Product Service

TEST REPORT

ANSI/CAN/UL 9540A:2019

TUV SUD Test Report for Module Level – Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems on Module Level

Report No.:	64.280.24.60054.01
Date of issue:	2024-09-24
Project handler:	5.1.2e
Testing laboratory:	TÜV SÜD New Energy Testing (Guangdong) Co., Ltd.
Address:	North-1/F, 2/F & Unit 301-3/F, TÜV SÜD Testing Center, D1, 5.1.2e 5.1.2e Shilou Town, Panyu District, Guangzhou 511447, China
Testing location:	As above
Client:	Huawei Technologies Co., Ltd.
Client number:	041829
Address:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, 5.1.2e Shenzhen, PEOPLE'S REPUBLIC OF CHINA
Contact person:	5.1.2e
Standard:	This TUV SUD test report form is based on the following requirements: ANSI/CAN/UL 9540A:2019 Fourth Edition (4Ed)
TRF number and revision:	TRF ANSI/CAN/UL 9540A:2019 Rev 0
eDoc_ID:	
TRF originated by:	TUV SUD NEW ENERGY TESTING (GUANGDONG) CO., LTD., 5.1.2e
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Non-standard test method: National deviations:	☒ No ☐ Yes, see details under *Summary of testing* N/A		
Number of pages *(Report)*: Number of pages *(Attachments)*:	36 N/A		
Compiled by: (+ signature)	5.1.2e 5.1.2e	Approved by: (+ signature)	5.1.2e

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Test sample:	Protype Sample
Type of test object:	Rechargeable Lithium Ion Battery (Energy Storage Module)
Trademark:	HUAWEI
Model and/ or type reference:	ESM-166560AS1
Rating(s):	166.4Vd.c., 560Ah

Manufacturer:	Huawei Technologies Co., Ltd.
Manufacturer number:	041829
Address:	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Ban[5.1.2e] District, [5.1.2e] Shenzhen, PEOPLE'S REPUBLIC OF CHINA
Name and address of factory(ies)	
Huizhou Sunwoda Energy Technology Co., Ltd. "Jiduwei" (local name) section of Z[5.1.2e] Lixi Economic Union, Yuanzhou Town, Bol[5.1.2e] County, [5.1.2e] Huizhou City, Guangdong, PEOPLE'S REPUBLIC OF CHINA	

Sub-contractors / tests (clause):	N/A
Name:	N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order:	2024-02-02
Date of receipt of test item:	2024-05-13
Date(s) of performance of test:	2024-05-16 to 2024-09-23
Test item particulars:	
According to Module Level of ANSI/CAN/UL 9540A:2019 Fourth Edition. Decision rule according to IEC Guide 115:2023, clause 4.3 was applied.	
Purpose of the product (description of intended use):	
Rechargeable Lithium Ion Battery (Energy Storage Module), model no. ESM-166560AS1 is used in Battery Energy Storage Systems.	

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Characteristic data (not shown on the marking plate):	
Product name	Rechargeable Lithium Ion Battery (Energy Storage Module)
Type/model	ESM-166560AS1
Nominal voltage	166.4Vd.c.
Rated capacity	560Ah
Charging voltage specified by manufacturer	187V
Charging current specified by manufacturer for charge and discharge cycles	112A
Maximum continuous charging current	331.85A
Discharging current specified by manufacturer for charge and discharge cycles	112A
Maximum continuous discharging current	331.85A
End of discharge voltage	140.4V or any cell reaches 2.5V
Standard charging method specified by manufacturer	Charge at constant current 112A until voltage reaches 187V or any cell reaches 3.6V, then charge at constant current 60A until voltage reaches 187V any cell reaches 3.65V.
Standard discharging method specified by manufacturer	Discharge at constant current 112A until voltage reaches 140.4V or any cell reaches 2.5V.
Dimension	Width*Depth*Height: 785mm*2135mm*249mm
Weight	(670±10)kg
Number of cells in module and module configuration	2P52S

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Attachments:

Attachment 1: Exploding drawing of module & Identification/location of cells within the module
Attachment 2: Pre-conditioning profile
Attachment 3: Photo(s) for sample(s) before test and test setup with thermocouple location
Attachment 4: Photo(s) for sample(s) after test
Attachment 5: Monitored temperature chart
Attachment 6: Flammable gas generation and composition data chart
Attachment 7: Heat release rate versus time data chart
Attachment 8: Peak smoke release rate and total smoke release data chart
Attachment 9: Summary of Heat release rate & Peak smoke release rate and total smoke release data

If additional information is necessary, please provide

N/A

Copy of marking plate:

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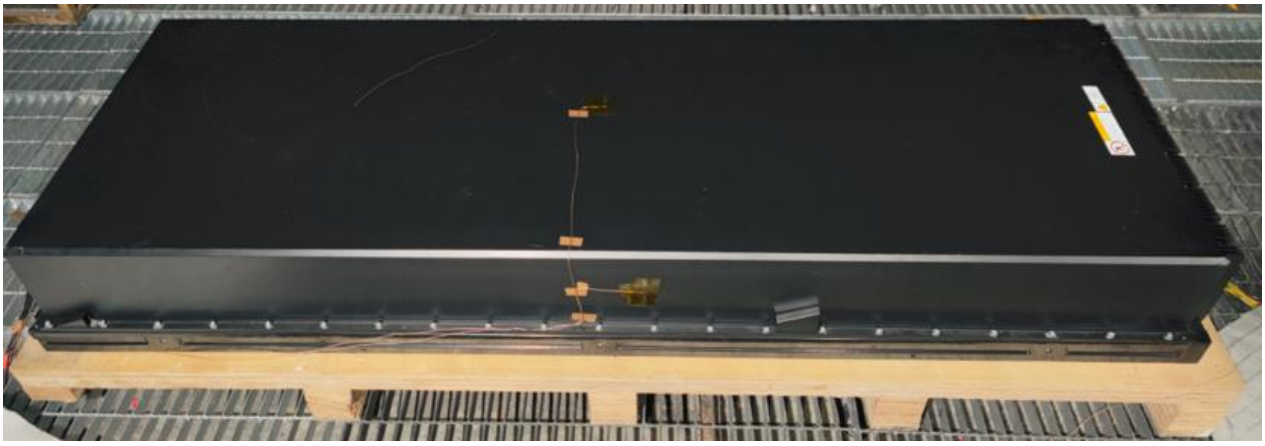
Pictures of the product:



Summary of testing:

>>>> module level testing:

Module model number	ESM-166560AS1
Nominal voltage and rated capacity	166.4Vd.c., 560Ah
Number of cells in module and module configuration	2P52S
Whether UL 1973 compliant	No related documentation was provided
Module voltage corresponding to the tested SOC	173.72V
Method used to initiate thermal runaway	Heating the cell with externally applied flexible film heaters that cover two wider side surfaces of the cell
Thermal runaway of other cells within module:	Cell 20-2, Cell 21-1, Cell 21-2 (see Attachment 1)
Heat release rate versus time data	See Attachment 7 and Attachment 9
Peak smoke release rate and total smoke release data	See Attachment 8 and Attachment 9
Flammable gas generation and composition data	See Table 2 and Attachment 6
Observation(s) of flying debris:	No observation of flying debris
Observation(s) of explosive discharge of gas:	No observation of explosive discharge of gas
Observation(s) of sparks, electrical arcs or other electrical events:	No observation of sparks, electrical arcs or other electrical events
Locations and visual estimations of flame	No observation of flame
Re-ignitions	N/A (No flame during test)
Performance - module level test:	
a) Thermal runaway is contained by module design; and	Thermal runaway was contained by module design
b) Cell vent gas is nonflammable as determined by the cell level test.	The cell vent gas presented a flammability hazard

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Performance - cell level test: (tested by UL-CCIC Company Limited Guangzhou Branch, Report No.: 4789795626)	
a) Thermal runaway cannot be induced in the cell; and	Thermal runaway was induced in the cell
b) The cell vent gas does not present a flammability hazard when mixed with any volume of air, as determined in accordance with ASTM E918 at both ambient and vent temperatures.	The cell vent gas presented a flammability hazard

☐ deviation(s) found

☐ no deviations found

The product fulfils the requirements of: ☐ UL 9540A (as indicated on page 1)
☐ CAN/UL 9540A (as indicated on page 1)

☒ Please refer to Table 1, Table 2 and Table 3 for the test results.

Additional information on non-standard test method(s)

Sub clause:	N/A
Page:	N/A
Rational:	N/A

Possible test case verdicts:	
test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)

General remarks:

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report ***a*** ☐ ***Comma*** / ☒ ***Point*** *is used as the decimal separator.*

The test results presented in this report relate only to the object tested.

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MODULE LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	INTRODUCTION		
1.	**Scope**		—
2	**Units of Measurement**		—
3	**Normative References**		—
4	**Glossary**		—
	CONSTRUCTION		
5.	**General**		P
5.1	**Cell**		P
5.1.1	The cells associated with the BESS that were tested shall be documented in the test report, including cell chemistry (e.g. NMC, LFP), the physical format of the cell (i.e. prismatic, cylindrical, pouch), cell electrical rating in capacity and nominal voltage, the overall dimensions of the cell, and weight.		P
5.1.2	The cell documentation included in the test report shall indicate if the cells associated with the BESS comply with UL 1973.	No related documentation was provided	N/A
5.1.3	Refer to 7.6.1 for further details to be included in the cell level test report		P
5.2	**Module**		P
5.2.1	The modules associated with the BESS that were tested shall be documented in the test report, including the generic (e. g., metallic or nonmetallic) enclosure material, the general layout of the module contents and the electrical configuration of the cells in the modules and the modules in the BESS.	Metallic enclosure	P
5.2.2	The module documentation included in the test report shall indicate if the modules associated with the BESS comply with UL 1973.	No related documentation was provided	N/A
5.2.3	Refer to 8.3 for further details to be included in the module level test report.		P
5.3	**Battery energy storage system unit**		—
5.4	**Flow Batteries**		—
	PERFORMANCE		
6	**General**		P

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MODULE LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
6.1	The tests in this standard are extreme abuse conditions conducted on electrochemical energy storage devices that can result in fires, explosions, smoke, off gassing of flammable and toxic materials, exposure to toxic and corrosive liquids, and potential exposure to hazardous voltages and electrical energy. See Annex B for recommended testing practices.		P
6.2	At the conclusion of testing, samples shall be discharged in accordance with the manufacturer's specifications. All samples shall be disposed of in accordance with local regulations.		P
7	**Cell Level**		—
8	**Module Level**		F
8.1	**Sample**		P
8.1.1	Module samples shall be conditioned, prior to testing, through charge and discharge cycles for a minimum of 2 cycles, using a manufacturer specified methodology to verify that the module is functional. Each cycle shall be defined as a charge to 100% SOC and allowed to rest a maximum of 8 h and then discharged to an end of discharge voltage (EODV) specified by the module manufacturer. During conditioning the ambient temperature and conditions shall be maintained in accordance with 8.2.1.	See Attachment 2: Pre-conditioning profile Charging method: Charge at constant current 112A until voltage reaches 187V or any cell reaches 3.6V, then charge at constant current 60A until voltage reaches 187V any cell reaches 3.65V. Discharge method: Discharge at constant current 112A until voltage reaches 140.4V or any cell reaches 2.5V.	P
8.1.2	The module to be tested shall be charged to 100% SOC and allowed to rest a maximum of 8 h before the start of the test. The module voltage shall be determined by measuring at the module terminals after charging up to the fully charged condition and before beginning testing. The sample module shall stabilize for a minimum of one hour prior to testing		P
8.1.3	Electronics and software controls such as the battery management system (BMS) are not relied upon for this testing.		P

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MODULE LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
8.2	**Test method**		P
8.2.1	Ambient indoor laboratory conditions shall be 25 ±5°C (77 ±9°F) and 50 ±25% RH at the initiation of the test.		P
8.2.2	The test shall be conducted under a smoke collection hood that is sized appropriately to collect the gasses generated from the module.		P
8.2.3	The weight of the module shall be recorded before and after testing is completed to determine weight loss.		P
8.2.4	The number of cells within the module that are forced into thermal runaway can be one or multiple cells, and is dependent upon the energy contained within the individual cells. A sufficient number of cells shall be forced into thermal runaway to create a condition of cell to cell propagation within the module. For example, it may be necessary to force nine, 3-Ah cells into thermal runaway as opposed to one, 30-Ah cell in order to get cell to cell propagation. The location of the cell (s) forced into thermal runaway shall be selected to present the greatest thermal exposure to adjacent cells that are not forced into thermal runaway. Factors to be taken into consideration shall include selecting locations within the module where heat transfer is maximized to other cells, cooling by ventilation is restricted or limited, and thermal sensors, detection and suppression discharge points are remote.		P
8.2.5	The methodology used for initiating thermal runaway pursuant to 7.2 shall be used to initiate thermal runaway within the module.		P
8.2.6	With reference to 8.2.5, occurrence of thermal runaway shall be verified by sustained temperature above the cell surface temperature at the onset of thermal runaway, as determined in Section 7.		P
8.2.7	The module shall be placed on top of a noncombustible horizontal surface with the module orientation representative of its intended final installation.		P
8.2.8	The chemical heat release rate of the module in thermal runaway shall be measured with oxygen consumption calorimetry.		P
8.2.9	The chemical heat release rate shall be measured for the duration of the test. See 8.2.10.		P
8.2.10	The chemical heat release rate shall be measured by a measurement system consisting of a paramagnetic		P

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MODULE LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	oxygen analyzer, non-dispersive infrared carbon dioxide and carbon monoxide analyzer, velocity probe, and a Type K thermocouple. The instrumentation shall be located in the exhaust duct of the heat release rate calorimeter at a location that minimizes the influence of bends or exhaust devices. See 8.2.11.		
8.2.11	With reference to 8.2.10, calculate the chemical heat release rate at each of the flows as follows: $HRR_i = \left\| E \times \varphi \cdot (E_{\infty} \cdot E) \times \frac{1-\eta}{2} \times \frac{X_{O_2}^{\infty}}{X_{O_2}^{a}} \right\| \times \frac{\dot{m}_a}{1+\varphi \times (\alpha-1)} \times \frac{M_{O_2}}{M_a} \times (1 - X_{H_2O}^{\infty}) \times X_{O_2}^{\infty}$		P
8.2.12	Vent gas composition shall be measured using a Fourier-Transform Infrared Spectrometer with a minimum resolution of 1 cm-1 and a path length of at least 2 m (6.6 ft), or equivalent gas analyzer, and velocity and temperature measurements respectively shall be obtained in the exhaust duct of the heat release rate calorimeter using equipment specified in 8.2.10.		P
8.2.13	The hydrocarbon content of the vent gas shall be measure using flame ionization detection. Hydrogen gas shall be measured with a palladium-nickel thin-film solid state sensor.		P
8.2.14	The light transmission in the exhaust duct of the heat release rate calorimeter shall be measured using a white light source and photo detector for the duration of the test, and the smoke release rate shall be calculated. See 8.2.15.		P
8.2.15	Smoke release rate shall be calculated as follows: $SRR = 2.303\left(\frac{V}{D}\right) Log_{10}\left(\frac{I_o}{I}\right)$		P
8.3	**Module level test report**		P
8.3.1	The report on module level testing shall include the following:	(See appended table)	P
	a) Module manufacturer name and model number (and whether UL 1973 compliant)	Module manufacturer name: Huawei Technologies Co., Ltd. Model number: ESM-5.1.2e No related documentation for UL 1973 was provided	P
	b) Number of cells in module;	104pcs cells in module	P
	c) Module configuration with cells in series and parallel;	2P52S	P
	d) Module construction features per 5.2;	See Attachment 1	P

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MODULE LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	e) Module voltage corresponding to the tested SOC;	See Table 1	P
	f) Thermal runaway initiation method used including number and locations of cells for initiating thermal runaway;	See Table 1 and Attachment 1	P
	g) Heat release rate versus time data;	See Attachment 7 and 9	P
	h) Flammable gas generation and composition data;	See Table 2 and Attachment 6	P
	i) Peak smoke release rate and total smoke release data.	See Attahment 8 and 9	P
	j) Observation(s) of flying debris or explosive discharge of gases;	See Table 1	P
	k) Observation(s) of sparks, electrical arcs, or other electrical events;	See Table 1	P
	l) Identification/location of cells(s) that exhibited thermal runaway within the module;	See Table 1	P
	m) Locations and visual estimations of flame extension and duration from the module shall be documented;	See Table 1	P
	n) Module weight loss based on measurements per 8.2.3; and	See Table 1	P
	o) Video of the test.		P
8.4	**Performance at module level testing**		F
8.4.1	Unit level testing in Section 9 is not required if the following performance conditions are met during the module level test:	"F" in this clause indicates that unit level testing is required	F
	a) Thermal runaway is contained by module design; and	Thermal runaway was contained by module design	P
	b) Cell vent gas is nonflammable as determined by the cell level test.	"F" in this clause indicates that cell vent gas presented a flammability hazard	F
9	**Unit Level**		—
10	**Instalaton Level**		—

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MODULE LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict

ANNEX A	**Test Concepts And Application Of Test Results To Installations** (informative)		—
A1	Introduction		N/A
A2	Test Methodology and Purpose		N/A
A3	Evaluating the Results		N/A

ANNEX B	**Safety Recommendations for Testing** (informative)		—
B1	General		P

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MODULE LEVEL

TABLE: Critical components information					
Object/part no.	**Manufacturer/ trademark**	**Type/model**	**Technical data**	**Standard**	**Mark(s) of conformity**
Rechargeable Li-ion Cell	EVE POWER Co., Ltd	LF280K	3.2Vd.c., 280Ah	-	-
Enclosure	Huawei Technologies Co., Ltd.	-	Top: Fe, 03Z80, 1.0mm Front: AL, DC01, 1.2mm Bottom: Fe, Q500, 1.5mm AL, 3003, 1.2mm AL, 6060, 5.0mm Fe, 03Z80, 1.2mm	-	-
Supplementary information: N/A					

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MODULE LEVEL

MODULE LEVEL TEST RESULT:

Table 1: Thermal runaway test result	
Initial ambient temperature:	25.8 °C
Initial relative humidity:	59%RH
Pre-conditioning time	From 2024-05-14 17:12:07 to 2024-05-15 22:12:51
Thermal runwaway test start time	2024-05-16 20:26:54
Module voltage (OCV) before test:	173.72V
Methods used to initiate thermal runaway	Heating the cell with externally applied flexible film heaters that cover two wider side surfaces of the cell
Average heating rate:	5.6 °C/min
Surface temperature at which gases were first vented:	246.1 °C
Time when gases were first vented:	2024-05-16 21:21:04
Surface temperature prior to thermal runaway:	240.3 °C
Time when thermal runaway:	2024-05-16 21:23:26
Module voltage (OCV) after test:	166.75V
Location of cell(s) for intiating thermal runaway	Cell 20-1 (see Attachment 1)
Thermal runaway of other cells within module:	Cell 20-2, Cell 21-1, Cell 21-2 (see Attachment 1)
Observation(s) of flying debris:	No observation of flying debris
Observation(s) of explosive discharge of gas:	No observation of explosive discharge of gas
Observation(s) of sparks, electrical arcs or other electrical events:	No observation of sparks, electrical arcs or other electrical events
Locations and visual estimations of flame	No observation of flame
Module weight before test:	674.5kg
Module weight after test:	674.0kg

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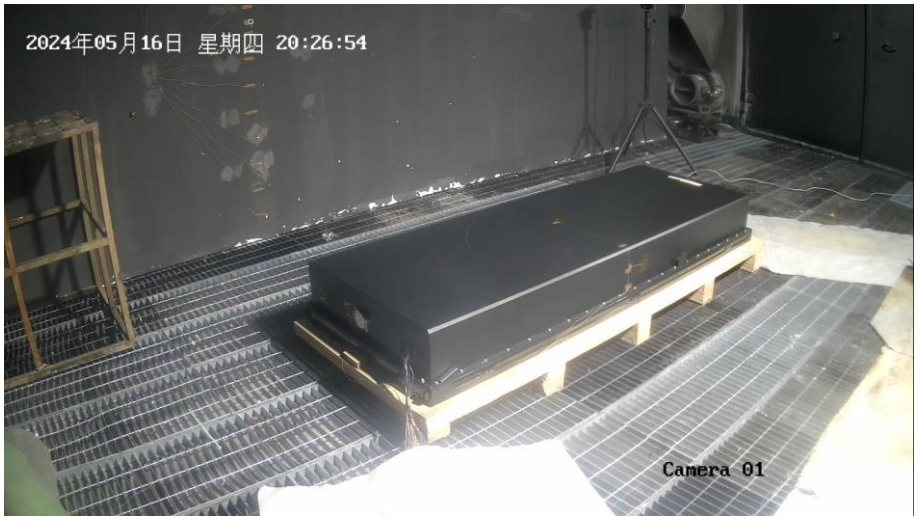
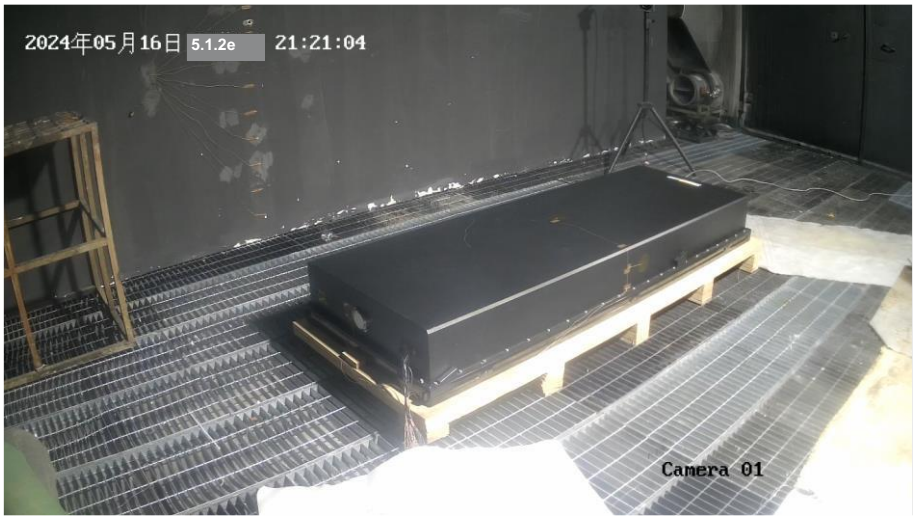
MODULE LEVEL

Module weight loss:	0.5kg	
Timeline of thermal runaway		
Time (hh:mm:ss)	Event	Description
2024-05-16 20:26:54	Start testing	
2024-05-16 21:21:04	The initiating cell vented	

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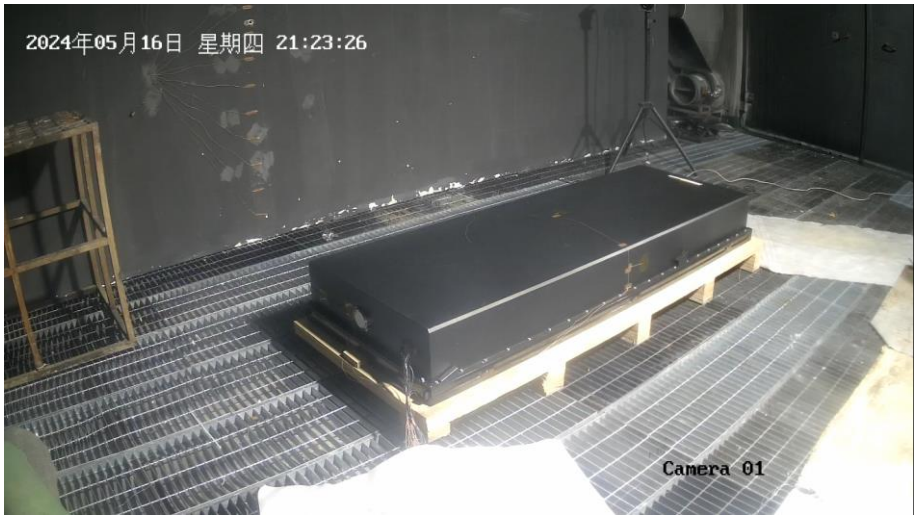
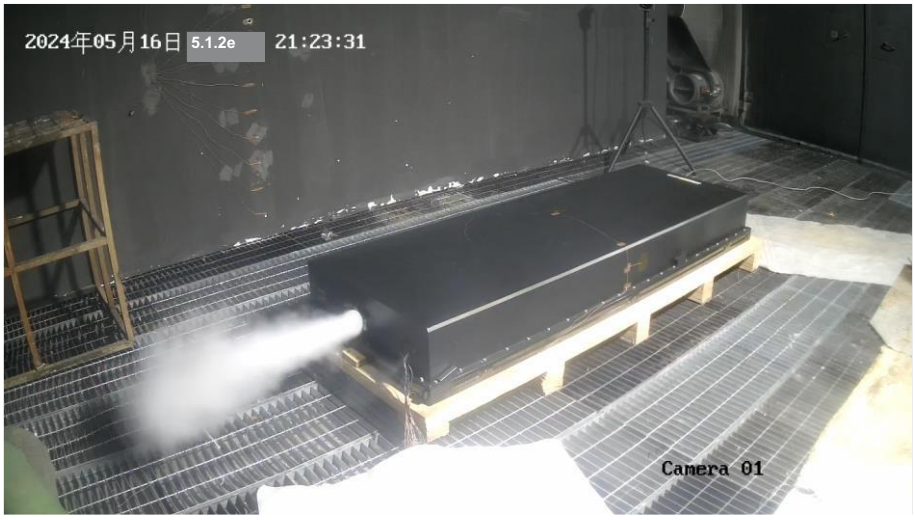
MODULE LEVEL

2024-05-16 21:23:26	The temperature of initiating cell started to rise sharply, thermal runaway occurred	
2024-05-16 21:23:31	After the initiating cell thermal runaway, smoke started to generate continuously	
2024-05-16 21:24:42	After the initiating cell thermal runaway, smoke generated continuously	

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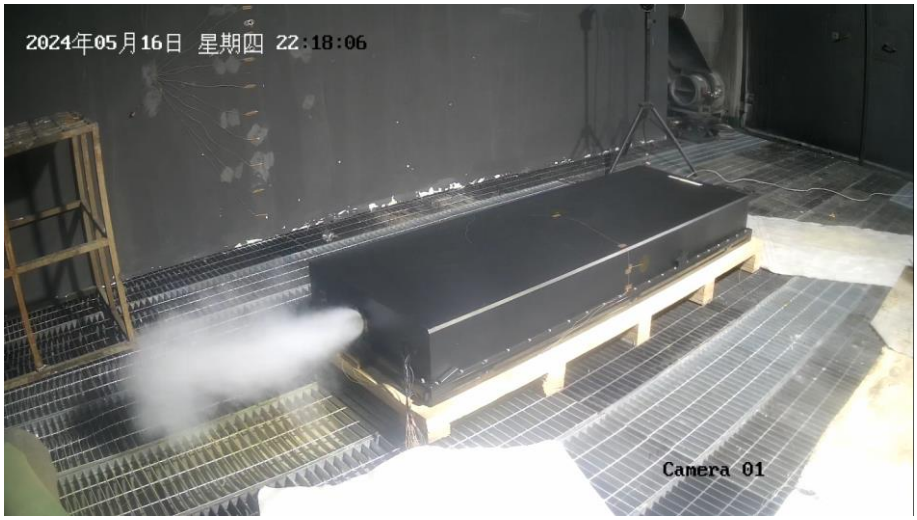
2024-05-16 21:26:59	Smoke reduced	
2024-05-16 21:29:33	First propagation occurred, smoke generated continuously	
2024-05-16 22:18:06	Last propagation occurred, smoke generated continuously	

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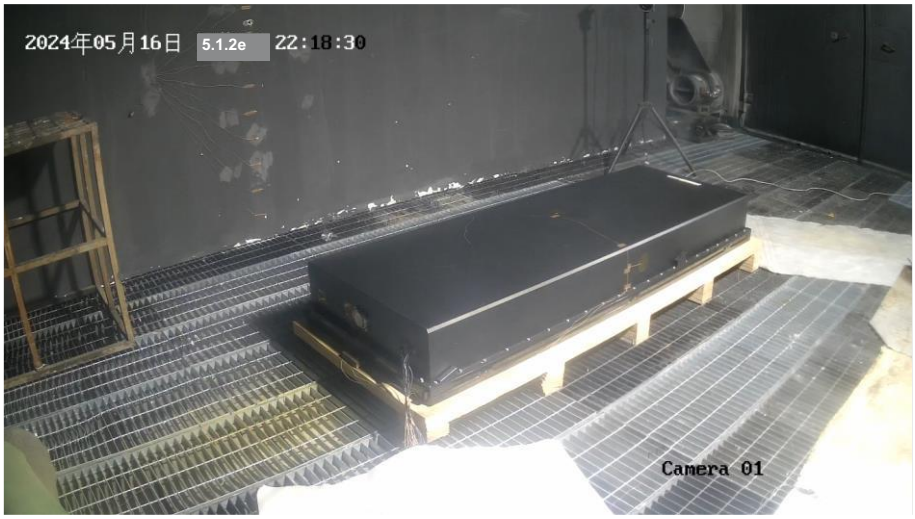
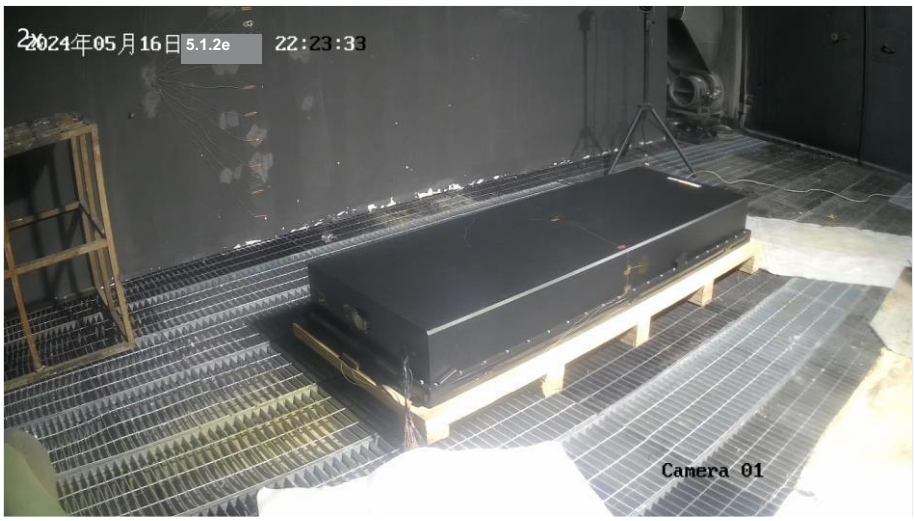
2024-05-16 22:18:30	Smoke released slowly	
2024-05-16 22:23:33	No smoke released	

Remark: Refer to attachment 3 for details of sample before test and test setup with thermocouple location

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Table 2: Vented gas composition result				
Composition	Chemical formula	Measurement peak (L/s)	Measurement (L)	Analysis Method
Carbon monoxide	CO	0.0031	0.0353	FTIR
Carbon dioxide	CO2	0.0322	14.5593	FTIR
Methane	CH4	0.0020	0.0919	FTIR
Acetylene	C2H2	-	-	-
Ethene	C2H4	-	-	-
Ethane	C2H6	-	-	-
Propane	C3H8	-	-	-
Butane	C4H10	-	-	-
Pentane	C5H12	-	-	-
Benzene	C6H6	-	-	-
Hexane	C6H14	-	-	-
Hydrofluoric acid	HF	-	-	-
Hydrogen chloride	HCl	-	-	-
Diethyl carbonate	C5H10O3	-	-	-
Ethyl methyl carbonate	C4H8O3	0.0060	0.0698	FTIR
Methanol	CH4O	-	-	-
Phosphorus pentafluoride	PF5	-	-	-
Phosphorus oxyfluoride	POF3	-	-	-
Propylene carbonate	C4H6O3	-	-	-
Ethylene carbonate	C3H4O3	-	-	-
Hydrogen	H2	0	0	Hydrogen sensor
Total Hydrocarbons	(Propane Equivalent)	0.0589	37.5122	FID
Flow rate in exhaust duct (m^3/s)		1.5		

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Table 3: Monitored temperature result			
Thermocouple number	Thermocouple location	Measured maximum temperature, °C	Limit, °C
7-1	Center of the cell 7-1, the widest side surface near cell 7-2	132.2	-
23-2	Center of the cell 22-1, the widest side surface near cell 23-2	177.8	-
22-1	Center of the cell 22-2, the widest side surface near cell 22-1	243.1	-
22-2	Center of the cell 21-1, the widest side surface near cell 22-2	333.0	-
21-1	Center of the cell 21-2, the widest side surface near cell 21-1	494.1	-
21-2	Center of the cell 20-1, the widest side surface near cell 21-2	758.4	-
20-1	Center of the cell 20-1, the widest side surface near cell 20-2	987.7	-
20-1 positive	Near the positive terminal of cell 20-1	904.1	-
20-2	Center of the cell 20-2, the widest side surface near cell 19-1	395.9	-
19-1	Center of the cell 19-1, the widest side surface near cell 19-2	201.1	-
19-2	Center of the cell 19-2, the widest side surface near cell 18-1	125.8	-
32-1	Center of the cell 32-1, the widest side surface near cell 31-2	197.9	-
32-2	Center of the cell 32-2, the widest side surface near cell 32-1	225.2	-
33-1	Center of the cell 33-1, the widest side surface near cell 32-2	198.9	-
33-2	Center of the cell 33-2, the widest side surface near cell 33-1	124.7	-
33-2 positive	Near the positive terminal of cell 33-2	472.0	-
34-1	Center of the cell 33-2, the widest side surface near cell 34-1	258.6	-
34-2	Center of the cell 34-1, the widest side surface near cell 34-2	112.9	-
35-1	Center of the cell 34-2, the widest side surface near cell 35-1	137.0	-

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MODULE LEVEL			
35-2	Center of the cell 35-1, the widest side surface near cell 35-2	66.8	-
36-1	Center of the cell 35-2, the widest side surface near cell 36-1	87.8	-
46-1	Center of the cell 46-2, the widest side surface near cell 46-1	139.6	-
Module_Top	Center and top of the enclosure	142.0	-
Module_Right	Center and right of the enclosure	46.6	-
Module_Back	Center and rear of the enclosure	71.8	-
Module_Front	Center and front of the enclosure	33.3	-
Module_Left	Center and left of the enclosure	58.2	-
AT	Ambient	26.4	-

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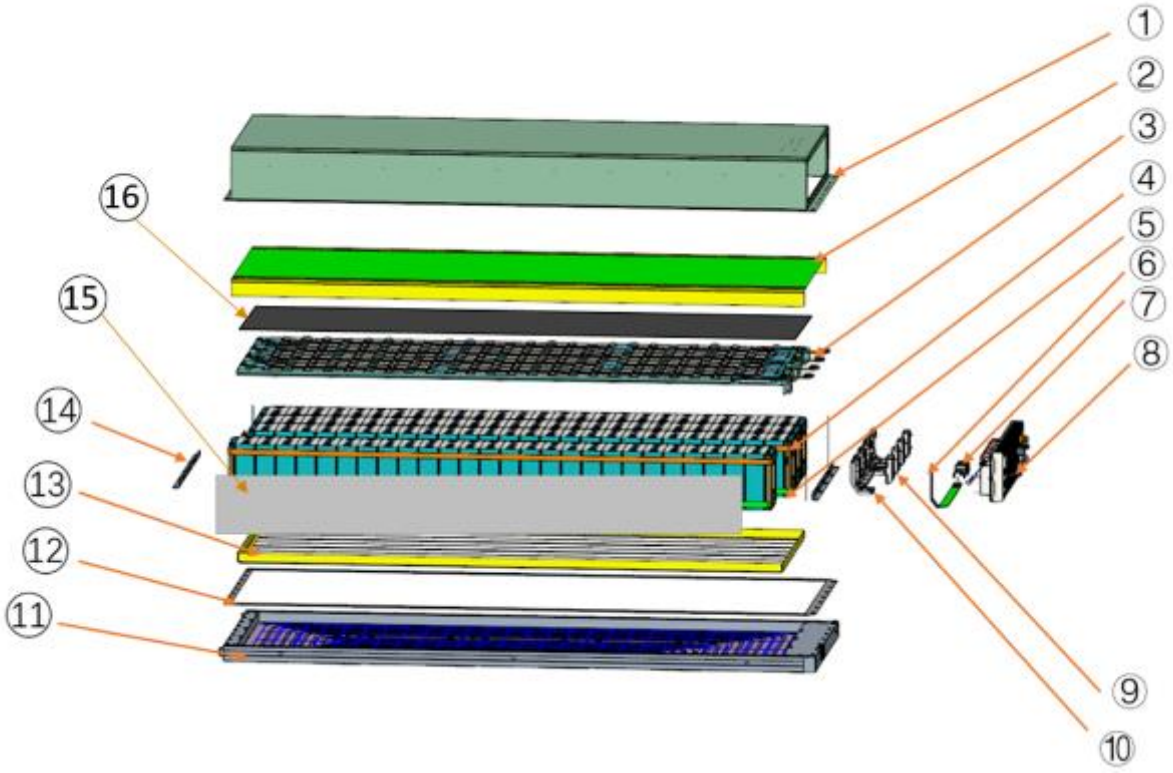
MODULE LEVEL

Attachment 1: Exploding drawing of module & Identification/location of cells within the module



Identification/location of cells within the module as below:

Cell 1-1	Cell 1-2											Cell 7-1	Cell 7-2									Cell 13-1	Cell 13-2
Cell 26-1	Cell 26-2						Cell 23-2	Cell 22-1	Cell 22-2	Cell 21-1	Cell 21-2	Cell 20-1	Cell 20-2	Cell 19-1	Cell 19-2	Cell 18-1							Cell 14-1	Cell 14-2
Cell 27-1	Cell 27-2								Cell 31-2	Cell 32-1	Cell 32-2	Cell 33-1	Cell 33-2	Cell 34-1	Cell 34-2	Cell 35-1	Cell 35-2	Cell 36-1					Cell 39-1	Cell 39-2
Cell 52-1	Cell 52-2											Cell 46-1	Cell 46-2										Cell 40-1	Cell 40-2

Remark: Cell 20-1 is the initiating cell.

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Attachment 2: Pre-conditioning profile

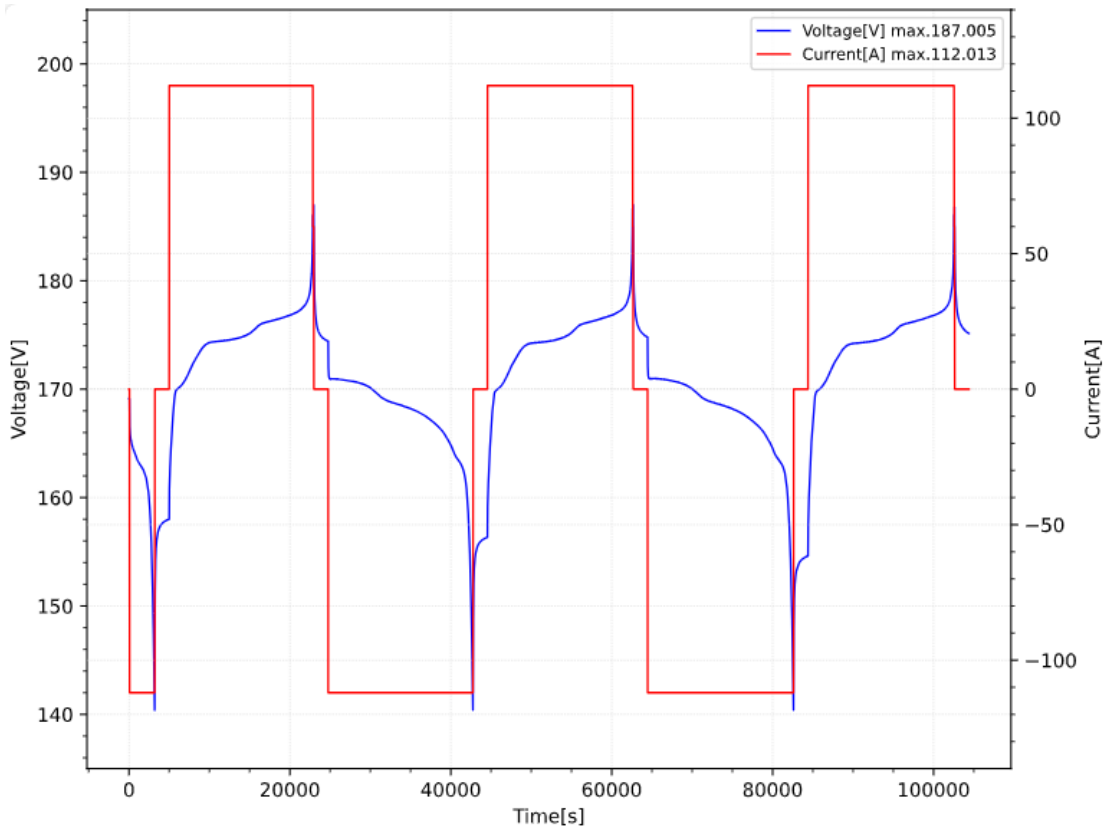

Figure 1 of Attachment 2: charge and discharge cycles chart for module

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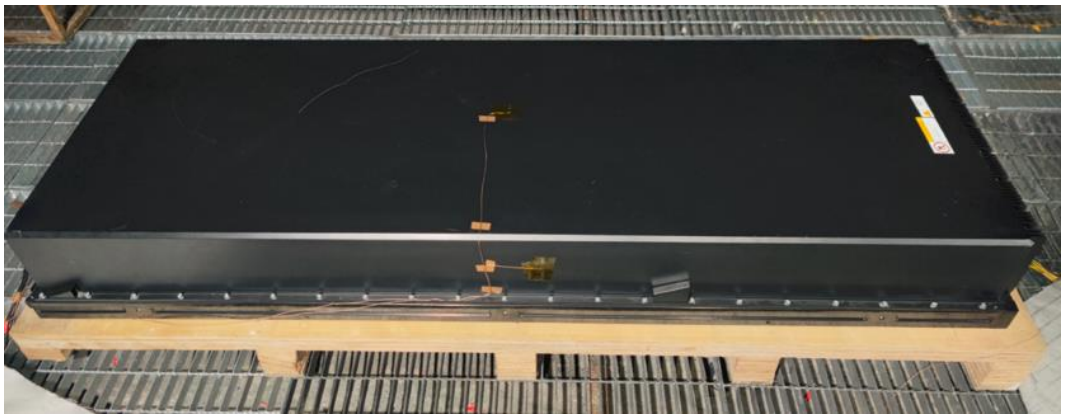
MODULE LEVEL

Attachment 3: Photo(s) for sample(s) before test and test setup with thermocouple location

Details of:	Figure 1 of Attachment 3 Overview of sample & thermocouple location_before test
	

Details of:	Figure 2 of Attachment 3 Overview of sample & thermocouple location_before test
	

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Details of:	Figure 3 of Attachment 3 Overview of sample & thermocouple location_before test
	

Details of:	Figure 4 of Attachment 3 Overview of sample & thermocouple location_before test
	

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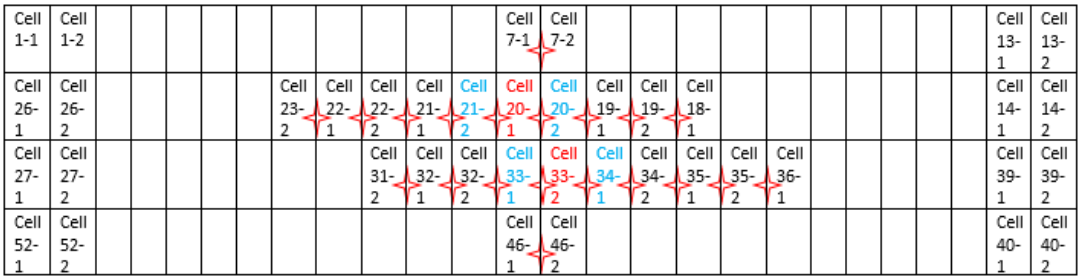
Details of:	Figure 5 of Attachment 3 Thermocouple location within module



Remark: Cell 20-1 is the initiating cell.

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MODULE LEVEL

Attachment 4: Photo(s) for sample(s) after test

Details of:	Figure 1 of Attachment 4 Overview of sample_after test
	

Details of:	Figure 2 of Attachment 4 Overview of sample_after test
	

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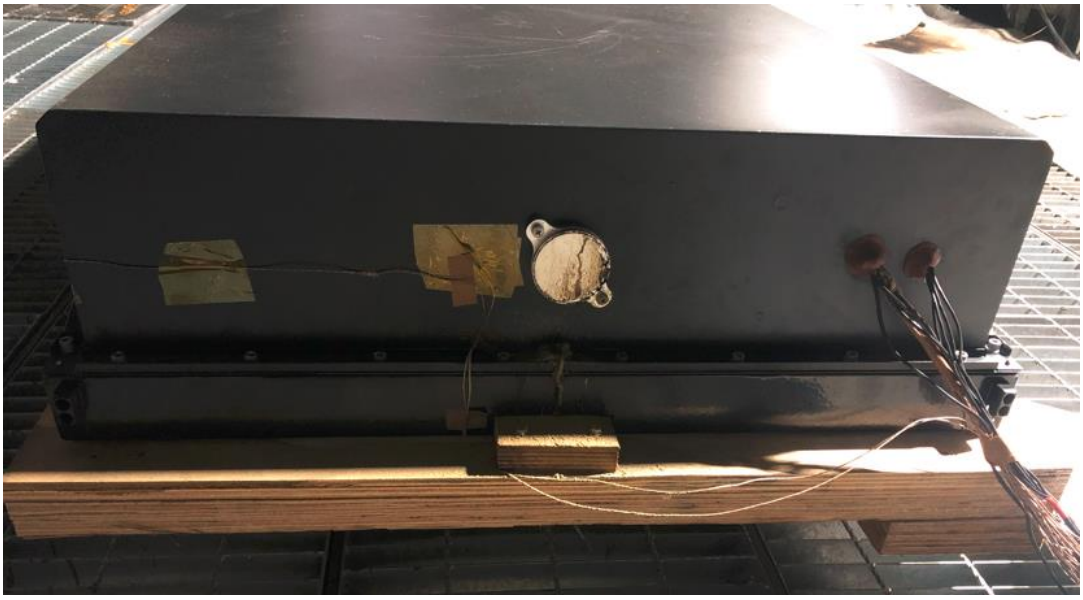
MODULE LEVEL

Details of:	Figure 3 of Attachment 4 Overview of sample_after test
	

Details of:	Figure 4 of Attachment 4 Overview of sample_after test
	

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Attachment 5: Monitored temperature chart

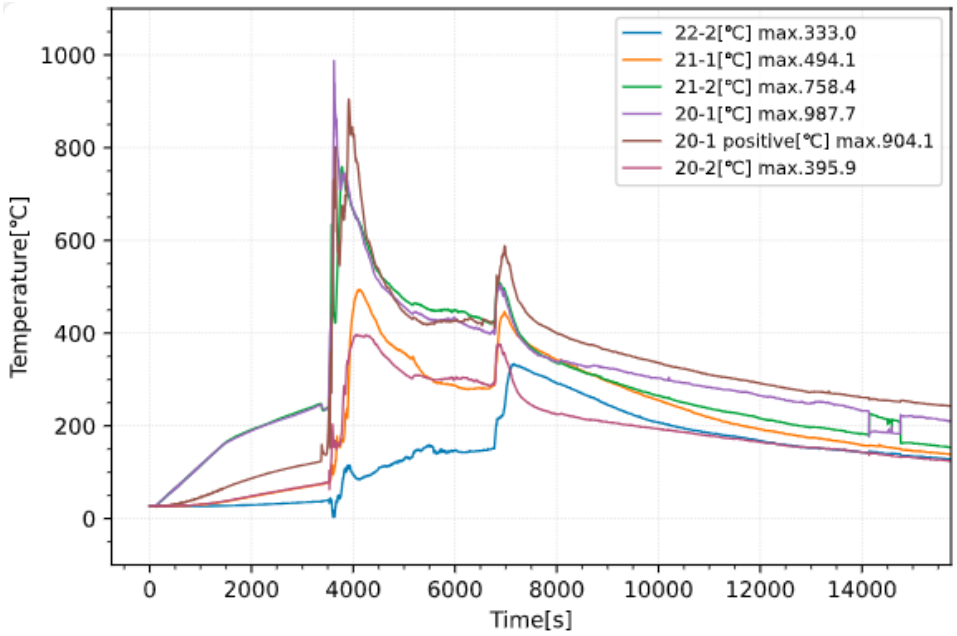

Figure 1 of Attachment 5: Temperature of cells (thermocouple number: 22-2, 21-1, 21-2, 20-1, 20-1 positive, 20-2) in module

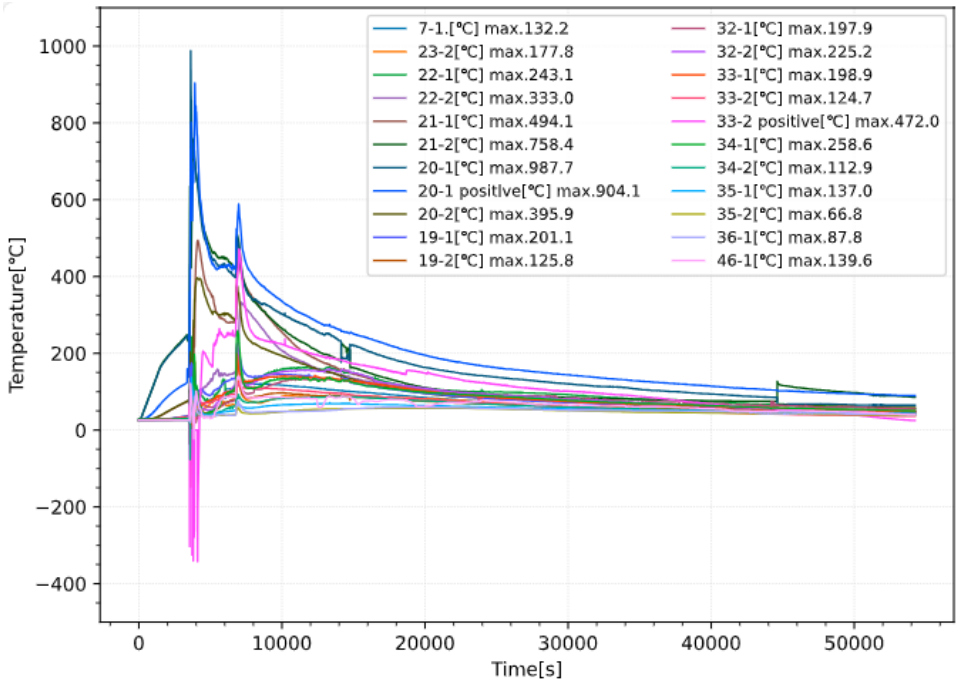

Figure 2 of Attachment 5: Temperature of all cells in module

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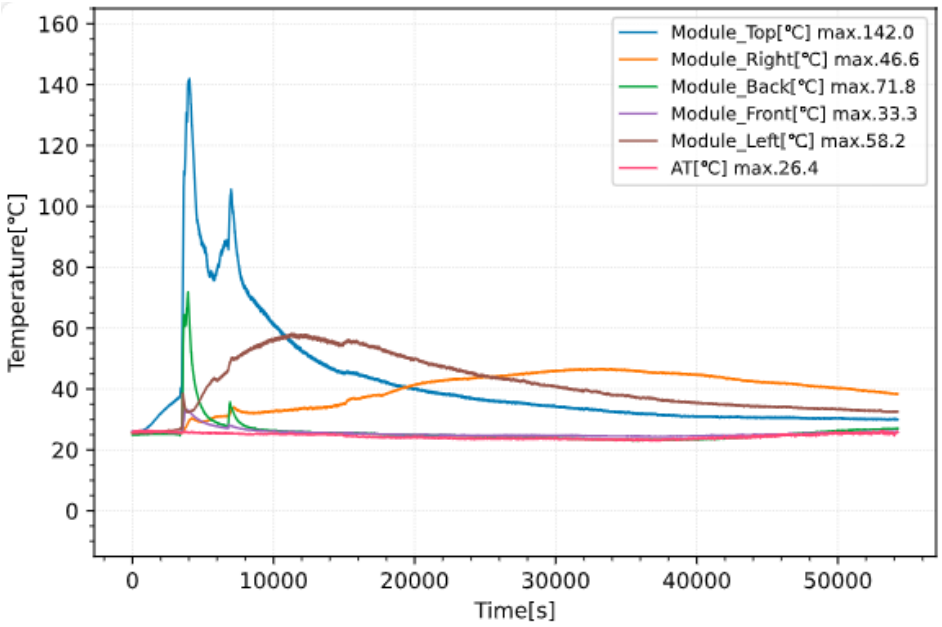

Figure 3 of Attachment 5: Temperature of module case

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MODULE LEVEL

Attachment 6: Flammable gas generation and composition data chart

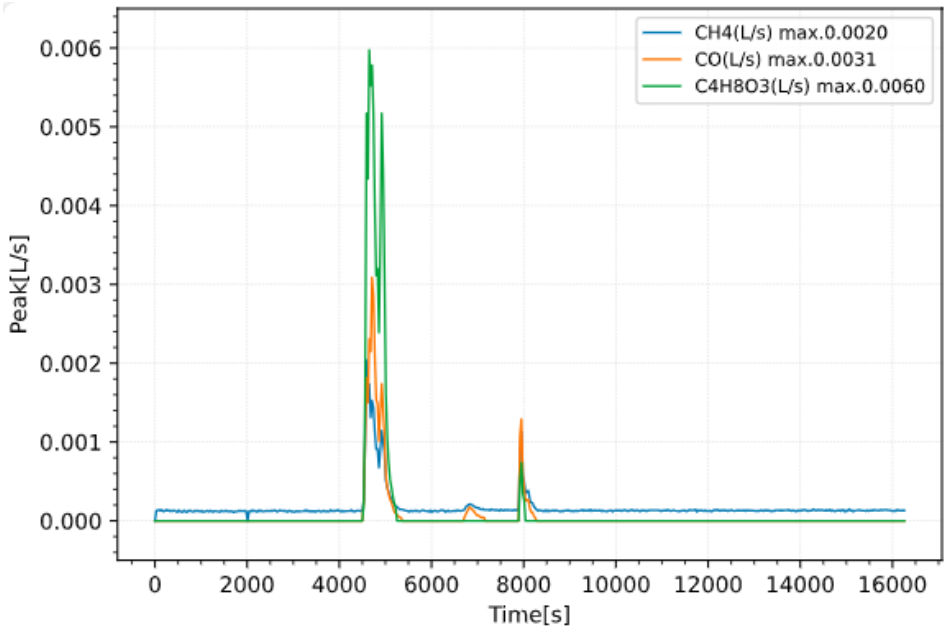

Figure 1 of Attachment 6: Gas generation and composition data chart (Detected by FTIR)

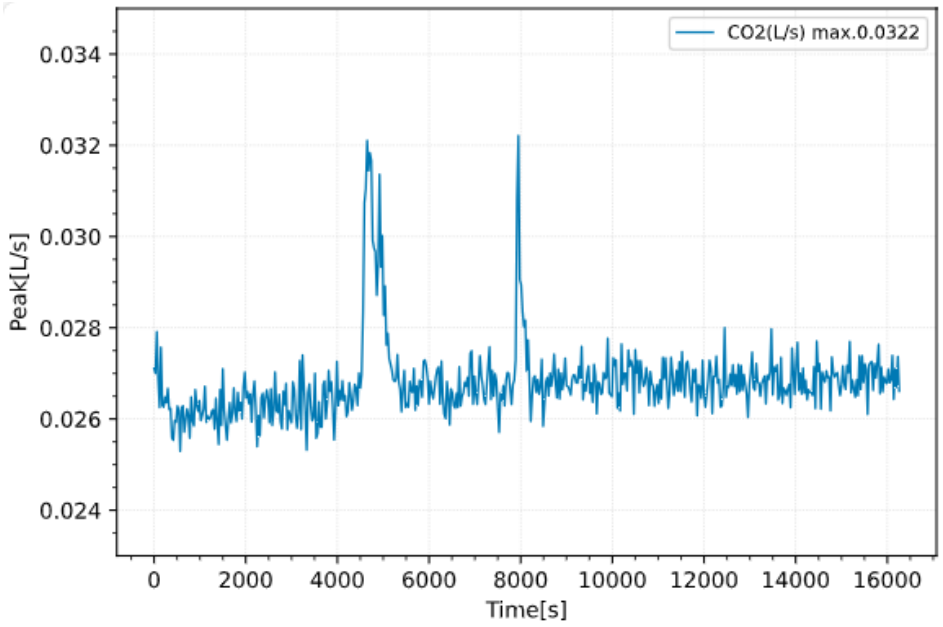

Figure 2 of Attachment 6: Gas generation and composition data chart (Detected by FTIR)

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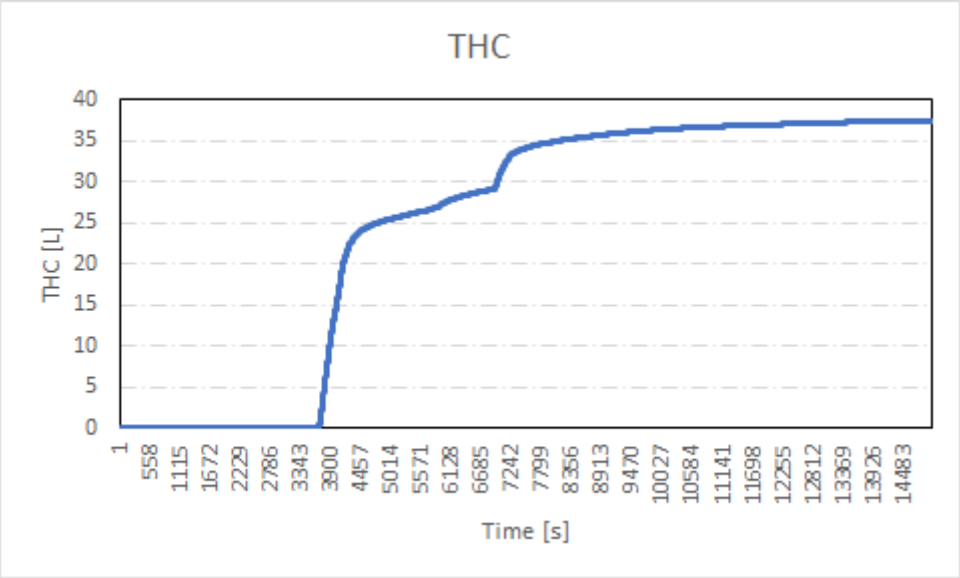

Figure 3 of Attachment 6: THC (Total Hydrocarbon Content) chart (Detected by FID)

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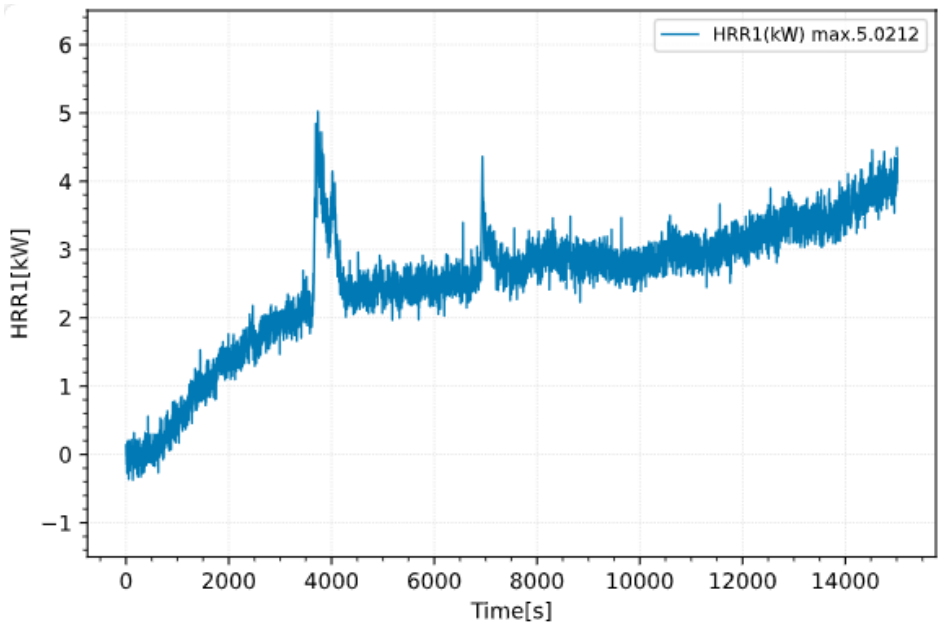
MODULE LEVEL

Attachment 7: Heat release rate versus time data chart



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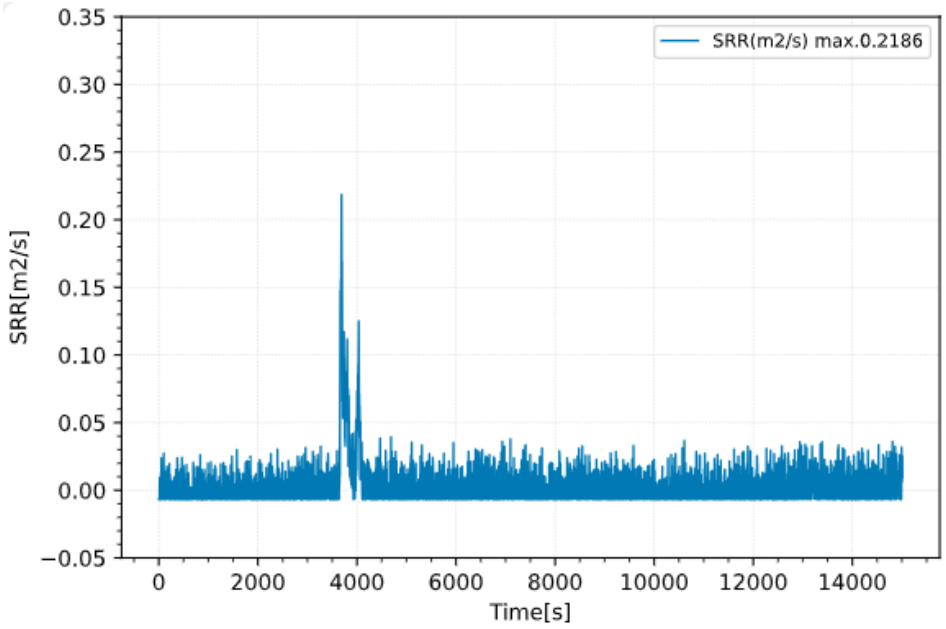
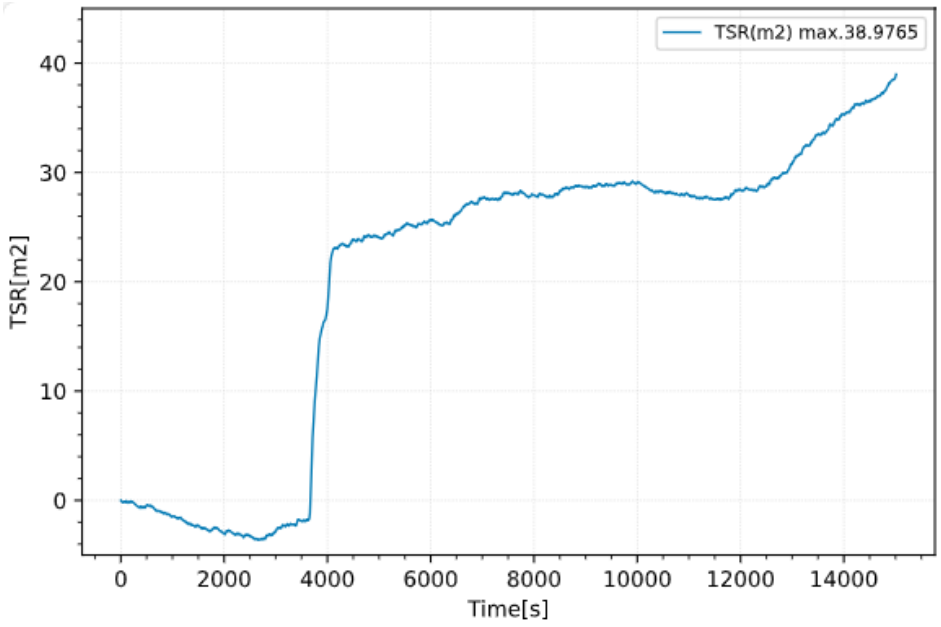
MODULE LEVEL

Attachment 8: Peak smoke release rate and total smoke release data chart





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MODULE LEVEL

Attachment 9: Summary of Heat release rate & Peak smoke release rate and total smoke release data

Peak heat release rate	5.0212kW
Total smoke release	38.9765m^2
Peak smoke release rate	0.2186m^2/s

--------- END REPORT ----------

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Legenda toegepaste uitzonderingsgrondslagen

In dit document zijn gegevens definitief geanonimiseerd op grond van:

Wet	Artikel	Omschrijving	Pagina's
Wet open overheid	Art. 5.1 lid 2 sub e	De eerbiediging van de persoonlijke levenssfeer	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36
Burgerlijk wetboek 6	Art. 6:230b BW	Dit gegeven hoeft volgens art. 6:230b BW alleen verstrekt te worden aan de afnemer van de verleende diensten.	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 34, 36