

**AUTOMOTIVE INDUSTRY STANDARD**

**CMVR Type Approval of Electric  
Propulsion Kit Intended for Conversion  
of Vehicles for Pure Electric Operation**

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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  
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)  
GOVERNMENT OF INDIA

February 2016

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

<b>Sr. No.</b>	<b>Corr-igenda.</b>	<b>Amendment</b>	<b>Revision</b>	<b>Date</b>	<b>Remark</b>	<b>Misc.</b>

**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 electric propulsion kit intended for conversion of vehicles for pure electric operation.

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 F and Annexure G respectively.

**CMVR Type Approval of  
Electric Propulsion Kit Intended for Conversion of Vehicles  
for Pure Electric Operation**

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**CMVR Type Approval of Electric Propulsion Kit Intended for Conversion of Vehicles for Pure Electric Operation**

**1.0 SCOPE**

This standard lays down the requirements specific to Electric Propulsion Kit intended for conversion of vehicles of L5, M, N1 and N2 category for pure electric operation, which

- i) are manufactured on and after 1<sup>st</sup> January 1990;
- ii) are not provided with permits for carrying dangerous or hazardous goods, as defined in CMVR.

**2.0 REFERENCES**

2.1	AIS-049 (Rev.1):2015	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 and Part 2):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(Rev.1):2015	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 (Rev.1):2015	Electric power train vehicles – Requirements for construction and functional safety
2.8	AIS-039 (Rev.1):2015	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 3):2009 | Automotive vehicles – Requirements for electromagnetic compatibility  |
| 2.14 | 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 |
| 2.15 | AIS-048:2009          | Battery Operated Vehicles - Safety Requirements of Traction Batteries   |
| 2.16 | ISO:6722-2006         | Road vehicles – 60v and 600v single core cables – Dimensions, test method and requirements.   |
| 2.17 | JASO D 616:2011       | Automotive parts – Test method and general performance requirements for wiring harness connectors.  |
| 2.18 | IS 2-1960             | Rules for rounding off numerical values   |
| 2.19 | IS 14785 – 2000       | Automotive Vehicles - Determination of Road-load Constants by Coast Down Test Method  |

### **3.0 DEFINITION**

For the purpose of this standard the following definitions shall apply:

#### **3.1 Electric Propulsion Kit**

Means aggregate of components added by kit manufacturer/ supplier to the base vehicle by replacing IC engine and associated accessories for pure electric operation.

**3.2 Drive System** - It is a mean means of connecting the Electric Powertrain i.e. Motor to the wheels.

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

**3.4 Motor Controller**- It is a 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** - 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 **BMS** – REESS Management System is an electronic Control Unit to manage the REESS operation and ensure safety.
- 3.11 Where necessary, the definitions given in Annexure C of AIS-049 (Rev.1) shall apply.

**4.0 VEHICLE WEIGHMENT**

- 4.1 Vehicle weighment shall be done as per IS 11825-1986 with Electric Propulsion Kit fitted. Permissible increase in vehicle unladen weight due to Electric Propulsion Kit shall be as follows:

<b>Vehicle Category</b>	<b>Permissible increase in ULW (%)</b>	<b>Remarks</b>
L5M	25	--
M1/M2	25	--
M3	25	
L5N/N1/N2	Equal to weight of Electric Propulsion Kit	Increase in FAW shall not be more than 10% and all axle loads shall be within laden limits prescribed in APPENDIX XII of CMV Rule 1989.

**5.0 COAST DOWN TEST**

- 5.1 Coast down test shall be done as per IS 14785-2000 to find out vehicle road load coefficients for range and electric energy consumption tests. At the choice of the kit manufacture/supplier, power table method can be used to determine vehicle road load coefficients for vehicles of category L5, M1, M2 and N1.

**6.0 VISUAL INDICATION**

- 6.1 Electric Propulsion Kit manufacturer/supplier shall provide minimum following indications:
  - Rechargeable Energy Storage System State of Charge (REESS SOC)
  - Motor temperature
  - Electric Kit fault
 These indications shall be as per the guidelines of AIS-071 (Part 1 and Part 2).



**7.0 GRADEABILITY TEST**

7.1 The vehicle fitted with Electric Propulsion Kit shall meet requirement of gradeability as specified in AIS-049(Rev 1), as per AIS-003.

**8.0 Measurement of Electric Range and Electric Energy Consumption**

8.1 The electric range of vehicle fitted with Electric Propulsion Kit shall be measured as per AIS-040(Rev 1):2015.

The electric energy consumption of vehicle fitted with Electric Propulsion Kit shall be measured as per AIS-039(Rev 1):2015.

Reference mass for chassis dynamometer setting shall be as per AIS 049(Rev 1) and Driving cycle shall be as per clause 5.1 of AIS-039(Rev 1):2015  
Results of electric range (in km) and electric energy consumption (Wh/km) shall be reported.

**9.0 BRAKE PERFORMANCE**

9.1 The vehicle fitted with Electric Propulsion Kit shall meet the requirements of brake performance test when tested as per IS 11852-2001 (Part 1 to Part 9) and Annexure A of this standard.

**10.0 MEASUREMENT OF PASS BY NOISE LEVEL**

The vehicle fitted with Electric Propulsion Kit shall meet the requirement of Pass By Noise Level as per IS 3028-1998 with additional test conditions as specified in AIS-049(Rev 1).

**11.0 TRACTION MOTOR TEST**

Following tests shall be carried out on traction motor Electric Propulsion Kit.

11.1 Motor Power Test: Test shall be carried out as per AIS-041(Rev 1):2015

11.2 Environmental validation tests for traction motor:

Manufacturer/supplier of Electric Propulsion Kit shall provide 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 EMC TEST**

12.1 Electric Propulsion Kit electronic components shall meet the requirements of EMC test as per AIS-004 (Part 3):2009.

At the request of kit manufacturer/supplier, EMC test may be performed on vehicle fitted with Electric Propulsion Kit, instead of performing EMC test on individual kit components.

REESS charger shall be excluded from the test as it is utilized when vehicle is in off condition.

**13.0 VERTICAL ORIENTATION OF DIPPED BEAM – HEAD LAMP**

13.1 Electric Propulsion Kit manufacturer / supplier shall carry out head lamp leveling adjustment on converted vehicle to comply with the requirement of AIS-008 (Rev.1): 2010.

This requirement is not applicable to L5 category converted vehicles.

**14.0 REQUIREMENTS FOR CONSTRUCTIONAL AND FUNCTIONAL SAFETY**

14.1 The vehicle fitted with Electric Propulsion Kit shall meet requirements for constructional and functional safety as per AIS-038(Rev 1):2015.

**15.0 REQUIREMENTS FOR RECHARGEABLE ENERGY STORAGE SYSTEM (REESS)**

15.1 The REESS of the Electric Propulsion Kit shall meet the requirements of AIS-048.

**16.0 WIRING HARNESS / CABLES / CONNECTORS**

16.1 Manufacturer/supplier of Electric Propulsion Kit shall comply with the following standards and guidelines for control, power harness and all connectors used in harness.

OR

Manufacturer/supplier of Electric Propulsion Kit shall provide the test reports of the following tests conducted on control, power harness and all connectors used in harness as given in 16.2 and 16.3.

16.2 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.

**16.3 General guidelines for performance and reliability of single pole and multi pole connectors for wiring harness:**

It is desirable to use counter mating connector to pig tail any existing connector. The mating connector shall meet the following requirements. JASO D 616:2011 standard or equivalent 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.

**17.0 ADDITIONAL REQUIRMENTS**

- 17.1 The vehicle fitted with Electric Propulsion Kit shall continue to comply with the requirements for external projection as per IS: 13942:1994.
- 17.2 Bus (M3 category) complying with requirements of Bus Body Code as per AIS- 052(Rev.1) shall continue, to comply with the said requirements after Electric Propulsion Kit fitment.
- 17.3 Vehicle equipped with speed limiting device (SLD) or speed limiting function (SLF), if fitted with Electric Propulsion Kit, shall continue to comply with the requirements of clause 5.7 of AIS-018 as amended from time to time.
- 17.4 If the increase in weight on steered axle of the vehicle, falling in the scope of 11948: 2010, fitted with Electric Propulsion Kit is greater than 10 percent in case of M1 and N1 type of vehicles and 5% in case of other vehicles, the vehicle shall be retested for checking compliance with the requirements of Steering Effort as per IS 11948: 2010.
- 17.5 The transport vehicle intended for fitment of Electric Propulsion Kit shall have valid certificate of fitness as per CMV Rule 62.
- 17.6 The vehicle with modifications in configuration/components/sub systems due to Electric Propulsion Kit fitment shall continue to comply with CMVR requirements applicable to base vehicle and its components and sub system. Additional test(s) to be carried out to establish this compliance shall be decided by the Test Agency.

**18.0 TECHNICAL SPECIFICATION**

18.1 Technical specification for Electric Propulsion Kit and vehicle fitted with Electric Propulsion Kit shall be provided as per Annexure B and C respectively.

**19.0 CODE OF PRACTICE**

19.1 Electric propulsion kit manufacture/supplier and authorized retrofitter shall comply with Code of Practice as per Annexure D. Documentary evidence shall be provided at the time of Type Approval along with technical specification.

**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 Electric Propulsion Kit 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 E 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.

**21.0 TYPE APPROVAL CERTIFICATE AND ITS VALIDITY**

21.1 Testing Agency shall issue Type Approval to the Electric Propulsion Kit based on the tests carried out on the vehicle retrofitted with kit submitted for Type Approval.

Based on the request by the Kit manufacturer/supplier to the testing agency, Type Approval can be extended to the Electric Propulsion Kit for fitment on vehicle irrespective of its make and model provided ,

- a) GVW of vehicle is within a range of  $\pm 10\%$  of the converted vehicle tested for Type Approval as per this standard.
- b) Electric Propulsion kit components have same specifications as that of Type approved configuration.

For the extension of Type Approval of Electric Propulsion Kit for fitment on other vehicle models, Test Agency shall carry out following tests on each model.

- i. Requirements for construction and functional safety as per clause 14.0
- ii. Vehicle Weighment as per clause 4.0
- iii. Electric Range and Electric Energy Consumption tests as per clause 8.0
- iv. Brake test, if applicable, based on the guidelines of criteria for extension of approval as per IS 11852-2001 (Part 1 to Part 9) (clause 9.0)
- v. Steering effort test, if applicable, based on the guidelines of criteria for extension of approval as per IS 11948: 2010

Type Approval of Electric Propulsion Kit shall be extended for fitment on vehicle models complying with the requirements specified in (i) to (v) above.

- 21.2 Validity of such Type Approval certificate shall be 3 years and needs to be revalidated thereafter. During revalidation, Electric Propulsion Kit installed vehicle shall be subjected to electric range, electric energy consumption tests and physical verification of the converted vehicle as per the layout submitted by kit manufacturer/supplier during initial type approval.
- 21.3 Validity of type approval certificate issued by Test Agency shall cover vehicles, manufactured after the year of manufacture of the prototype converted vehicle on which such kit has been tested and type approved

**ANNEXURE A**  
(See 9.0)  
**ADDITIONAL REQUIREMENTS FOR REGENERATIVE  
BRAKING SYSTEM**

- A-1.0 Definitions**
- A-1.1 **Electric Regenerative Braking System:** A braking system, which during deceleration, provides for the conversion of vehicle kinetic energy into electrical energy.
- A-1.2 **Electric Regenerative Brake Control:** A device which modulates the action of the electric regenerative braking system
- A-1.3 **Electric Regenerative Braking System of Category A:** An electric regenerative braking system, which is not part of the service braking system.
- A-1.4 **Electric Regenerative Braking System of Category B:** An electric regenerative braking system, which is part of the service braking system.
- A-2.0 Vehicles Fitted with Electric Regenerative Braking System of Category A**
- A-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.
- A-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.
- A-3.0 Vehicles Fitted with Electric Regenerative Braking System of Category B**
- A-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
- A-3.2 The service braking system control shall also actuate the action of the electric regenerative braking system simultaneously.
- A-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.
- A-4.0** If so desired by the Electric Propulsion Kit 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.

**A-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 B**  
(See 18.1)

**TECHNICAL SPECIFICATION OF ELECTRIC PROPULSION KIT**

<b>1.</b>	<b>Details of Electric Propulsion Kit Manufacturer / Supplier</b>
a.	Name of the Electric Propulsion Kit Manufacturer / Supplier:
b.	Address:
c.	Telephone No. and Fax No.:
d.	Contact person:
<b>2.</b>	<b>System Identification</b>
a.	Identification No.:
b.	Variants, if any:
<b>3.</b>	<b>Electric Motor</b>
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:
<b>4</b>	<b>Motor Controller Unit</b>
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.....



d.	Control Principle: (e.g vectorial / open loop / closed / other)	
e.	Cooling System (Liquid /Air / Naturally air cooled):	
f.	International Protection (IP)-Code:	
<b>5.</b>	<b>REESS</b>	
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:	
<b>6.</b>	<b>Charger</b>	
a.	Name of the manufacturer :	
b.	Model name/Identification No.:	
c.	Type:	
d.	Rating:	
e.	Charger (on board / external):	
f.	Specifications of mains:	
	i	mains (single phase/ three phase):
	ii	Nominal Voltage (V) and frequency (Hz) with tolerances:

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

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):
<b>7</b>	<b>Charging / interlocking Socket</b>	
a.	Name of the manufacturer:	
b.	Model name/Identification No.:	
c.	Type:	
d.	Rating:	
<b>8</b>	<b>Power Harness</b>	
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 ( DC side ) sqmm:	
i.	Cable size ( AC side ) sqmm:	
j.	Electrical circuit diagram and Layout:	
<b>9.</b>	<b>Control Harness</b>	
a.	Name of manufacturer:	
b.	Model name/Identification No.:	

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

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:
<b>10</b>	<b>REESS State of Charge (SOC) and Fault indicator / HMI</b>
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:
<b>11</b>	<b>REESS Management System (Popularly known as Battery Management System,(BMS)</b>
a.	Name of manufacturer:
b.	Model name/Identification No.:
c.	Type:
<b>12</b>	<b>Brief Description of System Including Dimensional Layout for Electric Propulsion Kit components Installation in the vehicle.</b>  Typical layout shall indicate details of circuit brakers, MCBs used, location of charger, etc., and key Electric Propulsion Kit components
<b>13</b>	<b>Current Limiting Device (Fuse)</b>
a.	Name of manufacturer:
b.	Identification No.:

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

c.	Voltage/current rating:
d.	Type:
<b>14</b>	<b>Main Contactor / REESS Cut-off Switch</b>
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 C**  
(See 18.1)

**TECHNICAL SPECIFICATION OF VEHICLE  
FITTED WITH ELECTRIC PROPULSION KIT**

<b>1.0</b>	<b>General Description of Vehicle</b>
1.1	Vehicle Make / Model:
1.2	Vehicle Type:
1.3	Year and Month of Manufacture:
1.4	Engine No.:
1.5	Chassis No.:
<b>2.0</b>	<b>Engine</b>
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):
<b>3.0</b>	<b>Clutch</b>
3.1	Type:
3.2	Outside Diameter:
<b>4.0</b>	<b>Gear Box</b>
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:
	1 <sup>st</sup>
	2 <sup>nd</sup>
	3 <sup>rd</sup>
	4 <sup>th</sup>
	5 <sup>th</sup>
	6 <sup>th</sup>
	Reverse
4.5	Front Axle:
4.6	Rear Axle:
4.7	Ratio:
<b>5.0</b>	<b>Steering</b>
5.1	Steering Wheel Diameter:
5.2	Ratio:
<b>6.0</b>	<b>Frame</b>
6.1	Long member size,mm:
6.2	No. of cross members:
<b>7.0</b>	<b>Suspension</b>
7.1	Front:
7.2	Rear:
<b>8.0</b>	<b>Brake</b>
8.1	Service Brake:
8.2	Front:
8.3	Rear:
8.4	Parking Brake:
8.5	Wheels and Tyres:
<b>9.0</b>	<b>Electrical System</b>
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	Battery:
9.3	Alternator (Max. Output):
<b>10.0</b>	<b>Dimensions</b>
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:
<b>11.0</b>	<b>Weights</b>
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:
<b>12.0</b>	<b>Other details</b>
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 D**

(See 19.1)

**CODE OF PRACTICE FOR FITMENT OF  
ELECTRIC PROPULSION KIT ON VEHICLES****1.0 General**

This code of practice may be called as "Code of Practice for Use of Electric Propulsion Kit fitted on Vehicles".

**2.0 Scope**

This code of practice shall apply to the design, installation, operation, inspection and testing and maintenance of Electric Propulsion Kit. In general the standard is directed towards vehicle installations.

**3.0 Responsibility of Electric Propulsion Kit manufacturer / supplier**

The fitment of the Electric Propulsion Kit 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 kit manufactured complies with the provisions thereof shall be that of the Electric Propulsion Kit manufacturer /supplier.

3.1 Electric Propulsion Kit manufacturer/ supplier shall have third party ISO-9000 certification. The ISO 9000 certificate shall be submitted to the Test Agency at the time of type approval.

3.2 After obtaining type approval certification, Electric Propulsion Kit manufacturer / supplier shall authorize installer to undertake kit fitment. The Electric Propulsion Kit manufacturer/supplier shall submit the information to Regional Transport Authorities as asked.

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

3.4 Name, address, and phone number of all the installer facilities which are authorised by the Electric Propulsion Kit manufacturer / supplier to install the approved kit or sell the spare parts of kit shall be published on kit manufacturer/supplier website.



3.5 **Electric Propulsion Kit Layout:** The layout indicating the locations of key elements of the kit shall be prepared by the kit manufacturer / supplier and shall be submitted to the testing agency at the time of type approval. 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 Electric Propulsion Kit.

3.5.1 Test Agency shall verify the weight distribution due to Electric Propulsion Kit installation for any adverse impact on vehicle structure using best engineering practices.

If any part of kit is fitted on roof top of buses (M3 category), Test Agency may consider carrying out Stability Test as per AIS 052(Rev.1) to ascertain stability after kit fitment.

3.5.2 Serviceability and accessibility of the original vehicle shall not be adversely affected due to Electric Propulsion Kit mounting.

3.6 **Owner's Manual for Electric Propulsion Kit**

The Owner's manual shall be prepared by the kit manufacturer / supplier and shall clearly highlight the changes that would supersede the OEM vehicle Owner's manual. Kit manual shall clearly highlight the changes that would supersede the original manual. The kit manufacturer / supplier shall ensure and instruct the kit installers that the kit owner's manual is provided with every kit installed vehicles.

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

3.6.1 Approved Electric Propulsion Kit layout diagram.

3.6.2 Description of the Electric Propulsion Kit including description of major components and their theory of operation.

3.6.3 REESS charging procedure.

3.6.4 **Warranty information of Electric Propulsion Kit:** It should include the warranty information of kit 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 kit.

Responsibility of vehicle converted with Electric Propulsion Kit is transferred from OEM to kit manufacturer / supplier, except in case of zero kilometer fitments.

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

3.6.6 Owner's manual shall cover FAQs and troubleshooting of Electric Propulsion Kit.

The Electric Propulsion Kit 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 kit manufacturer /supplier as and when they are ready but not later than beginning of commercial production.

**3.7 Service Manual for Electric Propulsion Kit**

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

3.8 The kit manufacturer/supplier shall impart training to installer on installation, maintenance and operation of kit and issue the training certificate to installer after completion of training.

**3.9 Wiring harness, Cables and Connectors**

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

3.9.1 Electric cables used in power and control wiring harness shall comply with the requirements of ISO 6722-2006 as per the para. 16 of this standard.

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

3.9.3 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.

3.9.4 The kit 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.

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

The kit 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.

3.9.5.1 Guidelines for sharing sensors with pulse / frequency output or digital output.

3.9.5.1.1 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.

- 3.9.5.1.2 Logic zero voltage should not lift up due to sharing circuit.
- 3.9.5.1.3 The device should not allow reverse flow of current.
- 3.9.5.1.4 The input stage should not pick up any noise.
- 3.9.5.1.5 The input stage shall not introduce noise if it is kept open.
- 3.9.5.1.6 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

Examples of Digital output type sensors:

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

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

- 3.9.5.2.1 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.
- 3.9.5.2.2 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.
- 3.9.5.2.3 The device should not allow reverse flow of current.
- 3.5.9.2.4 The input stage should not pick up any noise.
- 3.9.5.2.5 The input stage shall not introduce noise if it is kept open.
- 3.9.5.2.6 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

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

3.9.5.4 In case kit 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.

3.10 **Traction Motor**

Electric Propulsion Kit manufacturer/supplier shall ensure that the motor used is in compliance with automotive requirements, of this standard, section 11.0.

3.11 **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.

3.12 **Charging Socket and its Location**

Vehicle starting system shall be disabled if the charging cable is plugged-in to the vehicle.

To the extent possible, charging socket shall be located close to on-board charger, if available.

3.13 **REESS disconnect**

Vehicles should be equipped with an automatic disconnect for REESS to isolate the propulsion circuits in case of any fault in Electric Propulsion Kit. The kit 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:

3.13.1 Manual action to break the connection.

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

3.14 **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.

3.15 **Compliance Plate**

Each converted vehicle shall be fitted with the compliance plate. It shall be suitably located in an approachable location. Compliance plate shall provide the following information about the Electric Propulsion Kit and its installation.

- Date of Installation:

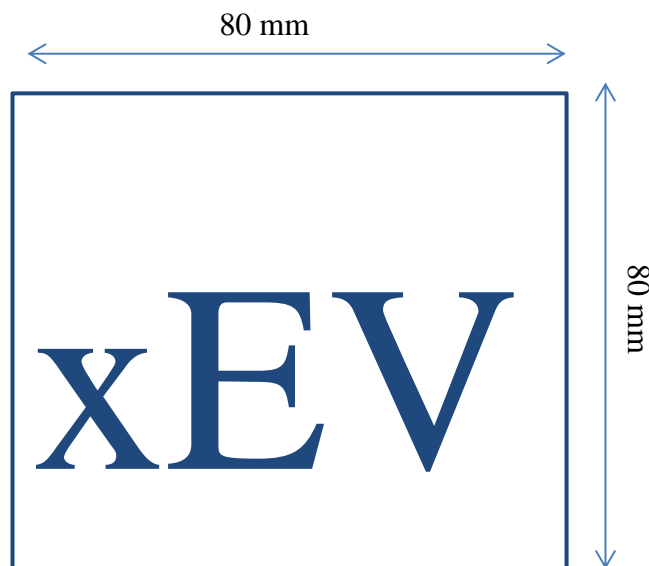
- Vehicle Reg. Number:
- Electric Propulsion Kit Identification Number:
- Manufactured by:
- Installed by:

3.16 **Labels**

**Identification label in front and rear:** Label conforming to the specifications 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 fitted with Electric Propulsion Kit shall have identification label as follows:

- 3.16.1 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.
- 3.16.2 The label shall be in position at all times, shall be in good condition, and the shape, colouring and lettering shall be easily identifiable.
- 3.16.3 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).



3.17 **Safety Instructions**

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

4.0 **Responsibility of the Electric Propulsion Kit installer**

4.1 **Criteria to Authorize Electric Propulsion Kit Installer**

Only the installer authorized by kit manufacturer /supplier shall fit the kit on vehicles. For this purpose, the kit manufacturer/supplier shall issue a certificate of authorization to the installer concerned duly authorizing them to fit the kit on behalf of kit manufacturer/supplier.

**4.2 Electric Propulsion Kit 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<sub>2</sub> type fire extinguisher – minimum 1 number of 5 kg with ISI mark.
- Fire buckets – 2 buckets
- Testing equipment recommended by Kit Manufacturer

4.3 Installer shall have trained technicians having qualification as specified by kit manufacturer/ supplier. Kit manufacturer/supplier shall impart extensive training to the technicians on kit installation and certify the same.

4.4 Installer to display in the premises, authorization certificate issued by kit manufacturer / supplier.

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

4.6 Installer should do fitness and performance checks of the converted vehicle at least once in a year and maintain the records of the parameters audited and observations as per the norms established by kit manufacturer /supplier.

- 4.7 Installer shall only use spare parts recommended by kit manufacturer / supplier.
- 4.8 Installer shall install kit as per the guidelines and instructions provided by the kit manufacturer / supplier. The installer shall also provide all documentation to the vehicle owner as instructed by kit manufacturer / supplier as well as documentation required by law.
- 4.9 Installer shall assess the fitness of the vehicle for kit fitment, explain the same to vehicle owner and seek written consent from vehicle owner.

**ANNEXURE E**  
(See 20.0)  
**CRITERIA FOR EXTENSION APPROVAL**

<b>1.0</b>	<b>Electric Propulsion Kit manufacturer and Test Agency shall mutually agree for test to be carried out in case of following Changes</b>
	<ul style="list-style-type: none"> <li>a. Change in Make , Type, rating of Motor</li> <li>b. Change in Make , Type, rating of Motor Drive/ECU</li> <li>c. Change in Make, Type, rating of REESS</li> <li>d. Change in cable harness</li> </ul>

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



**ANNEXURE F**

(See introduction)

**COMPOSITION OF AISC PANEL ON  
CMVR TYPE APPROVAL OF ELECTRIC PROPULSION KIT INTENDED  
FOR CONVERSION OF VEHICLES FOR PURE ELECTRIC OPERATION\***

<b>Convener</b>	
Shri. A.A. Deshpande	The Automotive Research Association of India (ARAI)
<b>Members</b>	
Shri M. M. Desai	The Automotive Research Association of India (ARAI)
Representative from	National Automotive Testing and R&D Infrastructure project (NATRiP)
Representative from	Vehicle Research and Development Establishment (VRDE)
Representative from	International Center for Automotive Technology (iCAT)
Representative from	Central Institute of Road Transport (CIRT)
Representative from	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. S Ravishankar	Ashok Leyland Ltd. – Technical Center (SIAM)
Shri. Manik Narula/ Shri Dilrajsingh Bhullar	Maruti Suzuki India Ltd. (SIAM)
Shri Philip Jose / Shri Vikas Ratan	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 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.
Shri Rakesh Sharma	Alfa Bravo Pvt Ltd.

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

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

<b>Chairman</b>	
Mrs. Rashmi Urdhwareshe	Director The Automotive Research Association of India, Pune
<b>Members</b>	<b>Representing</b>
Representative from	Ministry 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
Representative from	National Automotive Testing and R&D Infrastructure Project (NATRiP)
Shri N.K Sharma	Bureau of Indian Standards (BIS), New Delhi
Director	Central Institute of Road Transport(CIRT), Pune
Director	Indian Institute of Petroleum(IIP), Dehra Dun
Director	International Centre for Automotive Technology(ICAT), Manesar, Delhi.
Director	Vehicles Research and Development Establishment (VRDE), Ahmednagar
Shri Shrikant R. Marathe	Former Chairman, Automotive Industry Standards Committee
Representatives from	Society of Indian Automobile Manufacturers (SIAM), New Delhi
Shri T.R.Kesavan	Tractor Manufacturers Association (TMA), New Delhi
Shri Uday Harite	Automotive Components Manufacturers Association of India (ACMA), New Delhi

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