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BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

Draft Indian Standard

ELECTRIC VEHICLE BATTERY SWAP SYSTEM – PART 4 LIGHT ELECTRIC VEHICLES – SECTION 2 CONNECTION SYSTEMS

Last date for comments : **25 September 2022**

Electrotechnology in Mobility Sectional Committee, ETD 51

NATIONAL FOREWORD

(*Formal clauses will be added later***)**

The Indian Standards for an interoperable Battery as a Service (BaaS) System for Light Electric Vehicles consist of following series of standards:

Part 1 General Guidelines
Part 2 Safety Guidelines
Part 3 Central Management System
Part 4/Sec 1 Light Electric Vehicle- Guidelines and Pack Dimensions
Part 4/Sec 2 Light Electric Vehicle- Connection System
Part 4/Sec 3 Light Electric Vehicle- Communication protocol

In order to increase the pace of transformation of mobility, the Government of India is promoting Battery as a Service (BaaS) wherein the electric vehicles batteries can be replaced at the Battery Swap Station. BaaS is designed as an interoperable system for consumer convenience, faster adoption (scalability), and asset utilisation wherein within the light electric vehicle categories, any vehicle can use these battery packs inter-changeably. This standard covers swappable battery system (SBS) coupler/connector and coupler/connector for Battery swap station and vehicle side.

The composition of the committee responsible for formulation of this standard is given at Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2: 1960 ‘Rules for rounding of numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

ELECTRIC VEHICLE BATTERY SWAP SYSTEM
PART 4 LIGHT ELECTRIC VEHICLES
SECTION 2 CONNECTION SYSTEM

1 SCOPE

1.1 This standard is applicable to Battery Swap System(BSS) connected to supply, with rated input supply voltage upto 415 V a.c, 50 Hz or up to 400 V d.c. and swappable battery system(SBS) with a nominal voltage of 48 V d.c. and a maximum working voltage of less than or equal to 60 V d.c.

1.2 The aspects covered in this standard include:

a) Requirements for Swappable battery system (SBS) coupler/connector;
b) Requirements for coupler/connector for Battery swap station and vehicle side.

1.3 The standard does not cover the detailed requirements for Battery swap systems located in hazardous areas where flammable gas or vapor and/or combustible materials, fuels or other combustible or explosive materials are present. Additional requirements as per CEA , PESO regulations may apply for such locations.

2 REFERENCES

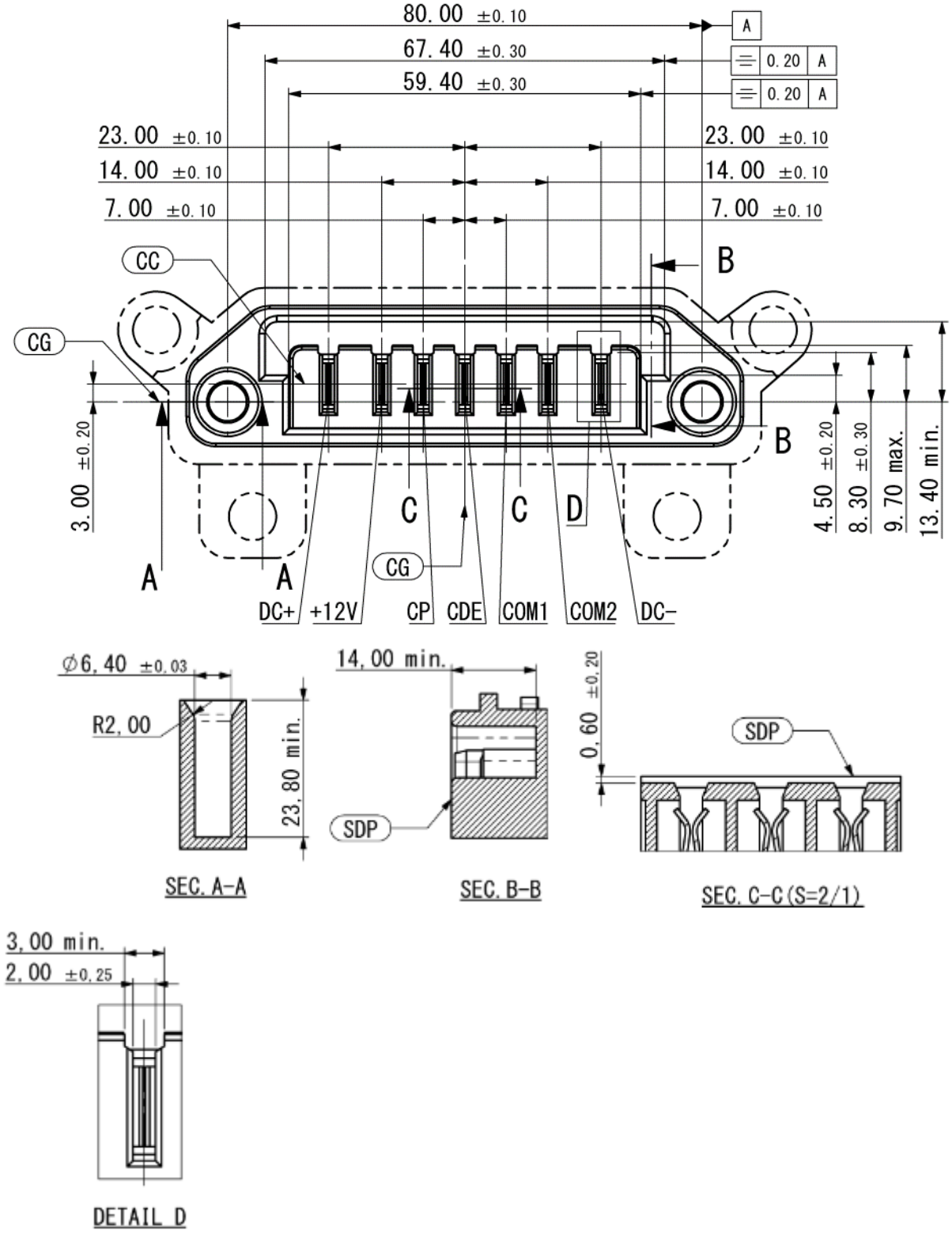
This clause of 17896(Part 4/Sec1) (*under development*) is applicable**.**

3 TERMINOLOGY

This clause of 17896(Part 4/Sec1) (*under development*) is applicable**.**

4 SWAPPABLE BATTERY SYSTEM (SBS) COUPLER/CONNECTOR – DIMENSIONS AND DOCKING DETAILS (TYPE A)

Dimensions in mm



KEY

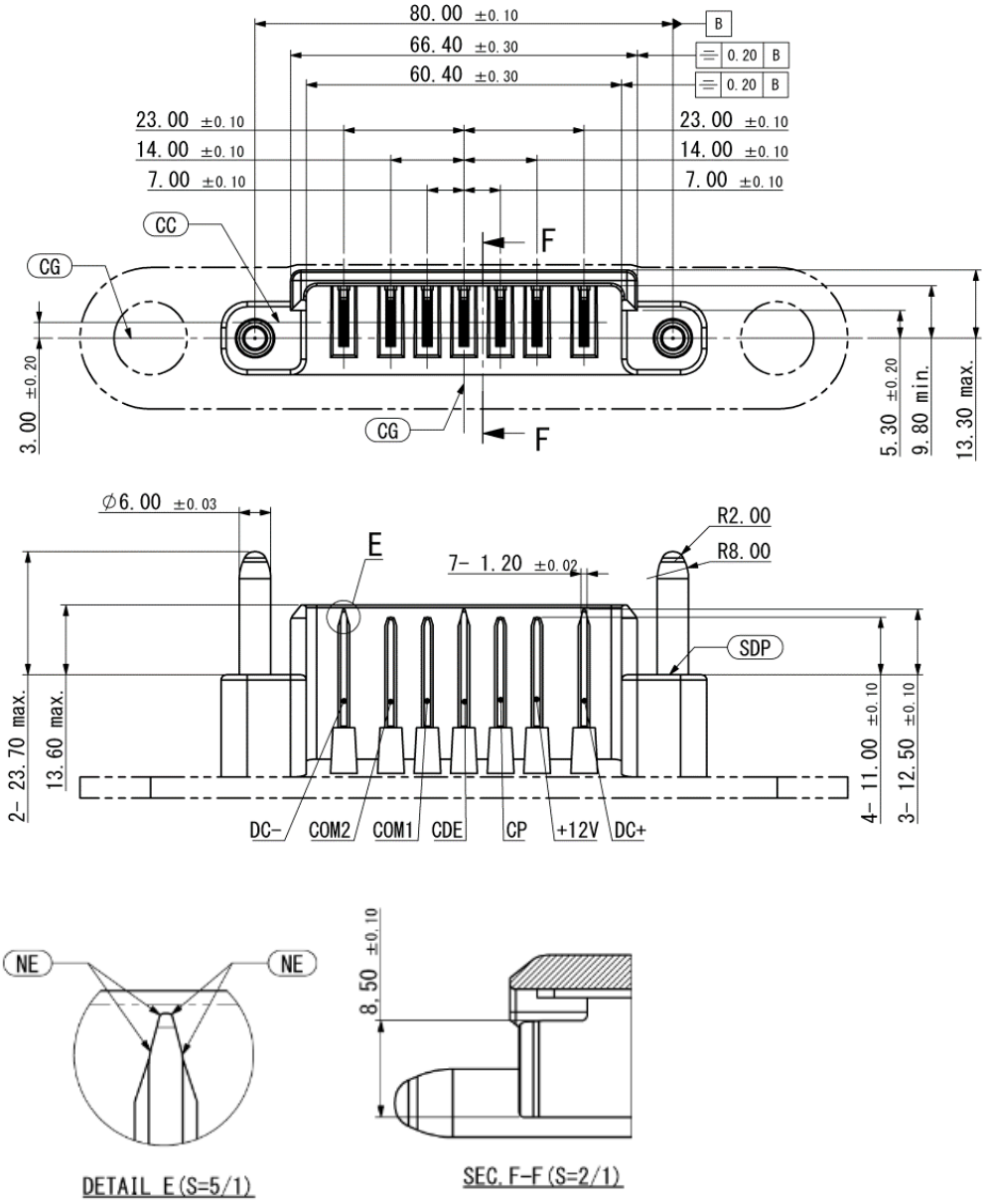
SDP Standard datum plane
CC Center line of contact
CG Center line of guide

NE No sharp edges

FIG. 1 –SWAPPABLE BATTERY SYSTEM (SBS) CONNECTOR/COUPLER (TYPE A)

5 BATTERY SWAP STATION AND VEHICLE SIDE COUPLER/CONNECTOR – DIMENSIONS AND DOCKING DETAILS (TYPE B)

Dimensions in mm



KEY

SDP Standard datum plane
CC Center line of contact
CG Center line of guide
NE No sharp edges

FIG. 2 – BATTERY SWAP STATION AND VEHICLE SIDE COUPLER/CONNECTOR (TYPE B)

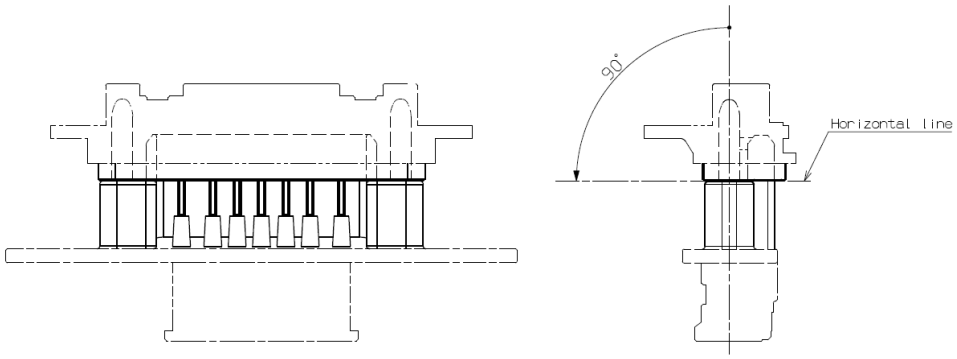


FIG. 3 INSTALLATION POSITION RANGE OF COUPLER/CONNECTOR (TYPE A AND TYPE B)

6 CONNECTOR/COUPLER PICTORIAL REPRESENTATION

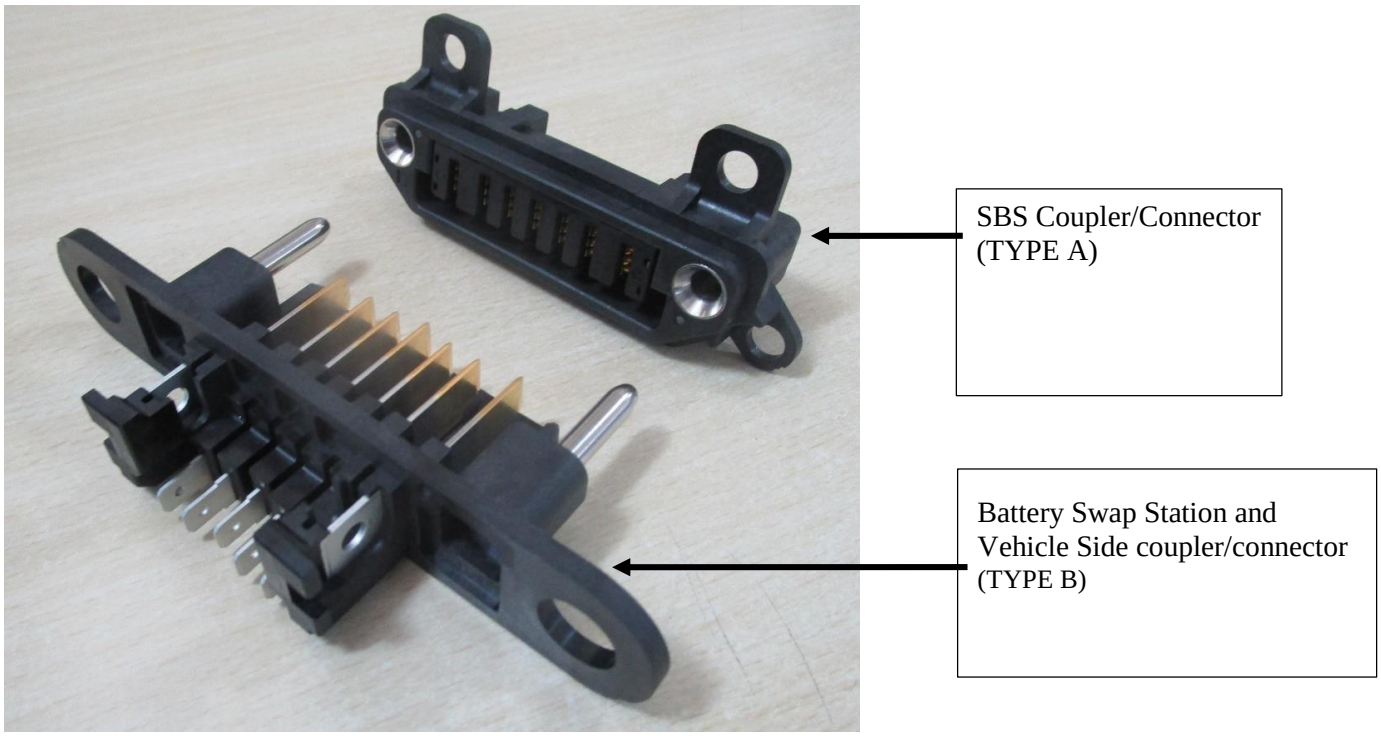


FIG. 4 – SBS COUPLER/CONNECTOR(TYPE A) AND BATTERY SWAP STATION AND VEHICLE SIDE COUPLER/CONNECTOR (TYPE B) PICTORIAL REPRESENTATION

7 TECHNICAL SPECIFICATIONS

SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector shall be designed to meet electrical and mechanical performance requirements as given in Table **1**.

Table 1-Technical Specifications

(*Clause* 7)

SI. No	Parameter	Specifications
1	Power pin thickness	Blade type - 1.2 mm
2	Power pin Voltage (*nominal*)	50 V d.c.
3	Power pin Voltage (*max.*)	≤ 60V d.c.
4	Power pin current (Continuous/Peak)	65 A d.c./ 100 A d.c. for 5 min
5	Power pin type	Blade type
6	Power pin termination	Terminal Base
7	No of Power Pins	02
8	Signal pin thickness	Blade type - 1.2 mm
9	Signal Pin Voltage (*max.*)	12 V d.c.
10	Signal Pin Current (*max.*)	1 A d.c.
11	No of Signal Pins	05
12	Signal pin type	Blade
13	Signal pin termination	Blade Terminal
14	a.c. Withstand Voltage	3000 V a.c.
15	Insulation Resistance	>100 MΩ at 500 V DC
16	Flammability Rating	UL 94 V0
17	Operating Temperature	–30 to 120 °C
18	Insertion and Extraction force	Insertion Force = 60 N (*max.*) Extraction Force = 45 N (*max.*)
19	Mating Cycles	≥ 10000
20	Directivity	Unidirectional
21	Material	Connector Body: Nylon Resin Terminal: Plated copper alloy

8 INTERFACE

Terminal interface and function details shall be as given in Table **2.**

Table 2- Overview of The Basic Interface, Configuration Docking Connector Type A & B

(*Clause* 8)

Position number [a]	DC	Functions
1	60V 65A	d.c.+
2	12V 1A	d.c.12V
3	12V 1A	CP
4	12V 1A	CDE
5	12V 1A	COM1
6	12V 1A	COM2
7	60V 65A	d.c.–
[a] Position number does not refer to the location and/or identification of the contact in the accessory.		

NOTES –

1 CP stands for Control Pilot.

2 CDE stands for clean data earth and is common ground between BSS and SBS.

3 COM1 and COM2 are CAN-H and CAN-L signal line pair for CAN communication respectively.

9 TESTS

SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector shall comply with the following test requirements:

9.1 Temperature Rise Test

Connectors shall be so constructed that the temperature rise of power pins and surface in normal use shall comply with the specified requirements.

Compliance is checked by testing the SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector under mated condition at an ambient temperature of 25°C ± 5 °C.

Unless cable is provided by the manufacturer, connectors shall be fitted or soldered with conductors of cross-sectional area. The terminal screws or nuts are tightened by applying torque specified by manufacturer.

For the purpose of this test, a length of atleast 20 cm of the cable shall be connected to the terminals.

The d.c. test current shall be passed through power pins of connectors in mated condition as given in Table 3.

Table 3 – d.c. Test Current

(*Clause* 9.1)

d.c Current	Time Duration
65 A	60 min
100 A	5 min

The temperature rise is determined by fine wire thermocouples, positioned so that they have negligible effect on the temperature of the part under test.

The maximum permissible temperature rise (ΔT) shall not exceed

a) 40°C for power pin terminals, and
b) 60°C for non-metal connector body parts.

9.2 Insulation Resistance Test

Compliance is checked by the tests given here which are made immediately after the test specified in of **9.8.2** in the humidity cabinet or in the room in which the samples were brought to the prescribed temperature.

The insulation resistance is measured by applying a d.c. voltage of 500 V for 1 min.

The insulation resistance shall be measured:

a) between all poles connected together and the connector body;
b) between each pole in turn and all others, these being connected to the connector body; and
c) between any metal part and metal foil in contact with the outer surface of connector insulating lining, if any, a gap of approximately 4 mm being left between the metal foil and the edge of the lining.

The insulation resistance shall be not less than 5 MΩ.

9.3 Dielectric Withstand Voltage

The dielectric withstand voltage of 3000 V a.c. at power frequency of 50 Hz, shall be applied for 1 min.

The voltage shall be applied:

a) between all poles connected together and the connector body;
b) between each pole in turn and all others, these being connected to the connector body; and
c) between any metal part and metal foil in contact with the outer surface of connector insulating lining, if any, a gap of approximately 4 mm being left between the metal foil and the edge of the lining.

No flashover or breakdown shall occur during the test. It shall be verified that the SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector made of thermoplastic materials have not been impaired.

Compliance is checked by visual inspection.

9.4 Vibration Test

The test is performed to ensure that vibrations encountered during transportation (normal operation of vehicle) do not deteriorate the contact resistance performance of the SBS coupler/connector and SBS charger/Vehicle side connector under mated conditions.

The SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector under mated condition and loaded with 10 kg mass shall be firmly secured to the platform of the vibration machine in such a manner as to ensure that the vibrations are directly transmitted to the connectors.

The test shall be conducted at an ambient temperature of 25 ± 5 °C.

The mounting arrangement shall be subjected entire range of frequencies (7 Hz –200 Hz) and return frequencies (200 Hz –7 Hz) traversed in 15 minutes.

This test shall be repeated for 12 times (3 hours) in the vertical direction of the mounting orientation of the REESS as specified by the manufacturer.

The mounting arrangement shall be subjected to following test conditions as given in Table 4.

Table 4 – Conditions for Vibration Test

(Clause 9.4)

Frequency Hz	**Acceleration** m/s^2
7 – 18	10
18 - approximately 50 (1)	gradually increased from 10 to 80
25 - 200	20

(1) The amplitude is maintained at 0.8 mm (total excursion – 1.6 mm) and the frequency is increased until the maximum acceleration is achieved.

Contact resistance shall be measured before, during and after the vibration test. There shall not be more than 10 percent degradation in contact resistance during the test from initial measurements before the start of the test.

9.5 Resistance to Heat

The SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector shall be sufficiently resistant to heat.

The connectors under unmated conditions are kept for 1 h in a heating cabinet at a temperature of 110°C ± 5 °C.

They shall not undergo any change impairing their further use, and sealing compound shall not flow to such an extent that live parts are exposed.

9.6 Corrosion and Resistance to Rusting

Ferrous parts of both connectors, shall be adequately protected against rusting. Compliance is checked by the following test on SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector under unmated condition.

All grease is removed from the connectors to be tested, by immersion in ethyl acetone, acetone, methylethyl ketone or an equivalent degreasing agent for 10 min. The parts are then immersed for 10 min in a 10 percent solution of ammonium chloride in water at a temperature of 20°C ± 5 °C.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of 20°C ± 5 °C.

After the parts have been dried for 10 min in a heating cabinet at a temperature of 100°C ± 5 °C, their surfaces shall show no signs of rust. Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

9.7 Resistance to aging of Rubber and Thermoplastic material

The SBS coupler/connector and SBS charger/Vehicle side connector with rubber or thermoplastic material, shall be sufficiently resistant to ageing. Compliance is checked by an accelerated ageing test made in an atmosphere having the composition and pressure of the ambient air.

The samples are suspended freely in a heating cabinet, ventilated by natural circulation. The temperature in the cabinet and the duration of the ageing test are

a) 70°C ± 2 °C and 10 days (240 h), for rubber; and
b) 80°C ± 2 °C and 7 days (168 h), for thermoplastic material.

After the samples have been allowed to attain approximately room temperature, they shall be examined and show no crack visible to the naked eye, nor shall the material have become sticky or greasy.

After the test, the samples shall show no damage which would lead to non-compliance with this standard. If there is a doubt as to whether the material has become sticky, the sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the sample plus 500 g. Equilibrium is then restored by pressing the sample with the forefinger, wrapped in a dry piece of coarse woven cloth.

No trace of the cloth shall remain on the sample and the material of the sample shall not stick to the cloth.

The use of an electrically heated cabinet is recommended. Natural circulation may be provided by holes in the walls of the cabinet.

9.8 Degree of Protection

9.8.1 *Degrees of Protection Against Solid Foreign Objects and Water*

The SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector under mated conditions shall have an IP degree at least IP 44, according to IS/IEC 60529: 2001.

Compliance is checked by test in accordance with IS/IEC 60529: 2001.

9.8.2 *Humidity Treatment*

The SBS coupler/connector and Battery Swap Station and Vehicle Side coupler/connector under mated conditions shall be proof against humid conditions which may occur in normal use

Compliance is checked by the humidity treatment described in **9.8.2** (*this clause*) immediately by the measurement of the insulation resistance and by the dielectric strength test, specified in **9.2** and **9.3.**

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 percent and 95 percent. The temperature of the air, at all places where samples can be located, is maintained within 1°C of any convenient value of temperature (T) between 20°C and 30°C.

Before being placed in the humidity cabinet, the connector samples are brought to a temperature between T and T + 4 °C. The samples are kept in the cabinet for 7 days (168 h).

In most cases, the samples may be brought to the temperature specified by keeping them at this temperature for at least 4 h before the humidity treatment.

A relative humidity between 91 percent and 95 percent can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water, having a sufficiently large contact surface with the air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within it and, in general, to use a cabinet that is thermally insulated. After this treatment, the connector samples shall show no damage within the meaning of this standard.

9.9 Contact Resistance for Terminals

The contact resistance of all connector terminals shall be less than 5 mΩ.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Electrotechnology in Mobility Sectional Committee, ETD 51

(*will be added later*)