

Prüfbericht-Nr.: <i>Test report no.:</i>	CN26H50G 001	Auftrags-Nr.: <i>Order no.:</i>	326178369	Seite 1 von 47 Page 1 of 47
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	2487803	Auftragsdatum: <i>Order date:</i>	2026-03-24	
Auftraggeber: <i>Client:</i>	NINGBO DEYE ESS TECHNOLOGY CO., LTD. No.568, South Rixian Road, Binhai Economic Development Zone, Cixi, Ningbo, Zhejiang P.R. China			
Prüfgegenstand: <i>Test item:</i>	Rechargeable Li-ion Battery System			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	SE-F16 Max-6, SE-F16 Max			
Auftrags-Inhalt: <i>Order content:</i>	Test report			
Prüfgrundlage: <i>Test specification:</i>	UL 9540A: 2026 (Sixth Edition) Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2026-06-17			
Prüfmuster-Nr.: <i>Test sample no.:</i>	#2026061701			
Prüfzeitraum: <i>Testing period:</i>	2026-06-18 to 2026-06-24			
Ort der Prüfung: <i>Place of testing:</i>	See page 6 Testing location			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	See main report			
geprüft von: tested by: Jiabao Li	genehmigt von: authorized by: Minhao Hu			
Datum: Date: 2026-07-15	Ausstellungsdatum: Issue date: 2026-07-15			
Stellung / Position: Project Engineer	Stellung / Position: Authorizer			
Sonstiges: <i>Other:</i>				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>		Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>		
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet				
* Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
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Test report no.:

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Anforderungen Remarks

1	Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. <i>The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.</i>
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3	Prüfklausel mit der Note * wurden an qualifizierte Unterauftragnehmer vergeben und sind unter der jeweiligen Prüfklausel des Berichts beschrieben. Abweichungen von Prüfspezifikation(en) oder Kundenanforderungen sind in der jeweiligen Prüfklausel im Bericht aufgeführt. <i>Test clauses with remark of * are subcontracted to qualified subcontractors and described under the respective test clause in the report.</i> <i>Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.</i>
4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnissen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezüglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. <i>The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the "Zero Guard Band Rule" and "Simple Acceptance" in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.</i>

TEST REPORT	
ANSI/CAN/UL 9540A:2026	
Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems	
Report Number	CN26H50G 001
Date of issue	See cover page
Total number of pages	See cover page
Name of Testing Laboratory	TÜV Rheinland (Shanghai) Co., Ltd.
Preparing the Report	No. 177, Lane 777, West Guangzhong Road, Jing'an District, Shanghai 200072, P. R. China
Applicant's name	NINGBO DEYE ESS TECHNOLOGY CO., LTD.
Address	No.568, South Rixian Road, Binhai Economic Development Zone, Cixi, Ningbo, Zhejiang P.R. China
Test specification:	
Standard	ANSI/CAN/UL 9540A:2026
Test procedure	TÜV Rheinland Test Report
Non-standard test method	N/A
Test Report Form No.	UL 9540A-F01
Test Report Form(s) Originator	TÜV Rheinland (Shanghai) Co., Ltd.
Master TRF	Dated 2026-03-20
General disclaimer:	
The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the TÜV Rheinland (Shanghai) Co., Ltd., responsible for this Test Report.	
Other / Scope:	
This report presents the result of unit level test of UL 9540A: 2026. All tests were conducted at TUV Rheinland (Shanghai) Co., Ltd. and TUV Rheinland's partner labs that were under supervision of TÜV Rheinland's engineer. All tests were under supervision of TÜV Rheinland's engineer.	

List of Attachments:
Attachment A: Test Setup

Attachment B: Module Conditioning (Charge/Discharge) Profiles

Attachment C: Observations and Records

Attachment D: Module and Initiating Cell(s) Temperature Profiles during Testing

Attachment E: Smoke Release Rate, Chemical Heat Release Rate, Convective Heat Release Rate and Heat Flux

Attachment F: Flammable Gas Generation and Composition Data

Attachment G: Sample Photos and Test Photos

Attachment H: List of Test and Measurement Instruments

Attachment I: Revision Information

Summary of Testing:

Model no.:	SE-F16 Max-6
Ratings:	51.2 V, 16 kWh
Cells in series/parallel:	1P16S
BESS dimensions:	464mm*914mm*244.5mm
BESS weight:	120kg
Maximum Target BESS Temperature:	40.7°C
Maximum Wall Surface Temperature:	46.0°C
BESS enclosure material:	Matel enclosure
BESS Intended Installation: Non-residential: outdoor ground mounted, indoor floor mounted, outdoor wall mounted, indoor wall mounted, roof top, open garage Residential: Outdoor ground mounted, indoor floor mounted, outdoor wall mounted, indoor wall mounted	Residential: indoor floor mounted, indoor wall mounted
Total number of cell(s) went into thermal runaway:	2
Thermal Runaway and Propagation:	1 initiating cell went into thermal runaway and propagated to 1 adjacent cell
Maximum Smoke Release Rate:	6.90 m ² /s
Total Smoke Released:	282.16 m ²
Peak Chemical Heat Release Rate:	No flaming occurred
Peak Convective Heat Release Rate:	No flaming occurred
Total Heat Release:	No flaming occurred
External Flaming:	No external flaming occurred
Location(s) of Flame Venting:	No flaming occurred
Flying Debris:	No flying debris occurred

Re-ignitions:	No further re-ignitions were observed during posttest observation
Installation space required:	25 m ³
Concentration of combustible gas:	1.33% (Criteria 25% LFL: 1.825%)

Summary of Unit Level Test Gas Analysis Data:
Gas Analysis:

Flame ionization detection	☒
Fourier-Transform Infrared Spectrometer	☒
Hydrogen sensor (palladium-nickel, thin-film solid state sensor)	☒
White light source with photo detector (smoke release rate)	☒

Gas Composition & Volume for Each Compound (Pre-Flaming and Post-Flaming):

Gas Compound	Gas Type	Pre-Flaming(L)	Post-Flaming(L)
Total Hydrocarbons (Propane Equivalent)	Hydrocarbons	89.53	No flaming
Carbon Monoxide	Carbon Containing	28.82	No flaming
Carbon Dioxide	Carbon Containing	152.03	No flaming
Hydrogen	Hydrogen	213.30	No flaming
Note: See Attachment F for detailed gas analysis data.			

Result of Testing:

Performance Criteria in accordance with Table 9.1 for Outdoor ground mounted, indoor floor mounted, outdoor wall mounted, indoor wall mounted residential unit:

Charring or ignition of the cheesecloth indicator is not observed;	☒
Flaming outside the initiating BESS unit is not observed as demonstrated by no flaming or charring of the cheesecloth indicator;	☒
Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit did not exceed the temperature at which thermally initiated cell venting occurred, as determined in 7.3.1.10;	☒
Surface temperature measurements on wall surfaces do not exceed 97°C (175°F) of the temperature rise above ambient;	☒
Explosion hazards were not observed, including deflagration, detonation; and	☒
The concentration of flammable gas does not exceed 25% LFL in air for the smallest specified room installation size;	☒

Heat flux measured at the minimum distance to a means of egress ²⁾ shall not exceed 1.3kW/m ² .	☒
Necessity for Installation Level Test:	
The performance criteria of the unit level test as indicated in Table 9.1 of UL 9540A 6th edition has not been met, therefore an installation level testing in accordance with UL 9540A will need to be conducted on the representative the installation with this unit installed.	☐
The performance criteria of the unit level tests as indicated in Table 9.1 of UL 9540A 6th edition has been met, therefore an installation level testing in accordance with UL 9540A need not be conducted.	☒
Tests performed (name of test and test clause): UL 9540A cl 9. Unit Level	Testing location: Lead New Power Technology (Zhejiang) Co., Ltd. Area T2, Warehouse 4, Hangzhou Bonded Logistics Center, Baoshui Road, Jingjiang Subdistrict, Xiaoshan District, Hangzhou, Zhejiang, China
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: See cover page Date (s) of performance of tests: See cover page	
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.	
Name and address of factory(ies) : Same as applicant	
Other: N/A	

UL 9540A Testing Information:
Cell Level Information

Manufacturer:	Jiangsu ZENERGY Battery Technologies Co., Ltd.
Model number:	YPH3L7-314AH
Chemistry:	LiFePO ₄
Physical configuration:	Prismatic
Electrical rating:	Rated capacity: 314 Ah
	Nominal voltage: 3.2 V
UL 9540A cell test report number:	Accepted test report from TÜV Rheinland, Report No.: CN23DJ6S 001
Average cell surface temperature at gas venting:	168.7°C
Average cell surface temperature at thermal runaway:	176.8°C
Gas Volume:	174.8 L
Lower flammability limit (LFL), % volume in air at the ambient temperature:	7.8%
Lower flammability limits (LFL), % volume in air at the venting temperature:	7.3%
Burning velocity (S _u):	0.828 m/s
Maximum pressure (P _{max}):	0.749 MPa

Cell Level Gas Composition:

Gas Component	Concentration % (v/v)
CH ₄	4.832
C ₂ H ₂	0.219
C ₂ H ₄	4.947
C ₂ H ₆	0.924
C ₃ H ₄	0.027
C ₃ H ₆	0.343
C ₃ H ₈	0.367
C ₄ H ₆	0.177
C ₄ H ₈	0.119
C ₄ H ₁₀	0.101
H ₂	50.103
CO	12.553
CO ₂	25.288

Total	100
Module Level Information	
Remark: The smallest structural element of the product is the unit.	

General product information

Photo of battery system



Manufacturer name:		NINGBO DEYE ESS TECHNOLOGY CO., LTD
Model number:		SE-F16 Max-6
Physical configuration	SECC	
	Weight: 118 kg	
	Cells in series/parallel: 1P16S	
Cooling method:		Natural Air cooling
Electrical rating:	51.2V	
	Rated capacity: 314 Ah	
Standard charge method	Charge current :	157A
	End of charge voltage :	57.6V
	Charge temperature range:	0~55°C (without heating film) -20~55°C (with heating film)
Standard discharge	Discharge current :	157A
	End of discharge voltage :	44.8 V

method	Discharge temperature range:	-20~55 °C
External dimensions:		464mm*914mm*244.5mm
Manufacturer name:		NINGBO DEYE ESS TECHNOLOGY CO., LTD
Model number:		SE-F16 Max
Physical configuration	SECC	
	Weight: 118kg	
	Cells in series/parallel: 1P16S	
Cooling method:		Natural Air cooling
Electrical rating:	51.2V	
	Rated capacity: 314 Ah	
Standard charge method	Charge current :	157A
	End of charge voltage :	57.6V
	Charge temperature range:	0~55°C (without heating film) -20~55°C (with heating film)
Standard discharge method	Discharge current :	157A
	End of discharge voltage :	44.8 V
	Discharge temperature range:	-20~55 °C
External dimensions:		464mm*914mm*244.5mm

Note: Aerosol fire suppression inside the battery pack is an optional item.

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
CONSTRUCTION			--
5	General		--
5.1	Cell		P
5.1.1	The cells associated with the BESS that were tested shall be documented in the test report.	Accepted test report from TÜV Rheinland, Report No.: CN23DJ6S 001	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.	Accepted test report and certificate from UL Report No.: MH65902-20230912 Cert. No.: UL-CA-2331928-0	P
5.1.3	Refer to 7.7.1 for further details be included in the cell level test report.		N/A
5.2	Module		N/A
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.		N/A
5.2.2	The module documentation included in the test report shall indicate if the modules associated with the BESS comply with UL 1973.	Test with unit	N/A
5.2.3	Refer to 8.4 for further details to be included in the module level test report.		N/A
5.3	Battery energy storage system unit	DUT complied with UL1973	P
5.3.1	The BESS unit documentation included in the test report shall indicate the units that comply with UL 9540 and include the manufacturer, model, electrical ratings, and energy capacity of all BESS.		N/A
5.3.2	For BESS units for which UL 9540 compliance cannot be determined, the documentation included in the test report shall include the number of modules in the BESS, electrical configuration of the module, and physical layout of the modules in the BESS, battery management system (BMS) and other major components of the BESS. It shall be documented as to whether the battery system complies with UL 1973 in addition to the overall BESS compliance to UL 9540.	Accepted test report and certificate from TÜV Rheinland Report No.: CN26W9UU 001 Cert. No.: CU_72608697_0001	P
5.3.3	If applicable, the details of any fire detection and suppression systems that are an integral part of the BESS shall be noted in the test report.		N/A
5.3.4	Refer to 9.7, 10.4 and 10.7 for further details to be included in the unit level and if applicable, installation level test reports.		P
5.4	Flow Batteries	Not applicable to Li-ion cell	N/A

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
PERFORMANCE			--
6	General		--
6.1	The tests in this standard are extreme abuse conditions conducted on electrochemical energy storage devices that can result in fires.		P
6.2	At the conclusion of testing, samples shall be discharged in accordance with the manufacturer's specifications.		P
6.3	Temperatures on parts and surfaces shall be measured continuously, taking the average over every 60 seconds. The maximum of these averages shall be documented for each thermocouple location. Cell surface temperatures shall be measured continuously, but not averaged over every 60 seconds as the other temperature measurements are.		P
6.4	When heat flux measurements are taken, they shall be measured continuously, taking the average over every 60-second interval. The maximum of these averages shall be documented for each gauge location.		P
9	Unit Level		--
9.1	Sample and test configuration		P
9.1.1	The Unit Level Test is designed to evaluate the ability of a BESS design to control a propagating thermal runaway event, with the initial thermal runaway condition established from the module level procedure of 8.2.4 as the initiating condition. The Unit Level Test is required for any of the following:	Applied c) Residential use electrochemical BESS greater than 1 kWh and intended for use inside a dwelling unit;	P
	a) Residential use electrochemical BESS greater than 20 kWh; b) Residential use electrochemical BESS with less than 0.9 m (3 ft) separation distance between BESS, windows or doors; c) Residential use electrochemical BESS greater than 1 kWh and intended for use inside a dwelling unit; d) Residential use electrochemical BESS with a non-metallic enclosure; or e) Electrochemical BESS with an active thermal runaway propagation prevention system, such as a direct injection cooling system, that is integrated within the BESS.		P
9.1.2	For all other electrochemical BESS that do not meet 9.1.1 (a)– (e), the Unit Level Test is not required and the Installation Level– Large Scale Fire Test of Section 10 shall be conducted.		N/A

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
9.1.3	The unit level test shall be conducted with BESS units installed as described in the manufacturer's instructions and this section. Test configurations may include the following:	Applied b). Indoor floor mounted residential use BESS; d) Outdoor ground mounted residential use BESS; f) Indoor wall mounted residential use BESS; h) Outdoor wall mounted residential use BESS; j) Rooftop residential use BESS.	P
	a) Indoor floor mounted non-residential use BESS; b) Indoor floor mounted residential use BESS; c) Outdoor ground mounted non-residential use BESS; d) Outdoor ground mounted residential use BESS; e) Indoor wall mounted non-residential use BESS; f) Indoor wall mounted residential use BESS; g) Outdoor wall mounted non-residential use BESS; h) Outdoor wall mounted residential use BESS; i) Rooftop non-residential use BESS; j) Rooftop residential use BESS; and k) Open parking garage non-residential use BESS installations.		P
9.1.4	The unit level test requires one initiating BESS unit, in which a thermal runaway condition resulting in cell to cell thermal runaway propagation in accordance with the module level test in 8.2.4 is initiated, and adjacent target BESS units representative of an installation. Tests conducted for indoor floor mounted installations for residential BESS may be considered representative of both indoor floor mounted and outdoor ground mounted installations. Tests shall be conducted indoors with fire propagation hazards and separation distances between initiating and target units representative of the installation.	See figure 6-13 for test installations	P
	The results of such tests for residential BESS may be considered to also represent an outdoor installation. Examples of potential test configurations are shown in Figure 9.1, Figure 9.2, and Figure 9.3.	Outdoor ground mounted, indoor floor mounted, outdoor wall mounted, indoor wall mounted residential BESS	P

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
	a) Wind screens are utilized with a maximum wind speed maintained at ≤ 12 mph; b) The temperature range is within 10 °C to 40 °C (50 °F to 104 °F); c) The humidity is < 90 % RH; d) There is sufficient light to observe the testing; e) There is no precipitation during the testing; f) There is control of vegetation and combustibles in the test area to prevent any impact on the testing and to prevent inadvertent fire spread from the test area; and g) There are protection mechanisms in place to prevent inadvertent access by unauthorized persons in the test area and to prevent exposure of persons to any hazards as a result of testing.	indoor floor mounted, indoor wall mounted residential unit	N/A
9.1.5	For outdoor non-residential use High Temperature Batteries installed in a container, the unit level test is waived as there is no additional information to be collected at the unit level for this technology when it is utilized for outdoor use only. Instead, the installation level test shall be conducted in accordance with 10.12.	Not applicable to Li-ion cell	N/A
9.1.6	For installations, where the high temperature battery modules are not installed on racks but rather within separate compartments within the container, the module is considered the test unit for the test of 10.12. See 10.12.1 and 10.12.2.	Not applicable to Li-ion cell	N/A
9.1.7	Depending upon the configuration and design of the BESS (e.g. the BESS is composed of multiple separate parts within separate enclosures), this testing to determine fire characterization can be done at the battery system level. The suitability of this approach shall be determined based upon the overall design of the BESS and an analysis of the battery system as representative of the overall BESS for fire characterization concerns.	Testing at battery rack level	P
9.1.8	Where the manufacturer's instructions indicate that the BESS can be installed outdoors and in open parking garages less than 3 m (10 feet) from the means of egress or other exposures, testing shall be conducted as described in this Section.		N/A
9.1.9	The initiating BESS unit shall contain components representative of a BESS unit in a complete installation. Combustible components that interconnect the initiating and target BESS units shall be included.		P

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
9.1.10	Target BESS units shall include the outer cabinet (if part of the design), racking, module enclosures, and components that retain cells components. The target BESS units may also include one live, populated module at the location of the highest anticipated temperature in the enclosure. The remaining target BESS unit module enclosures do not need to contain cells.		P
9.1.11	The initiating BESS unit shall be brought to the maximum operating state of charge (MOSOC) in accordance with the manufacturer's specifications and allowed to rest for a minimum of 1 hour at room ambient before the start of the test.		P
9.1.12	Prior to initiating the test, the voltage of the initiating module shall be measured and recorded. If the voltage drop is greater than 0.1 % of the fully charged voltage of the module, then the initiating BESS shall be charged again as noted in 9.1.11 and the voltage of the initiating BESS shall be recorded.		P
9.1.13	If a BESS unit includes an integral fire suppression system, there is an option of providing this with the DUT. If the BESS unit is provided with an optional integral fire suppression system, the system shall not be provided on the DUT.	The BESS unit contains an aerosol fire suppression system.	P
9.1.14	Electronics and software controls such as the battery management system (BMS) in the BESS are not relied upon for this testing. This does not include a fire suppression control in accordance with UL 864 that is external to the BESS, but provided as part of an integral fire suppression system per 9.1.13.		P
9.2	Test method – Indoor floor mounted BESS units		P
9.2.1	During an indoor test, the test room environment shall be controlled to prevent drafts that may affect test results. At the start of the test, the room ambient temperature shall not be less than 10 °C (50 °F) nor more than 32 °C (90 °F).	Outdoor ground mounted, indoor floor mounted, outdoor wall mounted, indoor wall mounted residential unit	P
9.2.2	Any access door(s) or panels on the initiating BESS unit and adjacent target BESS units shall be closed, latched and locked at the beginning and duration of the test.		P
9.2.3	The initiating BESS unit shall be positioned adjacent to two instrumented wall sections.	See figure 5	P
9.2.4	Instrumented wall sections shall extend not less than 0.49 m (1.6 ft) horizontally beyond the exterior of the target BESS units.		P
9.2.5	Instrumented wall sections shall be at least 0.61-m (2-ft) taller than the BESS unit height, and not less than 2.13 m (7 feet) in height above the floor		P

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Clause	Requirement – Test	Result - Remark	Verdict
9.2.6	The surface of the instrumented wall sections shall be covered with gypsum wall board and painted flat black. An incremental visual reference shall be provided on the instrumented wall sections for scale so that flame extension can be accurately measured if applicable. The gypsum wall board shall be 13-mm (1/2-inch) thick at minimum.		P
9.2.7	The initiating BESS unit shall be centered underneath an appropriately sized smoke collection hood of an oxygen consumption calorimeter.		P
9.2.8	The light transmission in the calorimeter's exhaust duct 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 as described in 8.2.17.		P
9.2.9	The chemical and convective heat release rates shall be measured for the duration of the test, using the methodologies specified in 8.2.13 and 9.2.12, respectively.	See Attachment E	P
9.2.10	With reference to 9.2.9, the heat release rate measurement system shall be calibrated using an atomized heptane diffusion burner.	See Attachment E	P
9.2.11	With reference to 9.2.9, the convective heat release rate shall be measured using thermopile, a velocity probe, and a Type K thermocouple, located in the exhaust system of the exhaust duct.	See Attachment E	P
9.2.12	With reference to 9.2.9, the convective heat release rate shall be calculated using the following equation: $HRR_c = V_e A \frac{353.22}{T_e} \int_{T_o}^T C_p dT$		P
9.2.13	The physical spacing between BESS units (both initiating and target) and adjacent walls shall be representative of the intended installation as noted in 9.1.		P
9.2.14	Separation distances shall be specified by the manufacturer for distance between:		P
	a) The BESS units and the instrumented wall sections; and b) Adjacent BESS units.	See figure 5	P
9.2.15	Wall surface temperatures shall be measured in vertical array(s) at 152-mm (6-inch) intervals for the full height of the instrumented wall sections. The thermocouples for measuring the temperature on wall surfaces shall be horizontally positioned in the wall locations anticipated to receive the greatest thermal exposure. Temperatures shall be measured continuously, averaging over every 60-second interval per 6.3. The maximum of these averages shall be documented for each thermocouple location		P

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
9.2.16	Thermocouples shall be secured to gypsum surfaces by the use of staples placed over the insulated portion of the wires. The thermocouple tip shall be depressed into the gypsum and held in thermal contact with the surface at that point.		P
9.2.17	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt Boelter or Gardon gauges at the surface of each instrumented wall as follows in (a)– (c). Heat flux shall be measured continuously, averaging over every 60-second interval per 6.4. The maximum of these averages shall be documented for each gauge location		P
	a) Both are collinear with the vertical thermocouple array;		P
	b) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module; and		P
	c) One is positioned at the elevation estimated to receive the greatest heat flux during potential propagation of thermal runaway within the initiating BESS unit.		P
9.2.18	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt Boelter or Gardon gauges at the surface of each adjacent target BESS unit that faces the initiating BESS unit as follows in (a) and (b). Heat flux shall be measured continuously, averaging over every 60-second interval per 6.4. The maximum of these averages shall be documented for each gauge location		P
	a) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module within the initiating BESS; and		P
	b) One is positioned at the elevation estimated to receive the greatest surface heat flux due to the thermal runaway of the initiating BESS.		P
9.2.19	For BESS intended for installation outdoors or in open parking garages covered by 9.1.6, heat flux shall be measured with the sensing element of at least one water-cooled Schmidt-Boelter or Gardon gauge positioned at the mid height of the initiating unit at the minimum horizontal distance from the BESS specified by the manufacturer or the point where the majority of off-gas venting is expected from the initiating unit. Heat flux shall be measured continuously, averaging over every 60-second interval per 6.4		P

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
9.2.20	No. 24-gauge or smaller, Type-K exposed junction thermocouples shall be installed to measure the temperature of the surface proximate to the cells and between the cells and exposed face of the initiating module. Temperatures shall be measured continuously, averaging over every 60-second interval per 6.3. The maximum of these averages shall be documented for each thermocouple location.		P
9.2.21	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator.		P
9.2.22	Cell to cell thermal runaway propagation in accordance with the module level test shall be created within a single module in the initiating BESS unit:		P
	a) The position of the module shall be selected to present the greatest thermal exposure to adjacent modules (e.g. above, below, laterally), based on the results from the module level test; and		P
	b) The setup (i.e. type, quantity and positioning) of equipment for initiating thermal runaway in the module shall be the same as that used to initiate and propagate thermal runaway within the module level test (Section 8).	Same as module level test	P
9.2.23	The composition, velocity and temperature of the initiating BESS unit vent gases shall be measured within the calorimeter's exhaust duct as outlined in 8.2.12. The hydrocarbon content of the vent gas shall be measured using flame ionization detection. Hydrogen gas shall be measured with a palladium-nickel thin-film solid state analyser. Composition, velocity and temperature instrumentation shall be collocated with heat release rate calorimetry instrumentation		P
9.2.24	The hydrocarbon content of the vent gas may additionally be measured using a Fourier-Transform Infrared Spectrometer with a minimum resolution of 1 cm ⁻¹ and a path length of at least 2.0 m (6.6 feet), or equivalent gas analyser.		P
9.2.25	The test shall be terminated if:		P
	a) There are three consecutive temperature readings measured inside each module within the initiating BESS unit that are determined to be falling over 15-minute intervals;		N/A
	b) The modules return to a temperature less than 60 °C (140 °F);	The module temperature returns to ambient temperature	P
	c) The fire propagates to adjacent units or to adjacent walls;		N/A
	d) A condition hazardous to test staff or the test facility requires mitigation; or		N/A

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
	e) Flaming outside the test room is observed.		N/A
9.2.26	For residential use systems, the gas collection data gathered in 9.2 shall be compared to the smallest room installation specified by the manufacturer to determine if the flammable gas collected exceeds 25% LFL in air.		P
9.3	Test method – Outdoor ground mounted units		N/A
9.3.1	Outdoor ground mounted non-residential use BESS being evaluated for installation in close proximity to buildings and structures shall use the test method described in 9.2. If intended for outdoor use only installations, including rooftop installations, the smoke release rate, the convective and chemical heat release rate and content, velocity and temperature of the released vent gases need not be measured.		N/A
9.4	Test Method – Indoor wall mounted units		N/A
9.5	Test Method – Outdoor wall mounted units		N/A
9.6	Rooftop and open garage installations		N/A
9.7	Unit level test report		P
9.7.1	The report on the unit level testing shall identify the type of installation being tested, as follows:		P
	a) Indoor floor mounted non-residential use BESS; b) Indoor floor mounted residential use BESS; c) Outdoor ground mounted non-residential use BESS; d) Outdoor ground mounted residential use BESS; e) Indoor wall mounted non-residential use BESS f) Indoor wall mounted residential use BESS; g) Outdoor wall mounted non-residential use BESS; h) Outdoor wall mounted residential use BESS; i) Rooftop installed non-residential use BESS; or j) Open parking garage installed non-residential use BESS.	b).d).f).h)	P
9.7.2	With reference to 9.7.1, if testing is intended to represent more than one installation type, this shall be noted in the report.	four installation types	P
9.7.3	The report shall include the following, as applicable:		P
	a) Unit manufacturer name and model number (and whether UL 9540 compliant);	See the summary of this report	P
	b) Number of modules in the initiating BESS unit;	See figure 6	P
	c) The construction of the initiating BESS unit per 5.3;	See figure 6	P

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
	d) Fire protection features/detection/suppression systems within unit;		N/A
	e) Module voltage(s) corresponding to the tested SOC;	See Attachment C	P
	f) The thermal runaway initiation method used;	External heaters	P
	g) Location of the initiating module within the BESS unit;	See figure 6	P
	h) Diagram and dimensions of the test setup including mounting location of the initiating and target BESS units, and the locations of walls, ceilings, soffits as applicable, and thermocouples;	See figure 5	P
	i) Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension;	See Attachment C	P
	j) Chemical and convective heat release rate versus time data;	See Attachment E	P
	k) Separation distances from the initiating BESS unit to target walls (e. g. distances A and C in Figure 9.1);	See figure 5	P
	l) Separation distances from the initiating BESS unit to target BESS units (e.g. distances D and H in Figure 9.1);	See figure 5	P
	m) The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple;	See Attachment D	P
	n) The maximum ceiling or soffit surface temperatures achieved during the indoor or outdoor wall mounted test and the location of the measuring thermocouple;		N/A
	o) The maximum incident heat flux on target wall surfaces and target BESS units;	See Attachment E	P
	p) The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test;		N/A
	q) Gas generation and composition data if conducted indoors;	See Attachment F	P
	r) Peak smoke release rate and total smoke release data if conducted indoors;	See Attachment E	P
	s) Indication of the activation of integral fire protection systems and if activated the time into the test at which activation occurred;		N/A
	t) Observation of flying debris or explosive discharge of gases unless mitigated by an engineered deflagration protection system;	See Attachment C	P
	u) Observation of re-ignition(s) from thermal runaway events;	See Attachment C	P
	v) Observation(s) of sparks, electrical arcs, or other electrical events;	See Attachment C	P

ANSI/CAN/UL 9540A:2026			
Clause	Requirement – Test	Result - Remark	Verdict
	w) Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units; 3) Adjacent walls, ceilings, or soffits;	See Attachment C	P
	x) Photos and video of the test.	Recorded	P
	y) If the test is terminated in accordance with 9.2.25, the circumstances of the termination; and		P
	z) Module level test report summary and cell level test report summary.		P
9.8	Performance at unit level testing		P
9.8.1	Installation level testing in Section 10 is not required if the following performance conditions outlined in Table 9.1 are met during the unit level test.	Installation level testing is not required according to the performance conditions.	P
	a) Flaming outside the initiating BESS unit is not observed;	No flaming observed	P
	b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10;	Max. Temperature during the test: 40.7°C Criteria Temperature: 168.7°C	P
	c) Surface temperature measurements on wall surfaces do not exceed 97°C (175°F) of temperature rise above ambient	Max. Temperature during the test: 46.0°C Criteria Temperature: 122.3°C	P
	d) Explosion hazards are not observed, including deflagration or detonation	No explosion observed	P
	e) The concentration of flammable gas does not exceed 25% LFL in air for the smallest specified room installation size.	Criteria 25% LFL: 1.825% Specified room installation size: 25 m³ The concentration of combustible gas: 1.33%	P
9.9	Flow battery unit tests	Not applicable to Li-ion cell	N/A
9.10	Flow battery unit level test report	Not applicable to Li-ion cell	N/A
9.11	Flow battery unit level performance criteria	Not applicable to Li-ion cell	N/A

--End of Report--

Attachment A: Test Setup

Figure 1. Cell numbering of initiating module

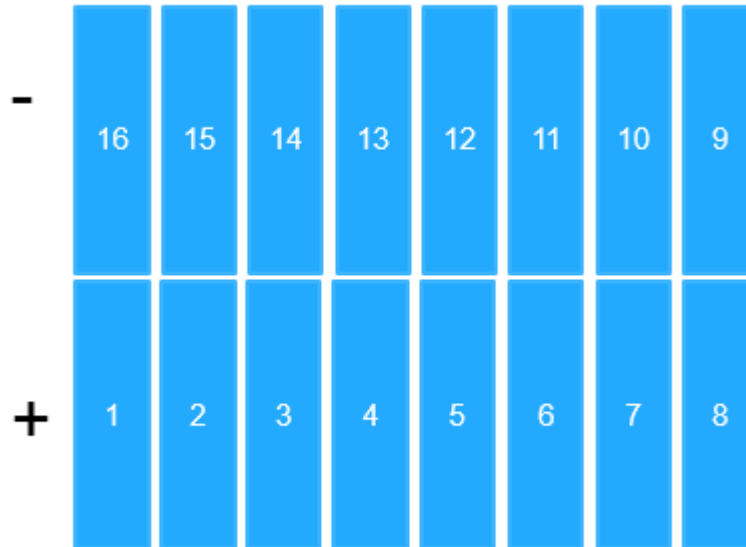


Figure 2. Thermocouple locations of initiating cell

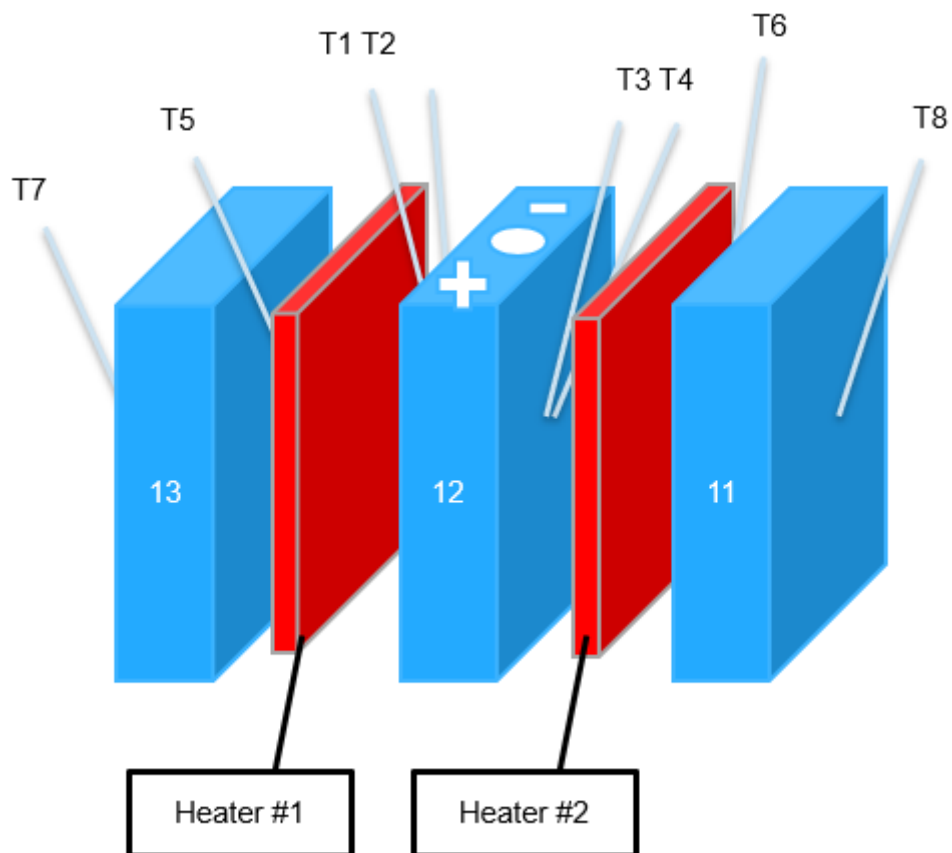


Figure 3. Cell numbering, heater locations and thermocouple locations inside the module

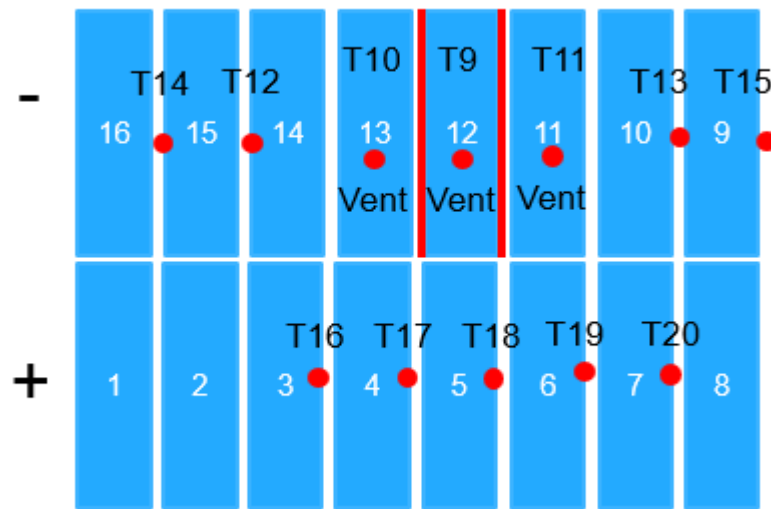


Figure 4. Thermocouple locations outside the module

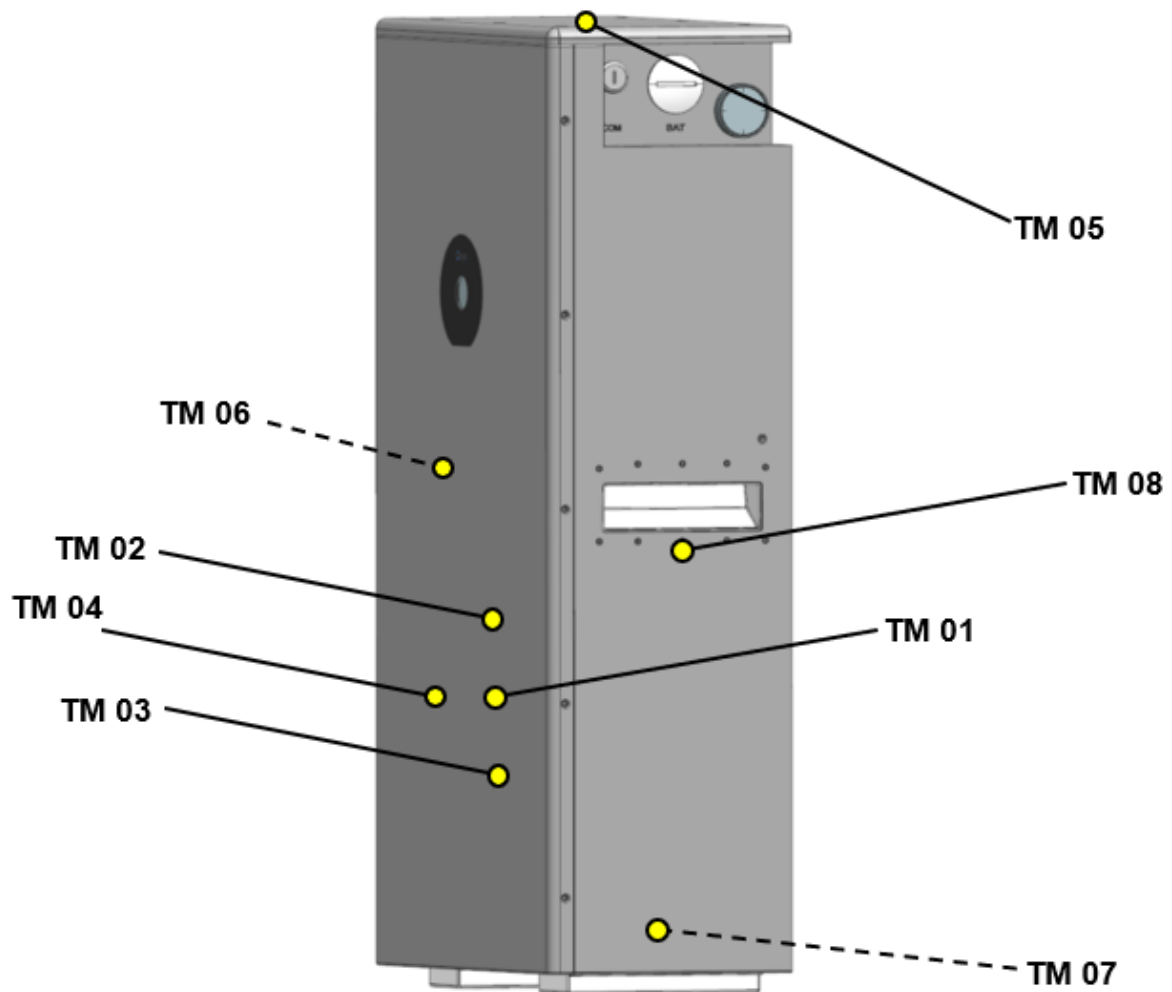


Figure 5. Test site setup diagram with separation distance (Front view)

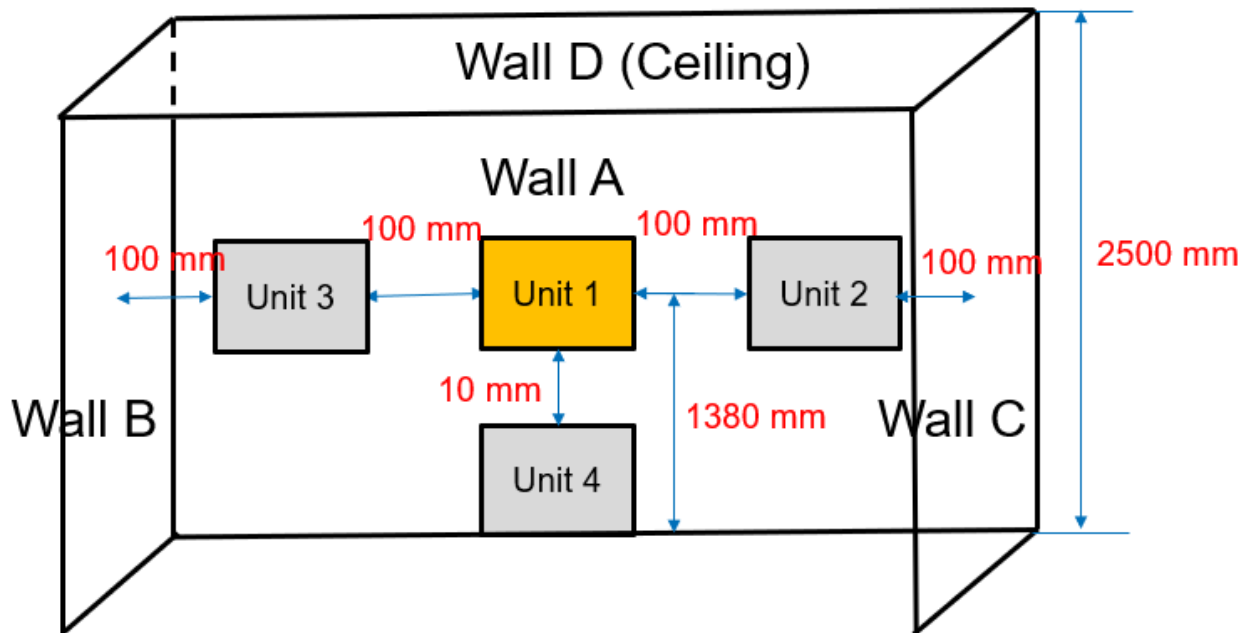


Figure 6. Thermocouple locations on modules in initiating unit 2



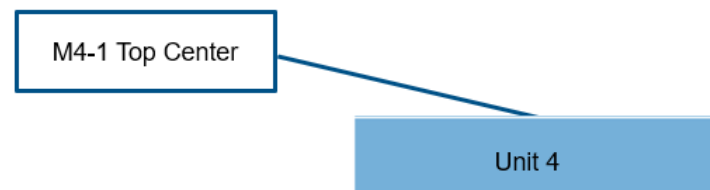
View direction: towards instrument wall A with reference to Figure 5

Figure 7. Thermocouple locations on modules in target unit 3



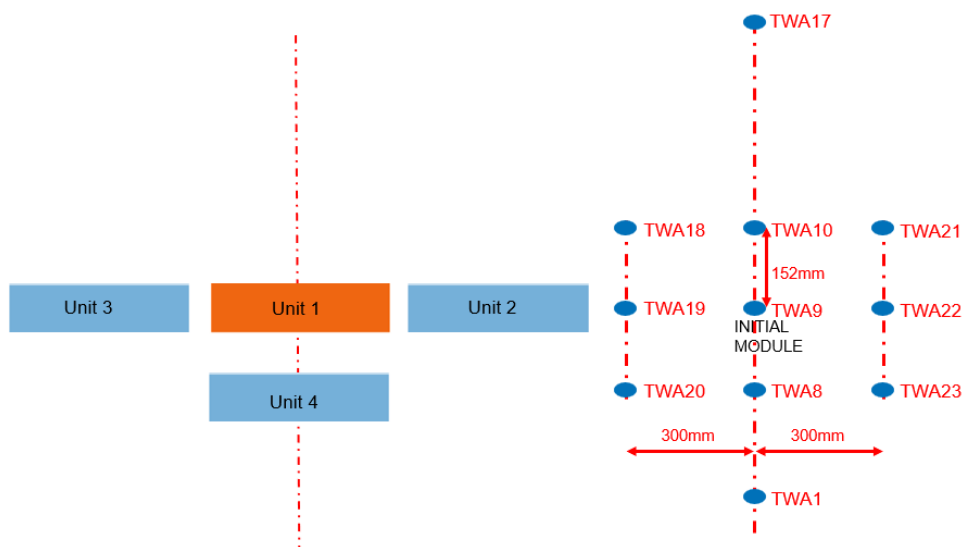
View direction: backward instrument wall A with reference to Figure 5

Figure 8. Thermocouple locations on modules in target unit 4



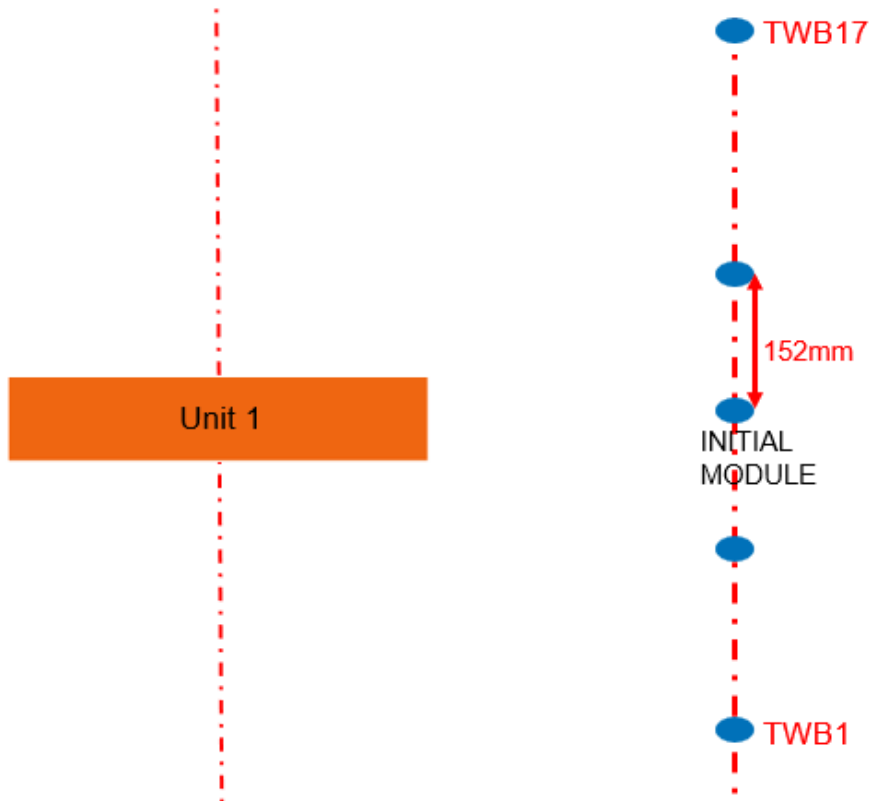
View direction: backward instrument wall A with reference to Figure 5

Figure 6. Vertical positions of the thermocouples on the wall



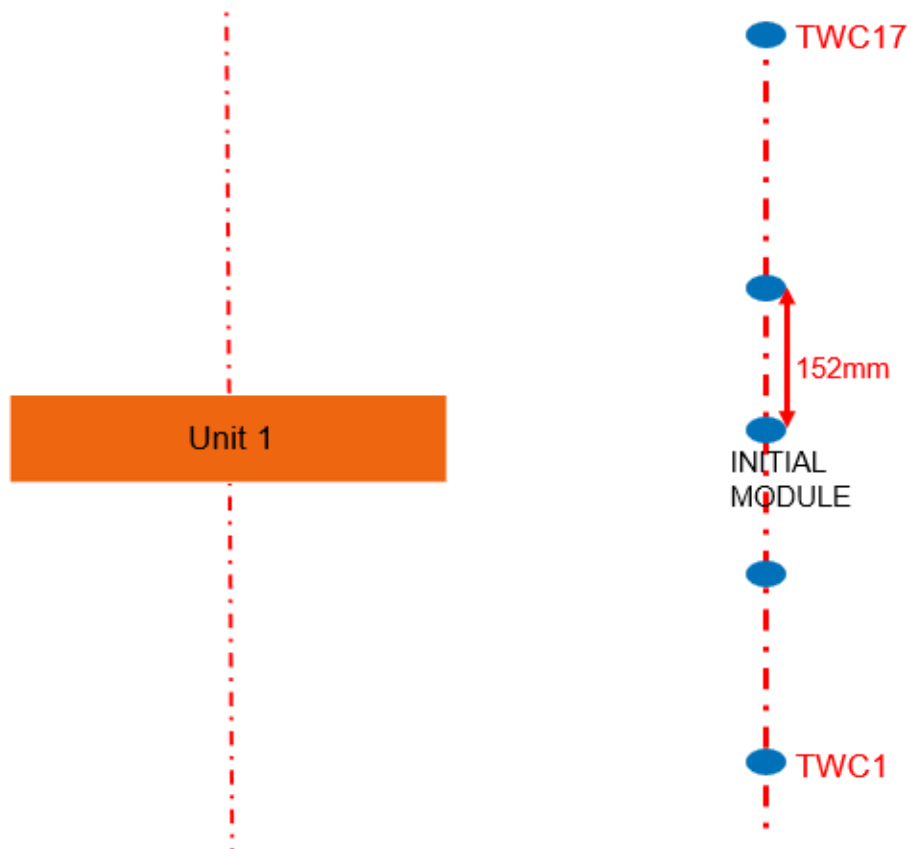
View direction: towards instrument wall A with reference to Figure 5

Figure 7. Vertical positions of the thermocouples on the wall B



View direction: towards instrument wall B with reference to Figure 5

Figure 8. Vertical positions of the thermocouples on the wall C



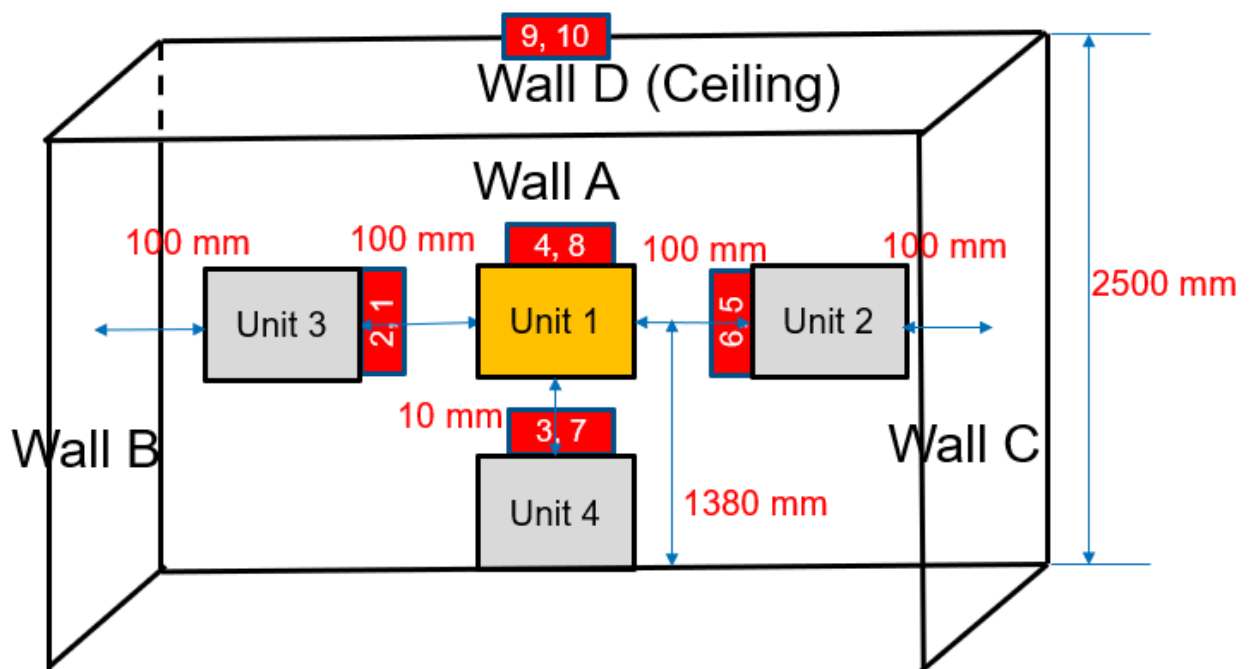
View direction: towards instrument wall C with reference to Figure 5

Figure 12. Vertical positions of the thermocouples on the wall D



View direction: towards instrument wall D with reference to Figure 5

Figure 13. Heat flux sensor locations on instrument walls

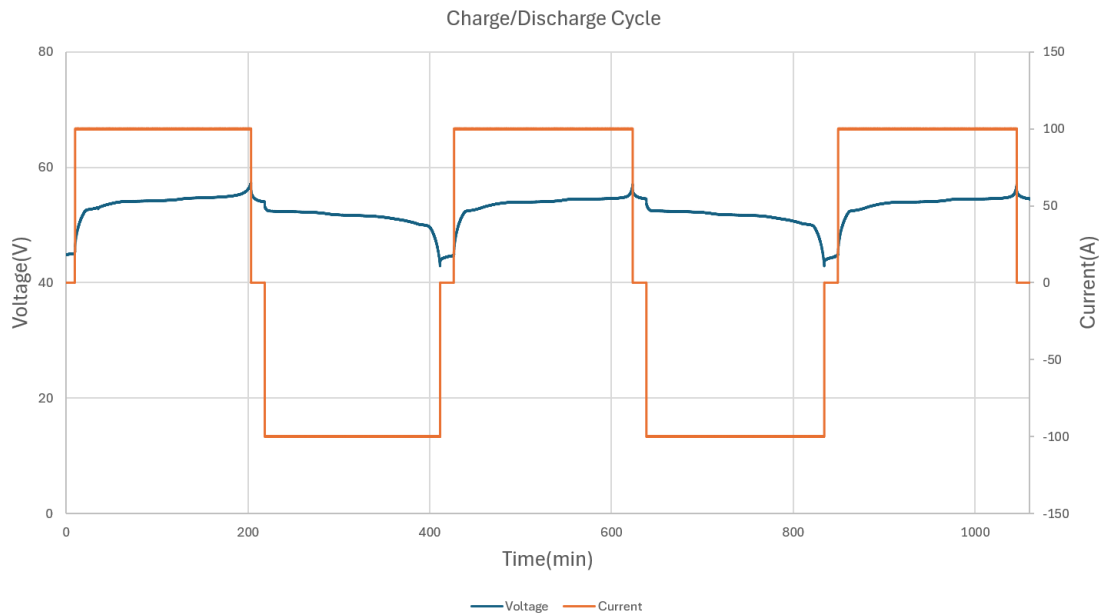


Attachment B: Module Conditioning (Charge/Discharge) Profiles

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 then discharged to an end of discharge voltage (EODV) specified by the module manufacturer.

Ambient indoor laboratory conditions shall be 25 ± 5 °C (77 ± 9 °F) and 50 ± 25 % RH during pre-condition.

Figure 14. Module charge and discharge voltage/current profiles



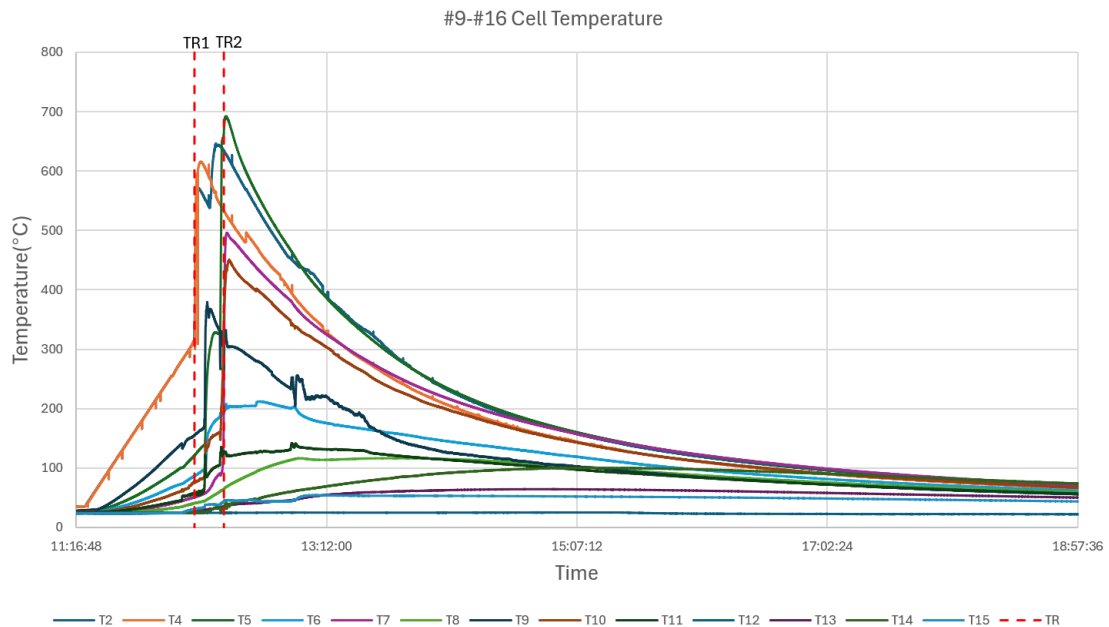
Attachment C: Observations and Records

Test Initiation Details	
Ambient conditions at the initiation of the test:	25.3°C, 61.3% RH
Sample number:	#2026061701
Open circuit voltage before test:	54.34 V
Weight before test:	120.8 kg (with thermocouples)
Open circuit voltage after test:	46.84 V
Weight after test:	118.8 kg (with thermocouples)
Weight loss:	2.0 kg

Test Overview Timeline		
Locations (Cell #)	Event	Time
-	Test start	11:16
#12	Vent	12:05
#12	Thermal runaway	12:11
#13	Vent	12:22
#13	Thermal runaway	12:24
Note: 1) No flying debris or explosive discharge of gases during test. 2) No sparks, electrical arcs, or other electrical events during test. 3) No flaming observed.		

Attachment D: Module and Initiating Cell(s) Temperature Profiles during Testing

Figure 15. Temperature of cell #9-#16



Note: Thermocouple T1, T3 was damaged during the test.

Figure 16. Temperature of cell #3~#7

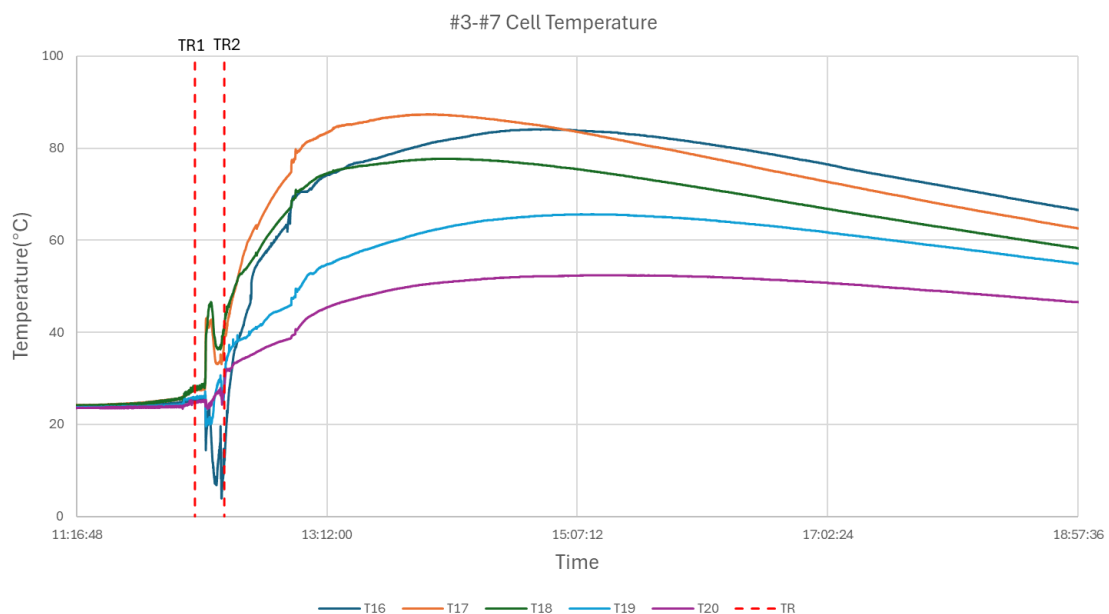


Figure 17. Temperature of module surface

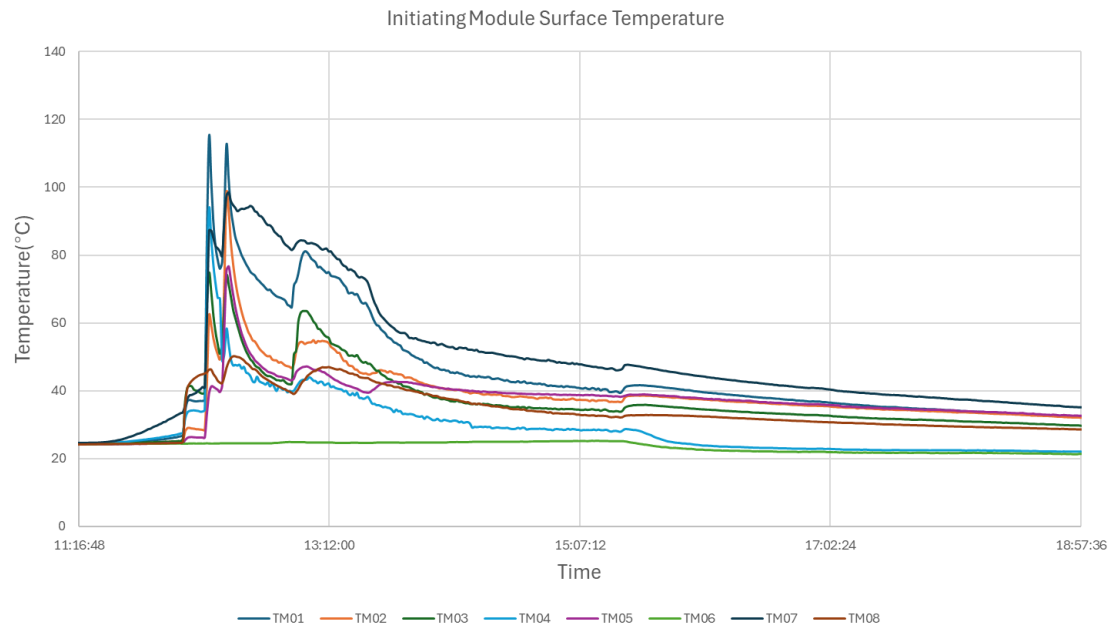
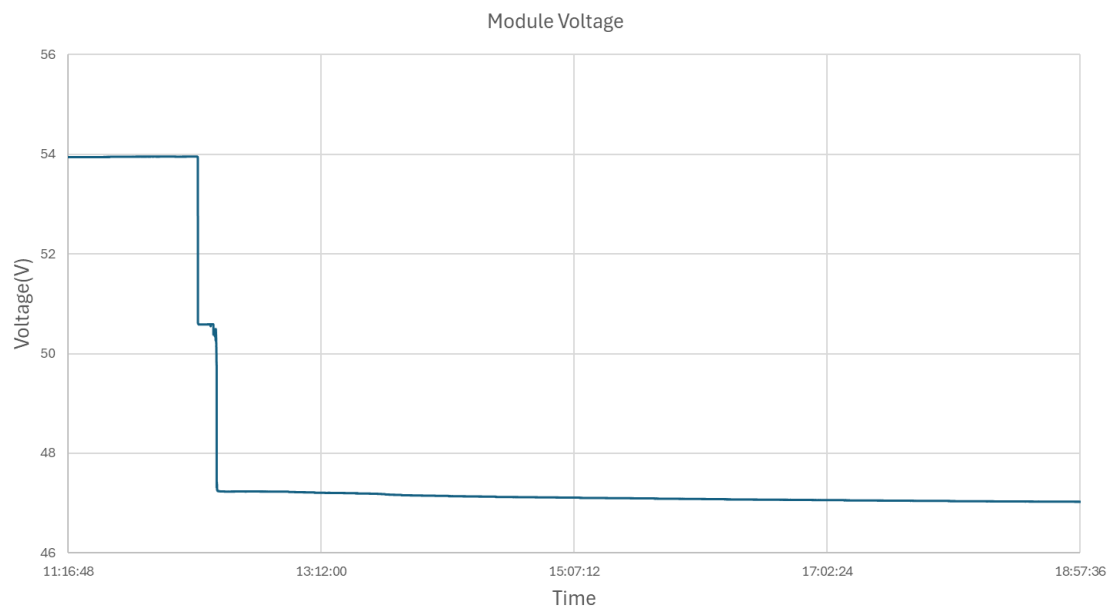


Figure 18. Module voltage



Maximum Temperature in Target Units		
UL 9540A Performance Criteria, Cell Surface Temperature at Gas Venting: 168.7°C		
Location		Maximum Module Temperature (°C)
Surface temperature of modules in target unit 2	M2-1	40.7
Surface temperature of modules in target unit 3	M3-1	32.1
Surface temperature of modules in target unit 4	M4-1	30.9

Figure 9. Surface temperature of modules in target unit 2

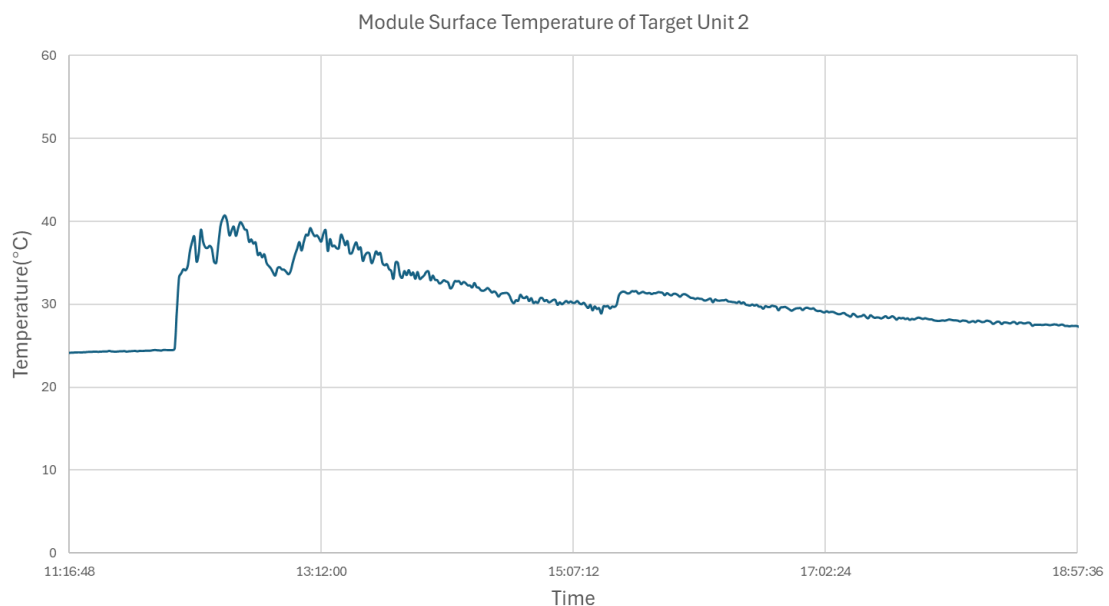


Figure 10. Surface temperature of modules in target unit 3

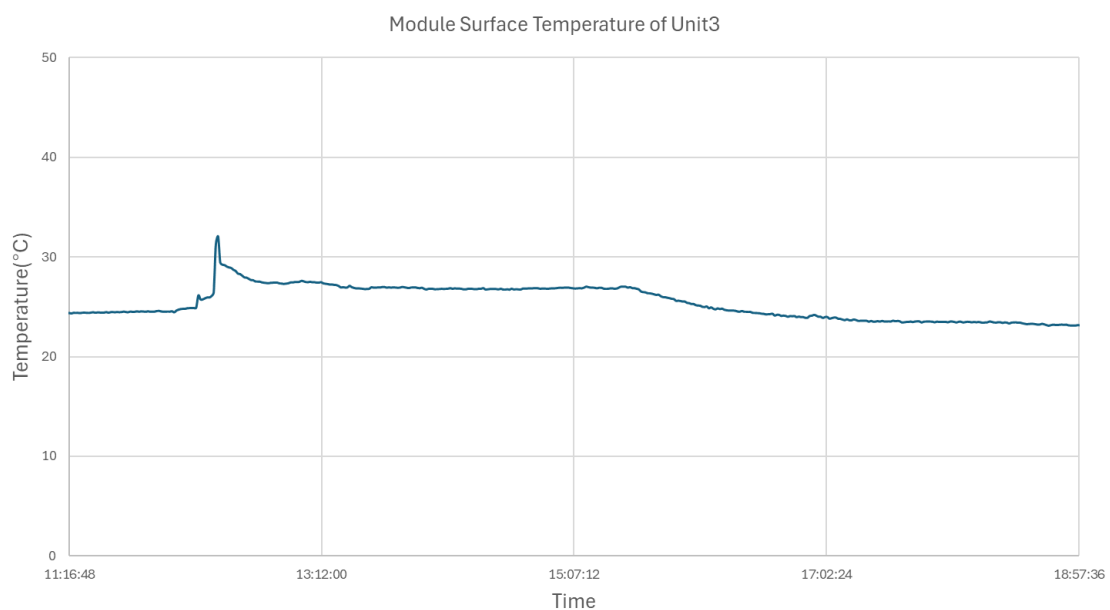
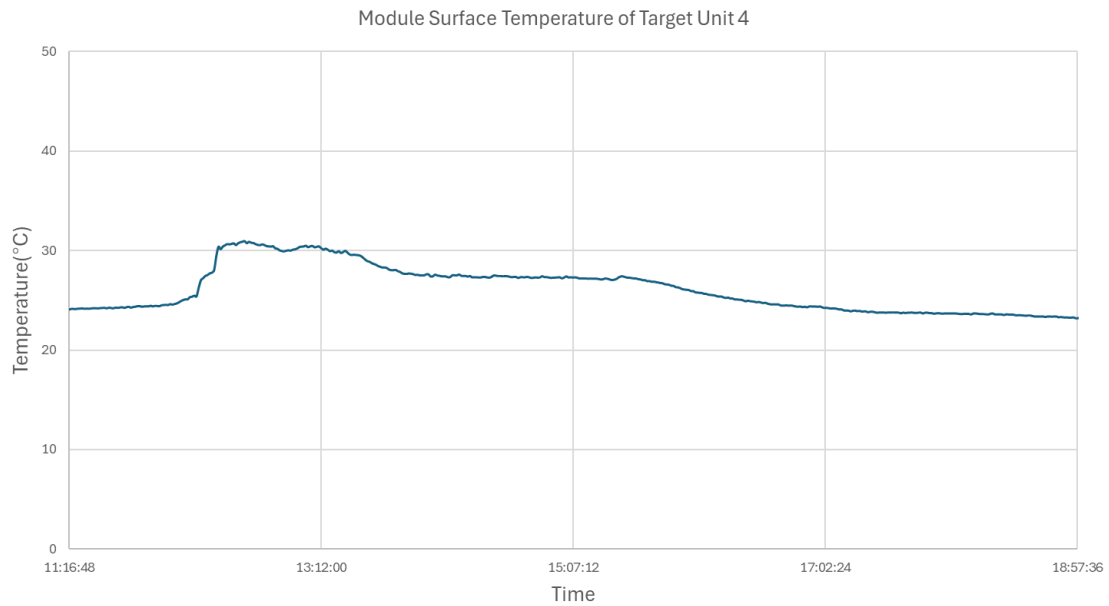


Figure 11. Surface temperature of modules in target unit 4



Maximum Temperature on Instrument Wall		
Ambient Temperature: 25.3°C		
UL 9540A Performance Criteria, Ambient + 97°C: 122.3°C		
Location		Maximum Wall Temperature (°C)
Wall A	TWA19	46.0
Wall B	TWB17	25.8
Wall C	TWC17	26.7
Wall D	TWD3	29.5

Figure 12. Temperature on instrument wall A



Figure 13. Temperature on instrument wall B

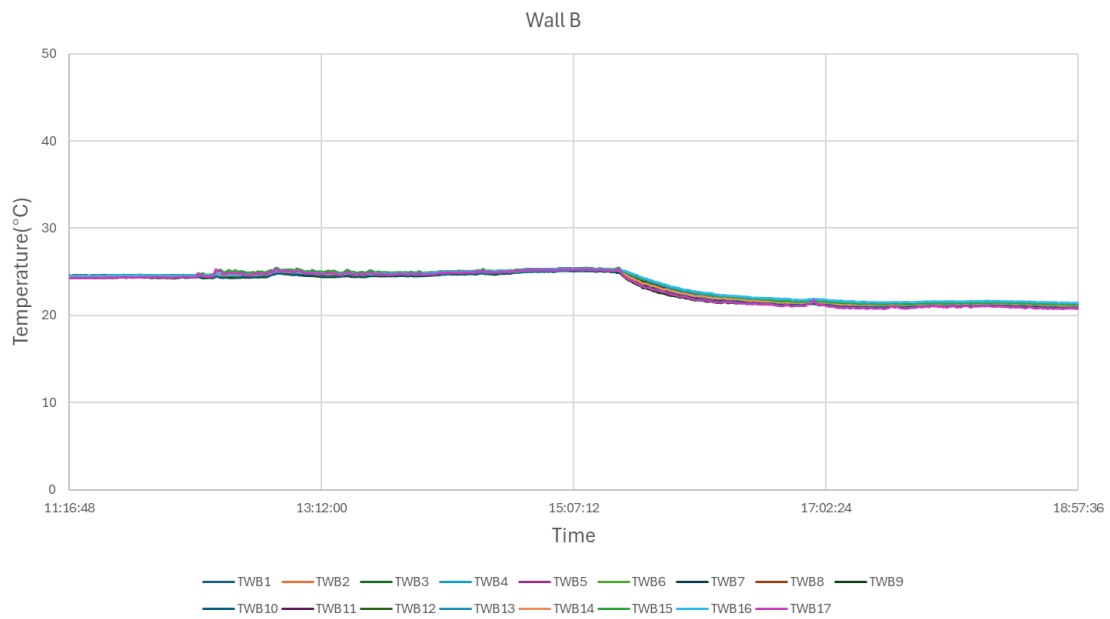


Figure 14. Temperature on instrument wall C

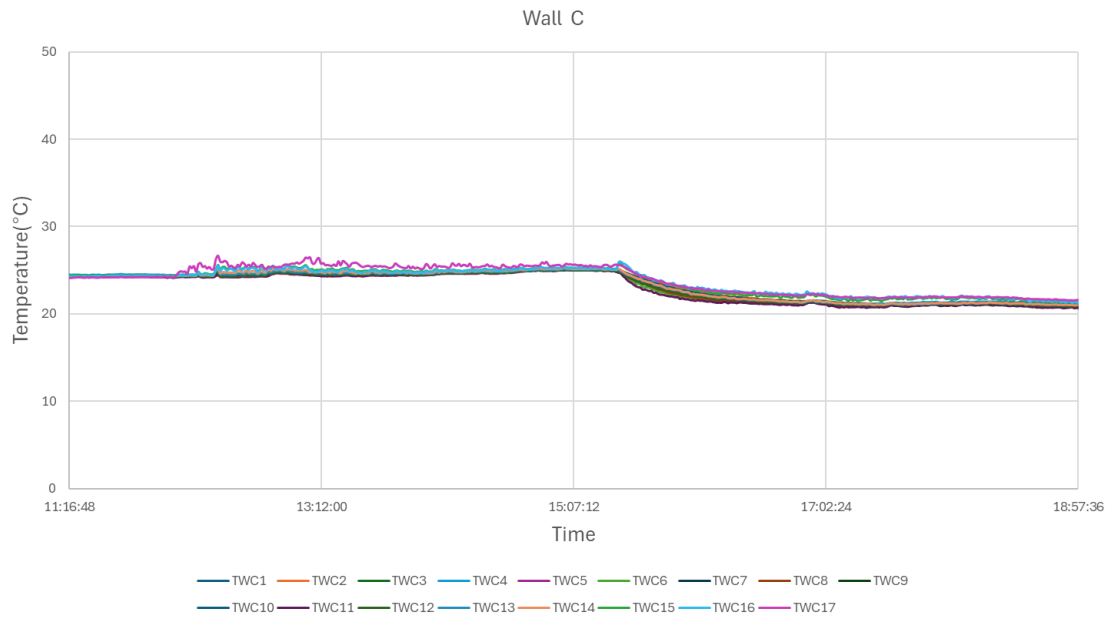


Figure 25. Temperature on instrument wall D



Attachment E: Smoke Release Rate, Chemical Heat Release Rate, Convective Heat Release Rate and Heat Flux

Smoke and Heat Release Rate		
Smoke Release Rate (SRR)	Maximum SRR(m ² /s)	6.90
	Total Smoke Released(m ²)	282.16
Heat Release Rate (HRR)	Peak Chemical HRR(kW)	No flaming observed
	Peak Convective HRR(kW)	No flaming observed
	Total Heat Release(MJ)	No flaming observed

Figure 26. SRR curve

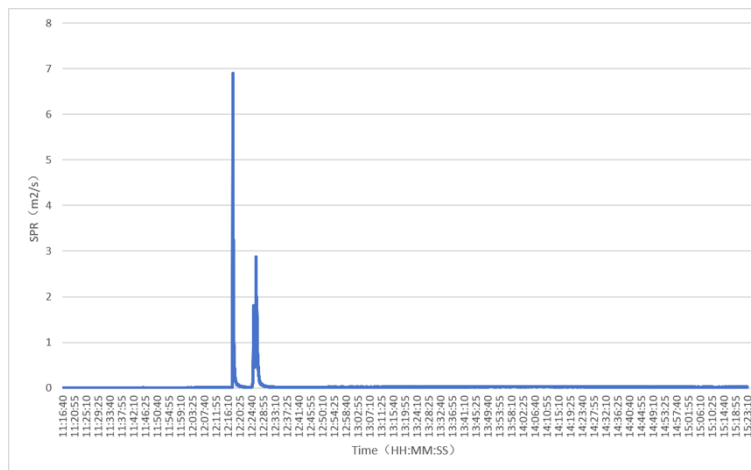
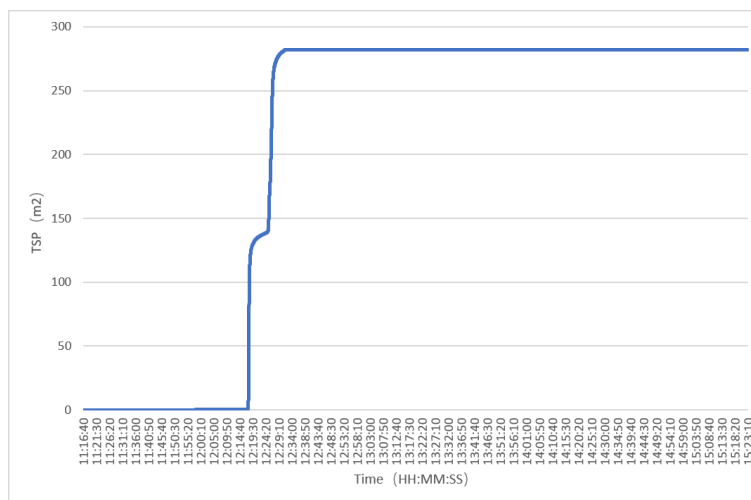
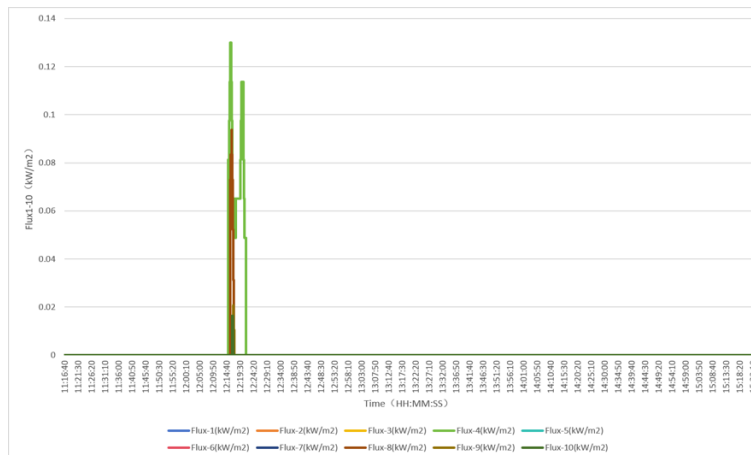


Figure 15. TSR curve



Maximum Heat Flux	
Number of Heat Flux Gauge	Maximum Heat Flux (kW/m ²)
HF 1	0
HF 2	0
HF 3	0
HF 4	0.13
HF 5	0
HF 6	0
HF 7	0
HF 8	0.09
HF 9	0.02
HF 10	0.02

Figure 28. Heat Flux



Attachment F: Flammable Gas Generation and Composition Data

Measurement Method	Gas Compound	Gas Type	Pre-Flaming(L)	Post-Flaming(L)
Flame Ionization Detection	Total Hydrocarbons (Propane Equivalent)	Hydrocarbons	89.53	No flaming
Fourier-Transform Infrared Spectrometer	Carbon Monoxide	Carbon Containing	28.82	No flaming
	Carbon Dioxide	Carbon Containing	152.03	No flaming
Solid-state Hydrogen Sensor	Hydrogen	Hydrogen	213.30	No flaming
Note: The collection time is from 11:16 to 15:23.				

Measurement Method	Gas Components		Total Volume of Gas (L)	
			Pre-Flaming	Post-Flaming
Fourier-Transform Infrared Spectrometer	Methane	CH ₄	2.24	No flaming
	Ethylene	C ₂ H ₄	1.06	No flaming
	Propane	C ₃ H ₈	7.12	No flaming

Figure 16. Total Hydrocarbons

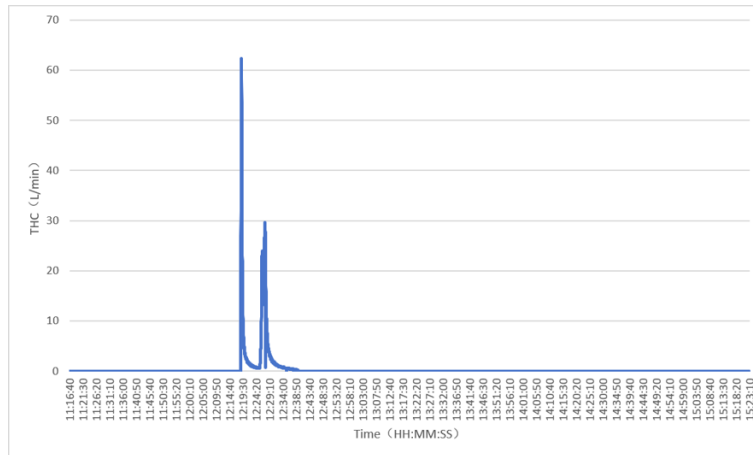


Figure 30. CO, CO2 concentration

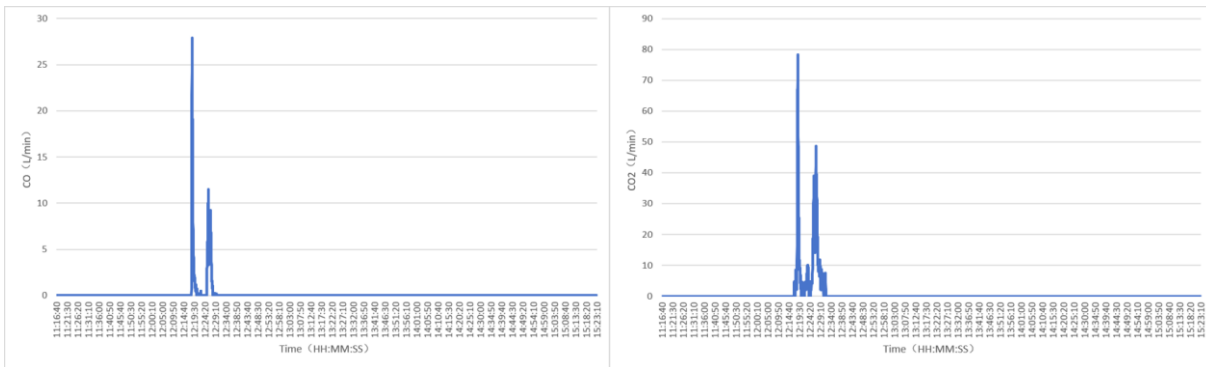


Figure 31. Hydrogen concentration

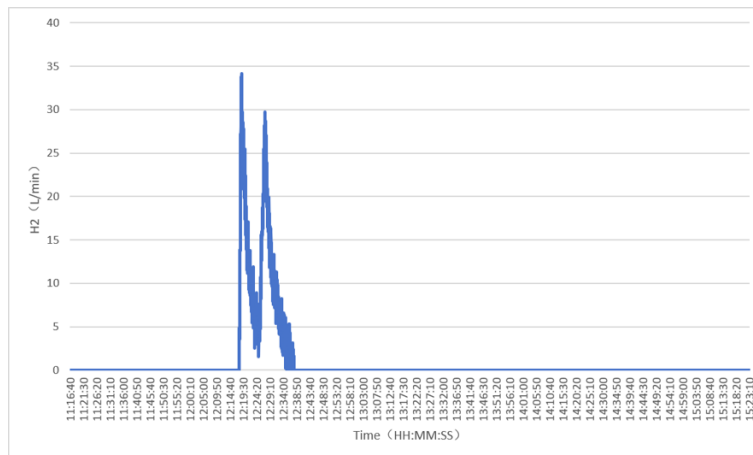
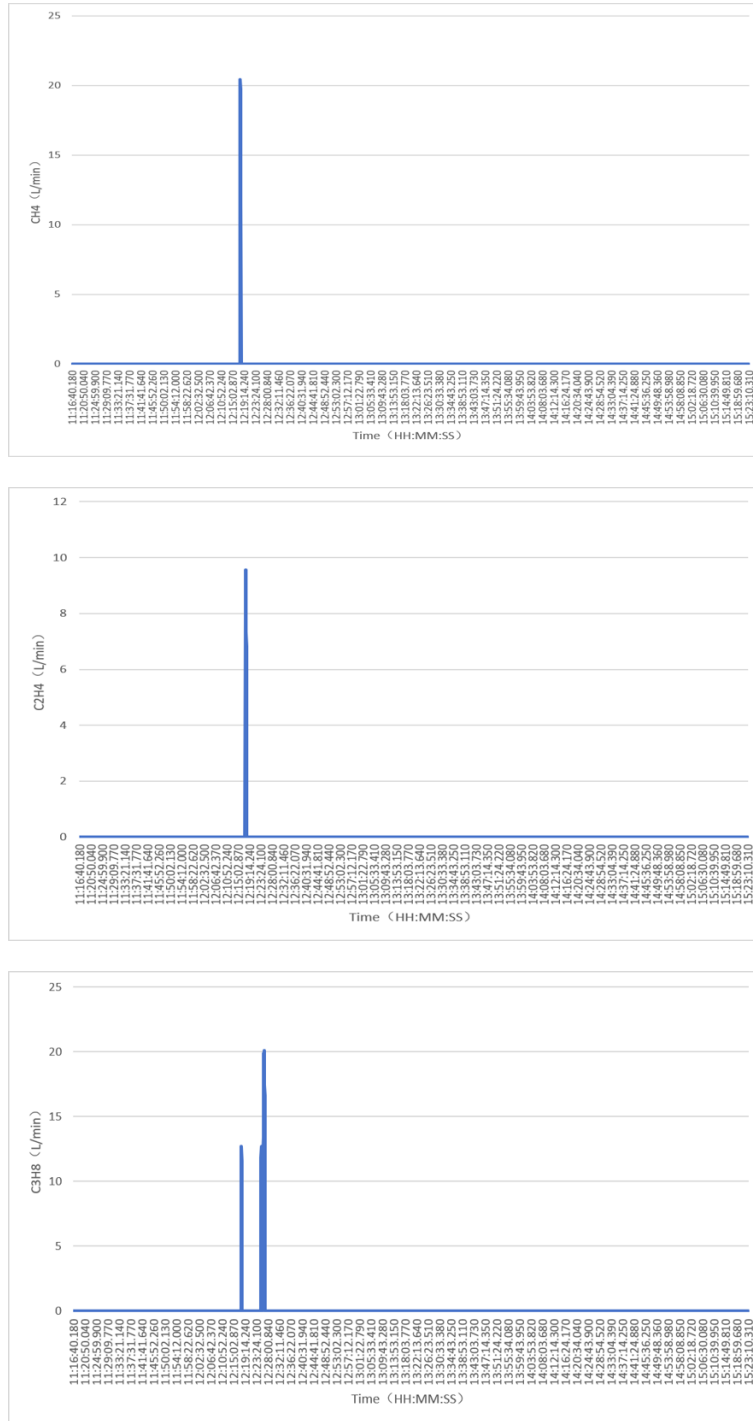
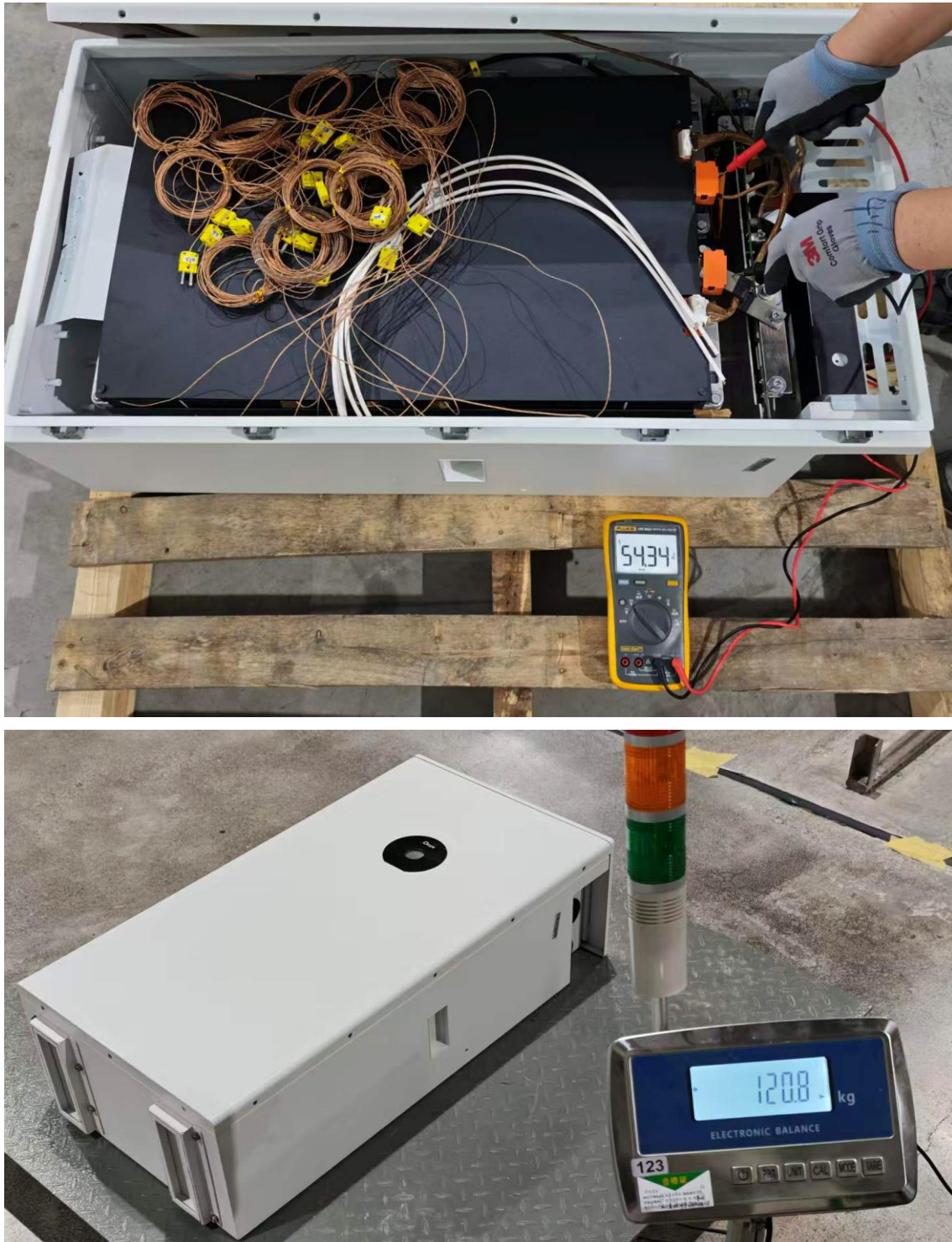


Figure 32. Hydrocarbon species



Attachment G: Sample Photos and Test Photos

Figure 33. Sample before test





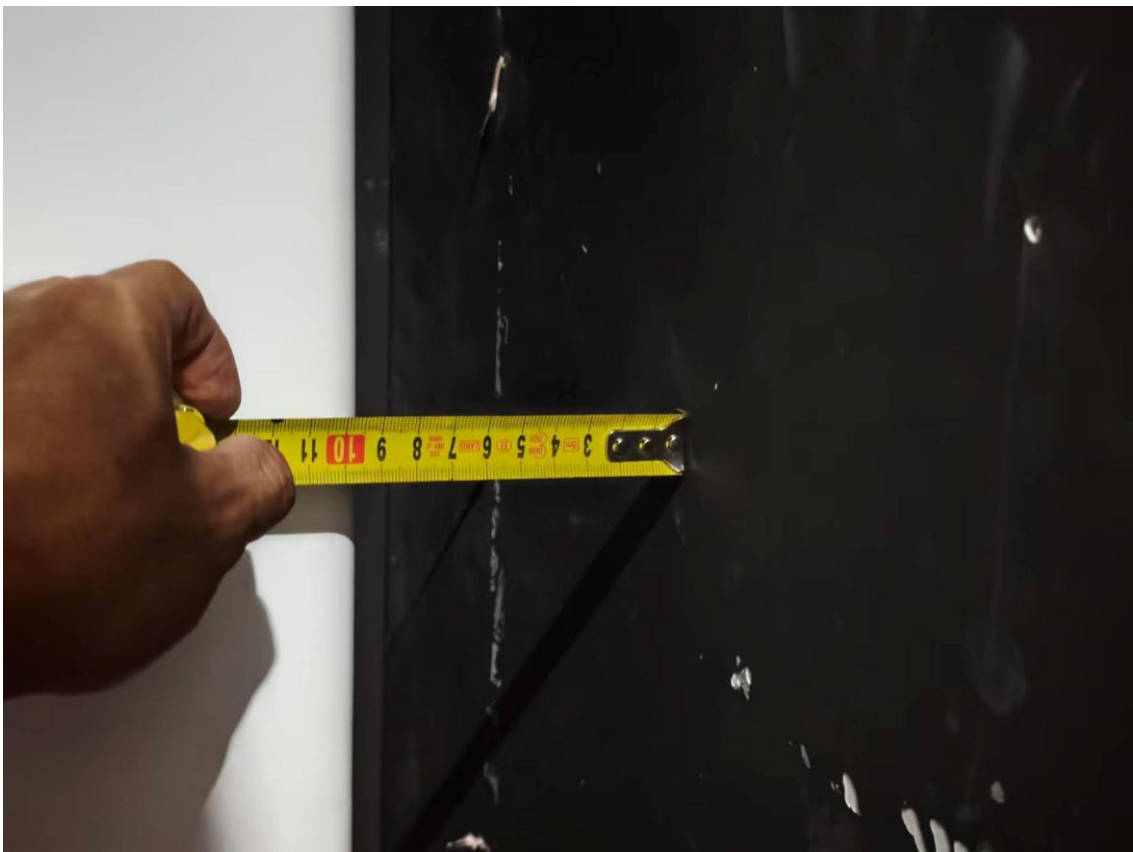
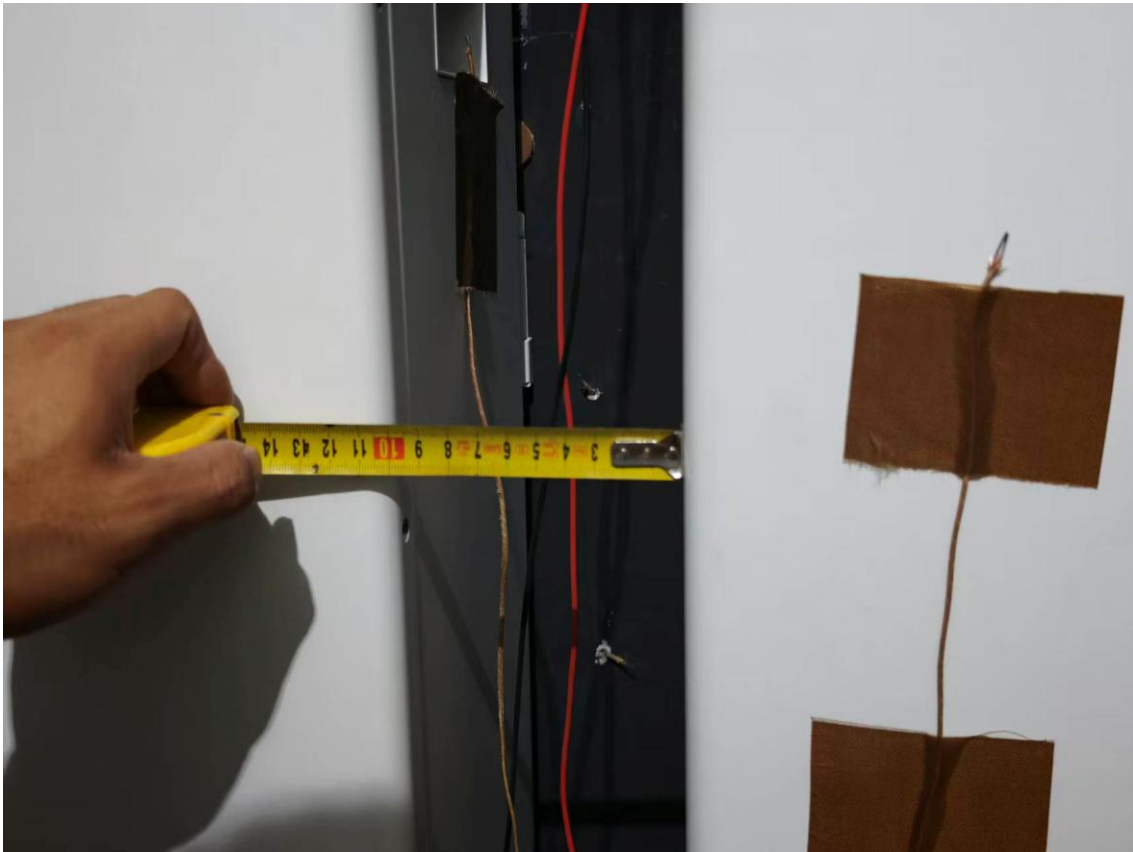
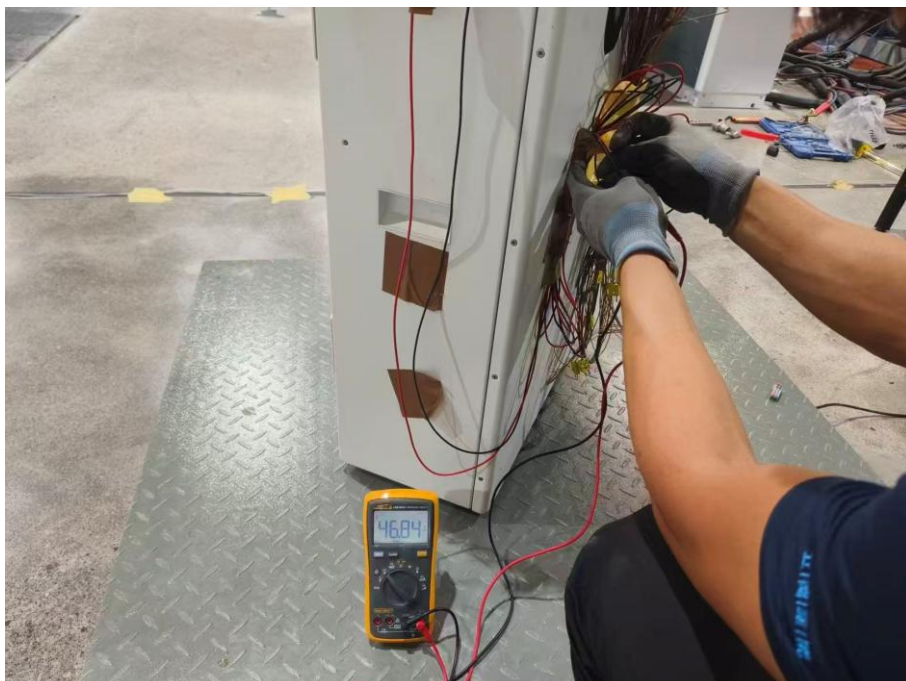
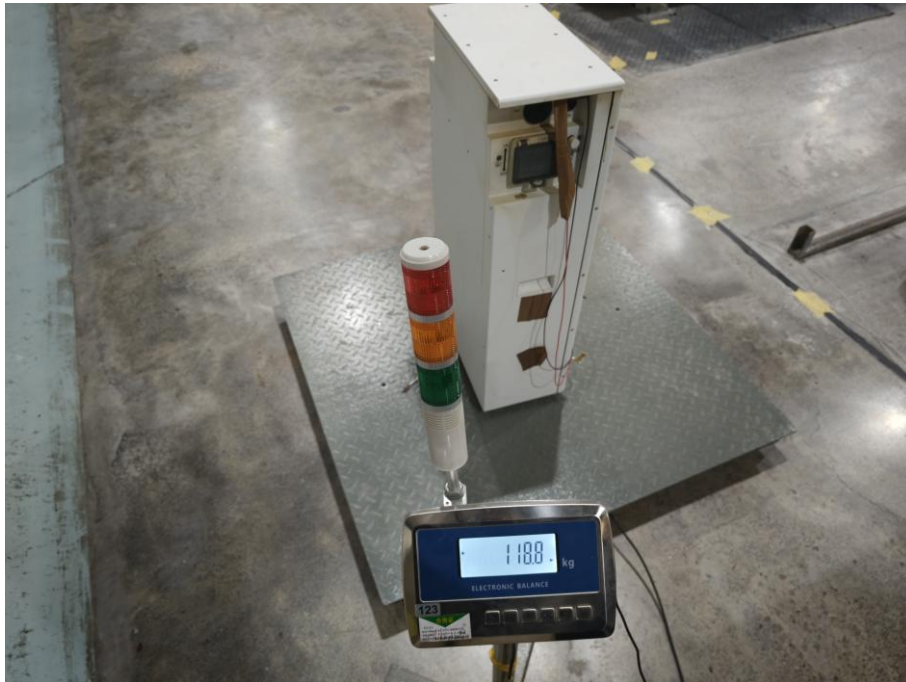


Figure 35. Smoke release during test



Figure 36. Photos after test





Attachment H: List of Test and Measurement Instruments

No.	Equipment	Model	Rating	Inventory no.	Cal. Expire date
1	Electronic Scale	WT11D-2	0Kg~1000Kg	0123	2027/3/2
2	Digital Multimeter	34401A	DCV, ACV: 100 mV to 1,000 V DCI: 100 μ A to 3 A	0133	2026/8/10
3	500V 600A Charging and Discharging Equipment	BAT-NEH-15050060002-V007	Charge: 1V-500V Discharge: 30V-500V, -600A~600A	0028	2026/10/17
4	Total Hydrocarbon Analyzer	DL-7000	/	0083-5	2026/12/11
5	Lithium Battery Heating System	PX08028	The linear rate of temperature increase is $\leq 3\%$, and the temperature stability and control accuracy is $\leq 1^{\circ}\text{C}$.	0083-7	2026/8/10
6	Data Acquisition Instrument	LR8450	0~100V 0 $^{\circ}$ C~1000 $^{\circ}$ C	0083-8	2026/8/10
7	Temperature and Humidity Data Logger	ENV-085	Temperature: -20 $^{\circ}$ C-50 $^{\circ}$ C Humidity: 0-100%	0106	2027/2/10
8	Heat-flow Meter	STT-25-50-R/WF Schmidt-Boelter	Total heat flux: 12.687mV@50kW/m ³ 3.941(kW/m ³)/mV Pure radiation:Sapphire window:150 $^{\circ}$ 9.909mV@50kW/m ³ 5.046(kW/m ³)/mV	/	/
9	3-in-1 Gas Analysis Instrument	4100	CO2 10%mol/mol O2 25.0%VOL CO 10000ppm	/	2026/12/11
10	Palladium-Nickel Hydrogen Sensor	710B	10%H2	/	2026/11/23

Attachment I: Revision Information

New report, no revision information.