

Test Report issued under the responsibility of:



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TEST REPORT UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems	
Report Number	CMCC-ESH-P26032840
Date of issue.....	2026-06-02
Total number of pages	26 pages
Name of Testing Laboratory preparing the Report.....	BUREAU VERITAS LCIE CHINA COMPANY LIMITED Building 4, No. 518, Xinzhuan Road, Caohejing Songjiang High-Tech Park, Shanghai, P.R.China (201612)
Applicant's name	Dunext Technology Xiamen Co., Ltd.
Address	Building 7, No. 1001 Haiming Road,Xiamen Torch High-tech Industrial Development Zone (Xiang'an), Xiamen, Fujian, China
Test specification:	
Standard	ANSI/CAN/UL9540A:2025
Test Items	Module level
Non-standard test method	N/A
TRF template used	UL9540A:2025, Ed.1.5
Test Report Form No.....	UL9540A
Test Report Form(s) Originator	UL Solutions (Demko)
Master TRF	Dated 2025-02-24
UL Standard for Safety for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, ANSI/CAN/UL 9540A	
General disclaimer:	
The test results presented in this report relate only to the object tested. Specific test results are summarised in the main text of the test results.	

Test item description :	Lithium-ion battery	
Trademark(s) :	DUNEXT	
Manufacturer :	Dunext Technology Xiamen Co.,Ltd	
Model/Type reference :	PowerPack-52.2HV-EU	
Ratings :	166.4V 314Ah 52.25kWh	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
☒ Testing Laboratory:	BUREAU VERITAS LCIE CHINA COMPANY LIMITED	
Testing location/ address:	Building 4, No. 518, Xinzhuan Road, Caohejing Songjiang High-Tech Park, Shanghai, P.R.China (201612)	
Tested by (name, function, signature):	Alter Qiu (Project Manager)	
Approved by (name, function, signature) ...:	Robin Wu (Reviewer)	
☐ Testing procedure: CTF Stage 1:		
Testing location/ address:		
Tested by (name, function, signature):		
Approved by (name, function, signature) ...:		
☐ Testing procedure: CTF Stage 2:		
Testing location/ address:		
Tested by (name + signature)		
Witnessed by (name, function, signature) ..:		
Approved by (name, function, signature) ...:		
☐ Testing procedure: CTF Stage 3:		
☐ Testing procedure: CTF Stage 4:		
Testing location/ address:		
Tested by (name, function, signature):		
Witnessed by (name, function, signature) ..:		
Approved by (name, function, signature) ...:		
Supervised by (name, function, signature) :		

Attachment 1 (Pictures for product): Page 24
Attachment 2 (The location of triggered cell): Page 25
Attachment 3 (Test Equipment list): Page 26

Tests performed (name of test, test clause and date test performed):

Testing location: (CBTL, SPTL, CTF, Subcontractor)

**BUREAU VERITAS LCIE CHINA COMPANY
LIMITED**
Building 4, No. 518, Xinzhuang Road, Caohejing
Songjiang High-Tech Park, Shanghai, P.R.China
(201612)

☒ The product fulfils the requirements of ANSI/CAN/UL9540A:2025.

Use of uncertainty of measurement for decisions on conformity (decision rule) :

☒ No decision rule is specified by the UL standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty ("simple acceptance" decision rule, previously known as "accuracy method").

☐ Other: ... (to be specified, for example when required by the standard or client, or if national accreditation requirements apply)

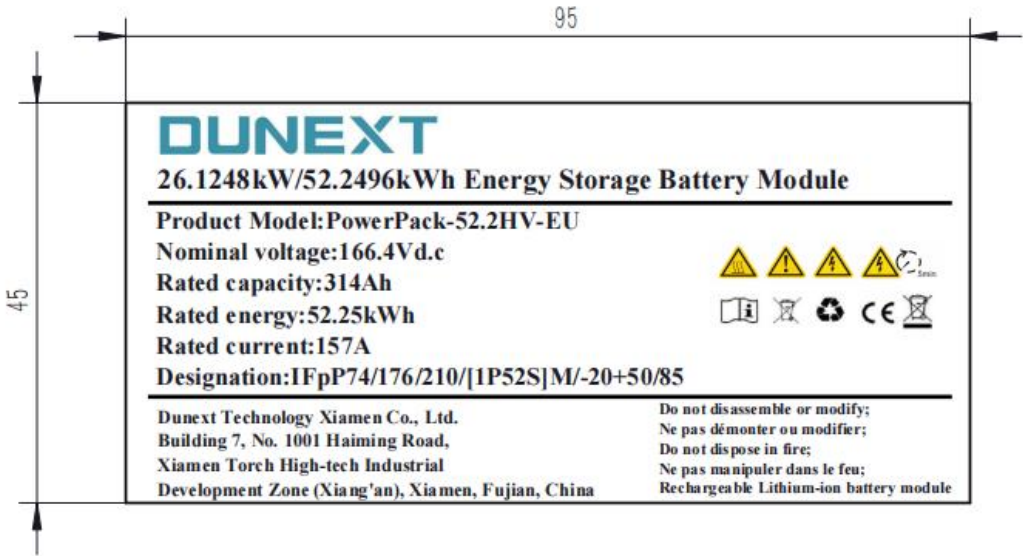
Information on uncertainty of measurement:

The uncertainties of measurement are calculated by the laboratory based on application of criteria given by OD-5014 for test equipment and application of test methods, decision sheets and operational procedures of IECEE.

IEC Guide 115 provides guidance on the application of measurement uncertainty principles and applying the decision rule when reporting test results within IECEE scheme, noting that the reporting of the measurement uncertainty for measurements is not necessary unless required by the test standard or customer.

Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

Copy of marking plate:



Test item particulars	--
Classification of installation and use.....	To be defined in final product
Supply Connection	DC Connector
Possible test case verdicts:	
- test case does not apply to the test object.....	: N/A
- test object does meet the requirement.....	: P (Pass)
- test object does not meet the requirement.....	: F (Fail)
Testing	:
Date of receipt of test item.....	: 2026-03-02
Date (s) of performance of tests	: 2026-03-02 to 2026-03-15
General remarks:	
"(See Enclosure #)" refers to additional information 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.	
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies).....	Dunext Technology Xiamen Co., Ltd. Building 7, No. 1001 Haiming Road,Xiamen Torch High-tech Industrial Development Zone (Xiang'an), Xiamen, Fujian, China

General product information and other remarks:

The main features of the battery are shown as below:

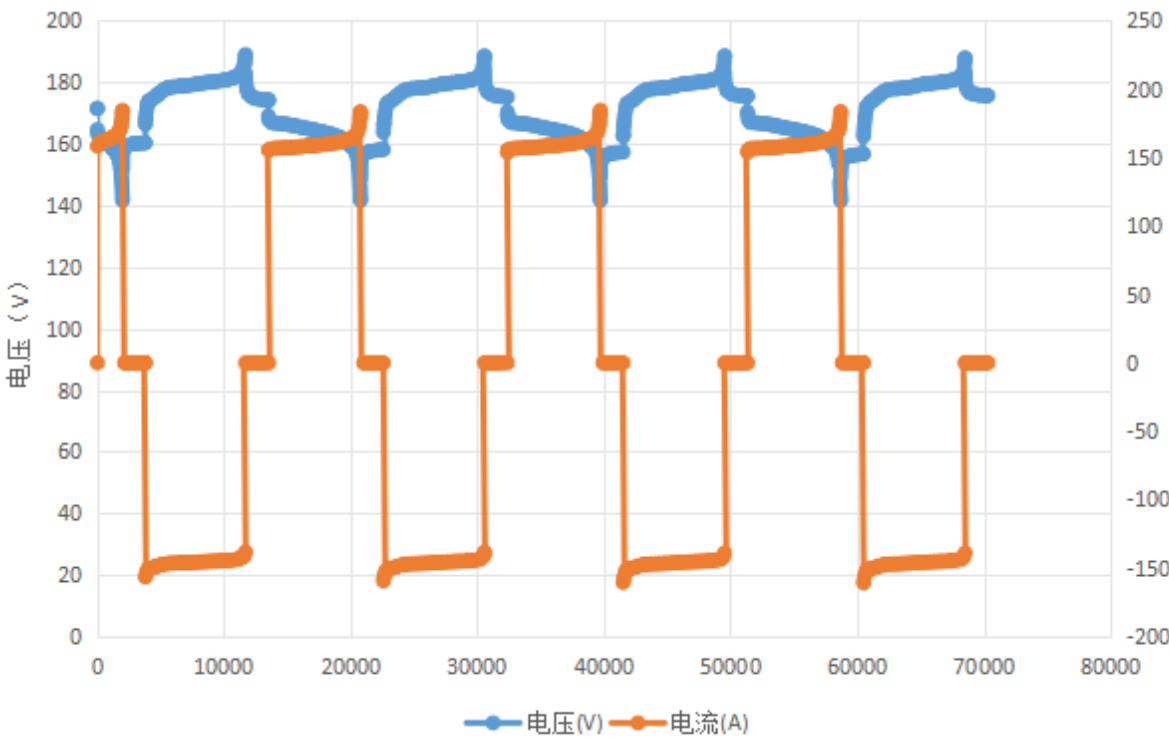
Sample name	26.1248kW/52.2496kWh Energy Storage Battery Module	Model	PowerPack-52.2HV-EU
Appearance & Shape	Cuboid	Module cell configuration	1P52S
Nominal voltage (V)	166.4V	Mass (kg)	342±5kg
Nominal energy (kWh)	52.25 kWh	Rated capacity (Ah)	314Ah
Charging current (A)	157A	Discharge current (A)	157A
End of charge Voltage (V)	187.2V	End of discharge voltage (V)	143V
Overall size	1145mm×790mm×246mm		

2.1	BATTERY SYSTEM THERMAL RUNAWAY		P
	General requirements		P
2.1.1	Sample Conditioning		P
2.1.2	Thermal runaway records		P
2.1.3	Temperature Measurement		P
2.1.4	Heat Release Measurements		P
2.1.5	Gas Composition Measurement		P
2.1.6	Flue gas measurement		P

3	INFORMATION FOR SAFETY		P
	The cell manufacturer provides information about current, voltage and temperature limits of their products		P
	The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users.		P

ANNEX A	TEST CONCEPTS AND APPLICATION OF TEST RESULTS TO INSTALLATIONS		P
A1.1	This Annex is designed to help test sponsors, designers, owners, insurance companies and code authorities understand: a) The purpose of the tests included in this Standard; b) How the individual tests relate to each other; and c) How to interpret and apply the results to achieve a code compliant installation.		P
A1.2	Model fire codes and energy storage system standards require energy storage systems to comply with UL 9540, which in turn requires battery cells and modules to comply with UL 1973.		P
A1.3	To address these fire and explosion hazards associated with the installation of a BESS, the fire and other codes require energy storage systems to meet certain location, separation, fire suppression and other criteria.		P

2.1	TABLE: Thermal runaway test		
Test results			
Cell failure test method performed:		Heat, 5.5°C/min	
Number of initiating cells:		52	
Number of cells with thermal runaway in the module:		2	
Maximum Smoke Release Rate (m2/s)		3.877	
Total Smoke Released: (m2)		3720.370	
Peak Chemical Heat Release Rate: (kW)		37.987	
Loss of mass (kg)		0.7 (0.2%)	
Performance Criteria in accordance with Clause 8.4 and Figure 1.1:			
☒ The effects of thermal runaway was contained by the module design;			
☒ Cell vent gas (based upon the cell level test) was non-flammable ;			
Necessity of a unit level test:			
☐ The performance criteria of the module level test as indicated in 8.4 and as shown in Figure 1.1 of UL 9540A has not been met, therefore unit level testing in accordance with UL 9540A will need to be conducted on a complete unit employing this module.			
☐ The performance criteria of the module level test as indicated in 8.4 and as shown in Figure 1.1 of UL 9540A has been met, therefore unit level testing in accordance with UL 9540A need not be conducted.			

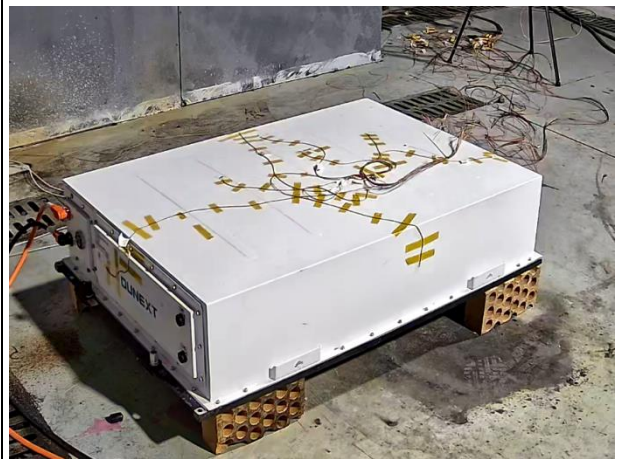
2.1.1	TABLE: Sample Conditioning
The battery samples shall be conditioned as follows: a) Place the samples in an environmental chamber at $25 \pm 5^{\circ}\text{C}$ and $50 \pm 25\%\text{RH}$ for 6 hours; b) Discharge the battery samples at a constant power of 26124.8 W until the voltage of any single cell drops below 2.75 V, then let them stand for 30 minutes; c) Charge the battery samples at a constant power of 26124.8 W until the voltage of any single cell exceeds 3.6 V, then let them stand for 30 minutes; d) Discharge the battery samples at a constant power of 26124.8 W until the voltage of any single cell drops below 2.75 V, then let them stand for 30 minutes; e) Repeat steps c) and d) twice; f) Charge the battery samples at a constant power of 26124.8 W until the voltage of any single cell exceeds 3.6 V, then let them stand for 30 minutes.	
During conditioning, the ambient temperature was maintained at $25\pm5^{\circ}\text{C}$ and $50\pm25\%\text{RH}$. The battery voltage and current curves during battery conditioning are shown below:	
	

2.1.2	TABLE: Thermal runaway records			
Environmental conditions at the start of the test	21° C, 70%RH			
Module open circuit voltage before test (V)	174.758			
Module weight before test (kg)	340.45			
Trigger thermal runaway method	Heat, 5.5°C/min			
Test start time	2026/03/13 17:15:09			
Open valve/thermal runaway recording during testing	Number of valve openings	Valve opening time	Number of thermal runaway	Thermal runaway time
	1st	18: 16: 36	1st	18: 40: 24
	2nd	19: 54: 38	2nd	21: 05: 26
	3rd	21: 08: 46	3rd	/
Test Process Test Phenomenon Record	Nothing but smoke			
Test end time	2026/3/14 14:02:41			
Module voltage at the end of the test (V)	0.003			
Sample status after testing	Thermal runaway 2 cells			
Module weight after test (kg)	339.75			
Loss of module mass before and after testing (kg)	0.7 (0.2%)			

Test Photos



Test start 17:15:09



Open valve 18:16:36



Thermal runaway 18:40:24



Thermal runaway 21:05:26



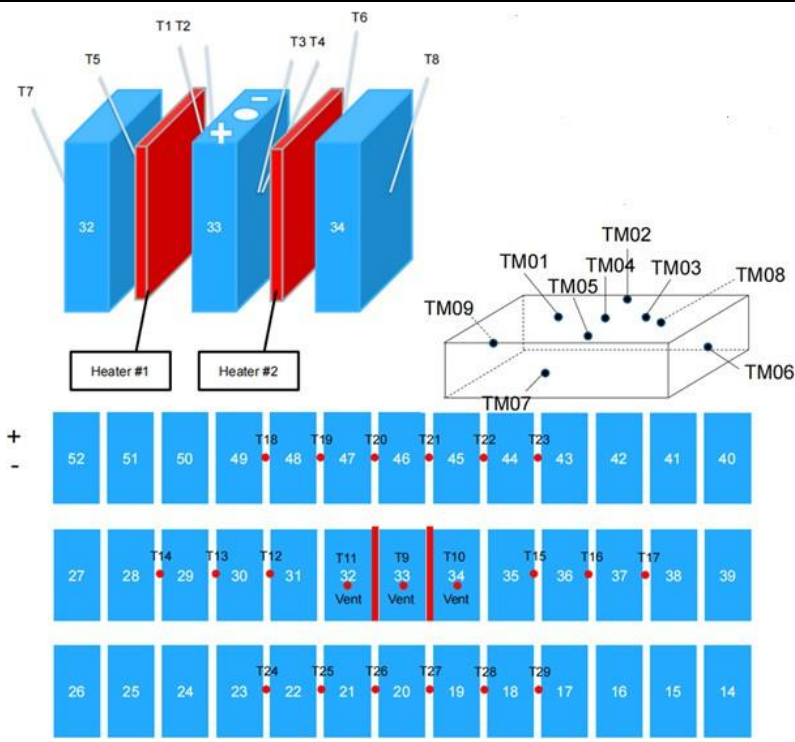
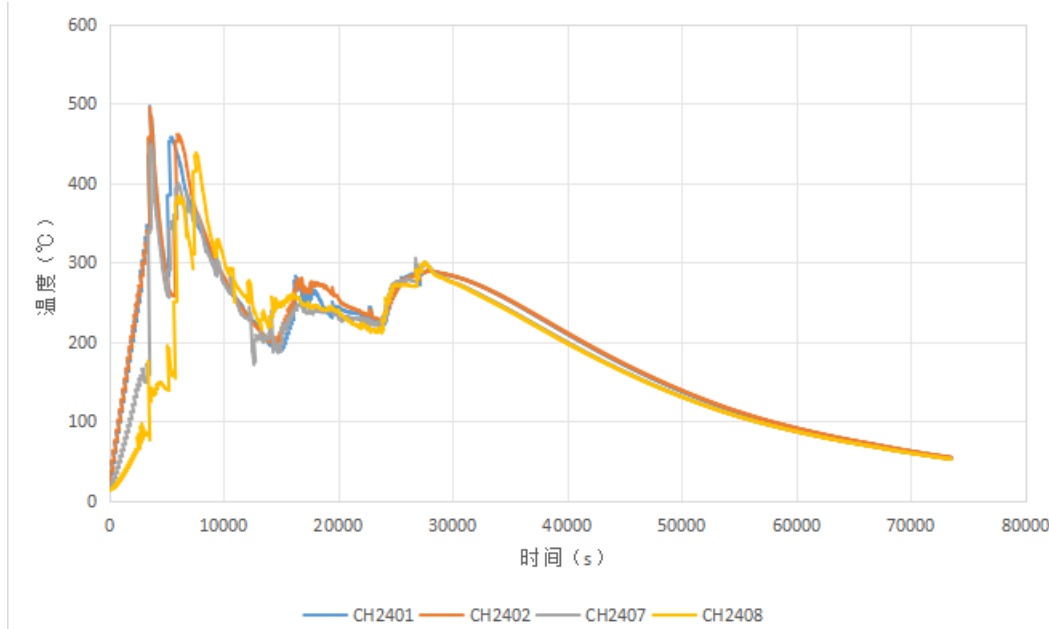
Test ends at 14:02:41(second day)

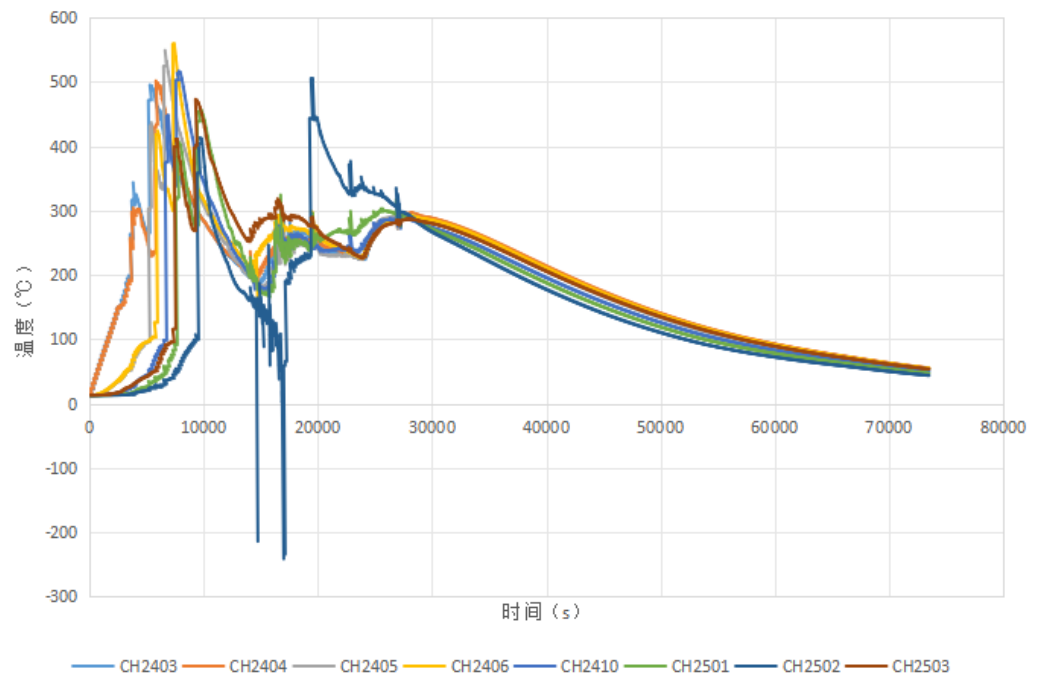


Sample overall after testing

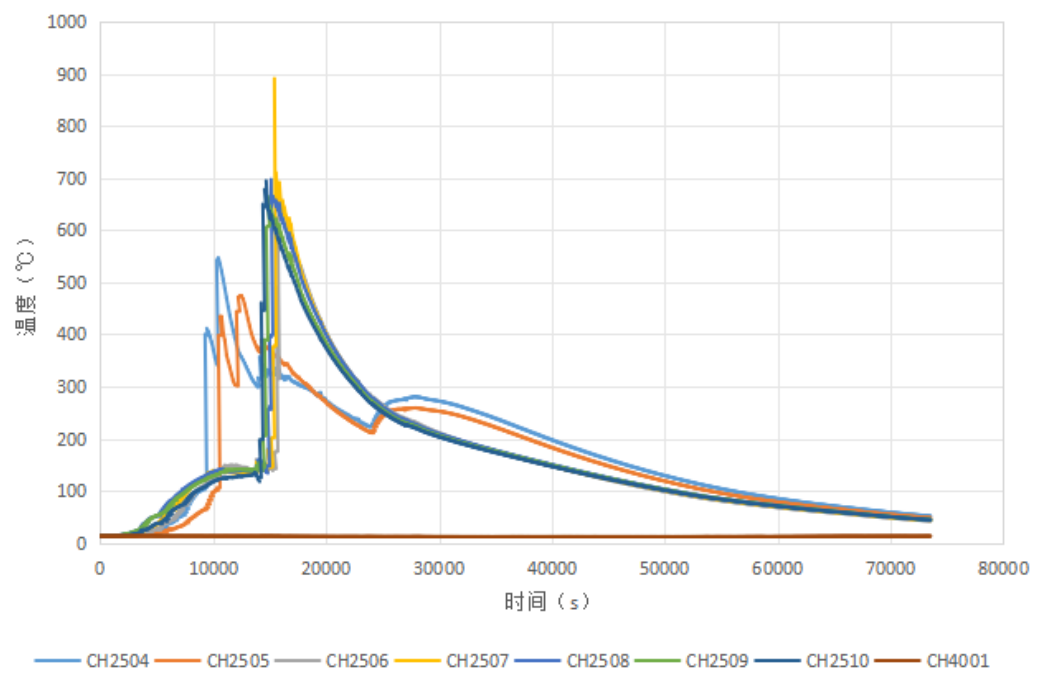


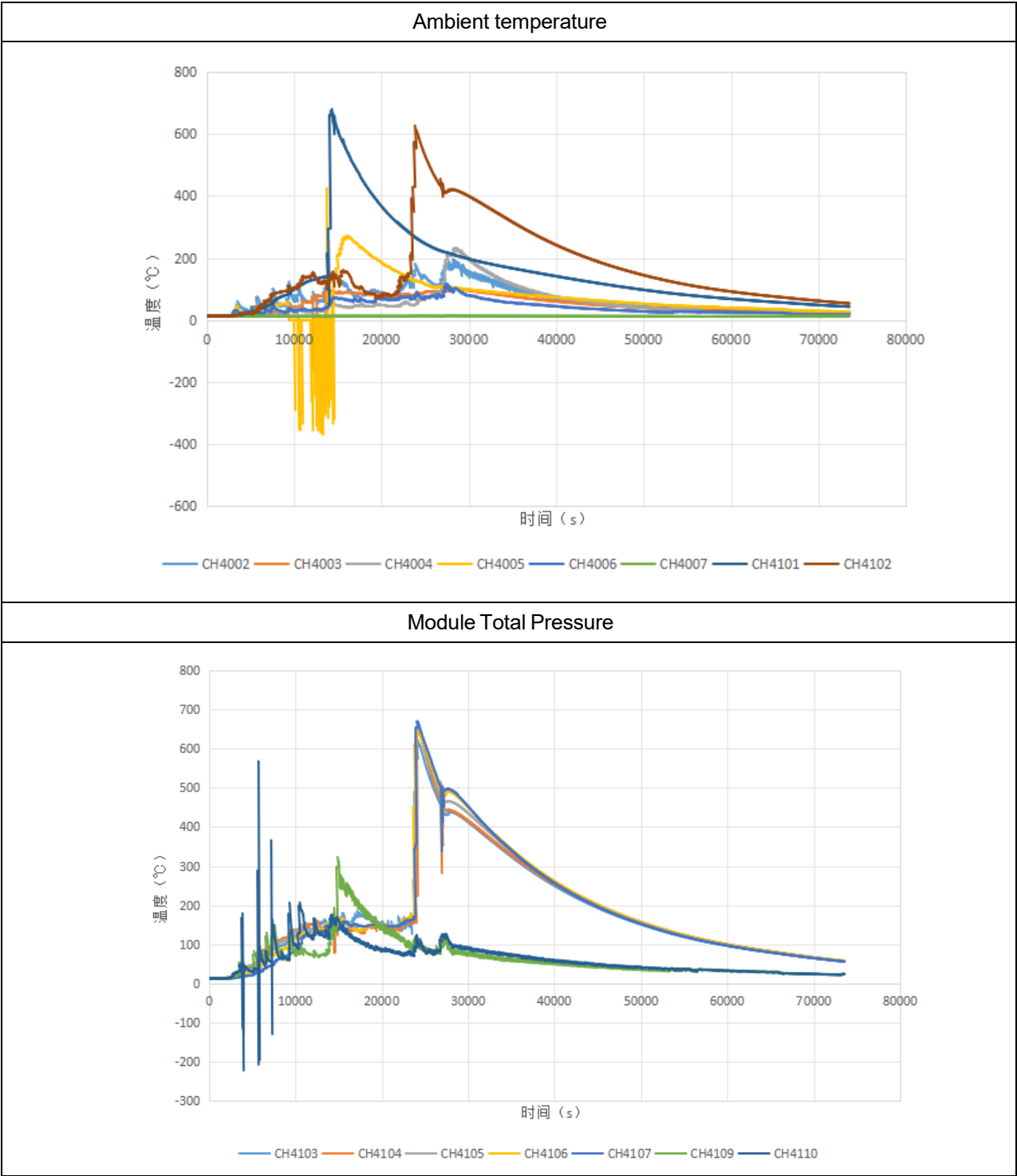
Sample uncapping after testing

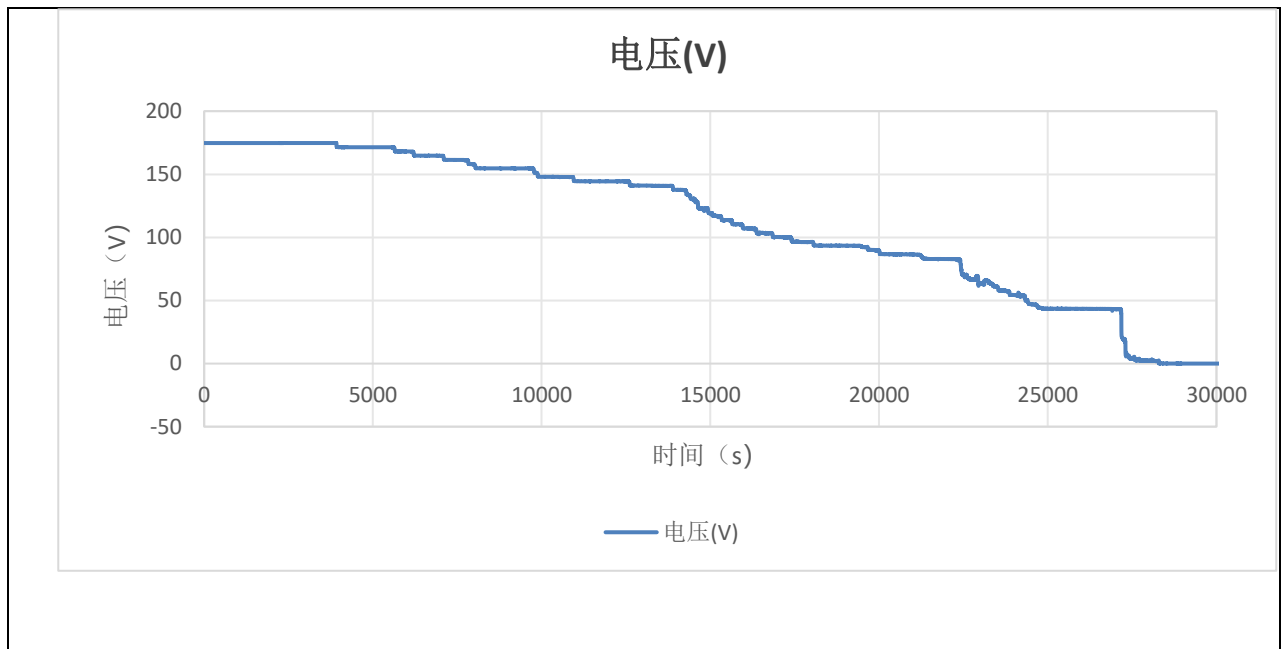
2.1.3	TABLE: Temperature Measurement
Thermocouple arrangement scheme and schematic	
	
The temperature profile is shown in the graph below:	
Module Trigger Cell Temperature	
	
Temperature of other cells inside the module	



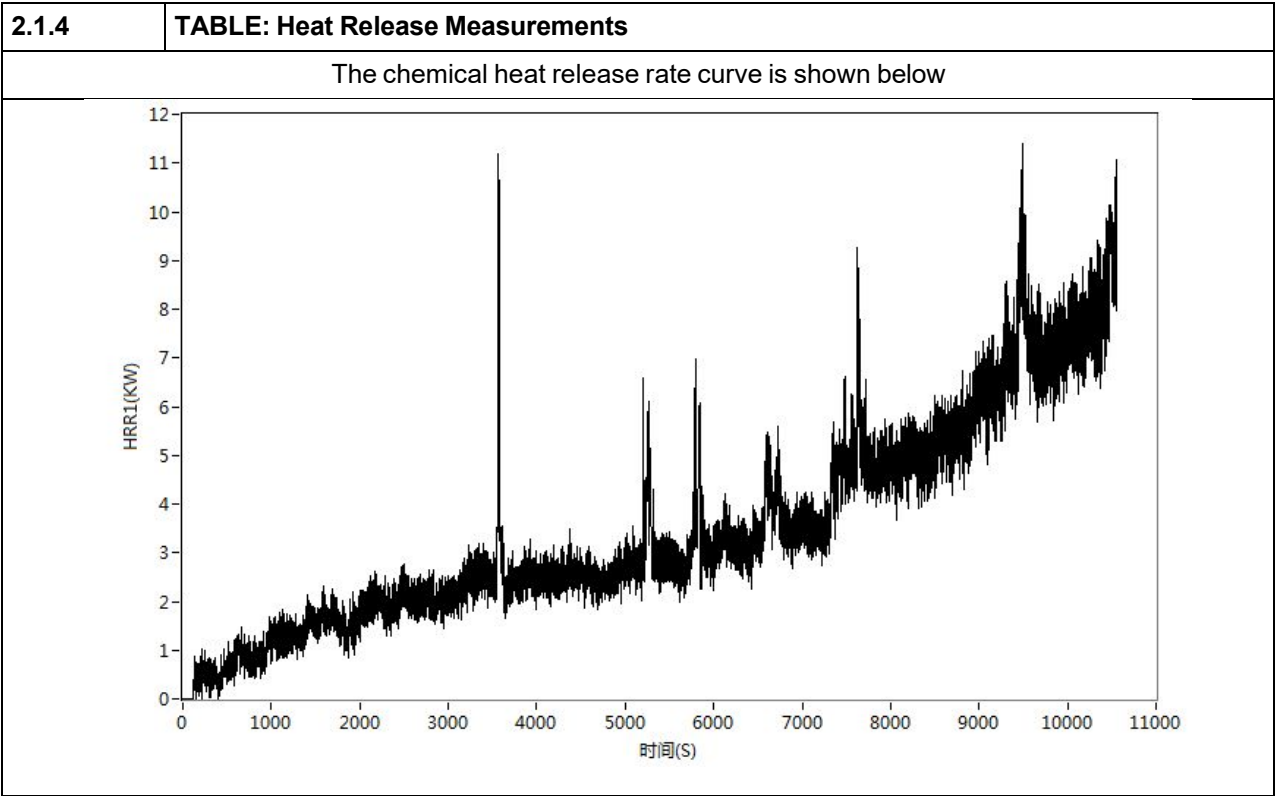
Module Case Temperature

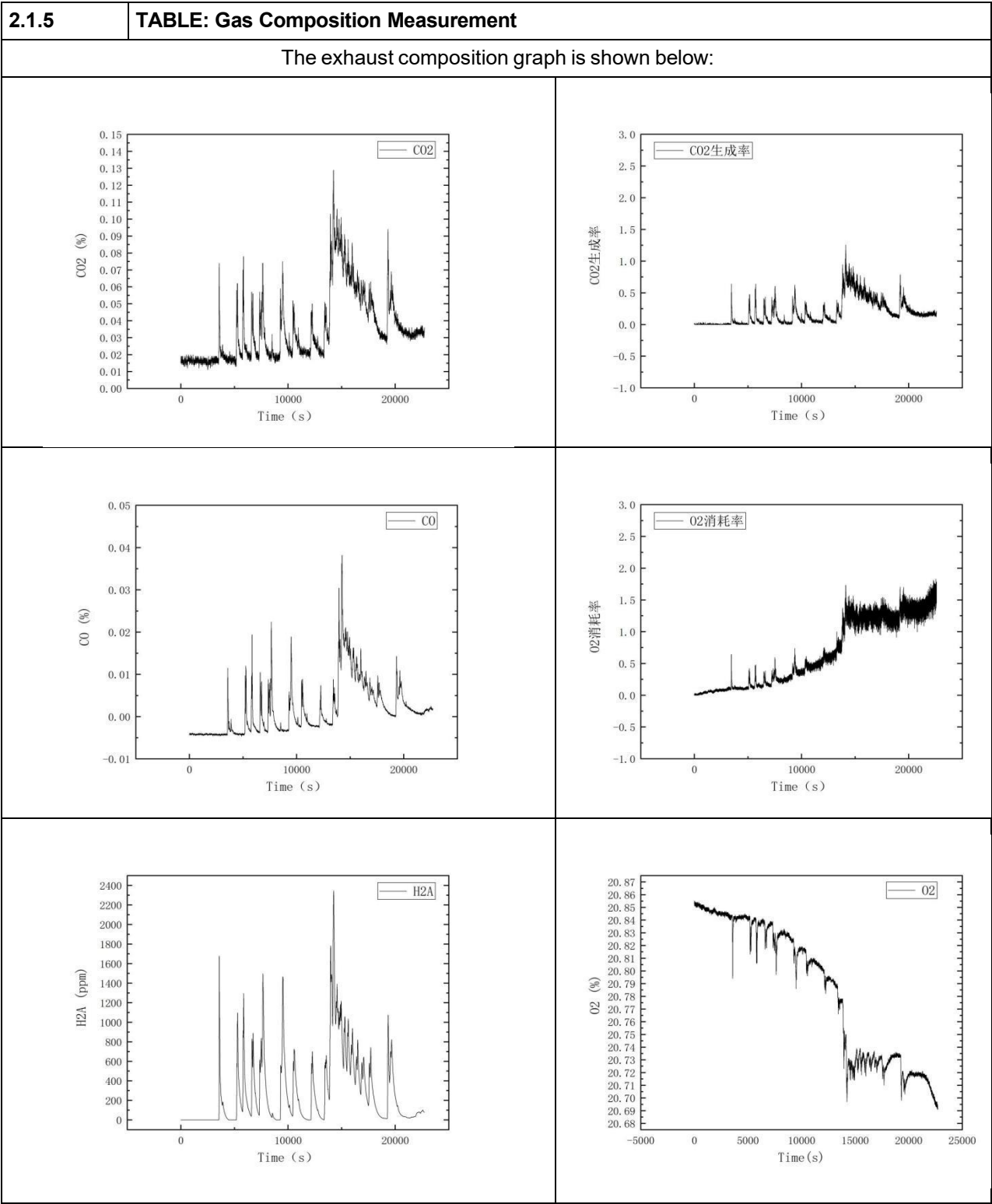


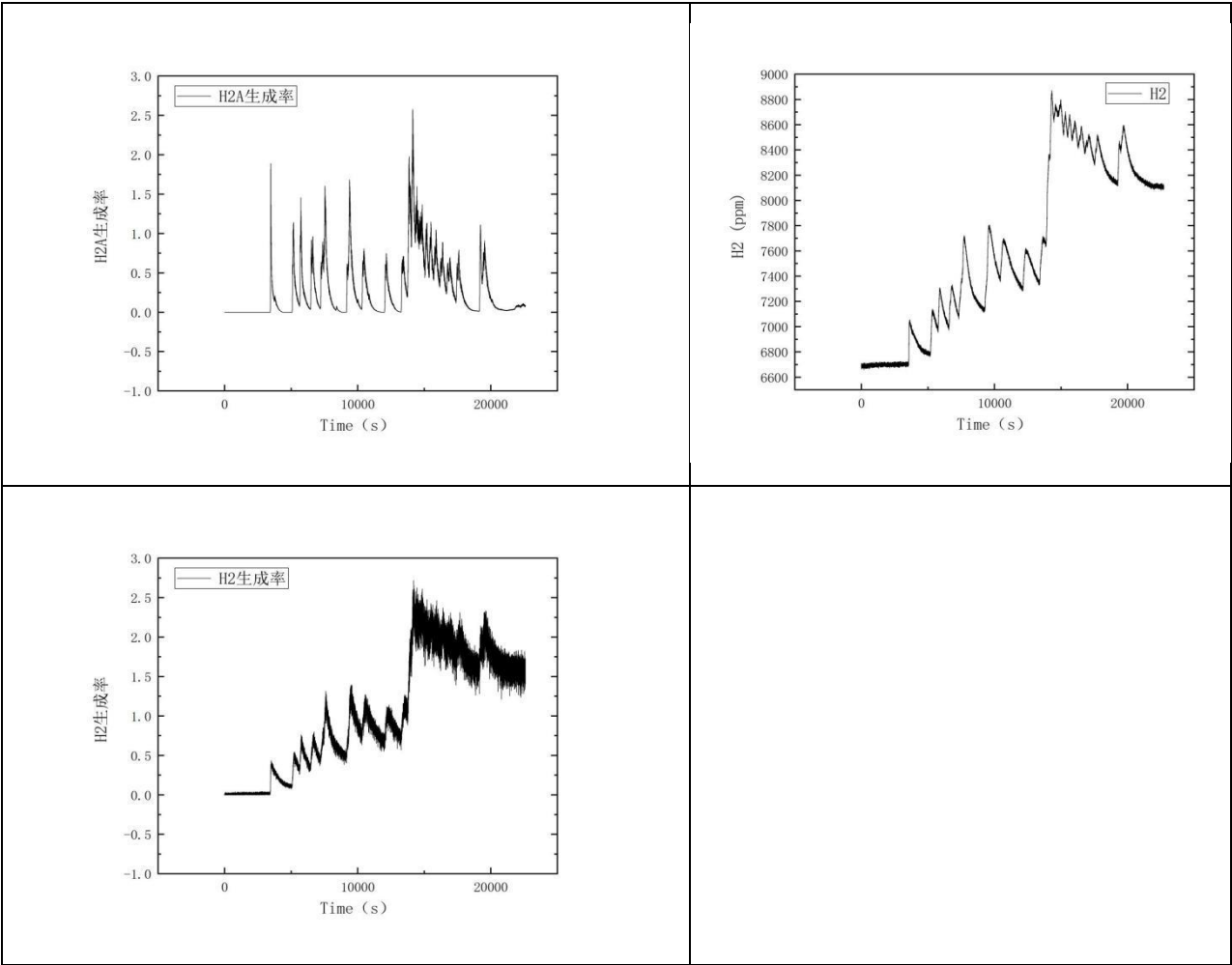




The maximum temperature at each point is shown in the table below					
Temp. No.	Maximum temperature (°C)	Temp. No.	Maximum temperature (°C)	Temp. No.	Maximum temperature (°C)
T1	345.74	T15	472.7	T29	669.6
T2	513.1	T16	547.4	T30	failed
T3	349.3	T17	474.5	T31	322.9
T4	497.9	T18	675.3	T32	537.4
T5	494.9	T19	889.1	/	/
T6	501.3	T20	696.6	/	/
T7	548.6	T21	663.9	/	/
T8	559.1	T22	694.5	/	/
T9	447.8	T23	679.3	/	/
T10	438.5	T24	626.3	/	/
T11	failed	T25	621	/	/
T12	516.5	T26	654.9	/	/
T13	455.4	T27	654.7	/	/
T14	505.1	T28	644.6	/	/





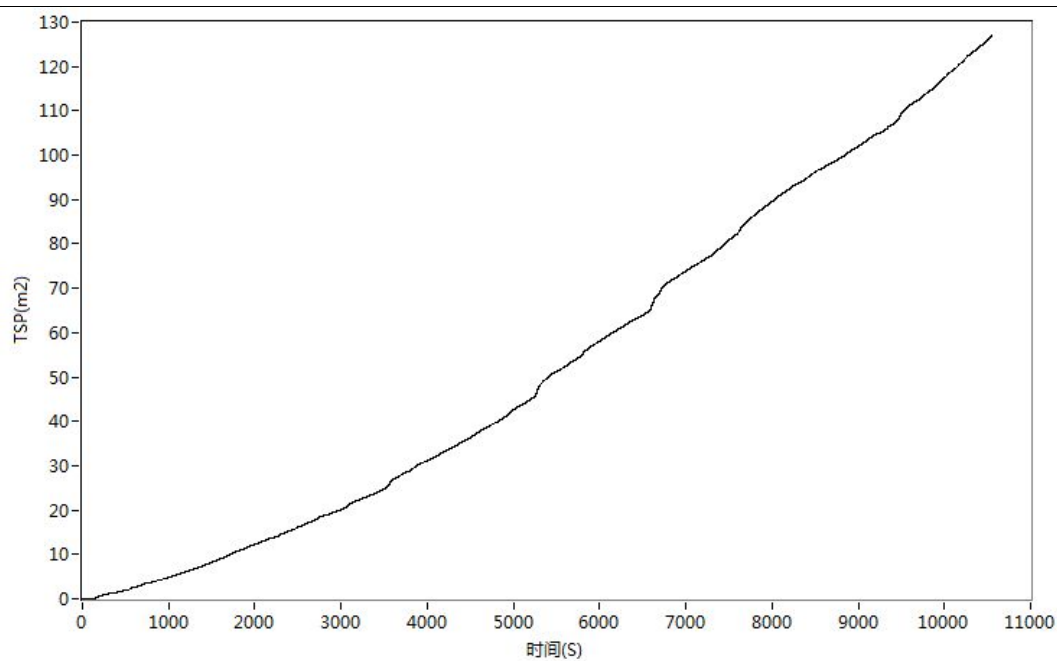
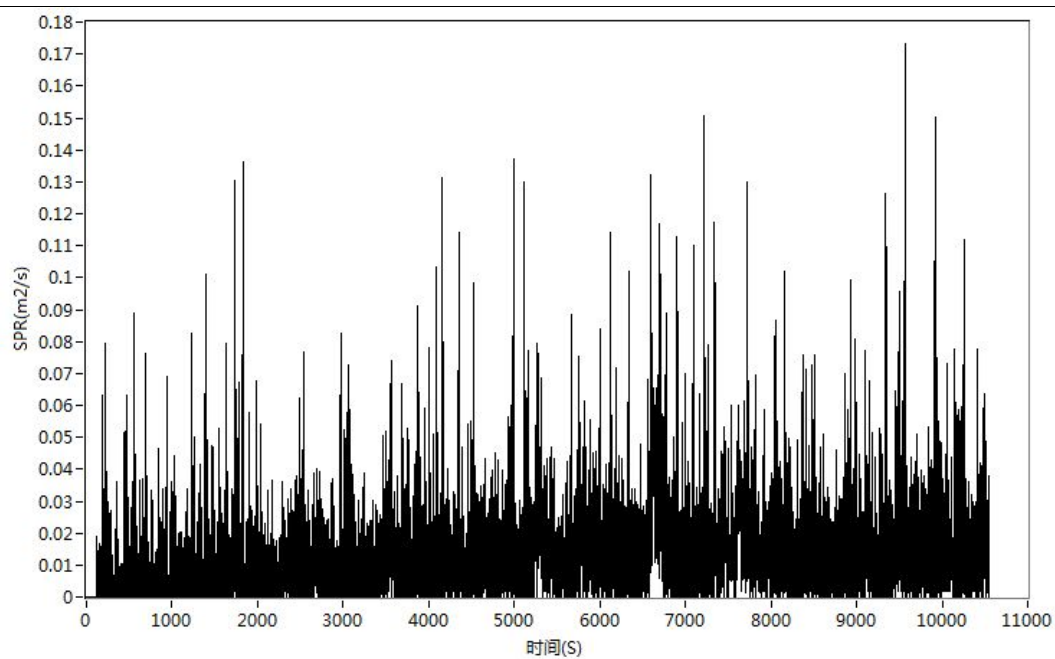


The exhaust composition and volume are as follows				
Gas type	Gas components		Total volume of gas (L)	
			Before cell opening	Throughout the test period
Hydrocarbon species	Methane	CH ₄	0	/
	Acetylene	C ₂ H ₂	0	/
	Ethylene	C ₂ H ₄	0	/
	Ethane	C ₂ H ₆	0	/
	Propylene	C ₃ H ₆	0	/
	Propane	C ₃ H ₈	0	/
Hydrogen halide species	Hydrogen Cyanide	HCN	0	/
	Hydrogen Chloride	HCL	0	/
	Hydrogen Fluoride	HF	0	/
	Hydrogen bromide	HBr	0	/
Nitrogen containing species	Nitrogen Monoxide	NO	0	/
	Nitrogen Dioxide	NO ₂	0	/
	Nitrous Oxide	N ₂ O	0	/
Others	Carbon Monox (NDIR)	CO	0	36.9
	Carbon Dioxide (NDIR)	CO ₂	0	63.1
	Hydrogen (Palladium nickel thin film solid state sensor)	H ₂	0	26.8
	Carbonyl Sulfide	COS	0	/
	Oil as octane	/	0	/
	Diethyl carbonate	C ₅ H ₁₀ O ₃	0	/
	Dimethyl carbonate	C ₃ H ₆ O ₃	0	/
	Ethylene oxide	C ₂ H ₄ O	0	/
	Ethylmethyl carbonate	C ₄ H ₈ O ₃	0	/
	Formaldehyde	CH ₂ O	0	/
	Methanol	CH ₄ O	0	/
	Ammonia	NH ₃	0	/
	Total Hydrocarbons (equivalent to CH ₄ , measured by FID)		0	

2.1.6

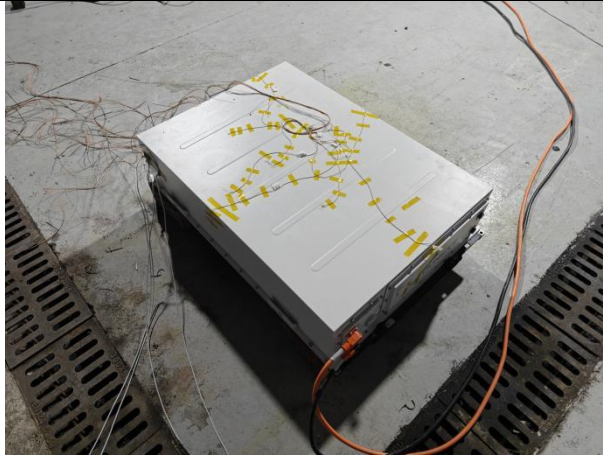
TABLE:Flue gas measurement

Smoke release rates and total smoke production are shown below



Attachment 1(Pictures for product)

Picture for product Battery module PowerPack-52.2HV-EU



Attachment 2 (The location of triggered cell)



Attachment 3 (Test Equipment list)

No.	Equipment	Internal No,	Type	Manufacturer	Last Calibration	Due Date
1	Oscilloscope	A4089036SH	DL850	YOKOGAWA	7/May/25	6/May/26
2	Voltage probe	A4089059SH	DP6150A	CYBERTEK	5/Jun/25	4/Jun/26
3	Current probe	A4089061SH	CPL8100A	CYBERTEK	5/Jun/25	4/Jun/26
4	Bidirectional AC power source	A7040135SH	AGS-40-7006	ACTION	5/Jun/25	4/Jun/26