using external measuring equipment, vehicle HES manufacturer/suppliers should preferably integrate appropriate, safe and accessible connection points in

the vehicle. If that is not feasible, the vehicle HES manufacturer/supplier is obliged to support the Testing Agency by providing the means to connect a current transducer to the wires connected to the REESS in the above described manner

2.1.2 The output of the current transducer shall be sampled with a minimum sample frequency of 5 Hz. The measured current shall be integrated over time, yielding the measured value of Q, expressed in Ampere hours (Ah).

2.1.3 The temperature at the location of the sensor shall be measured and sampled with the same sample frequency as the current, so that this value can be used for possible compensation of the drift of current transducers and, if applicable, the voltage transducer used to convert the output of the current transducer.

2.2 A list of the instrumentation HES manufacturer/supplier, model no., serial no.) used by the HES manufacturer/supplier for determining

(a) When the minimum state of charge of the REESS has been reached during the test procedure defined in para. A-2.0. and A-3.0. of Annexure A; and

(b) The correction factors K fuel and KCO_2 (as defined in para. A-4.0., and A-5.0. of Annexure A and the last calibration dates of the instruments (where applicable) should be provided to the Technical Service.

3. 0 Measurement procedure

3.1 Measurement of the REESS current shall start at the same time as the test starts and shall end immediately after the vehicle has driven the complete driving cycle.

3.2 Separate values of Q shall be logged over the Part One (urban driving) and Part Two (extra- urban driving) of the MIDC driving cycle."

ANNEXURE B

(See 9.0)

ADDITIONAL REQUIREMENTS FOR REGENERATIVE BRAKING SYSTEM

B-1.0 Definitions

B-1.1 **Electric Regenerative Braking System:** A braking system, which during deceleration, provides for the conversion of vehicle kinetic energy into electrical energy.

B-1.2 **Electric Regenerative Brake Control:** A device which modulates the action of the electric regenerative braking system

B-1.3 **Electric Regenerative Braking System of Category A:** An electric regenerative braking system, which is not part of the service braking system.

B-1.4 **Electric Regenerative Braking System of Category B:** An electric regenerative braking system, which is part of the service braking system.

B-2.0 Vehicles Fitted with Electric Regenerative Braking System of Category A

B-2.1 The electric regenerative braking shall be only activated by accelerator control and/or the gear neutral position. In addition, for vehicles of categories M2, the electric regenerative braking control can be a separate switch or lever.

B-2.2 In the case of vehicles fitted with Category A type of regenerative braking system, any separate electric regenerative braking control which is provided, shall not be used during the Type P and Type F tests.

B-3.0 Vehicles Fitted with Electric Regenerative Braking System of Category B

B-3.1 It shall not be possible to disconnect partially or totally one part of the service braking system other than by an automatic device

B-3.2 The service braking system control shall also actuate the action of the electric regenerative braking system simultaneously.

B-3.3 The service braking system shall not be adversely affected by the disengagement of the motor(s) or gear ratio used, except during the short duration of operation of gear shifting.

B-4.0 If so desired by the HES manufacturer/supplier the performance requirements may be verified without the use of the electric regenerative system by appropriately disconnecting the system. if, so this shall be recorded in the test report.

B-5.0 General

For vehicles powered completely or partially by an electric motor or motor(s), permanently connected to the wheels, all tests must be carried out with these motor(s) connected.

ANNEXURE C

(See A -2.3.1)

METHOD OF MEASURING THE ELECTRIC RANGE OF VEHICLES POWERED BY RETROFITTED HYBRID ELECTRIC POWER TRAIN AND THE OVC RANGE OF VEHICLES POWERED BY RETROFITTED HYBRID ELECTRIC POWERTRAIN

C-1.0 The test method described hereafter permits to measure the electric range and OVC range, expressed in km, of externally chargeable retrofitted HEV's (OVC-HEV) as defined in para. A-1.

C-2.0 Parameters, Units and Accuracy of Measurements

Parameters, units and accuracy of measurements shall be as given in Table C-1:

Table C1

Parameters, Units and Accuracy of Measurements

Parameter	Unit	Accuracy	Resolution
Time	s	± 0.1 s	0.1 s
Distance	m	± 0.1 per cent	1 m
Temperature	°C	± 1°C	1°C
Speed	km/h	± 1 per cent	0.2 km/h
Mass	kg	± 0.5 per cent	1 kg
Electricity balance	Ah	+/- 0.5 per cent	0.3 per cent

C-3.0 Test Conditions

C-3.1 **Condition of the vehicle**

C-3.1.1 The vehicle tyres shall be inflated to the pressure specified by the vehicle HES manufacturer/supplier when the tyres are at the ambient temperature.

C-3.1.2 The viscosity of the oils for the mechanical moving parts shall conform to the specifications of the vehicle HES manufacturer/supplier.

C-3.1.3 The lighting and light-signalling and auxiliary devices shall be off, except those required for testing and usual daytime operation of the vehicle.

C-3.1.4 All REESS systems available for other than traction purposes (electric, hydraulic, pneumatic, etc.) shall be charged up to their maximum level specified by the HES manufacturer/supplier.

C-3.1.5 If the batteries are operated above the ambient temperature, the operator shall follow the procedure recommended by the vehicle HES manufacturer/supplier in order to keep the temperature of the REESS in the normal operating range.

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

C-3.1.6 The vehicle must have run at least 300 km during the seven days before the test with those batteries that are installed in the test vehicle. This condition can be waived on request of the vehicle HES manufacturer/supplier.

C-3.2 **Climatic conditions**

C-3.2.1 For testing performed outdoors, the ambient temperature shall be between 5 °C and 32 °C.

C-3.2.2 The indoors testing shall be performed at a temperature between 20 °C and 30 °C.

C-3.2.3 The test may be carried out at temperatures different from those specified above, at the request of HES manufacturer/supplier.

C-4.0 Operation Modes

The test method includes the following steps

(a) Initial charge of the REESS.

(b) Application of the cycle and measurement of the electric range.

Between the steps, if the vehicle shall move, it is pushed to the following test area (without regenerative recharging).

C-4.1 **Initial Charge of the 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.

C-4.1.1 **Discharge of the REESS**

C-4.1.1.2 For externally chargeable hybrid electric vehicle (OVC HEV) without an operating mode switch

C-4.1.1.2.2 The procedure for discharge of the electrical energy/power storage device of the vehicle is as per para. A-2.1.1.

C-4.1.1.3 For externally chargeable hybrid electric vehicle (OVC HEV) with an operating mode switch.

C-4.1.1.3.1 If there is not a pure electric position, the HES manufacturer/supplier shall provide the means for performing the measurement with the vehicle running in pure electric operating state. The procedure for discharge of the electrical energy/power storage device of the vehicle is as per para. A-2.1.1.

C-4.1.1.3.2 If there is a pure electric position, the procedure for discharge of the electrical energy/power storage device of the vehicle is as per para. A-3.3.1.

C-4.1.2 **Application of a normal overnight charge**

The electrical energy/power storage device shall be charged according to the normal overnight charge procedure given below.

C-4.1.2.1 **Normal overnight charge procedure**

The charging is carried out

(a) with the on board charger if fitted, or

(b) with an external charger recommended by the HES manufacturer/supplier using the charging pattern prescribed for normal charging;

(c) in an ambient temperature comprised between 20 ºC and 30 ºC.

HES manufacturer/supplier

This procedure excludes all types of special charges that could be automatically or manually initiated like, for instance, the equalisation charges or the servicing charges. The HES manufacturer/supplier shall declare that during the test, a special charge procedure has not occurred.

C-4.1.3 **End of charge criteria**

The end of charge criteria corresponds to a charging time of 12 hours, except if a clear indication is given to the driver by the standard instrumentation that the electrical energy/power storage device is not yet fully charged. In this case,

$$\text{The maximum time is} = \frac{\text{3 x claimed REESS capacity (Wh)}}{\text{Mains power supply (W)}}$$

C-4.2 **Application of the cycle and measurement of the range**

C-4.2.1 The applicable test sequence as per the driving cycle used for mass emission testing is applied on a chassis dynamometer until the end of the test criteria is reached. Gear shifting pattern shall be as prescribed in para. A-2.1.4.2.

C-4.2.2 To determine the electric range of a hybrid electric vehicle

C-4.2.2.1 The end of the test criteria is reached earliest

C-4.2.2.1.1 When the vehicle is not able to meet the target curve up to 30 km/h,

C-4.2.2.1.2 or when an indication from the standard on-board instrumentation is given to the driver to stop the vehicle

C-4.2.2.1.3 or when the fuel consuming engine starts up.

Then the vehicle shall be slowed down to 5 km/h by releasing the accelerator pedal, without touching the brake pedal and then stopped by braking.

C-4.2.2.2 At a speed over speeds specified in para. C-4.2.2.1 when the vehicle does not reach the required acceleration or speed of the test cycle, the accelerator pedal shall remain fully depressed until the reference curve has been reached again.

C-4.2.2.3 To respect human needs, up to three interruptions are permitted between test sequences, of no more than 15 minutes in total.

C-4.2.2.4 At the end, the measure D_e of the covered distance in km is the electric range of the hybrid electric vehicle. It shall be rounded to the nearest whole number as per IS: 2:1960. Where the vehicle operates both in electric and hybrid modes during the test, the periods of electric only operation will be determined by measuring current to the injectors or ignition.

C-4.2.3 To determine the OVC range of a hybrid electric vehicle

C-4.2.3.1 To measure the OVC range the end of the test criteria is reached when the REESS has reached its minimum state of charge according to the criteria defined in Annexure A. Driving is continued until the final idling period in the extra-urban cycle.

C-4.2.3.2 To respect human needs, up to three interruptions are permitted between test sequences, of no more than fifteen minutes in total.

C-4.2.3.3 At the end, the total distance driven in km, rounded to the nearest whole number as per IS:2:1960, is the OVC range of the hybrid electric vehicle.

ANNEXURE D

(See A-4.4)

SPECIAL REQUIREMENTS FOR MEASUREMENT AND CORRECTION OF THE TEST RESULTS FOR CO_2 AND FUEL CONSUMPTION FOR NOT EXTERNALLY CHARGEABLE (NOVC) HEV'S.

D-1 In the case of M and N category vehicles, emissions of carbon dioxide (Co_2) and fuel consumption shall be determined separately for the Part One (urban driving) and the Part Two (extra-urban driving) of the specified driving cycle.

D-2 Test Results

D-2.1 The test results (fuel consumption C [l/100 km] and CO_2-emission M [g/km]) of the test are corrected in function of the energy balance ΔE_{batt} of the vehicle's REESS. The corrected values (C_0 [l/100 km] and M_0 [g/km]) should correspond to a zero energy balance ($\Delta E_{batt} = 0$), and are calculated using a correction coefficient determined by the HES manufacturer/supplier as defined below. In case of other storage systems than an electric REESS, ΔE_{batt} is representing $\Delta E_{storage}$, the energy balance of the electric REESS device.

D-2.2 The electricity balance Q [Ah], measured using the procedure specified in Appendix 2 of Annexure A, is used as a measure of the difference in the vehicle REESS's energy content at the end of the cycle compared to the beginning of the cycle. In the case of M and N category vehicles, the electricity balance is to be determined separately for the Part One cycle and the Part Two cycle.

D-2.3 Under the conditions below, it is allowed to take the uncorrected measured values C and M as the test results:

a) in case the HES manufacturer/supplier can prove that there is no relation between the energy balance and fuel consumption,

b) in case that ΔE_{batt} always corresponds to a REESS charging,

c) in case that ΔE_{batt} always corresponds to a REESS discharging and ΔE_{batt} is within 1 per cent of the energy content of the consumed fuel (consumed fuel meaning the total fuel consumption over one cycle)

Energy content of the consumed fuel can be calculated from the following equation :

Total Fuel Energy = $NHV_{fuel} * m_{fuel}$

Where,

NHV_{fuel} = Net heating value of consumable fuel in J/kg

mf_{uel} = Total mass of fuel consumed over one test cycle

The change in REESS energy content ΔE_{batt} can be calculated from the measured electricity balance Q as follows

$$\Delta E_{batt} = \Delta SOC(\%) \cdot E_{TEbatt} \cong 0.0036 \cdot |\Delta Ah| \cdot V_{batt} = 0.0036 \cdot Q \cdot V_{batt}(MJ)$$

with E_{TEbatt} [MJ] the total energy storage capacity of the REESS and V_{batt} [V] the nominal voltage.

D-3 Fuel consumption correction coefficient (k_{fuel}) defined by the HES manufacturer/supplier

D-3.1 The fuel consumption correction coefficient (K_{fuel}) shall be determined from a set of n measurements performed by the HES manufacturer/supplier. This set should contain at least one measurement with $Q_i < 0$ and at least one with $Q_j > 0$.

D-3.2 If the latter condition cannot be realised on the driving cycle (Part One or Part Two of modified Indian Driving Cycle in the case of M and N category or IDC in the case of L category as applicable) used in this test, then it is up to the testing agency to judge the statistical significance of the extrapolation necessary to determine the fuel consumption value at $\Delta E_{batt} = 0$

The fuel consumption correction coefficient (K_{fuel}) is defined as

$$k_{fuel} = \frac{n.\Sigma Q_i C_i - \Sigma Q_i \cdot \Sigma C_i}{n\Sigma Q_i^2 - (\Sigma Q_i)^2} \quad (1/100 \text{ Km /Ah})$$

where

C_i : fuel consumption measured during i-th HES manufacturer/ supplier's test (l/100 km)

Q_i : electricity balance measured during i-th HES manufacturer/supplier's test (Ah)

n : number of data

The fuel consumption correction coefficient shall be rounded to four significant figures (e.g. 0.xxxx or xx.xx). The statistical significance of the fuel consumption correction coefficient is to be judged by the testing agency.

D-3.3 In the case of M and N category, separate fuel consumption correction coefficients shall be determined for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively

D-4.0 Fuel Consumption at Zero Energy Balance (C_0)

D-4.1 The fuel consumption C_0 at $\Delta E_{batt} = 0$ is determined by the following equation

$C_0 = C - K_{fuel} * Q$ (l/100 km)

Where

C **:** fuel consumption measured during test (l/100 km)

Q **:** electricity balance measured during test (Ah)

D-4.2 In the case of M and N category, fuel consumption at zero energy balance shall be determined separately for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively

D-5.0 CO_2-Emission Correction Coefficient (K_{co2}) defined by the HES Manufacturer/Supplier

D-5.1 The CO_2-emission correction coefficient (K_{CO2}) shall be determined as follows from a set of n measurements performed by the HES manufacturer/supplier. This set should contain at least one measurement with $Q_i < 0$ and at least one with $Q_j > 0$. If the latter condition can not be realised on the driving cycle (Part One or Part Two in the case of M and N category or IDC as applicable) used in this test, then it is up to the testing agency to judge the statistical significance of the extrapolation necessary to determine the CO_2- emission value at $\Delta E_{batt} = 0$.

D-5.2 The CO_2-emission correction coefficient (K_{CO2}) is defined as

$$k_{fuel} = \frac{n.\Sigma Q_i M_i - \Sigma Q_i \cdot \Sigma M_i}{n\Sigma Q_i^2 - (\Sigma Q_i)^2} \qquad \text{g/km/Ah}$$

Where

M_i **:** CO_2-emission measured during i-th HES manufacturer/supplier's test (g/km)

Q_i **:** electricity balance during i-th HES manufacturer/supplier's test (Ah)

n **:** number of data

The CO_2-emission correction coefficient shall be rounded to four significant figures (e.g. 0.xxxx or xx.xx). The statistical significance of the CO_2-emission correction coefficient is to be judged by the testing agency.

D-5.3 In the case of M and N category, separate CO_2-emission correction coefficients shall be determined for the CO_2 emission values measured over the Part One cycle and the Part Two cycle respectively.

D-5.4 CO_2-emission at zero energy balance (M_0).

D-5.5 The CO_2-emission M_0 at $\Delta E_{batt} = 0$ is determined by the following equation:

$M_0 = M - K_{CO2} * Q$ (g/km)

Where

C : CO_2 emission measured during test (g/km)

Q : electricity balance measured during test (Ah)

D-5.6 In the case of M and N category, CO_2 - emission at zero energy balance shall be determined separately for the CO_2 - emission values measured over the Part One cycle and the Part Two cycle respectively

ANNEXURE E
(See 18.1)

TECHNICAL SPECIFICATION OF HYBRID ELECTRIC SYSTEM

1. Details of Hybrid System Manufacturer / Supplier / Installer

a. Name of the HES Manufacturer / HES Supplier:

b. Address:

c. Telephone No. and Fax No.:

d. Contact person:

2. System Identification

a. Identification No.:

b. Variants, if any:

3. Electric Motor

a. Name of manufacturer:

b. Model name/Identification No.:

c. Type: (e.g. Asynchronous AC Induction, Synchronous Permanent Magnet AC, BLDC, SRM etc.)

d. No. of Phases:

e. Maximum Power (kw @ xxxx rpm):

f. Maximum torque (Nm @ xxxx rpm):

g. Maximum Thirty Minutes Power, kW:

h. Maximum Thirty Minutes speed km/h:

i. Cooling System (Liquid /Air / Naturally air cooled):

j. International Protection (IP)-Code:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

4 Motor Controller Unit

a. Name of manufacturer:

b. Model name/Identification No:

c. Type:

d. Control Principle: (e.g vectorial / open loop / closed / other)

e. Cooling System (Liquid /Air / Naturally air cooled):

f. International Protection (IP)-Code:

5. REESS

a. Name of manufacturer:

b. Identification No.:

c. Type: (e.g Lead Acid/ Li-Ion etc.)

d. Voltage:

e. Capacity (kWh):

f. End of discharge voltage value:

g. No. of batteries used:

h. Weight of REESS:

6. Charger (Applicable only for Externally Chargeable HEV's)

a. Name of the manufacturer

b. Model name/Identification No.

c. Type

d. Rating

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

e. Charger (on board / external):

f. Specifications of mains

i mains (single phase/ three phase):

ii Nominal Voltage (V) and frequency (Hz) with tolerances:

g. Recommended duration of a complete charge:

h. In case of on-board charger

i Continuous rating of charger socket (A):

ii Maximum initial in-rush current (A):

7 Charging / interlocking Socket

a. Name of the manufacturer:

b. Model name/Identification No.:

c. Type:

d. Rating:

8 Power Harness

a. Name of manufacturer:

b. Model name/Identification No.:

c. Type : FLRY

d. Operating Temperature:

e. Insulation material used:

f. IEC protection class

g. Conduits provided Yes / No:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

h. Cable size (DC side) sqmm:

i. Cable size (AC side) sqmm:

j. Electrical circuit diagram and Layout:

9. Control Harness

a. Name of manufacturer:

b. Model name/Identification No.:

c. Type: FLRY

d. Operating Temperature

e. Insulation material used:

f. IEC protection class:

g. Conduits provided Yes / No:

h. Cable size in sqmm:

i. Electrical circuit diagram and Layout:

10 REESS State of Charge (SOC) and Fault indicator / HMI

a. Name of manufacturer:

b. Model name/Identification No:

c. Type:

d. Details of indication when state of charge of the REESS reaches a level when the manufacturer recommends re-charging

i Indication format:

ii Relationship of state of charge indicator and the indication:

11 Hybrid Controller Unit

a. Name of manufacturer:

b. Model name/Identification No.:

c. Type:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

12 REESS Management System (Popularly known as Battery Management System, BMS)

a. Name of manufacturer:

b. Model name/Identification No.:

c. Type:

13 Brief Description of System Including Dimensional Layout for Hybrid Electric System components Installation in the vehicle.

Typical layout shall indicate details of circuit brakers, MCBs used, location of charger, etc., and key Hybrid Electric System (HES) components

14 Catalytic Converter (OE fitted)

a. Name of manufacturer:

b. Model name/Identification No.:

c. Type:

15 Current Limiting Device (Fuse)

a. Name of manufacturer:

b. Identification No.:

c. Voltage/current rating:

d. Type:

16 Main Contactor / REESS Cut-off Switch

a. Name of manufacturer:

b. Identification No.:

c. Voltage/current rating:

d. Type:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

ANNEXURE F
(See 18.1)

TECHNICAL SPECIFICATION OF IN USE VEHICLE RETROFITTED WITH HYBRID ELECTRIC SYSTEM

1.0 General Description of Vehicle

1.1 Vehicle Make / Model:

1.2 Vehicle Type:

1.3 Year and Month of Manufacture:

1.4 Engine No.:

1.5 Chassis No.:

1.6 Type of hybrid vehicle (Externally chargeable/Not externally chargeable):

1.7 Mode selection switch provided: Yes/No

1.8 If yes, the modes available:

2.0 Engine

2.1 Type:

2.2 Bore x Stroke, mm:

2.3 No. of Cylinders:

2.4 Displacement:

2.5 Compression Ratio:

2.6 Max Engine Output:

2.7 Max Torque:

2.8 Weight of Engine (Complete):

3.0 Clutch

3.1 Type:

3.2 Outside Diameter:

4.0 Gear Box

4.1 Model:

4.2 Type:

4.3 No. of Gears:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

4.4 Gear ratio:

1st

2nd

3rd

4th

5th

6th

Reverse

4.5 Front Axle:

4.6 Rear Axle:

4.7 Ratio:

5.0 Steering

5.1 Steering Wheel Diameter:

5.2 Ratio:

6.0 Frame

6.1 Long member size,mm:

6.2 No. of cross members:

7.0 Suspension

7.1 Front:

7.2 Rear:

8.0 Brake

8.1 Service Brake:

8.2 Front:

8.3 Rear:

8.4 Parking Brake:

8.5 Wheels and Tyres:

9.0 Electrical System

9.1 System voltage:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

9.2 REESS:

9.3 Alternator (Max. Output):

10.0 Dimensions

10.1 Wheel Base, mm:

10.2 Overall Width, mm:

10.3 Overall Length, mm:

10.4 Front Track, mm:

10.5 Rear Track, mm:

10.6 Min. Ground Clearance, mm:

10.7 Cargo Box Dimensions:

10.8 Load Body Platform Area:

11.0 Weights

11.1 Gross Vehicle Weight (GVW):

11.2 Unladen Weight (ULW with 90% fuel, Spare wheel and tools etc):

11.3 Front Axle weight (FAW):

11.4 Rear Axle weight (RAW):

11.5 Maximum Gradeability in 1st Gear:

12.0 Other details

12.1 Fuel capacity:

12.2 Seating capacity:

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

ANNEXURE G

(See 19.1)

CODE OF PRACTICE FOR RETROFITMENT OF HYBRID ELECTRIC SYSTEM ON ICE VEHICLES

1.0 General

This code of practice may be called as "Code of Practice for Use of Hybrid Electric System retrofitted in Internal Combustion Engine Vehicles". This code of practice is applicable for M1/M2 and N1 category vehicles.

2.0 Scope

This code of practice shall apply to the design, installation, operation, inspection and testing and maintenance of Hybrid Electric System (Henceforth referred as Hybrid Electric System (HES)). In general the standard is directed towards vehicle installations.

3.0 Definitions of key components

For the purpose of this Standard, the following definitions shall apply:

3.1 **Hybrid Electric System (HES)** – Means aggregate of components added by HES manufacturer/supplier to the base vehicle for hybrid electric operation without modification / change / fuel type of base vehicle power train and base vehicle configuration.

3.2 **Drive System** – Means of connecting the Electric Powertrain i.e. Motor to the engine or wheels.

3.3 **Electric Motor** – An electromechanical device that converts electrical energy into mechanical energy

3.4 **Motor Controller** – Means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults.

3.5 **REESS** - REESS means a single mechanical assembly comprising of REESS modules and retaining frames or trays. A vehicle may have one or several REESS

3.6 **Charger** -Means for charging REESS from external power supply.

3.7 **Charging Socket -**Charging Socket means all the parts used to connect the vehicle to an external electric power supply (alternative or direct current supply).

3.8 **Wiring Harness - Power and Control –** Wiring harness is an assembly of cable or wires which transmit electric signals or electrical power.

3.9 **SOC Indicator** – REESS state of Charge Indicator.

3.10 **Hybrid ECU** – Electronic Control Unit to manage the Hybrid Electric system's operation.

3.11 **BMS** – REESS Management System is an electronic Control Unit to manage the REESS operation and ensure safety.

4.0 Responsibility of HES manufacturer / supplier

The retrofitment of the Hybrid Electric System (HES) shall be type approved by any one of the testing agencies specified in Rule 126 of the Central Motor Vehicle Rules. The responsibility of the type approval and ensuring that the HES manufactured comply with the provisions thereof shall be that of the HES manufacturer /supplier as the case may be.

4.1 HES manufacturer/ supplier should have third party ISO-9000 certification. The ISO 9000 certificate shall be submitted to the test agency at the time of type approval.

4.2 After obtaining type approval certification, HES manufacturer / supplier shall authorize installer to undertake Hybrid Electric System (HES) retrofitment. The HES manufacturer/supplier shall submit the information to Regional Transport Authorities as asked.

4.3 The HES manufacturer / HES supplier shall maintain the record of the vehicle identification numbers (VIN) and registration numbers of those vehicles on which the Hybrid Electric System (HES) has been installed. As part of this record, the HES manufacturer/supplier shall identify the installation date and the Hybrid Electric System (HES) type approval certification number and shall identify the vehicle owners at the time of installation, including the owner's current addresses and phone numbers.

4.4 Name, address, and phone number of all the installer facilities which are authorised by the HES manufacturer / supplier to install the approved Hybrid Electric System (HES) or sell the spare parts of Hybrid Electric System (HES) shall be published on HES manufacturer/supplier website.

4.5 **Hybrid Electric System (HES) Layout:** The layout indicating the locations of key elements of the Hybrid Electric system (HES) shall be prepared by the HES manufacturer / supplier and shall be submitted to the testing agency at the time of Homologation. This will include the placement of each important element such as motor, controller, wiring harness routing, batteries, charging socket and other components which forms the integral part of the Hybrid Electric System (HES).

4.5.1 Test Agency shall verify the weight distribution due to Hybrid Electric System (HES) installation for any adverse impact on vehicle structure using best engineering practices.

4.5.2 Serviceability and accessibility of the original vehicle shall not be adversely affected due to Hybrid Electric System (HES) mounting

4.5.3 There shall be no adverse impact on crash compatibility of Hybrid Electric System (HES) retrofitted vehicle. Test agency shall verify this requirement using best engineering practices

4.6 **Owner's Manual for Hybrid Electric System (HES)**

The Owner's manual shall be prepared by the HES manufacturer / supplier and shall clearly highlight the changes that would supersede the OEM vehicle Owner's manual. Hybrid system manual shall clearly highlight the changes that would supersede the original manual. The HES manufacturer / supplier shall ensure and instruct the HES installers that the HES owner's manual is provided with every Hybrid Electric System (HES) installed vehicles.

The Owner's manual shall cover the following minimum information:

4.6.1 Approved Hybrid Electric System (HES) layout diagram.

4.6.2 Description of the Hybrid Electric System (HES) including description of major components and their theory of operation.

4.6.3 REESS charging procedure.

4.6.4 **Warranty information of Hybrid Electric System (HES)** It should include the warranty information of Hybrid Electric System (HES) and its implications on the warranty provided by OEM (Base vehicle manufacturer). This notification must be signed by the purchaser prior to sale of the Hybrid Electric System (HES).

4.6.5 Listing of necessary service intervals and a Check list for checks will be provided in owner's manual.

4.6.6 Owner's manual shall cover FAQs and trouble shooting of Hybrid Electric System (HES).

The (HES) manufacturer / supplier shall submit the complete owner's manual to the test agency along with the application of the type approval. In case the owner's manual is not available at the time of submitting the prototype vehicle, they shall be submitted by the HES manufacturer /supplier as and when they are ready but not later than beginning of commercial production.

4.7 **Service Manual for Hybrid Electric System (HES)**

The HES manufacturer/supplier shall make service manual available comprising of company's all service and warranty policies.

4.8 The HES manufacturer/supplier shall impart training to installer on installation, maintenance and operation of Hybrid Electric System (HES) and issue the training certificate to installer after completion of training.

4.9 **Wiring harness, Cables and Connectors**

Guidelines for Installation and Routing the Control and Power Harness through vehicle.

4.9.1 Electric cables used in power and control wiring harness shall comply with the requirements of ISO 6722-2006 as per the para. 14 of AIS-123.

4.9.2 The electrical circuit shall be provided with current limiting and or short circuit protection device.

4.9.3 The layout of the wiring harnesses shall be such that they are secured tightly and shall be properly insulated or contained in a loom (Non-flammable corrugated tube) along its length to avoid any metal contact of body, damage by any means (e.g. sharp metallic edges) or sagging.

4.9.4 The HES manufacturer/supplier has to select cables used for harness such a way that, there shall not be any EMI causing malfunction of harness and other electrical systems of the vehicle.

4.9.5 **Guidelines for sharing the signal from existing sensors in a vehicle**

The HES manufacturer/supplier shall follow the guidelines mentioned below for sharing the signal from existing sensors in a vehicle. This approach will ensure that the signals are not loaded and do not impact the functioning of the existing systems in the vehicle.

4.9.5.1 Guidelines for sharing sensors with pulse / frequency output or digital output

4.9.5.1.1 The input stage impedance should be such a way that it will not load the earlier stage. After loading the sensor signal by additional circuit, drop in the sensor voltage should not be more than 0.5% of sensor voltage before loading the circuit.

4.9.5.1.2 Logic zero voltage should not lift up due to sharing circuit.

4.9.5.1.3 The device should not allow reverse flow of current

4.9.5.1.4 The input stage should not pick up any noise.

4.9.5.1.5 The input stage shall not introduce noise if it is kept open.

4.9.5.1.6 The additional circuit shall not have any adverse effect on the existing sensor circuit.

Examples of pulse / frequency output type sensors:

- Vehicle speed sensor (VSS)
- Pressure sensor
- Engine speed sensor

Examples of Digital output type sensors:

- Brake switch
- Clutch switch
- Air Condition ON-OFF switch
- Pressure switch
- Temperature switch

4.9.5.2 Guidelines for sharing sensors with voltage / potentiometric / resistance type output. The input stage of the signal sharing device shall have the following characteristics –

4.9.5.2.1 Differential input: This will provide high common mode rejection. It will not interfere with the electronics of the existing vehicle as it will not measure the signal with respect of signal ground.

4.9.5.2.2 High Input impedance: The input stage impedance should be such a way that it will not load the earlier stage. After loading the sensor signal by additional circuit, drop in the sensor voltage should not be more than 0.25% of sensor voltage before loading the circuit.

4.9.5.2.3 The device should not allow reverse flow of current.

4.5.9.2.4 The input stage should not pick up any noise.

4.9.5.2.5 The input stage shall not introduce noise if it is kept open.

4.9.5.2.6 The additional circuit shall not have any adverse effect on the existing sensor circuit.

Example of Voltage / Resistance type sensors:

- Throttle position sensor
- Pressure sensor
- Temperature sensor
- O_2 sensor
- Air flow sensor

4.9.5.3 Similar approach is in use for sharing the sensor in a CNG/LPG close loop systems. For e.g. O_2 Sensor (Voltage type), Throttle position sensor (potentiometric type), Crankshaft position sensor (pulse type). In case of CNG/LPG systems the fuel injectors of the existing system are cut-off using an electronic circuit called Emulator. It also emulates i.e. gives false impression to the ECU as if the engine is running on fuel.

4.9.5.4 The motor controller and onboard charger shall be isolated from the vehicle Battery during 'Ignition off' condition.

4.9.5.5 In case Hybrid Electric System (HES) is connected to the grounded chassis, it shall be equipped with Earth Leakage / Dark current protection at any time when vehicle is connected to the external / mains supply.

4.10 Traction Motor

HES manufacturer/supplier shall ensure that the motor used is in compliance with automotive requirements, AIS-123 section 11.0.

4.11 Motor Controller

The motor controller shall be designed to provide protection for Short circuit, over temperature, Input and Output Overloading. Controller should be so placed that the heat generated is adequately dissipated.

4.12 **Charging Socket and its Location**

Vehicle starting system shall be disabled if the charging cable is plugged-in to the vehicle. In case of running engine if the charging cable is plugged-in to the vehicle, the engine shall be shut down.

To the extent possible, charging socket shall be located close to on board charger, if available. The location of charging socket should be away from the fuel tank. Preferably it should be on the opposite side of the fuel tank inlet. The socket body should be adequately earthed to prevent sparking and subsequent hazard of fire.

4.13 **REESS**

4.13.1 Installation of REESS in the vehicle shall not allow any potential dangerous accumulation of gases. Details of the ventilation provided by HES manufacturer/supplier shall be verified by Test Agency at the time of type approval.

4.13.2 REESS compartments containing REESS modules, which may produce hazardous gases, shall be safely ventilated. Details of ventilation provided by HES manufacturer/supplier shall be verified by the Test Agency at the time of type approval.

4.13.3 REESS and the electric power train shall be protected by properly rated fuse or circuit breakers. The components on the vehicle shall be as per the specifications declared by the HES manufacturer/supplier as per information provided in AIS-007/Annexure E and F. The same shall be verified by the Test Agency at the time of type approval.

4.13.4 **Mounting of REESS:** The mounting REESS in Hybrid Electric System (HES) fitted vehicle operated vehicle shall be such that REESS is not displaced from its place and there is no REESS displacement and spillage of electrolyte when vehicle is driven on gradient or any other type of road. This condition shall be deemed to be satisfied if no REESS displacement and spillage of electrolyte is observed in acceleration, deceleration and cornering scenario.

4.13.5 **Creepage Distance Measurement for REESS** This para. deals with additional leakage current hazard between the connection terminals of REESS including any conductive fittings attached to them and any conductive parts, due to the risk of electrolyte spillage in normal operating conditions. It does not apply to REESS, for which electrolyte leakage will not occur under normal operating conditions e.g. sealed REESS.

Minimum creepage distance shall be as follows:

a) In the case of a creepage distance between two REESS connection terminals:

$d > 0.25\ U + 5$

Where

d = Creepage distance measured on the tested REESS in mm

U = Nominal voltage between the two REESS connection terminals in V.

b) In the case of creepage distance between live parts and the electrical chassis :

$d > 0.125 U + 5$,

Where

d = Creepage distance measured between the live part and the electrical chassis in mm.

U = Nominal voltage between the two REESS connection terminals in V.

4.13.6 **REESS disconnect**

Vehicles should be equipped with an automatic disconnect for REESS to isolate the propulsion circuits in case of any fault in Hybrid Electric System (HES). The HES manufacturer/supplier shall describe the automatic disconnect provided in the Owner's manual.

A manual service disconnect should also be present. This disconnect should be operable with the following capabilities:

4.13.6.1 Manual action to break the connection.

4.13.6.2 The disconnection does not create exposed conductors capable of becoming energized while exposed.

4.14 **REESS Charger**

The charger and the BMS shall provide protection for overcharge, over discharge, cell/pack voltage variation, Temperature variation etc. for safe operation of batteries.

4.15 **Compliance Plate**

Each Hybrid Electric System (HES) retrofitted vehicle shall be fitted with the compliance plate. It will be suitably located in an approachable location. Compliance plate shall provide the following information about the Hybrid Electric System (HES) and its installation.

- Date of Installation:
- Vehicle Reg. Number:
- Hybrid System Identification Number:
- Manufactured by:
- Installed by:

4.16 **Labels**

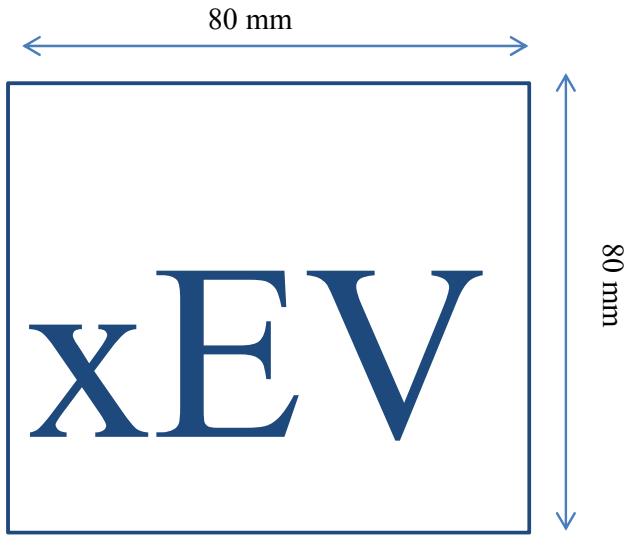
Identification label in front and rear: Label conforming to the specifications AIS-123 shall be affixed on left side of the front and rear safety glass so as to ensure visibility from the front and rear side of the vehicle.

Vehicles installed with Hybrid Electric System (HES) shall have identification label as follows:

4.16.1 Labels shall be affixed in a vertical position on the left side of the front and rear safety glass and shall ensure visibility from the front and rear sides.

4.16.2 The label shall be in position at all times, shall be in good condition, and the shape, colouring and lettering shall be easily identifiable.

4.16.3 Label shall be coloured 'white' and sized 80 mm x 80 mm square. Label shall have on them the text "xEV" in a central position not less than 20 mm high, coloured blue. The label shall have a blue border 1 mm wide, 5 mm inside the outer edge and running parallel to it. The 80 mm dimension is measured from the outer edge (Kindly refer the drawing given below).



4.17 **Safety Instructions**

Minimum one copy of safety instructions shall be displayed in passenger's compartment.

5.0 Responsibility of the HES installer

5.1 **Criteria to Authorize HES Installer**

Only the installer authorized by HES manufacturer /supplier shall fit the Hybrid Electric System (HES) on vehicles. For this purpose, the HES manufacturer/supplier shall issue a certificate of authorization to the installer concerned duly authorizing them to fit the Hybrid Electric System (HES) on behalf of HES manufacturer/supplier. Only that fitment centre's / shop's which are the franchise / dealership of the HES manufacturer / supplier shall be allowed to carry out the Hybrid Electric System (HES) fitments.

5.2 **HES installer shall be equipped with the following tools and equipment**

- Two post lift / ramp
- Electric hand drill machine and H.S.S. drill bits
- Set of 'D' ring and box spanners
- Set of screw driver (both flat and star)

- Set of Allen keys
- H.S.S. hand saw
- Crimping tool for electrical cable termination, if required
- Set letter and number punch
- Measurement tape
- Torque wrench
- Inspection light
- Vernier caliper
- Multimeter
- Silicon seal/sealant
- Alignment tool
- Belt tension measuring equipment
- Puller
- Fire - fighting equipment
- Dry chemical powder (DCP) type fire extinguisher – minimum two numbers of 5 kg each with ISI mark.
- CO_2 type fire extinguisher – minimum 1 number of 5 kg with ISI mark.
- Fire buckets – 2 buckets

5.3 Installer shall have trained technicians having qualification as specified by HES manufacturer/ supplier. HES manufacturer/supplier shall impart extensive training to the technicians on Hybrid Electric System (HES) installation and certify the same.

5.4 Installer to display in the premises, authorization certificate issued by HES manufacturer / supplier.

5.5 The record of conversion of vehicles carried out by the HES installer shall be maintained and made available to the authorities such as MoRTH or agencies authorized by MoRTH as and when demanded.

5.6 HES installer should do fitness and performance checks of the Hybrid Electric System (HES) retrofitted vehicle at least once in a year and maintain the records of the parameters audited and observations as per the norms established by HES manufacturer /supplier.

5.7 HES installer shall only use spare parts recommended by HES manufacturer / supplier.

5.8 The HES installer shall install Hybrid Electric System (HES) as per the guidelines and instructions provided by the HES manufacturer / supplier. The installer shall also provide all documentation to the vehicle owner as instructed by HES manufacturer / supplier as well as documentation required by law.

5.9 The HES installer shall assess the fitness of the vehicle for Hybrid Electric System (HES) fitment, explain the same to vehicle owner and seek written consent from vehicle owner.

6.0 Responsibility of HES Vehicle Owner

6.1 Vehicle owner shall get his Hybrid Electric System (HES) serviced at HES manufacturer/supplier authorized franchise / shop only as per given service intervals specified in Owner's manual.

6.2 Vehicle owner shall use spare parts recommended by HES manufacturer / supplier.

6.3 For any kind of Hybrid Electric System (HES) related repair, Vehicle owner has to contact HES manufacturer /supplier authorized franchise / shop.

6.4 In case of any concern / issues with the HES installed vehicle, the vehicle owner shall first contact HES manufacturer /supplier for assistance.

6.5 Vehicle owner shall follow safety instructions provided by HES manufacturer / HES supplier / HES installer.

6.6 Vehicle owner shall not allow any tampering / unauthorized modification in configuration, settings or components of Hybrid Electric System (HES) fitted in the vehicle.

6.7 Vehicle owner shall not allow any unauthorized use of components of Hybrid Electric System (HES) fitted in the vehicle.

6.8 The vehicle owner shall apply to the concerned registering authority within 14 days of undertaking the alteration, as required under Section 52 of Motor Vehicle Act 1988, for endorsement of particular alteration in registration certificate mentioning place and date of installation and installation certificate number. HES installer shall provide all relevant required by the vehicle owner to do so.

6.9 On receipt of intimation from the HES manufacturer /supplier, the vehicle owner shall make the vehicle available for annual fitness and performance check.

ANNEXURE H

(See 20.0)

CRITERIA FOR EXTENSION APPROVAL

1.0 HES manufacturer and test agency shall mutually agree for test to be carried out in case of following variants

a. Change in Make , Type, rating of Motor

b. Change in Make , Type, rating of Motor Drive/ECU

c. Change in Make, Type, rating of REESS

d. Change in cable harness

Test Agency:	Manufacturer:	Document No. (indicating revision status)
Signature:	Signature:	
Name:	Name:	
Designation:	Designation:	
Date:	Date:	Sheet no……..of……..

ANNEXURE I
(See introduction)

COMPOSITION OF AISC PANEL ON CMVR TYPE APPROVAL OF VEHICLES RETROFITTED WITH HYBRID ELECTRIC SYSTEM*

Convener	
Shri. A.B. Komawar	The Automotive Research Association of India (ARAI)
Members	
Shri A. A. Deshpande	The Automotive Research Association of India (ARAI)
Shri. Vikram Gulati	National Automotive Testing and R&D Infrastructure project (NATRiP)
Director	Vehicle Research and Development Establishment (VRDE)
Director	International Center for Automotive Technology (iCAT)
Director	Central Institute of Road Transport (CIRT)
Director	Indian institute of Petroleum (IIP)
Shri B Bhanot	Transport Engineering Division Council (TEDC)
Dr. A.K. Shukla	Indian Institute of Science
Shri. K.K. Gandhi / Shri Sourabh Rohila	Society of Indian Automobile manufacturers (SIAM)
Shri Venkat Srinivas/ Shri Arun Sivasubrahmaniyan	Ashok Leyland Ltd. – Technical Center (SIAM)
Shri. Manik Narula/ Shri Dilrajsingh Bhullar	Maruti Suzuki India Ltd. (SIAM)
Shri P.K.Banerjee	Tata Motors Ltd (SIAM)
Shri Nagendra H.V/ Shri Raju M	Toyota Kirloskar Motor Pvt. Ltd. (SIAM)
Shri Sanjay Deshpande / Shri Sanjay Tank	Mahindra & Mahindra Ltd. (SIAM)
Shri K. Umesh/ Shri V. M. Suresh	Mahindra Reva Electric Vehicles Pvt. Ltd. (SIAM)
Shri Neeraj Gupta/ Shri Rajendra Khile	General Motors Technical Center India Pvt. Ltd. (SIAM)

Shri Uday Harite	Automotive Components Manufacturers Association of India (ACMA)
Shri Sunil Gandhi/ Shri Tejas Kshatriya	KPIT Cummins Infosystems Ltd.
Shri P Chandrasekhar	HBL Power Systems Ltd.
Shri Ritwik Guha	Minda SAI Ltd. (Corporate Office)
Shri M. J. Purohit	AXIOM Energy Conversion Pvt. Ltd.
Shri D. A. Desai	Kirloskar Electric Co. Ltd.
Dr. Vijaymohanan K Pillai	Central Electrochemical Research Institute
Dr. S.K. Mittal	Exide Industries
Shri Vidyadhar Humnabadkar	Curtis Instruments India Pvt. Ltd.

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

ANNEXURE J
(See Introduction)
COMMITTEE COMPOSITION *
Automotive Industry Standards Committee

Chairman	
Shri Shrikant R. Marathe	Director The Automotive Research Association of India, Pune
Members	**Representing**
Representative from	Ministry of Road Transport and Highways (Dept. of Road Transport and Highways), New Delhi
Representative from	Ministry of Heavy Industries and Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, MSME, Ministry of Micro, Small and Medium Enterprises, New Delhi
Shri P.C.Joshi	Bureau of Indian Standards, New Delhi
Director Shri D. P. Saste (Alternate)	Central Institute of Road Transport, Pune
Director	Indian Institute of Petroleum, Dehra Dun
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Shri Uday Harite	Automotive Components Manufacturers Association of India, New Delhi

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