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R&D-Report:	Test report
Title:	Creepage and Clearance Distance Evaluation
Customer:	Ather India

Document approval		
	Name	**Signature**
Prepared by	Prijo Ulahannan	pki, BOSCH, APAC, P, R, Prijo.Ulahannan Digitally signed by pki, BOSCH, APAC, P, R, Prijo.Ulahannan Date: 2022.09.16 13:01:34 +05'30'
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1. Issues (situation, motivation and tasks)

The Ather Company has designed and developed a charging connector for electric vehicles, which is patented. Ather has approached Bosch (BGSW) to validate the charging connector between the vehicle and the charging station according to IS 17017 selective tests as prescribed by Ather requirements.

Creepage and Clearance Distances are required for the protection against the operating voltages to protect the equipment or user, moreover in case of malfunction of equipment. The criteria are as per **IS 17017** chapter no.**28.1, 28.3 & 28.4** to check the correct creep and clearance of the samples.

2. Results, short version

	o.k.	**not o.k.**
2.1 Evaluation of Creepage and Clearance Distance	☒	☐

The overall result of the examined samples is:

☒ **Positive**
☐ **Negative: No further analysis required**

Recommendation for further work: NA

3. Conclusions and consequences

All samples have passed the test. All the test parameters are within the specified limit of assessment criteria. From the sample cross section it is determined that the minimum clearance provided for the conducting or live parts are more than that of the required creepage and clearance as specified in the specifications. No electric breakdown and No damage on housings or terminals by deformations or melting observed after and withstand voltage test

4. Results, long version

4.1 Evaluation of creepage and clearance distances between live parts, with live parts with different polarity and other metallic accessories**. → OK (See chapter 5.4 for criteria)**

4.1.1 Creepage Distances and clearances in accordance to 28.1 → OK

4.1.2 Conducting Evaluation is in accordance with IS 15382 part 1 → OK

4.1.3 No burnt plastic parts were observed after and withstand voltage test (2000V and 50 Hz) → OK

5. Details

5.1 Part details:

Sl. No.	Description	Part number	Manufacture date / Received date	Remarks
1	Vehicle Inlet Male and Female Connectors	-----	August-2022	-

5.2 Sample preparation, test setup and test details:

1. Accessories are designed as per pollution degree 3 according to IS 15382(Part 1).
2. Evaluation of creepage and clearance distance in accordance with IS 15382(Part 1).
3. Visually inspect and measure the shortest distance between live parts, with live parts of opposite polarity and other metal accessories in proximity if any.
4. From the sample cross section it is determined that the minimum clearance provided for the conducting or live parts are more than that of the required creepage and clearance as specified in the specifications

5.3 Test conditions and assessment criteria:

1. RMS Voltage Input: **100V**.
2. Creepage distance to avoid tracking failure: **1.8 mm.**
3. Clearance distance needed**: 0.8 mm.**
4. Accessories are under the Overvoltage category **II.**

5.3.1 Data table for creepage distances to avoid tracking failure (IS 15382 (Part 1) :2003)

Table 4 – Creepage distances to avoid failure due to tracking

Voltage r.m.s. [1]	Minimum creepage distances								
	Printed wiring material Pollution degree 1	Printed wiring material Pollution degree 2	Pollution degree 1	Pollution degree 2			Pollution degree 3		
	All material groups	All material groups, except IIIb	All material groups	Material group I	Material group II	Material group III	Material group I	Material group II	Material group III [2]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,04	0,08	0,4	0,4	0,4	1	1	1
12,5	0,025	0,04	0,09	0,42	0,42	0,42	1,05	1,05	1,05
16	0,025	0,04	0,1	0,45	0,45	0,45	1,1	1,1	1,1
20	0,025	0,04	0,11	0,48	0,48	0,48	1,2	1,2	1,2
25	0,025	0,04	0,125	0,5	0,5	0,5	1,25	1,25	1,25
32	0,025	0,04	0,14	0,53	0,53	0,53	1,3	1,3	1,3
40	0,025	0,04	0,16	0,56	0,8	1,1	1,4	1,6	1,8
50	0,025	0,04	0,18	0,6	0,85	1,2	1,5	1,7	1,9
63	0,04	0,063	0,2	0,63	0,9	1,25	1,6	1,8	2
80	0,063	0,10	0,22	0,67	0,95	1,3	1,7	1,9	2,1
100	0,1	0,16	0,25	0,71	1	1,4	1,8	2	2,2
125	0,16	0,25	0,28	0,75	1,05	1,5	1,9	2,1	2,4
160	0,25	0,40	0,32	0,8	1,1	1,6	2,0	2,2	2,5
200	0,4	0,63	0,42	1	1,4	2,0	2,5	2,8	3,2
250	0,56	1,0	0,56	1,25	1,8	2,5	3,2	3,6	4,0

Note: The data marked in red box are of concern for determining the minimum expected Creepage and clearance distance.

5.3.2 Data Table for Clearance Distances. (IS 15382 (Part 1) :2003)

Table 2 – Clearances to withstand transient overvoltages[1]

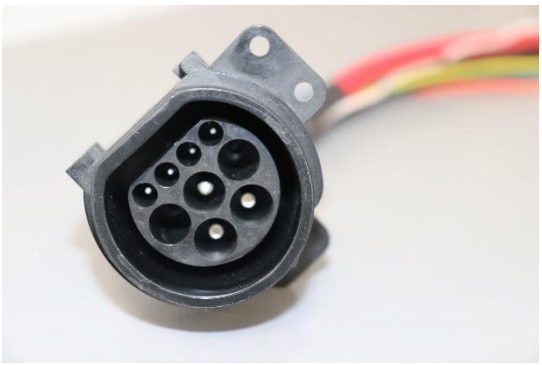
Required impulse withstand voltage [1) 5)]	Minimum clearances in air up to 2 000 m above sea level					
	Case A Inhomogeneous field (see 1.3.15)			Case B Homogeneous field (see 1.3.14)		
	Pollution degree [6)]			Pollution degree [6)]		
	1	2	3	1	2	3
kV	mm	mm	mm	mm	mm	mm
0,33 [2)]	0,01	0,2 [3) 4)]	0,8 [4)]	0,01	0,2 [3) 4)]	0,8 [4)]
0,40	0,02			0,02		
0,50 [2)]	0,04			0,04		
0,60	0,06			0,06		
0,80 [2)]	0,10			0,10		
1,0	0,15			0,15		
1,2	0,25	0,25		0,2		
1,5 [2)]	0,5	0,5		0,3	0,3	
2,0	1,0	1,0	1,0	0,45	0,45	
2,5 [2)]	1,5	1,5	1,5	0,60	0,60	
3,0	2,0	2,0	2,0	0,80	0,80	
4,0 [2)]	3,0	3,0	3,0	1,2	1,2	1,2
5,0	4,0	4,0	4,0	1,5	1,5	1,5
6,0 [2)]	5,5	5,5	5,5	2,0	2,0	2,0
8,0 [2)]	8,0	8,0	8,0	3,0	3,0	3,0
10	11	11	11	3,5	3,5	3,5

Note: The data marked in red box are of concern for determining the minimum expected Creepage and clearance distance.

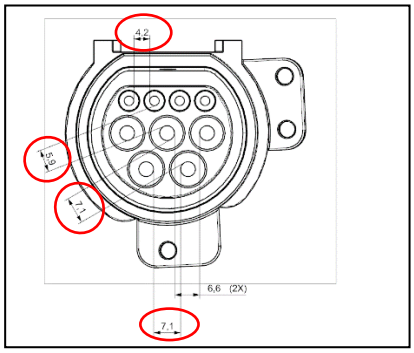
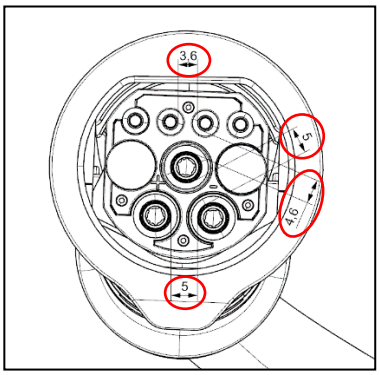
5.3.3 Material properties

1. Material Used: **PA66 (DOMAMID FR66)**
2. CTI Value of the Material being used: **600.**
3. Material Group: **I** (According to the CTI value).

6 Test Images

Inspection of sample connector terminal after test	
	
Connector male part	Connector female part

Inspection of sample connector terminal after test	
	
Connector male part	Connector female part

Reference Drawing	
	
Clearance distances of terminals of connector in proximity after mating with the housing.	Clearances of the female plug end cross section to be inserted to male live parts.

Withstand Voltage test set up