



राष्ट्रीय मोटर वाहन परीक्षण ट्रैक
(राष्ट्रीय मोटर वाहन बोर्ड, भारी उद्योग मंत्रालय, भारत सरकार के अंतर्गत)

NATIONAL AUTOMOTIVE TEST TRACKS

(Under National Automotive Board, Ministry of Heavy Industries, Government of India)

Report No. N T O B-Li S 0155

Date: 17-01-2025

ULR No. TC1471425000000152F

TEST REPORT

1.0	NAME AND ADDRESS OF THE CUSTOMER	M/s AMBIT TRANSMISSION PRODUCTS PVT. LTD. B-5, IIE SIGADDI GROWTH CENTRE, SIDCUL, KOTDWARA, PAURI GARHWAL, UTTARAKHAND-246149 (INDIA)
1.1	NAME AND ADDRESS OF THE MANUFACTURER	M/s AMBIT TRANSMISSION PRODUCTS PVT. LTD. B-5, IIE SIGADDI GROWTH CENTRE, SIDCUL, KOTDWARA, PAURI GARHWAL, UTTARAKHAND-246149 (INDIA)
2.0	TESTING REF. LETTER No.	AMBIT/NATRAX/2024-25-401, Dated:- 21-12-2024

3.0 DESCRIPTION OF DEVICE UNDER TEST (DUT):

3.1 REESS System detail

S.No	Particulars	Description
i	DUT NAME	REESS (Battery Pack)
ii	Trade Mark	9AP
iii	Battery Type	LiFePO4 Battery
iv	Battery Pack Capacity (Ah)	24Ah
v	Operating Voltage	20V ~ 29.2V
vi	Nominal Voltage	25.6V
vii	Battery Pack Model No.	9APLC-25.6V24Ah
viii	Battery Dimensions (l*b*h)	219mm x 169mm x 236mm
ix	Battery Weight In (Kg)	9.2Kg
x	Battery Module Drawing no.	9APDDLEI122404
xi	Battery Pack Sr. no.	9APZ2A04250103658



TRADE NAME - 9AP
BATTERY MODEL - 9APLC25.6V24Ah
CELL CHEMISTRY - LFP
CELL RATING - 3.2V/6Ah
BMS SPECIFICATION - 8S 40A
BMS MODEL - AQ16-40A-V6.4.2.4
MANUFACTURING - JANUARY 2025
SR.NO-9APZ2A04250103658

CRN :- NTX/CRN/2024-25/12/0087

Remarks: Refer page 28 of 28 for Disclaimer

NATRAX CASE ID: NATRAX/TB/25-26/172

Format no. NATRAX-QF-7-8-E

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EXEC. ENGINEER	ASST. MANAGER	PRINCIPAL ER-HOMOLOGATION

कार्यालय: आगरा - मुम्बई मार्ग (एन.एच. 52), पिथम्पुर फ्लाईओवर के आगे,
पोस्ट-खण्डवा (पिथम्पुर के पास), जिला-धार -454774 (म.प्र.)
Office: Agra - Mumbai Highway (NH - 52), Next to Pithampur Flyover,
Post- Khandwa (Near Pithampur), Dist. Dhar (M.P.) - 454774
Tel: 09893 892 310, Website: www.natrax.in

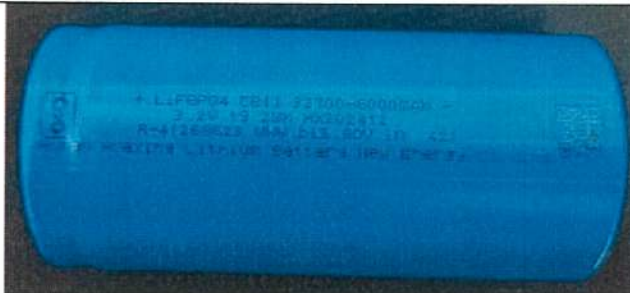

मुख्य कार्यालय: दूसरी मंजिल, प्रशासनिक भवन, आईकैट परिसर - II,
सेक्टर - 11, आई. एम. टी. मानेसर, गुरुग्राम, हरियाणा - 122051
Corporate Office: 2nd Floor, Administrative Building, ICAT Campus-II,
Sector-11, IMT Manesar, Gurugram, Haryana - 122051
Tel: 01246 900 000, Website: www.natrip.in

Report No. N T O B-Li S 0155 **Date:** 17-01-2025



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3.2	Cell	Description
i	Cell Manufacture Name	Hunan Huaxing Lithium Battery New Energy Co., Ltd.
ii	Cell Chemistry, Form Factor & Dimensions	LFP, Rechargeable LiFePO ₄ , (Diameter-32.2mm, length-70.5mm)
iii	Cell Voltage & Capacity	3.2V & 6000mAh
iv	Cell Voltage Range	2.0V to 3.65V
v	Cell Model No.	32700-6000mAh
vi	Configuration of cells	8S 4P
vii	Cell Type	LFP-Cylindrical
viii	Cell certification report/Date	STC/Test/2024083001, 3002. Dated:- 16-08-2024



CELL PHOTO		
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3.3	BMS	Description
i	BMS Make	M/s Lithion Power Pvt Ltd.
ii	BMS Model	AQ16-40A_V6.4
iii	BMS Software version/ Hardware version	9.3 / Version 6.4
iv	BMS Communication Protocol	CAN
v	BMS EMC Test Report (referred)	CT0MT0273, Dated:- 06.04.2024.
vi	BMS EMC (Extension Report)	CT1MT0574, dated:- 08.08.2024

BMS PHOTO		
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NATRAX CASE ID: NATRAX/TB/25-26/172


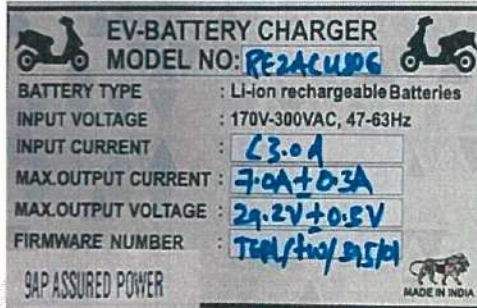


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3.4	Battery Charger	Description
i	Charger Sr. no.	241240253
ii	Charger (External/On Board)	External
iii	Charger Make / Model	Ambit Transmission Products Pvt.Ltd./ RE2AC4806
iv	Trade Name of Charger	9AP
v	Charger Type	Li-ion External Charger
CHARGER PHOTO	   	

4	Sample Receipt date	07.01.2025
5	Removable/ Fixed	Removable Types (Swappable)
6	Condition of Sample	Good (No physical damage observed)
7	Test Objective	To validate the safety requirements with respect to the Rechargeable Electrical Energy Storage System (REESS) of L category vehicle as per the requirements of AIS-156(Part II) 2020 amendment 4.
8	Functional Verification	Functional verification done and REESS was found satisfactory
9	Test Method	Test method referred from AIS-156(Part II) 2020 amendment 4.
10	Test Description and date of Performance	Please refer the ANNEXURE-1 of this report
11	Conclusion	The REESS specified in Sr. No. 3.0 of this test report met all the test requirements when tested as per AIS-156(Part II) 2020 amendment 4 as mentioned in Annexure-1 of this report.
12	Test Results	Please refer the test requirements and results in ANNEXURE-1 of this report
13	Test Location	EV Test Lab, NATRAX
14	Test Sample applicability on vehicle models:	L Category Only.
15	Any deviation from test method:	No
16	Total No. of Pages	28 (Report with Annexures) + 1 (Drawing)

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ANNEXURE-1

1.0 TEST REQUIREMENTS AND RESULTS:

1.1 Vibration Test			
Reference Standard: AIS 156(Part-II)-2020, (Cl.-6.2.1)			
1.1.1 Procedure			
Sample ID: NATRAX/TB/25-26/172-05	Particulars	Parameter During Test	
	Test Component	REESS Subsystem (Battery Pack)	
	Ambient temperature (20 ± 10°C)	27 °C	
	Test Component SOC (>50%)	>60%	
	Protection Devices of DUT	Fuse	
	Test Axis	Z-Axis (Vertical Axis)	
	Test Component Weight	9.2Kg	
	Frequency Type	Sinusoidal	
	Frequency Sweep	7 Hz to 200 Hz to 7 Hz Frequency [Hz] 7-18	
	For Weight 12Kg or more	Frequency [Hz]	Acceleration [m/s ²]
		7-18	10
		18 -approximately 50	Gradually increased from 10 to 80
		50 - 200	80
	Frequency Sweep Time	15 Minutes	
	Total Frequency Sweep	12	
	Test Duration	3 Hours	
	Observation duration after Standard Cycle	1 Hour	
Test Start Date	10.01.2025		
Test End Date	10.01.2025		
1.1.2 Test Result			
	Requirement	Observations	
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.	
	Standard cycle	Standard cycle was feasible after test.	

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ANNEXURE-1 (Continued)

1.1.3

Vibration Test Setup (Photo)



Test Report

Report time: Jan-10-2025 14:07:12
Test name: Vibration test: as per AIS-156 A3P2
Test status: Test paused

Data measured at: Jan-10-2025 14:07:12
Test type: VCS (Swept Sine)
Run folder: NATRAX/TB/25-26/172 SS

Testing time

Remaining Time: 00:00:00
Run Start Time: Jan-10-2025 09:43:15

Total elapsed time: 03:00:13

Full level elapsed time: 03:00:00

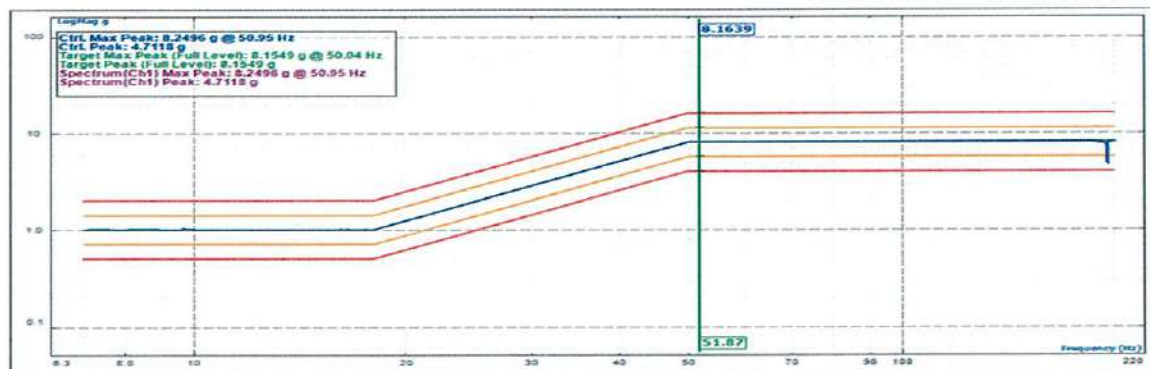
Test parameters

Current Frequency: 195.5 Hz
Signal Plot Points: 2048

Sweeping Rate: 0.64487 Oct/Min
Sweep Type: Logarithmic

Sweep Number: 24

Control Composite



Testing time

Remaining Time: 00:00:00

Total elapsed time: 03:00:13

Full level elapsed time: 03:00:00

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ANNEXURE-1 (Continued)

1.2	Thermal Shock & Cycling Test	
	Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.3.1)	
1.2.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-04	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Ambient temperature ($20 \pm 10^{\circ}\text{C}$)	22 $^{\circ}\text{C}$
	Test Component SOC (>50%)	>70 %
	Protection Devices of DUT	Fuse
	Positive Set Temperature	60 $^{\circ}\text{C}$
	Positive Temperature Duration	6 Hours
	Time taken to reach Negative Set Temperature	30 Minutes
	Negative Set Temperature	-40 $^{\circ}\text{C}$
	Negative Temperature Duration	6 Hours
	Time taken to reach Positive Set Temperature	30 Minutes
	No of Cycles	5
	Storage Time	24 Hours after test
	Test Start Date	07.01.2025
	Test End Date	10.01.2025

1.2.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	Standard cycle	Standard cycle was feasible after test.

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ANNEXURE-1 (Continued)

1.2.3

Thermal Shock & Cycling Test Setup (Photo)



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ANNEXURE-1 (Continued)

1.3	Mechanical Drop Test	
	Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.4.1.1)	
1.3.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-03	Particulars	Parameter During Test
	Test Component	REESS Subsystem
	Ambient temperature ($20 \pm 10^{\circ}\text{C}$)	26 $^{\circ}\text{C}$
	Test Component SOC ($\geq 90\%$)	> 95 %
	Protection Devices of DUT	Fuse
	Test Component Weight	9.4 Kg
	Height of the free fall for REESS	1 m
	Total no. of Drop (Free fall)	6 (Battery has 6 Faces)
	DUT Free fall orientation	Each surface facing floor
	Type of surface	Horizontal concrete pad
	Test Duration	3 Hours
	Observation duration after Standard Cycle	1 Hour
	Test Start Date	07.01.2025
	Test End Date	07.01.2025

1.3.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	Standard cycle	Standard cycle was feasible after test.

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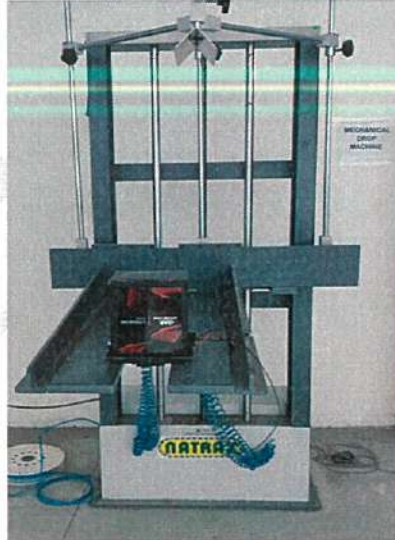
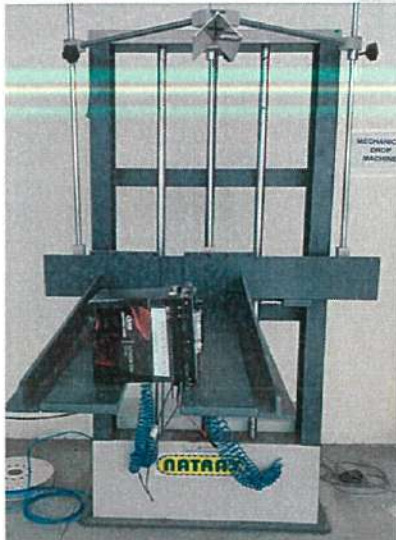
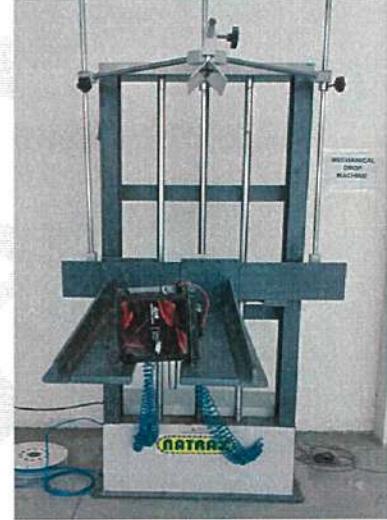
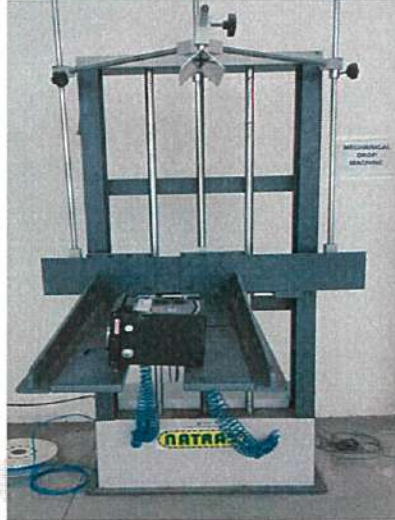
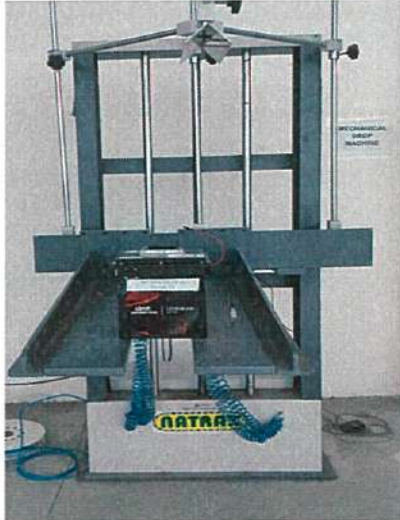
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ANNEXURE-1 (Continued)

1.3.3

Mechanical Drop Test Setup (Photo)



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ANNEXURE-1 (Continued)

1.4	Mechanical Shock	
	Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.4.2.1)	
1.4.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-01	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Ambient temperature (20 ± 10°C)	22 °C
	Test Component SOC (>50%)	>80 %
	Protection Devices of DUT	Fuse
	Test Axis	X-Axis (Linear Axis), Y-Axis (Lateral Axis) and Z-Axis (Vertical Axis)
	Test Component Weight	9.2Kg
	Frequency Type	Half-Sine
	Peak Acceleration	1500 m/s ²
	Pulse Duration	6 milliseconds
	Total Shock	18 (3 shocks in the positive direction followed by 3 shocks in the negative direction in all 3 axis)
	Observation duration after Standard Cycle	1 Hour
	Test Start Date	08.01.2025
	Test End Date	08.01.2025

1.4.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage, (b) Rupture, c) Fire, (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	Standard cycle	Standard cycle was feasible after test.

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ANNEXURE-1 (Continued)

1.4.3

Mechanical Shock Test Setup (Photo)

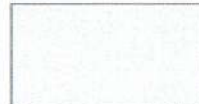


(Tarang Pneumatic Shock Test Machine)

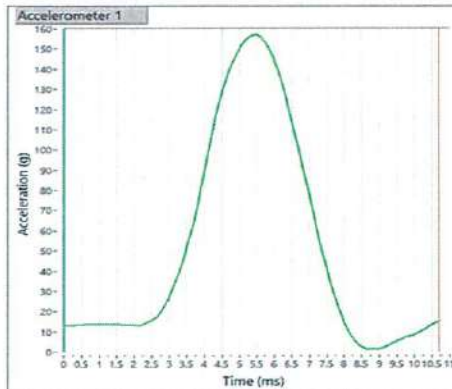
WAVE FORM REPORT

TARANG TSC-1001 Test Report File
Shock Test Number: 1
Time: 2:26:47 PM
Date: 1/8/2025
Test operator: Ambit-Y1
Channel Number: 1
Accelerometer Sensitivity (mV/g): 9.870
Accelerometer S No: LW225807

Observation 2



Selected Test
Peak (g): 156.94
Pulse Duration (ms): -2.50
Filter Cut Off (Hz): 350



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ANNEXURE-1 (Continued)

1.5	Fire Resistance Test Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.5.1)	
1.5.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-01	General Parameter	
	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Ambient temperature (> 0°C)	21°C
	Test Component SOC (>50%)	>80%
	Protection Devices of DUT	Fuse
	Fuel Temperature	Less than 20°C
	Test Fixture Parameter	
	Particulars	Parameters During Test
	Grating Table steel rods diameter (Eqvl.)	6-10 mm
	Distance between Grating Table steel rods	4-6 Cm
	Fuel	Petrol
	Fuel Pan Dimension	L- 250mm, B- 200mm, H- 80mm
	Fuel Level from Pan Top	< 8 cm
	Distance between Fuel Level and DUT	50 cm
	Fixed Component	Fuel Pan
	Movable Component	DUT Fixture
	Screen Height from Fuel Level	3 cm
	Length and Width of the screen	2 to 4 cm smaller than Pan
	Screen Material (Brick)	SK 30
	Test Lab Ventilation	Yes (Indoor with Ventilation)
	Test Parameter	
	Particulars	Parameter During Test
	Fuel Pan distance from DUT	3 m
	Pre-Heating Duration (Phase-A)	60 s
	Duration of DUT direct Exposure to Flame (Phase-B)	70 s
	Duration of DUT direct Exposure to Flame (Phase-C)	60 s
	Observation Time	3 Hours
	Test Start Date	07.01.2025
	Test End Date	07.01.2025

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ANNEXURE-1 (Continued)

1.6	Over-Charge Protection	
	Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.7.1)	
1.6.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-02	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Battery Management System	Available
	Ambient temperature (20 ± 10°C)	24 °C
	Protection Devices of DUT	Fuse
	DUT Condition	Active Mode
	Charging Current	08 A
	Test Stopped when	The charging continued until the tested-device (automatically) interrupts or limits the charging.
	Observation Period	1 Hour
	Test Start Date	07.01.2025
	Test End Date	07.01.2025

1.6.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	Over-charge Protection	Automatic Interruption
	Standard cycle	Standard cycle was feasible after test.
	The tested battery was kept in observation for 1 hour	Normal Functionality was observed.

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1.5.2	Test Result	
	Requirement	Observation
	No explosion at end of test.	No explosion observed.

1.5.3	Test Setup
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1.6.3

Test Setup

1	Test Name: Over Charge 172 S2									
2	Test Date: 07-01-2025 11:54									
3	Operator ID Admin									
4	Program Name CHARGE									
5	Program Description:									
6	Program Data C:\VisualLCN\Programs\NATRAX.mdb									
7	Module Type yd									
8	Module Description LCV 100-80									
9	Address: Port: 1, Sys Controller: 3 Circuit: 1									
10	Name: Port 1, Ctrl Device ID: Unknown									
11										
12	Exclude	Total Time, Cycle	Step		Current, A	Voltage, V	Power, W	Internal Re	Amp-Hour	Watt-Hour: U
13	No	00:01.0	1	1	8	27.01	216	0	0	0
14	No	00:02.0	1	1	8	27.03	216	0	0	0.1
15	No	00:03.0	1	1	7.99	27.04	216	0	0	0.1
16	No	00:04.0	1	1	8	27.05	216	0	0	0.2
17	No	00:05.0	1	1	8	27.06	216	0	0.01	0.2
18	No	00:06.0	1	1	8	27.07	216	0	0.01	0.3
19	No	00:07.0	1	1	8	27.07	216	0	0.01	0.4
20	No	00:08.0	1	1	8	27.08	216	0	0.01	0.4
21	No	00:09.0	1	1	8	27.09	216	0	0.01	0.5
22	No	00:10.0	1	1	8	27.1	216	0	0.02	0.5
23	No	00:11.0	1	1	8	27.1	216	0	0.02	0.6
24	No	00:12.0	1	1	8	27.11	216	0	0.02	0.7
25	No	00:13.0	1	1	8	27.11	216	0	0.02	0.7
26	No	00:14.0	1	1	8	27.12	216	0	0.03	0.8
27	No	00:15.0	1	1	8	27.12	216	0	0.03	0.8
7538	No	05:26.0	1	1	8	29.08	232	0	16.72	457.1
7539	No	05:27.0	1	1	8	29.09	232	0	16.72	457.1
7540	No	05:28.0	1	1	8	29.11	232	0	16.72	457.2
7541	No	05:29.0	1	1	8	29.12	232	0	16.72	457.3
7542	No	05:30.0	1	1	8	29.14	233	0	16.73	457.3
7543	No	05:31.0	1	1	8	29.16	233	0	16.73	457.4
7544	No	05:32.0	1	1	7.99	29.17	233	0	16.73	457.4
7545	No	05:33.0	1	1	0	40.6	0	0	16.73	457.4
7546	No	05:34.0	1	1	0	41.29	0	0	16.73	457.4
7547	No	05:35.0	1	1	0	41.64	0	0	16.73	457.4

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ANNEXURE-1 (Continued)

1.7	Over-Discharge Protection Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.8.1)	
1.7.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-03	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Battery Management System	Available
	Ambient temperature (20 ± 10°C)	22 °C
	Protection Devices of DUT	Fuse
	DUT Condition	Active Mode
	Discharging Current	12 A
	Test Stopped when	The discharging continued until the tested-device (automatically) interrupts or limits the discharging.
	Observation Period	1 Hour
	Test Start Date	07.01.2025
	Test End Date	07.01.2025

1.7.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	Over-discharge Protection	Interrupted the discharging current.
	Standard cycle	Standard cycle was feasible after test.
	The tested battery was kept in observation for 1 hour	Normal Functionality was observed.

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1.7.3 Test Setup

1	Test Name	Over Discharge 172 S3
2	Test Date:	07-01-2025 11:40
3	Operator	II Admin
4	Program	N Dis-charge
5	Program Description:	
6	Program D C:	VisualCN\Programs\NATRAX.mdb
7	Module Ty	yd
8	Module D	LCV 100-80
9	Address:	Port: 1, Sys Controller: 3 Circuit: 14
10	Name:	Port 1, Ctr Device ID:
11		
12	Exclude	Total Time Cycle Current, A Voltage, V Power, W Constant I Internal R Amp-Hour Watt-Hour Use
13	No	00:01.0 1 -12 25.63 -307 2.14 0 0 0
14	No	00:02.0 1 -12 25.6 -307 2.13 0 0 -0.1
15	No	00:03.0 1 -11.99 25.57 -306 2.13 0 0 -0.2
16	No	00:04.0 1 -12 25.55 -306 2.13 0 -0.01 -0.3
17	No	00:05.0 1 -12 25.53 -306 2.13 0 -0.01 -0.4
18	No	00:06.0 1 -12 25.51 -306 2.13 0 -0.01 -0.5
19	No	00:07.0 1 -12 25.5 -306 2.13 0 -0.02 -0.5
20	No	00:08.0 1 -12 25.49 -305 2.12 0 -0.02 -0.6
21	No	00:09.0 1 -12 25.47 -305 2.12 0 -0.02 -0.7
22	No	00:10.0 1 -12 25.47 -305 2.12 0 -0.03 -0.8
23	No	00:11.0 1 -12 25.46 -305 2.12 0 -0.03 -0.9
24	No	00:12.0 1 -12 25.45 -305 2.12 0 -0.03 -1
25	No	00:13.0 1 -12 25.44 -305 2.12 0 -0.04 -1
26	No	00:14.0 1 -12 25.43 -305 2.12 0 -0.04 -1.1
2113	No	35:01.0 1 -12 21.54 -258 1.8 0 -7 -171.2
2114	No	35:02.0 1 -12 21.53 -258 1.79 0 -7 -171.2
2115	No	35:03.0 1 -12 21.51 -258 1.79 0 -7 -171.3
2116	No	35:04.0 1 -12 21.49 -257 1.79 0 -7.01 -171.4
2117	No	35:05.0 1 -12 21.48 -257 1.79 0 -7.01 -171.4
2118	No	35:06.0 1 -12 21.46 -257 1.79 0 -7.01 -171.5
2119	No	35:07.0 1 -12 21.44 -257 1.79 0 -7.02 -171.6
2120	No	35:08.0 1 0.03 -0.31 0 25 0 -7.02 -171.6
2121	No	35:09.0 1 0.03 -0.29 0 25 0 -7.02 -171.6
2122	No	35:10.0 1 0.03 -0.23 0 25 0 -7.02 -171.6
2123	No	35:11.0 1 0.03 0 0 25 0 -7.02 -171.6
2124	No	35:11.9 1 0.03 0.19 0 25 0 -7.02 -171.6

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ANNEXURE-1 (Continued)

1.8	Over-Temperature Protection Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.9.1)	
1.8.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-06	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Temperature Sensor	On Board
	Battery Management System	Available
	Protection Devices of DUT	Fuse
	Chamber Temperature	60°C
	DUT Condition	Active Mode
	Charging Current	08 A
	Discharging Current	12 A
	Test Stopped when	Battery inhibits and/or limits the charge and/or discharge to prevent the temperature increase- (Auto Cut-off)
	Observation Period	1 Hour
	Test Start Date	07.01.2025
	Test End Date	07.01.2025

1.8.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	Over-temperature Protection	Inhibited and limits the charge to prevent the temperature increase, when battery temperature reached 55°C.

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ANNEXURE-1 (Continued)

1.9	Thermal Propagation Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.11)	
1.9.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-06	Particulars	Parameter During Test
	Test Component	REESS Subsystem (Battery Pack)
	Battery Management System	Operational
	Test Component SOC	> 95 %
	Trigger Method	Heating method
	Initiation cell temperature	15.6°C
	Maximum temperature (declared by the manufacturer)	60°C
	DUT Condition	OK
	Thermal runaway condition (i) The measured voltage of the initiation cell drops: (ii) The measured temperature exceeds [the maximum operating temperature defined by the manufacturer] (iii) $dT/dt \geq [1^\circ\text{C/s}]$ of the measured temperature. Thermal runaway can be judged when: (a) Both (i) and (iii) are detected: or (b) Both (ii) and (iii) are detected	Thermal runaway detected. 1) Condition (i), (ii) and (iii) were met as per the following: a) The measured temperature was 381°C. b) The declared operating temperature by manufacturer was 60°C c) $dT/dt = 150.2 - 144.7 / (1289 - 1286) = 5.5/3 = 1.8$ Therefore $dT/dt > [1^\circ\text{C/s}]$. 2). The Audio-visual alarm activated above 60°C.
	Test Stopped when	The test was stopped after detection of thermal runaway and No fire and no Explosion happened
	Test Start Date	08.01.2025
	Test End Date	08.01.2025

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1.9.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Fire. (b) Explosion.	1. No fire and No explosion observed during test. 2. The Audio-visual alarm activated above 60°C, 3. Max test temp. reached 381 °C. 4. As thermal runaway occurred and no fire or no explosion occurred, therefore the tested device meets thermal propagation requirement.

1.9.3	Documentation	
1.9.3.1	REESS manufacturer shall submit a risk reduction analysis using appropriate industry standard methodology (for example, IEC 61508, MIL-STD 882E, ISO 26262, AIAG DFMEA, fault analysis as in SAE J2929, or similar), which documents the risk to vehicle user and bystanders caused by thermal propagation which is triggered by an internal short circuit leading to a single cell thermal runaway and documents the reduction of risk resulting from implementation of the identified risk mitigation functions or characteristics.	Verified based on declaration submitted by the manufacturer vide document Annexure-A_DFMEA No Letter no:- 004, dt:- 10.12.2024
1.9.3.2	REESS manufacturer shall submit a system diagram of all relevant physical systems and components. Relevant systems and components are those which contribute to the protection of vehicle user and bystanders from hazardous effects caused by thermal propagation triggered by a single cell thermal runaway.	Verified based on declaration submitted by the manufacturer vide document of declaration Letter no:- 004, dt:- 10.12.2024
1.9.3.3	REESS manufacturer shall submit a diagram showing the functional operation of the relevant systems and components, identifying all risk mitigation functions or characteristics.	Verified based on declaration submitted by the manufacturer vide document of declaration Letter no:- 004, dt:- 10.12.2024

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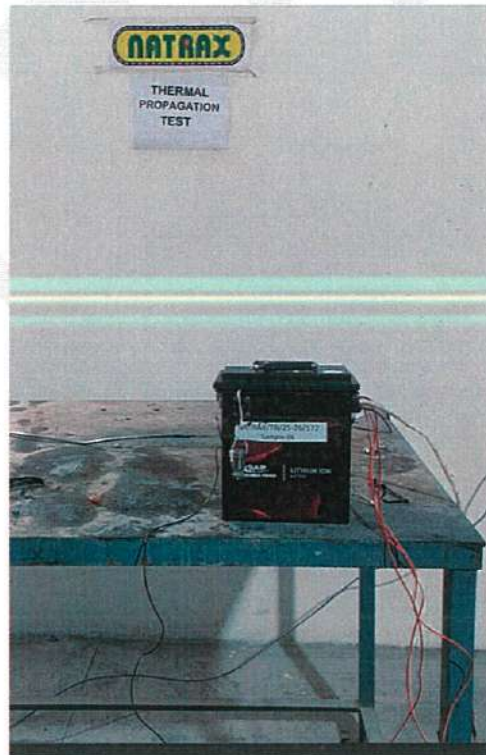


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1.9.4 Test Setup

	L	U	F	H
1	Thermal Propagation Ambient -172			
2	Date: - 08.01.2025			
3	Case Id: - NATRAX/TE/24-25/172			
4		Voltage	Temp	Temp02
5	0	3.36161	15.3293	15.6526
6	1	3.36161	15.3293	15.6526
7	2	3.36161	15.3293	15.6526
8	3	3.36161	15.3293	15.6526
9	4	3.36161	15.3293	15.6526
10	5	3.36161	15.3293	15.6526
11	6	3.36161	15.3293	15.6526
12	7	3.36161	15.3524	15.6526
13	8	3.36161	15.3524	15.6526
14	9	3.36161	15.3524	15.6526
15	10	3.36161	15.3524	15.6526
16	11	3.36161	15.3524	15.6526
1283	1278	1.377	123.518	386.762
1284	1279	0.223395	129.728	567.63
1285	1280	-0.105594	138.271	674.018
1286	1281	-9.77E-02	144.781	748.66
1287	1282	-4.15E-02	148.129	792.688
1288	1283	-1.53E-02	149.514	829.882
1289	1284	-1.16E-02	150.23	843.019
1290	1285	-1.16E-02	150.992	840.849
1291	1286	-1.19E-02	151.985	814.044
1292	1287	-1.19E-02	153.255	771.632
1293	1288	-1.19E-02	154.663	748.591
1294	1289	-1.19E-02	156.141	736.747
1295	1290	-1.16E-02	157.687	714.698
1387	1382	3.66E-03	379.767	529.49
1388	1383	3.66E-03	379.952	527.989
1389	1384	3.66E-03	380.205	526.511
1390	1385	3.36E-03	380.459	525.011
1391	1386	3.36E-03	380.713	523.556
1392	1387	3.05E-03	380.852	522.102
1393	1388	3.05E-03	381.037	520.647
1394	1389	2.75E-03	381.244	519.216
1395	1390	2.44E-03	381.36	517.761
1396	1391	2.14E-03	381.383	516.353
1397	1392	2.14E-03	381.383	514.968
1398	1393	1.83E-03	381.406	513.629
1399	1394	1.53E-03	381.429	512.336
1400	1395	1.53E-03	381.706	511.043
1401	1396	1.22E-03	381.775	509.773
1402	1397	1.22E-03	381.775	508.503
1403	1398	1.22E-03	381.729	507.256



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ANNEXURE-1 (Continued)

Water Ingress Protection Test

TEST REQUIREMENTS AND RESULTS:

1.10	<p style="text-align: center;">IPX7</p> <p style="text-align: center;">Reference Standard: IEC 60529, AIS 156(Part-II)-2020 (Cl.-6.1.1)</p>
1.10.1	Procedure
Sample ID: NATRAX/TB/25-26/172-03	<p>REESS with 100% SOC shall be tested: -</p> <div style="margin-left: 20px;"> <input checked="" type="checkbox"/> The lowest point of enclosures with a height less than 850 mm is located 1000 mm below the surface of water. </div> <div style="margin-left: 20px;"> <input type="checkbox"/> The highest point enclosures with a height equal to or greater than 850 mm is located 150 mm below the surface of the water </div> <p>Test Date: - 08.01.2025</p> <p>Test duration: - 30 min</p> <p>Acceptance Criteria: - There shall be no fire or explosion during testing of REESS.</p> <p>Test Result: - At the end of the test, no fire and no explosion was observed from tested device.</p>

1.10.2	Test Setup
	
	

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1.11.3

Test Setup



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ANNEXURE-1 (Continued)

1.11	External Short Circuit Protection Reference Standard: AIS 156(Part-II)-2020 (Cl.-6.6.1)	
1.11.1	Procedure	
Sample ID: NATRAX/TB/25-26/172-01	Particulars	Parameters During Test
	Test Component	REESS Subsystem (Battery Pack)
	Battery Management System	Available
	Ambient temperature (20 ± 10°C)	23°C
	Test Component SOC (>50%)	>70%
	Protection Devices of DUT	Fuse
	DUT Condition	Active Mode
	Test Component Weight	9.2Kg
	Connector resistance	< 5 mΩ
	Test Stopped when	REESS operated and interrupted the short circuit.
	Observation duration after Standard Cycle	1 Hour
	Test Start Date	07.01.2025
	Test End Date	07.01.2025

1.11.2	Test Result	
	Requirement	Observations
	During the test, there shall be no evidence of: (a) Electrolyte leakage (b) Rupture c) Fire (d) Explosion	No Electrolyte leakage, no rupture, no fire and no explosion.
	External Short Circuit Protection	REESS operated and interrupted the short circuit as soon as the current crossed the upper limit set in the Battery Management System
	Standard cycle	Standard cycle was feasible after test.
	The tested battery was kept in observation for 1 hour	Normal Functionality was observed.

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ANNEXURE-1 (Continued)

Sr.N	Cl. No.	Verification/Test Name	Date	Observation	Result
2.0 Verifications:					
2.1	6.1.2.1	BMS Shall be microprocessor/ microcontroller-based circuit	07.01.2025	Microcontroller Make: JPM	Complied
2.2	6.1.2.2	BMS shall comply EMC requirements as per AIS 004 Part 3 or AIS 004 Part 3 Rev 1 as applicable at ESA level (test report Verification)	07.01.2025	Report no: CT1MT0574, dated:- 08.08.2024, CT0MT0273, Dated:- 06.04.2024.	Complied
2.3	6.1.2.3 (a)	BMS over charge protection	07.01.2025	29.17V	Complied
2.4	6.1.2.3 (b)	BMS over discharge protection	07.01.2025	21.4V	Complied
2.5	6.1.2.3 (c)	BMS over temperature	07.01.2025	T charge= 55°C T discharge=60°C	Complied
2.6	6.1.2.3 (d)	BMS over current protection	07.01.2025	Charge Current =22A Discharge Current = 42A	Complied
2.7	6.1.2.3 (e)	BMS Short circuit protection	07.01.2025	Verified	Complied
2.8	6.1.3(a)	Charger voltage cut off	07.01.2025	29.15V	Complied
2.9	6.1.3(b)	Charger Soft start function	07.01.2025	Initial Current= 0.8 A Set Current= 7.2A	Complied
2.10	6.1.3 (c)	Charger Pre-charge function to detect over discharge	07.01.2025	Verified	Complied
2.11	6.1.3(d)	Charger Input supply variation with battery pack	07.01.2025	Verified	Complied
2.12	6.1.3(e)	Charger Earth leakage detection	07.01.2025	Verified	Complied
2.13	6.1.3(f)	Charger Communication verification with battery pack	07.01.2025	Verified	Complied

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ANNEXURE-1 (Continued)

Sr.N	Cl. No.	Verification/Test Name	Date	Observation	Result
2.0 Verifications:					
2.14	Annexure 8k-(1)	Verification of manufacturing date on cell	07.01.2025	Verified	Complied
2.15	Annexure 8k-(2)	Cell report Verification as per IS 16893	07.01.2025	Report No. ATS/230816/05, 06. Dated:- 09-10-2023	Complied
2.16	Annexure 8k-(3)	Verification of cell charge/discharge cycle data	08.01.2025	Verified	Complied
2.17	Annexure 8k-(4)	Verification of pressure release vent	07.01.2025	Verified	Complied
2.18	Annexure 8k-(5)	Verification of temperature sensor	07.01.2025	Verified	Complied
2.19	Annexure 8k-(6)	Verification of active paralleling circuit in the battery pack	07.01.2025	Verified	Complied
2.20	Annexure 8k-(7)	Verification of the cell to cell spacing in battery pack	07.01.2025	2.3 mm	Complied
2.21	Annexure 8k-(8)	Verification of additional safety fuse/ circuit breaker	07.01.2025	Verified	Complied
2.22	Annexure 8k-(9)	Verification of the cells, BMS, charger w.r.t serial number	07.01.2025	Verified	Complied
2.23	Annexure 8k-(10)	Protection against regenerative braking	08.01.2025	BMS is capable to restrict the regenerative current, as declared by customer.	Complied
2.24	Annexure 8k-(11)	BMS data logging	07.01.2025	Verified	Complied

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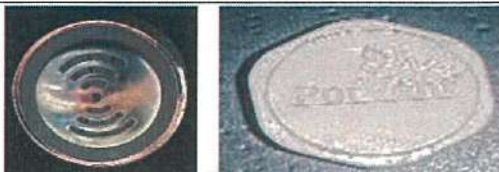


Verification

Verification of Temperature Sensor



Verification of Pressure Release vent & Visual Alarm



Verification of Safety Fuse- 40A



Verification of Microcontroller-based circuit



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