TEST REPORT
PPP 51094A:2022
TÜV SÜD Test Report for Stationary battery energy storage systems with lithium batteries - safety requirements

Report No.:	704082422811-00
Date of issue:	2025-04-15
Project handler:	Xiaohang Chen
Testing laboratory:	TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co.,Ltd.
Address:	No.15 Factory Building A, Jintong International Industrial Park, No.8 Xihu Road, Changzhou, Jiangsu, 213164, P. R. China
Testing location:	Details see Summary of testing
Client:	AISWEI New Energy Technology (Yangzhong) Co., Ltd.
Client number:	099678
Address:	No.588 Gangxing Road Economic Development Zone 212200 Yangzhong PEOPLE'S REPUBLIC OF CHINA
Contact person:	Haimei Xu
Standard:	This TUV SUD test report form is based on the following requirements: PPP 51094A:2022, VDE-AR-E 2510-50:2017
TRF number and revision:	TRF PPP 51094A:2022 Rev. 01:2022
eDoc_ID:	-
TRF originated by:	TUV SUD Product Service, Mr. Ryan Jin
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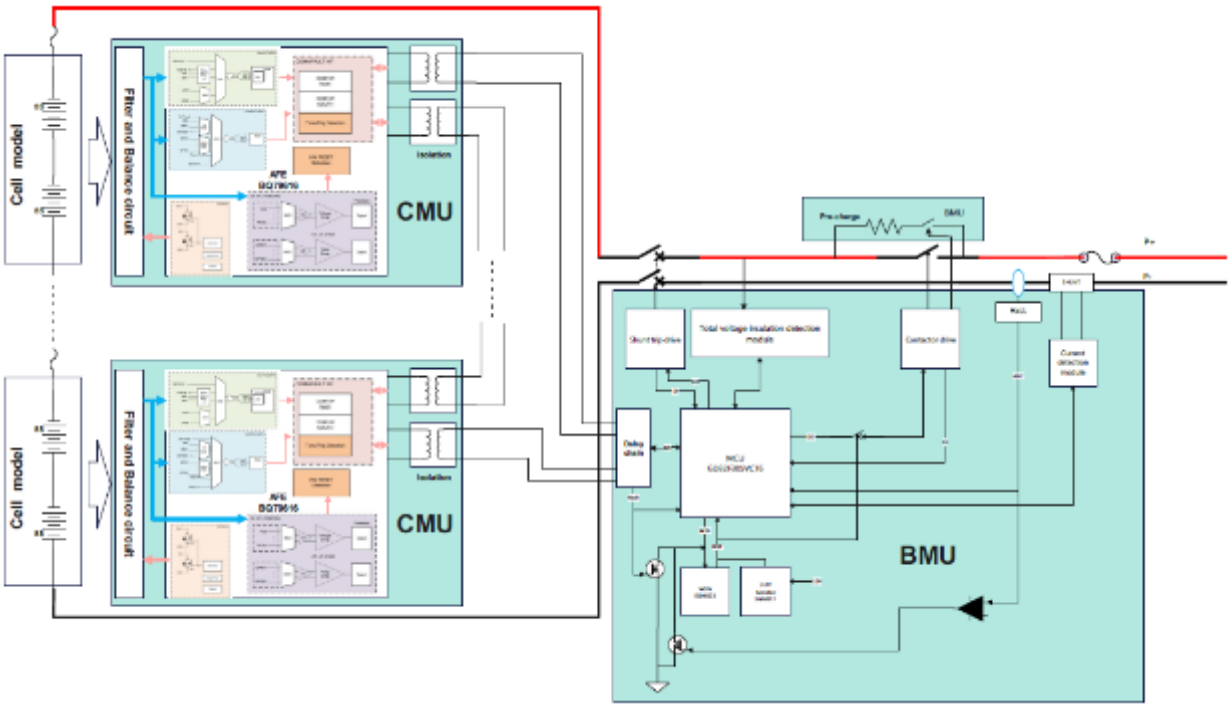
Scheme:	☒ TUV Mark ☐ without certification ☐ other:
Non-standard test method:	☒ No ☐ Yes, see details under *Summary of testing*
National deviations:	N/A
Number of pages *(Report)*:	33
Number of pages *(Attachments)*:	See page

Compiled by:	Xiaohang Chen	Approved by:	Haiyang Liu
(+ signature)	Xiaohang Chen	(+ signature)	Haiyang Liu

Test sample: Type of test object: Trademark: Model and/ or type reference:	Engineering prototype Rechargeable Li-ion Battery System Solplanet Ai-HB Pro 075A, Ai-HB Pro 100A, Ai-HB Pro 125A, Ai-HB Pro 150A, Ai-HB Pro 175A, Ai-HB Pro 200A
Rating(s):	See rating labels
Manufacturer: Manufacturer number: Address:	Same as the applicant - Same as the applicant
Name and address of factory(ies) AISWEI New Energy Technology (Yangzhong) Co., Ltd. No.588 Gangxing Road Economic Development Zone 212200 Yangzhong PEOPLE'S REPUBLIC OF CHINA	
Sub-contractors / tests (clause): Name:	N/A N/A
Order description:	☒ Complete test according to TRF ☐ Partial test according to manufacturer's specifications ☐ Preliminary test ☐ Spot check ☐ Others:
Date of order: Date of receipt of test item: Date(s) of performance of test:	2023-11-10(Original order), 2024-09-24(Additional order) 2024-03-06(Original test), 2025-01-16(Additional test) 2024-03-15 to 2024-06-21(Original test), 2025-02-13 to 2025-04-11(Additional test)
Test item particulars: According to PPP51094A:2022 & VDE-AR-E 2510-50:2017	
Purpose of the product (description of intended use): The rechargeable lithium ion battery system is used in stationary battery energy storage system and is limited to private and small commercial applications.	
Characteristic data (not shown on the marking plate):	
(1) The Rechargeable Li-ion Battery System, 6 models: Ai-HB Pro 075A, Ai-HB Pro 100A, Ai-HB Pro 125A, Ai-HB Pro 150A, Ai-HB Pro 175A, Ai-HB Pro 200A are used in industrial appliance. The battery system consists of one controller box and 3~6rechargeable Li-ion battery modules with model no. HB051050B connected in series. The Battery module HB051050B consists of 16 Rechargeable Li-ion Cell with model No. LFP39148100/50Ah connected in series. (2) The rechargeable lithium-ion battery system can be used at specified ambient range. Operating Temperature: 0 °C, …, +50 °C, altitude: ⩽ 3000 m, Relative humidity range: 0%-95%, indoor or outdoor use.	

Circuit diagram:



Additionally, details information of the cell and battery are shown in following table:

Table for parameters:			
Item	Specifications		
Product name	Rechargeable Li ion Cell	Rechargeable Li ion Battery Module	Rechargeable Li ion Battery System
Type/model	LFP39148100/50Ah	HB051050B	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A
Nominal voltage	3.2 Vd.c.	51.2Vd.c.	Ai-HB Pro 075A:153.6Vd.c. Ai-HB Pro 100A:204.8Vd.c. Ai-HB Pro 125A:256.0Vd.c. Ai-HB Pro 150A:307.2Vd.c. Ai-HB Pro 175A:358.4Vd.c. Ai-HB Pro 200A:409.6Vd.c.
Rated capacity	50 Ah	50Ah	50Ah
Recommended charging voltage by manufacturer	3.65V	57.6V (cell 3.6V)	Ai-HB Pro 075A: 172.8V Ai-HB Pro 100A: 230.4V Ai-HB Pro 125A: 288.0V Ai-HB Pro 150A: 345.6V Ai-HB Pro 175A: 403.2V Ai-HB Pro 200A: 460.8V (cell 3.6V)

Upper limit charging voltage	3.65V	57.92V (cell 3.62V)	Ai-HB Pro 075A: 173.76V Ai-HB Pro 100A: 231.68V Ai-HB Pro 125A: 289.6V Ai-HB Pro 150A: 347.52V Ai-HB Pro 175A: 405.44V Ai-HB Pro 200A: 463.36V (cell 3.62V)
Recommended charging current by manufacturer	25A	25A	25A
Maximum continuous charging current	60A	50A	50A
Recommended discharging current by manufacturer	25A	25A	25A
Maximum continuous discharging current	60A	50A	50A
Standard temperature range for charging	0°C to 60°C	-	-
Standard temperature range for discharging	-30°C to 60°C	-	-
Operating Temperature	-	0°C to 50°C	0°C to 50°C
Standard charging method by manufacturer	Charging the cell with 25A constant current until to 3.65V, then constant voltage 3.65V until charging current reduces to 2.5A	Charge at constant current 25A until any cell voltage reaches 3.55V, then charge at constant current 5A until any cell voltage reaches 3.6V.	Charge at constant current 25A until any cell voltage reaches 3.55V, then charge at constant current 5A until any cell voltage reaches 3.6V.
Charging method for internal short-circuit test	Charging the cell with 60A constant current until to 3.65V, then constant voltage 3.65V until charging current reduces to 2.5A	-	-
Discharging cut off voltage	2.5V	41.6V or any cell reaches 2.6V	Ai-HB Pro 075A:124.8V or any cell reaches 2.6V Ai-HB Pro 100A:166.4V or any cell reaches 2.6V Ai-HB Pro 125A:208V or any cell reaches 2.6V Ai-HB Pro 150A:249.6V or any cell reaches 2.6V Ai-HB Pro 175A:291.2V or any cell reaches 2.6V Ai-HB Pro 200A:332.8V or any cell reaches 2.6V

Lower limit discharging voltage	2.5V	-	-
Dimension	Thickness: (39.7±1.0) mm Height: (100.6±1.0) mm, Width: (149.1±1.0) mm	Length: (540±2)mm Width: (390±2)mm Height: (130±4)mm	L×W×H Ai-HB Pro 075A: (540±2) mm×(390±2) mm×(600±4) mm Ai-HB Pro 100A: (540±2) mm×(390±2) mm×(730±4) mm Ai-HB Pro 125A: (540±2) mm×(390±2) mm×(860±4) mm Ai-HB Pro 150A: (540±2) mm×(390±2) mm×(990±4) mm Ai-HB Pro 175A: (540±2) mm×(390±2) mm×(1120±4) mm Ai-HB Pro 200A: (540±2) mm×(390±2) mm×(1250±4) mm
Weight	(1.10±0.1) kg	Approx. 31kg	Ai-HB Pro 075A: (109±3)kg Ai-HB Pro 100A: (140±3)kg Ai-HB Pro 125A: (171±3)kg Ai-HB Pro 150A: (202±3)kg Ai-HB Pro 175A: (233±5)kg Ai-HB Pro 200A: (264±5)kg
Configuration	-	16S	Ai-HB Pro 075A: (16S)3S Ai-HB Pro 100A: (16S)4S Ai-HB Pro 125A: (16S)5S Ai-HB Pro 150A: (16S)6S Ai-HB Pro 175A: (16S)7S Ai-HB Pro 200A: (16S)8S

License conditions:

-The battery system is only for use in a closed electrical operating area. The battery system is intended to be installed under the supervision of skilled or instructed persons. Protection by use of class II construction or by equivalent insulation is provided in battery sub-system, an insulation monitoring device (IMD) according to IEC 61557-8 shall be used in the end-use system, automatic disconnection of supply after a second fault is applied in accordance with IEC 60364-4- 41.

- Circulating currents due to parallel connected battery strings was considered and assessed as a safety critical function, however, parallel configuration of converter with common DC bus interconnected to battery converter and other power sources, e.g. PV may cause circulating currents, additional protective device shall be provided in the end-use application.

- Battery system incorporates SPD on the DC side, SPD in compliance with EN 61643-21 shall be installed for telecommunication and signalling lines in the end-use application, SPD in compliance with EN 61643-11 shall be installed for AC auxiliary power system. If the distance between the SPDs and the battery sub-system is greater than 10 m, then additional surge protective devices are installed in the vicinity of the system to be protected.

- The safety classification and circuit category of communication port of battery system and ethernet interface are SELV, it cannot be connected directly to a TNV (Telecommunication Network Voltage) circuit and intend for used in conditions for Network Environment.
- Battery system is intended for connection to circuits with multiple supply, multiple sources of energy are connected in parallel contributing to the fault simultaneously. Each source has a different time constant and amplitude and even the effect of a DC fault on the AC main should be taken into consideration and designed in accordance with IEC 61660.
- Ai-HB Pro 075A, Ai-HB Pro 100A, Ai-HB Pro 125A, Ai-HB Pro 150A, Ai-HB Pro 175A(≤ 20kWh): Battery system cannot be installed in the site and an area occupied by personnel without toxic gases detection system with audible alerts and visual signals.
For battery system located in the occupied site, appropriate ventilation systems shall be provided in the end-use application.
For unoccupied installation battery system, the end-use application shall have appropriate signage to identify restricted areas and the sign shall specify that flammable gases can be released from the battery system.
Ai-HB Pro 200A: The battery system is not intended for installation in the site and an area occupied by personnel. The fire protection plan is required and appropriate signage to identify a restricted area shall be provided around any flammable gas outlet according to local code. The deflagration analysis, review of fire protection plan and local code requirements are necessary. Information of the path of the exhausted flammable gases shall be provided in the end-use application.
- Battery sub-system is tested and assessed on the basis of sub-system with control system only. Battery control system's response to an uncontrolled condition have been evaluated with the requirements for PL c and SIL 1. Protection on the system level shall be provided in the end-use application to make a device compliant with the Single Fault Condition, and to utilize aspects of PL d and SIL 2 for the purpose of functional safety.
- Energy Management System, system demand controller and converter master controller featuring integral safety sub-functions are provided with redundant safety functions and diagnostic in the end-use application, apart from the operational functions of battery sub-system.
- Integrated system with multiple hierarchical levels to implement safety-related function and realized by a combination of multiple hardware categories, the resulting overall hardware category is determined by the characteristics of the overall system.

Attachments:

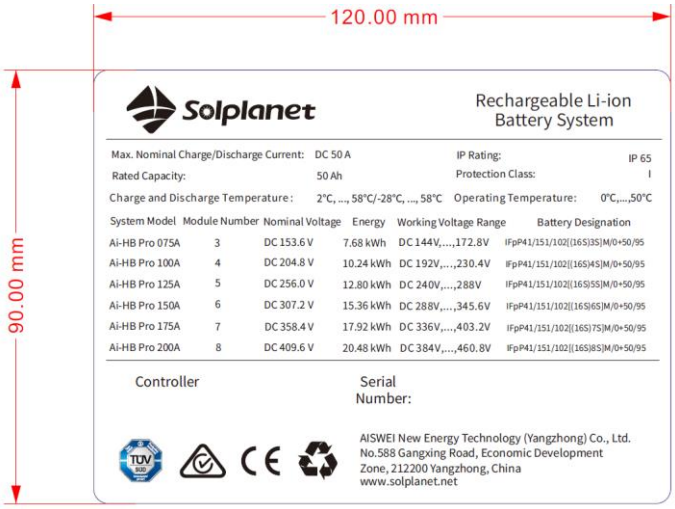
Item	Description	Certificate / Test report No./ File No.	Issued by	Model	Pages
Attachment 1	Hazard analyses and risk assessment	B178-RD02-0000	AISWEI	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	14
Attachment 2	Test report for Functional safety	704082422811-00 FS	TÜV SÜD	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	26
Attachment 3	EN IEC 62040-1:2019/A11:2021	704082422850-00 Part 1 of 2	TÜV SÜD	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	87

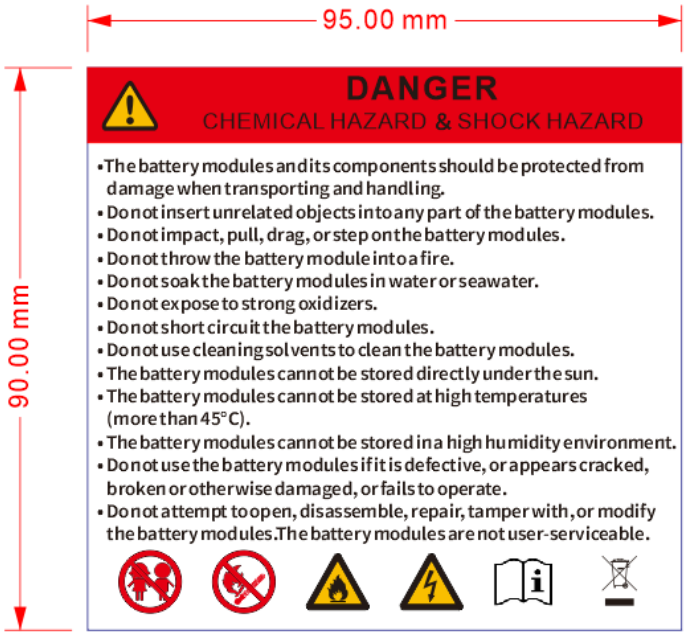
Attachment 4	EN 62477-1:2012/A12:2021	704082422850-00 Part 2 of 2	TÜV SÜD	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	82
Attachment 5	IEC 62619:2022	A2-4791613342-001	UL	LFP39148100/50Ah	22
Attachment 6	Photo documentation	704082422811-00	TÜV SÜD	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	22
Attachment 7	CDF documentation	704082422811-00	TÜV SÜD	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	16
Attachment 8	EN IEC 61000-6-1:2019 EN IEC 61000-6-3:2021	4840824389700	TÜV SÜD	Ai-HB Pro 075A Ai-HB Pro 100A Ai-HB Pro 125A Ai-HB Pro 150A Ai-HB Pro 175A Ai-HB Pro 200A	46
Attachment 9	UN 38.3	20241106J31982	CQC	HB051050B	26

If additional information is necessary, please provide

N/A

Copy of marking plate:





Remark:

1.Product serial number code: VP1103024C182014.
VP: Product code.
1: Product name.
(0 stand for Rechargeable Li-ion Battery System; 1 stand for Rechargeable Li-ion Battery Module; 2 stand for controller box).
10: BMS code (10: ASW-HV-T1).
3: Cell code (3: Hithium LFP39148100/50Ah).
0: Factory code (0: AISWEI).
24: Last two digits of year.
C: Month code shown in code table.
18: Day.
2014: Production serial number.
Month code table

Month	1	2	3	4	5	6	7	8	9	10	11	12
Corresponding code	1	2	3	4	5	6	7	8	9	A	B	C

2. Polarity “P+” and “P-” are marked near the connector of the battery system. The high voltage warning signs are on the surface of module.
3. The code “VP1103024C182014” can trace the manufacture information of the battery system. This is not the actual code and only for example.
4. Caution statement and disposal instructions are mentioned in the user manual.

Pictures of the product:

See attachment photo documentation

Summary of testing:

In section 6, tests were performed on the battery model No. Ai-HB Pro 200A except for clause 6.2.6 was conducted on Ai-HB Pro 075A.
In section 7, tests were performed on the battery model No. Ai-HB Pro 075A except for clause 7.8.3 was conducted on Ai-HB Pro 200A.
In section 8, test of clause 8.1.2 was conducted on cells, for model No. LFP39148100/50Ah, clause 8.1.3 was conducted on the battery system, for model Ai-HB Pro 200A, clause 8.2 was conducted on battery module HB051050B.

Test location:
TÜV SÜD New Energy Vehicle Testing (Jiangsu) Co.,Ltd.
Building A, No.15 Factory, Jintong International Industrial Park, No.8 Xihu Road, Wujin National Hi-tech Industrial Development Zone, Changzhou City, Jiangsu Province, P.R. China

Clause	Requirement + Test	Remark
Safety test		
6.2.2	Insulation resistance test	See the table 6.2.2
6.2.3	Stress resistance test	See the table 6.2.3
6.2.5	Propagation test: single solutions	N/A
6.2.6	Propagation test: stackable BESS	See the table 6.2.6
Functional safety test:		
7.3	Plausibility of voltage measurement	See the table 7.3
7.4	Detection of non-isolated switching elements	See the table 7.4
7.5	Open-circuit detection of sensing line	See the table 7.5
7.6	Checking the interlocking function for lockout	N/A
7.7	Functional test for load reduction (derating)	N/A
7.8.1	Checking the voltage monitoring under conditions of overcharge	See the table 7.8.1
7.8.2	Checking the voltage monitoring under conditions of deep/forced discharge	See the table 7.8.2
7.8.3	Checking the current monitoring	See the table 7.8.3
7.8.4	Checking the temperature monitoring under conditions of an excessively high temperature	See the table 7.8.4
7.8.5	Checking the temperature monitoring under conditions of excessively low temperature	See the table 7.8.5
7.9.1	Checking the current measurement	See the table 7.9.1
7.9.2	Checking the temperature measurement	See the table 7.9.2
7.10	Reaction to failure of components or communication	See the table 7.9.10
Reasonably foreseeable misuse		
8.1.2	External short circuit test (cell or cell block)	See the table 8.1.2
8.1.3	External short circuit test (module, pack, battery system)	See the table 8.1.3
8.2	Drop test	See the table 8.2
8.3	Impact test	See Attachment 5
8.4	Thermal abuse	See Attachment 5

8.4.1	Overcharge	See Attachment 5
8.4.2	Forced discharge	See Attachment 5

The samples comply with the standard requirements.

☐ deviation(s) found

☒ no deviations found

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 point** is used as the decimal separator.*
The test results presented in this report relate only to the object tested.

Clause	Requirement + Test	Result – Remark	Verdict
1.	**Scope**		—
2	**Normative references**		—
3	**Terms, definitions and abbreviated terms**		—
3.1	**Terms and definitions**		—
3.2	**Abbreviations**		—
4	**Risk assessment and methodology for functional safety**		P
4.1	Risk assessment	See Attachment 1.	P
	VDE-AR-E 2510-50 shall be used.		P
	Functional safety requirements shall be assessed in accordance with at least one of the standards listed below:	See Attachment 2.	P
	1) DIN EN 61508 (VDE 0803) or		N/A
	2) ISO 26262-2;		N/A
	3) DIN EN ISO 13849-1:2016-06;	Assessed in accordance with ISO 13849-1:2015, which is equivalent to DIN EN ISO 13849-1:2016	P
	4) DIN EN 62061 (VDE 0113-50):2016-05.		N/A
4.2	Requirements		P
	The methodology and documentation of the risk assessment is evaluated to ensure that all risks are eliminated or reduced to an appropriate level. In addition to the mere documentation inspection, the risk reduction measures are verified under practical conditions.	See the summary of testing	P
	For this purpose, the constructional and functional safety shall be tested as follows.		P
	Furthermore, risks or weak points identified as a result of functional safety considerations may lead to extended testing. This is intended to determine the hazard level and the verification of the safety of the BESS under practical conditions.		P
5	**General requirements**		P
5.1	CE marking	Conformity is declared by manufacturer	P
5.2	Electromagnetic compatibility (EMC)	See Attachment 8.	P
5.3	Low Voltage Directive (LVD)	See Attachment 3 and 4	P
5.4	Inverter/converter	No inverter and converter	N/A

Clause	Requirement + Test	Result – Remark	Verdict
5.5	Grid integration	Should be evaluated on the end-used system.	N/A
6	**Constructional safety requirements**		P
6.1	General requirement	Consisdered and evaluated according EN/IEC 62477-1 and EN/IEC 62040-1. See Attachment 3 and 4.	P
6.2	Tests		P
6.2.1	General	Type test	P
	Tests for which the number of test samples is not indicated shall be conducted using one test sample.	Tested type: See summary of test	P
6.2.2	Insulation resistance test		P
6.2.2.3	Requirements		P
	For all measurements, an insulation resistance of at least 100 Ω/V in relation to the final charge voltage of the battery shall be reached.		P
	The level of the relative and the absolute value of insulation resistance as well as the tested measurement path shall be documented.	See appended table for 6.2.2	P
	The leakage current shall not exceed 10 mA.		P
	Where systems are provided with an insulation monitor, it shall be disconnected during testing.	The insulation monitor function was closed during test	P
	Alternatively, external testing of the insulation resistance may be conducted during the dead times while the insulation monitor is not taking any measurements.		N/A
	In both cases, the insulation monitor shall not influence the test result.		P
6.2.3	Dielectric strength test		P
6.2.3.3	Requirements		P
	After conduction of each test, the compliance criteria in accordance with the applied relevant standard shall be met.	See appended table for 6.2.3	P
6.2.4	Internal short-circuit (propagation test)		P
6.2.4.3	Requirements		P
	Depending on the type of the BESS, different passing criteria apply:	Stackable BESS	P

Clause	Requirement + Test	Result – Remark	Verdict
	– single solutions (small storage systems with a single closed case for cell blocks and higher-level system components);		N/A
	– stackable BESS (systems with their modules stacked directly on top of or directly beside one another (e.g. 19″ modules within a rack)), see 6.2.6.		P
	The results of both options shall be taken into account in the risk evaluation. If applicable, further measures for minimizing risk shall be derived from this and verified.	Be considered	P
6.2.5	Propagation test: single solutions		N/A
6.2.5.3	Requirements	Stackable BESS	N/A
	Component verification: For the purpose of fire protection, each single module shall be equipped with a fire protection enclosure in accordance with DIN EN 62368-1 (VDE 0868-1), M 4.3, 6.4.8.		N/A
	The fire protection enclosure may be the secondary lithium battery itself or that of the device in which the secondary lithium battery is contained.		N/A
	The presence of this fire protection enclosure shall be demonstrated by means of the test report, by visual inspection of the relevant materials or by submitting the data sheet of the secondary lithium battery.		N/A
	Test verification: Hazards (liquid electrolyte, fire, explosion or ejected parts) shall not propagate beyond the system boundaries (except vented gases which are considered separately in 7.10.3).		N/A
	In case of burning of the cell or the storage system, the fire shall not propagate to the surrounding environment.		N/A
6.2.6	Propagation test: stackable BESS		P
6.2.6.3	Requirements	See appended table for 6.2.6	P
	Component verification: For the purpose of fire protection, each single module shall be equipped with a fire protection enclosure in accordance with DIN EN 62368-1 (VDE 0868-1), M 4.3, 6.4.8. The fire protection enclosure may be the one of the secondary lithium battery itself or that of the device in which it is contained.	The battery is contained by a fire enclosure.	P
	The presence of this fire protection enclosure shall be demonstrated by means of the test report or visual	Metal enclosure, see attachment 7 (CDF document).	P

Clause	Requirement + Test	Result – Remark	Verdict
	inspection of the relevant materials or by submitting the data sheet of the secondary lithium battery.		
	Test verification: – Cell defects shall only propagate within the module in which the thermal instability of the cell was intentionally caused.	See appended table for 6.2.6	P
	– A propagation from this module to an adjacent module shall be precluded by testing (see above).		P
	– Hazards (liquid electrolyte, fire, explosion or ejected parts) shall not propagate beyond the system boundaries (except vented gases which are considered separately in 7.10.3).		P
7	**Functional safety requirements**		P
7.1	Battery management system (BMS)		P
	Parameter monitored ……..:	Refer to TABLE: see attachment 7 (CDF document). Other details are indicated in user manual	P
7.2	Software requirements		P
	Safety-related functions are represented in the BMS entirely by software-based functions, the software is designed as safety-related software and is in compliance with clause 4	Assessed according to DIN EN ISO 13849-1, see attachment 2.	P
7.3	Plausibility of voltage measurement		P
7.3.3	Requirements		P
	The following parameters shall be documented:	See appended table for 7.3	P
	– uncertainty of the BMS cell/cell block voltage measurement;		P
	– measurement uncertainty of the calibrated test rig.		P
	The determined uncertainties are taken into account in the subsequent tests (for voltage-relevant requirements).	Be considered	P
7.4	Detection of non-isolated switching elements		P
7.4.2	Performance of the test		P
	For carrying out the test, the battery system shall be set to its normal operating condition at room temperature (BMS active, charge/discharge circuit closed). The following test is divided into two steps:	1) and 2) were considered	P
	1) simulation of non-disconnectable switching elements under conditions of disconnection under load:	See the table 7.4	P

Clause	Requirement + Test	Result – Remark	Verdict
	With the charge/discharge circuit in the closed condition, a switching element within the charge/discharge circuit is manipulated (simulation of adhering contactor or continuous semiconductor). By means of an external command or a fault simulation, the BMS shall be manipulated to interrupt the DC load circuit. 2) Switching-on in the presence of a non-disconnectable switching element: A previously simulated fault leading to opening of the redundant switching element is now reset/eliminated. As a result, the BMS shall be requested again to close the switching elements. The test ends when no further change of the switching condition is to be expected.		
7.4.3	Requirements		P
	If a fault under load occurs, the BESS interrupts the charging/discharging process by means of the next higher or an equal disconnecting element of the safety chain.	With an equal disconnecting element of the safety chain.	P
	Disconnecting elements which are externally triggered by the BESS via communication paths are also effective in case of a failure of the communication path (see 7.10.1).	Internal triggered by BMS of BESS	N/A
	The BESS prevents automatic reconnection of the charge/discharge circuit in the presence of a non-isolated disconnecting element.		P
	The BESS does not switch on again unless a skilled person has been consulted and the fault has been eliminated.		P
7.5	Open-circuit detection of sensing line		P
7.5.3	Requirements		P
	The BMS interrupts the load circuit in time before the operating range of the cell is exceeded.		P
7.6	Checking the interlocking function for lockout	Should be assessed in end use system	N/A
	The interlocking function check is conducted and evaluated at system level in accordance with DIN EN 62040-1 (VDE 0558-510), 5.6.		N/A
7.7	Functional test for load reduction (derating)	Should be assessed in end use system	N/A
7.7.3	Requirements		N/A
	For carrying out the test, it is assumed that a specification of the cell is provided by its		N/A

Clause	Requirement + Test	Result – Remark	Verdict
	manufacturer. This contains at least information on the following properties:		
	– constant charge/discharge current (/const,chr, /const,dchr);		N/A
	– charge/discharge current as a function of time (/chr(t), /dchr(t));		N/A
	– charge/discharge current as a function of temperature (/chr(T), /dchr(T)).		N/A
	In addition, the following requirements are met:		N/A
	– measurement and documentation of the numerical values and the recording rate for battery voltage, battery current, single cell voltages (or cell block voltage) and temperatures of the equipment under test;		N/A
	– the battery system shall not exceed at any point of the current profile the operating range of the cell defined by its manufacturer.		N/A
7.8	Functional test with exceeding the operating range limits		P
	For the safe operation of the energy storage system and the battery, the operating range for voltage, temperature and current are exceeded		P
	For the safe operation of the battery system, it is ensured at all times that the operating range of the cell indicated by its manufacturer is not exceeded		P
7.8.1	Checking the voltage monitoring under conditions of overcharge		P
7.8.1.3	Requirements		P
	In addition to the requirements described in E DIN EN 62619 (VDE 0510-39):2014-046), the following applies:	See appended table for 7.8.1	P
	– the BESS shall interrupt the charging process at the latest when the maximum cell voltage is reached;		P
	– the following values shall be used for the evaluation:		P
	1) the final charge voltage specified by the cell manufacturer;		P
	2) the maximum cell voltage determined by the BMS at the point of the charging process being interrupted by opening of the charge/discharge circuit;		P
	3) the measurement uncertainty of the BMS determined according to 7.1.		P
7.8.2	Checking the voltage monitoring under conditions of deep/forced discharge		P
7.8.2.3	Requirements		P

Clause	Requirement + Test	Result – Remark	Verdict
	The values indicated in the test procedure are measured and documented.	See appended table for 7.8.2	P
	Interruption of the imaginary discharging process shall be ensured by automatically opening the charge/discharge circuit (e.g. disconnecting elements) at the latest when the minimum final discharge voltage of the cell defined by its manufacturer is exceeded.		P
	Furthermore, the manufacturer shall provide technical measures to ensure that a restart requires consultation of a skilled person.		P
	NOTE Cell blocks consisting of cells in parallel connection can be used representatively for conducting the described test.		P
7.8.3	Checking the current monitoring		P
7.8.3.3	Requirements		P
	The BMS opens the charge/discharge circuit in both the charging and the discharging case at the latest when the safe operating range of the cell is exceeded.	See appended table for 7.8.3	P
7.8.4	Checking the temperature monitoring under conditions of an excessively high temperature		P
7.8.4.3	Requirements		P
	The values indicated in the test procedure are measured and documented.	See appended table for 7.8.4	P
	The system automatically stops the charging/discharging process at the latest when the maximum temperature for safe operation of the cell is exceeded. The ambient temperature measured by the test rig is used as the parameter for evaluating the temperature threshold for disconnection.		P
	Even in case of a communication fault or of a malfunction of the charger/inverter, it is ensured that the battery system is disconnected in time.	Cosisdered in single fault evaluated.	P
	After the first time the temperature exceeds the maximum cell temperature and falls below it, the system does not automatically restart.		P
	Restart of the battery system requires consultation of a skilled person.		P
7.8.5	Checking the temperature monitoring under conditions of excessively low temperature		P
7.8.5.3	Requirements		P

Clause	Requirement + Test	Result – Remark	Verdict
	The values indicated in the test procedure are measured and documented.	See appended table for 7.8.5	P
	The system shall automatically interrupt the charge/discharge circuit at the latest when the minimum temperature for safe operation of the cell is exceeded.		P
	The ambient temperature measured by the test rig are used as the parameter for evaluating the temperature threshold for disconnection.		P
	In case of a communication fault or of a malfunction of the charger/inverter, it is also ensured that the battery system is disconnected in time.	Cosisdered in single fault evaluated.	P
7.9	Checking the BMS measurands		P
7.9.1	Checking the current measurement		P
7.9.1.3	Requirements		P
	By measuring the current including associated tolerances, it is ensured that the maximum permissible current of the components under load is not exceeded at any time (including ripple currents (information provided by the manufacturer)).	See appended table for 7.9.1	P
	The BMS is using an appropriate measurement method (sampling rate, calculation) to measure the charger currents with sufficient accuracy in order to ensure that the maximum permissible current of the components under load is not exceeded at any time (including ripple currents (information provided by the manufacturer)).		P
7.9.2	Checking the temperature measurement		P
7.9.2.3	Requirements		P
	The tolerances for BMS temperature measurements determined in Step 1 are be taken into account when evaluating the functionality of the BMS (7.7).	See appended table for 7.9.2	P
	Step 2 demonstrates that the position and mechanical connection of the internal temperature sensors enable sufficiently accurate determination of temperature-critical components. For this purpose, the temperatures of safety-critical components are always correctly determined even when they are under electrical load. This means that the values measured by the BMS are be within the operating range of the cell while taking into account the tolerance derived from Step 1.		P
7.10	**Reaction to failure of components or communication**		**P**

Clause	Requirement + Test	Result – Remark	Verdict
	Safety-related functions of the BESS are implemented such that the BESS also switches into a safe state even in a condition of failure of listed components and of the communication between components.	BMS, Safety controller and CSC had been considered. Inverter or charge should be assessed in end use system	P
7.10.1	Communication failure		P
7.10.1.3	Requirements		P
	The communication connections meets the safety requirements in accordance with the safety class specified in the risk analysis.		P
	In case of a safety-related communication failure, the BESS interrupts charging/discharging processes by opening the charge/discharge circuit at the latest when the permissible operating range limits are exceeded.		P
7.10.2	Component failure		P
7.10.2.3	Requirements		P
	The following requirements is met:	See appended table for 7.10	P
	– documentation of the component failure method;		P
	– in case of failure of a safety-related component, the BESS interrupts the charging/discharging processes by opening the charge/discharge circuit at the latest when the permissible limits of the operating range are exceeded.		P
7.10.3	Cell/cell block failure		P
	VDE-AR-E 2510-50 shall be used.		P
7.10.3.3	Requirements		P
	The following requirements are met: Re 1) verification of the correct function of the CID/OSD by practical testing (e.g. according to 8.4.1, Overcharge) or testing by an accredited testing laboratory;	The overcharge protection function was operated by BMS through opening MOS. See appended table for 7.8.1	P
	Re 2) verification of the correct function of the temperature monitoring by practical testing (e.g. according to 7.8.4, Checking the temperature monitoring) or testing by an accredited testing laboratory;	See appended table for 7.8.4	P
	Re 3) visual inspection and, if applicable, verification of the correct function of the short-circuit protection device by practical testing (e.g. according to 8.1,	See appended table for 8.1.2 and 8.1.3	P

Clause	Requirement + Test	Result – Remark	Verdict
	External short-circuit) or testing by an accredited testing laboratory;		
	Re 4) verification of the correct function of the warning device and annunciator by practical testing (e.g. according to 6.2.4, Internal short-circuit (propagation test)) or testing by an accredited testing laboratory.	Warning signal was sent out from BMS and open contactor which verificated in internal short-circuit test	P
8	**Reasonably foreseeable misuse**		P
8.1	External short-circuit		P
8.1.1	External short-circuit test		P
	The test according to 1) may be omitted provided external short-circuit at cell level or cell block level can be precluded by one of the following measures:		N/A
	a) the construction of the cell or cell block meets the requirements regarding double/reinforced insulation;	Basic insulation	N/A
	b) no changes are made to the construction of the single cells or cell blocks on the operating site of the BESS (e.g. installation, disassembly, maintenance). The requirement according to a) is satisfied throughout the lifecycle phases of installation, operation (maintenance) and disassembly.		N/A
8.1.2	Cell or cell block	See appended table for 8.1.2	P
8.1.3	Module, pack, battery system	Test with Battery system	P
8.1.3.3	Requirements		P
	The following requirements shall are met:	See appended table for 8.1.3	P
	– the equipment under test does neither exhibit any signs of fire or flames nor explode;		P
	– measurement and documentation of the values described in the test procedure;		P
	– evaluation of shut-down times of the overcurrent protection device(s) taking into account the measured current and voltage values;		P
	– evaluation of the insulating resistance in accordance with 6.2.2.	＞100 Ω/V	P
8.2	Drop test		P
	In case of an impact, the safety of the BESS and its component parts ensure that the BESS and/or its component parts do not present any direct hazard.		P

Clause	Requirement + Test	Result – Remark	Verdict
8.2.3	Requirements	See appended table for 8.2	P
	– no fire, no explosion;		P
	– no venting;		P
	– no hazardous surface temperatures;		P
	– no ejected parts that may lead to injury of bystanders;		P
	– no direct access to active parts above the protective low voltage.		P
8.3	Impact test	See attachment 5	N/A
	The test demonstrated that an impact on one component (cell or cell block) does not lead to a hazard in its direct surrounding.		N/A
8.3.3	Requirements		N/A
	See E DIN EN 62619 (VDE 0510-39):2014-04, 8.2.2.		N/A
8.4	Thermal misuse	See attachment 5	N/A
	Thermal misuse is tested and evaluated in accordance with E DIN EN 62619 (VDE 0510-39):2014-04, 8.2.2 8) at cell/cell block level.		N/A
8.4.1	Overcharge	See attachment 5	N/A
	The overcharge test is conducted and evaluated in accordance with E DIN EN 62619 (VDE 0510-39):2014-04, 8.2.5 8) at cell/cell block level..		N/A
8.4.2	Forced discharge		N/A
	The forced discharge test is conducted and evaluated in accordance with E DIN EN 62619 (VDE 0510-39):2014-04, 8.2.6 8) at cell/cell block level.	See attachment 5	N/A
9	**Safety during transport**		**P**
	For both the cells and the modules of a battery system, the tests according to UN 38.3 of the currently valid edition of the United Nations Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, are complied with and conformity shall be demonstrated.	See attachment 9	P
	For road transport, particular attention shall be paid to special provisions and the current legislation relating to dangerous goods, in particular of the currently valid edition of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). This also applies to batteries “for disposal” or “for recycling”.	See attachment 9	P

Clause	Requirement + Test	Result – Remark	Verdict
10	**Inspection of markings**		P
10.1	Crossed-out wheeled bin		P
10.2	Marking and designation		P
11	**Documentation requirements**		P
	It shall be ensured that the BESS documentation contains the following indications provided by the manufacturer: – instructions for the correct operation including information on controls and indicators; – instructions for behavior in case of a fault; – hazard warnings, residual risks resulting from risk assessment; – information on the installation site under consideration of the environmental impacts, such as: • installation height, safety distances and position; • ambient temperature and humidity; • pollution degree (IP protection); • risk of external fire; • radiation; • vibration; • corrosive gases and liquids; • escape routes; • markings; – information on safe transport; – contact information of skilled persons responsible in a service case; – contact information of disposal companies responsible in case of disposal.		P

	TABLE: Critical components information				P
Object/part No.	**Manufacturer/ trademark**	**Type/Model**	**Technical Data**	**Standard**	**Marks of Conformity**
Refer to CDF：No.: 704082422811-00, date: 2025-04-10, 16 pages					
Supplementary information: N/A					

6.2.2	TABLE: Insulation resistance test			P
Model	**Insulation resistance between:**	**Insulation resistance, (MΩ)**	**Leakage current, (mA)**	**Result**
Ai-HB Pro 200A	Battery posotive and ground	51900	0.009	A, B
Ai-HB Pro 200A	Battery negtive and ground	>99999	<0.005	A, B
Ai-HB Pro 200A	Battery posotive and negtive	>99999	<0.005	A, B
Supplementary information: A – The leakage current did not exceed 10 mA B – Other (Please explain): The tested device only has DC ports, and the isulation resistance is greater than 100Ω/V.				

6.2.3	TABLE: Dielectric strength test			P
Model	**Dielectric strength test between:**	**Insulation type**	**Test potential applied (V)**	**Breakdown / flashover (Yes/No)**
Ai-HB Pro 200A	Battery+ primary side to metallic enclosure	BI	1600 Vd.c.	No
Ai-HB Pro 200A	Battery- primary side to metallic enclosure	BI	1600 Vd.c.	No
Ai-HB Pro 200A	Battery+ primary side to middle side	BI	1600 Vd.c.	No
Ai-HB Pro 200A	Battery- primary side to middle side	BI	1600 Vd.c.	No
Ai-HB Pro 200A	Middle side (DVC C) to COM port	BI	1600 Vd.c.	No
Supplementary information: OVC III AC 300Vrms system volage in end-use system is also considered for dielectric test of basic and reinforced insulation.				

6.2.5	TABLE: Propagation test: single solution				N/A
Model	**OCV of Battery System Before Test, (V dc)**	**OCV of Target Cell Before Test, (V dc)**	**Maximum Cell Case Temperature, (°C)**	**Maximum DUT Enclosure Temperature, (°C)**	**Result**
Method of cell failure			**Location of target cell**		
Supplementary information: A – No Explosion propagate beyond the system boundaries B – No Fire propagate beyond the system boundaries C – No Ejected parts propagate beyond the system boundaries D – No Liquid electrolyte propagate beyond the system boundaries E – Other (Please explain)					

6.2.6	TABLE: Propagation test: stackable BESS				P
Model	**OCV of Battery System Before Test, (V dc)**	**OCV of Target Cell Before Test, (V dc)**	**Maximum Cell Case Temperature, (°C)**	**Maximum DUT Enclosure Temperature, (°C)**	**Result**
Ai-HB Pro 075A	160.323	3.336	227.4	146.0	A, B, C, D, E, F

Method of cell failure	**Location of target cell**
Heating	4th cell in 16S cell block

Supplementary information:
A – Cell defects only propagated within the initiating module
B – No propagation from this module to an adjacent module
C – No Explosion propagate beyond the system boundaries
D – No Fire propagate beyond the system boundaries
E – No Ejected parts propagate beyond the system boundaries
F – No Liquid electrolyte propagate beyond the system boundaries
G – Other (Please explain):N/A

7.3	TABLE: Plausibility of voltage measurement				P
Model	**Voltage of cell, (V dc)**	**BMS voltage of cell, (Vdc)**	**Maximum cell voltage tolerance, (V dc)**	**Tolerances specified by the manufacturer, (V dc)**	**Result**
Ai-HB Pro 075A	3.509	3.521	0.012	±0.5	A

Supplementary information:
Results:
A - The maximum voltage tolerance of the measured cells or cell blocks did not exceed the tolerances specified by the manufacturer
B - The maximum voltage tolerance of the measured cells or cell blocks did exceed the tolerances specified by the manufacturer
C - Other (Please explain): N/A

7.4	TABLE: Detecting non-separable switching elements			P
Model	**The first level protection elemente(Name and type)**	**The second level protection elemente(Name and type)**	**Test location**	**Result**
Ai-HB Pro 075A	Contactor, model no.: EVHC100-12S	Circuit breaker, model no.: NDB2NZ-80H	Adhesion of positive relay's contacts	A, C

Supplementary information:
Results:
A - The circuit is disconnected.
B - The circuit is not disconnected.
C - The circuit is still disconnected when remove the fault signal.

D - The circuit is reconnected when remove the fault signal. E - Other (Please explain): N/A

7.5	Open-circuit detection of sensing line	P
Item		**Result**
Voltage measurement on cell/cell block interruption		A
Current measurement interruption		A
Temperature measurement interruption		A
Supplementary information: Results: A - No Fire or Explosion B - Leakage C -Venting D - Rupture E - Explosion F - Fire G - Other (Please explain)		

7.7	TABLE: Functional test for load reduction (derating)				N/A
Model	**Tested ambient temperature, (V dc)**	**Voltage of battery, (V dc) (Min/Max)**	**BMS voltage of battery, (Vdc)**	**BMS voltage of Cell/Cell Blocks, (Vdc) (Max/ Min)**	**Result**
	Cell temperature, (ºC) (Min/Max)	**BMS cell temperature, (°C) (Max/ Min)**	**Current of battery, (A)**	**BMS current of battery, (A)**	
Supplementary information: Results: A - No Fire or Explosion B – Fire C - Explosion D - The current of the measured did not exceed the maximum continuous current of cell E - The current of the measured did exceed the maximum continuous current of cell F - All function of battery system did operate as intended during the test. G - All function of battery system did not operate as intended during the test. H - Other (Please explain)					

7.8.1	TABLE: Checking the voltage monitoring under conditions of overcharge				P
Sample No.	**OCV at start of test for Cell/Cell Blocks, (V dc)**	**OCV at start of test for battery, (V dc)**	**Maximum charging current Imax, (A)**	**Maximum Voltage of Cell/Cell Blocks, (V dc)**	**Results**
Ai-HB Pro 075A	3.268	156.61	25.0	3.558	A, D, F
	Maximum voltage of cell (BMS), (Vdc)	**Maximum voltage of battery, (Vdc)**	**Maximum voltage of battery (BMS), (Vdc)**	**110% of upper limit charge voltage, (Vdc)**	
	3.557	169.93	169.400	190.08	

Supplementary information:

Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The voltage of the measured cells or cell blocks did not exceed the upper limit charging voltage
E - The voltage of the measured cells or cell blocks did exceed the upper limit charging voltage
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): N/A

7.8.2	TABLE: Checking the voltage monitoring under conditions of deep/forced discharge				P
Sample No.	**OCV at start of test for Cell/Cell Blocks, (V dc)**	**OCV at start of test for battery, (V dc)**	**Discharging current, (A)**	**Lower limit discharging voltage of cell, (V)**	**Results**
Ai-HB Pro 075A	3.263	156.606	25.0	3.000	A, D, F
	Minimum Voltage of Cell/Cell Blocks when protected, (V dc)	**Minimum BMS voltage of Cell/Cell Blocks when protected, (Vdc)**	**Voltage of battery when protected, (Vdc)**	**BMS voltage of battery when protected, (Vdc)**	
	3.071	3.070	145.605	146.100	

Supplementary information:

Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The voltage of the measured cells or cell blocks did not exceed the discharge cut-off voltage
E - The voltage of the measured cells or cell blocks did exceed the discharge cut-off voltage
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): N/A

7.8.3	TABLE: Checking the current monitoring					P
Model	**OCV of the discharged battery at Start of Test, (V dc)**	**Cell temperature, (ºC) (Min/Max)**	**BMS Cell temperature, (ºC) (Min/Max)**	**Charging current when protected, (A)**	**BMS charging current when protected, (A)**	**Result**
Ai-HB Pro 200A	405.78	27.2/27.4	26.6/27.8	58.6	58.0	A, D, F
	OCV of the battery at Start of Test, V dc)	**Cell temperature, (ºC) (Min/Max)**	**BMS Cell temperature, (ºC) (Min/Max)**	**Discharging current when protected, (A)**	**BMS discharging current when protected, (A)**	
	414.86	23.2/23.9	22.5/24.2	58.1	58.0	

Supplementary information:
Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The current of the measured did not exceed the maximum continuous current of cell
E - The current of the measured did exceed the maximum continuous current of cell
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): N/A

7.8.4	TABLE: Checking the temperature monitoring under conditions of an excessively high temperature				P
Maximun charging cell temperature:					
Model	**OCV at Start of Test, (V dc)**	**Voltage of Cell/Cell Blocks when protected, (V dc) (Min/Max)**	**BMS voltage of Cell/Cell Blocks when protected, (V dc) (Min/Max)**		**Result**
Two battery modules HB051050B and one controller box	106.838	3.413/3.381	3.382/3.413		A, D, F, H
	Battery voltage when protected, (V dc)	**BMS battery voltage when protected, (V dc)**	**Maximum cell temperature when protected, (ºC)**	**Maximum BMS cell temperature when protected, (ºC)**	
	110.997	108.700	58.0	58.0	

Supplementary information:
Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The temperature of the measured cells or cell blocks did not exceed the upper limit temperature for charging
E - The temperature of the measured cells or cell blocks not exceed the upper limit temperature for charging

F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain): After the first time the temperature exceeds the maximum cell temperature and falls below it, the batterry does not automatically restart.

7.8.5	TABLE: Checking the temperature monitoring under conditions of an excessively low temperature				P
Minimum charging cell temperature:					
Model	**OCV at Start of Test, (V dc)**	**Voltage of Cell/Cell Blocks when protected, (V dc) (Min/Max)**		**BMS voltage of Cell/Cell Blocks when protected, (V dc) (Min/Max)**	**Result**
Ai-HB Pro 075A	157.809	3.384/3.390		3.411/3.457	A, D, F
	Battery voltage when protected, (V dc)	**BMS battery voltage when protected, (V dc)**	**Minimum cell temperature when protected, (ºC)**	**Minimum BMS cell temperature when protected, (ºC)**	
	162.354	164.800	-0.12	-0.4	
Minimum discharging cell temperature:					
Model	**OCV at Start of Test, (V dc)**	**Voltage of Cell/Cell Blocks when protected, (V dc) (Min/Max)**		**BMS voltage of Cell/Cell Blocks when protected, (V dc) (Min/Max)**	**Result**
Ai-HB Pro 075A	157.609	3.066/3.076		3.045/3.113	A, D, F
	Battery voltage when protected, (V dc)	**BMS battery voltage when protected, (V dc)**	**Minimum cell temperature when protected, (ºC)**	**Minimum BMS cell temperature when protected, (ºC)**	
	148.083	148.300	-19.97	-20.1	

Supplementary information:
Results:
A - No Fire or Explosion
B – Fire
C - Explosion
D - The temperature of the measured cells or cell blocks did not exceed the lower limit temperature for charging
E - The temperature of the measured cells or cell blocks did exceed the lower limit temperature for charging
F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain):N/A

7.9.1	TABLE: Checking the current measurement				P
Model	**Current of battery, (A)**	**BMS current of battery, (A)**	**Maximum current tolerance, (A)**	**Tolerances specified by the manufacturer, (A)**	**Result**
Ai-HB Pro 075A	24.998	25.038	0.04	±0.1	A

Supplementary information:
Results:
A - The maximum current tolerance of the system did not exceed the tolerances specified by the manufacturer
B - The maximum current tolerance of the system did exceed the tolerances specified by the manufacturer
C - Other (Please explain): N/A

7.9.2	TABLE: Checking the temperature measurement				P
Model	**Temperature of cell, (ºC)**	**BMS temperature of cell, (ºC)**	**Maximum temperature tolerance, (ºC)**	**Tolerances specified by the manufacturer, (ºC)**	**Result**
Ai-HB Pro 075A	33.97	35.50	1.53	2.0	A

Supplementary information:
Results:
A - The maximum temperature tolerance of the measured cells or cell blocks did not exceed the tolerances specified by the manufacturer
B - The maximum temperature tolerance of the measured cells or cell blocks did exceed the tolerances specified by the manufacturer
C - Other (Please explain): N/A

7.10	TABLE: Reaction to failure of components or communication				P
No.	**Component No.**	**fault**	**Test voltage(V)**	**Test time**	**Result**
1	Filter resistor	Open circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Voltage difference fault, the unit shut down immediately. No damage. No hazard.
2	Filter capacitor C103	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Voltage difference fault, the unit shut down immediately. No damage. No hazard.
3	NTC R102, temperature	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Temp. sampling fault,

	sampling circuit				the unit shut down immediately. No damage. No hazard.
4	Communication transformer TX201	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Voltage sampling fault, the unit shut down immediately. No damage. No hazard.
5	Communication IC U122	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Voltage and temp. sampling fault, the unit shut down immediately. No damage. No hazard.
6	Communication circuit L112	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Communication fault, the unit shut down immediately. No damage. No hazard.
7	Main contractor drive MOSFET Q103	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. DC breaker operated, the unit shut down immediately. No damage. No hazard.
8	Insulation monitoring circuit relay U127	Open circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Insulation monitoring fault, the unit shut down immediately. No damage. No hazard.
15	SPS power supply circuit transformer TX101 Pin 5-6	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. The unit shut down immediately. No damage. No hazard.
9	SPS power supply circuit transformer TX101 Pin 8-12	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. The unit shut down immediately. No damage. No hazard.
10	Current sampling circuit U128	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Current sampling fault, the unit shut down immediately. No damage. No hazard.
11	Current sampling circuit U143 Pin 5-6	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Current sampling fault,

					the unit shut down immediately. No damage. No hazard.
12	BMU chip U135 power supply 3V	Short circuit	409.6V	10min	The fault applied during the unit operated in discharging mode. Communication fault, the unit shut down immediately. No damage. No hazard.
Supplementary information:--					

8.1.2	**TABLE: External short-circuit test (cell or cell block)**				**P**
Model.	**Test Temperature, (ºC)**	**OCV at start of test (V dc)**	**Resistance of Circuit (mΩ)**	**Maximum Case Temperature Rise ΔT (K)**	**Results**
Sample 1 LFP39148100/50Ah	22.9	3.337	3.183	70.1	A, E
Sample 2 LFP39148100/50Ah	25.3	3.337	4.556	47.5	A, E
Sample 3 LFP39148100/50Ah	25.2	3.337	4.490	56.3	A, E

Supplementary information:

A - No fire or Explosion
B - Fire
C - Explosion
D - The test was completed after 6 h
E - The test was completed after the cell casing cooled to 20% of the maximum temperature rise
F - Other (Please explain):

8.1.3	**TABLE: External short-circuit test (Module, pack, battery system)**						**P**
Model	**OCV at start of test (V dc)**	**OCV at end of test (V dc)**	**Resistance of Circuit (mΩ)**	**Maximum short circuit current, (A)**	**Maximum Case Temperature Rise ΔT (K)**	**Time for overcurrent protection device operated, (μs)**	**Result**
Ai-HB Pro 200A	426.600	0.004	9.431	3054	0.5	12000	A, F

Supplementary information:

Results:
A - No Fire or Explosion
B - Fire
C - Explosion
D - Venting
E - Rupture

F - All function of battery system did operate as intended during the test.
G - All function of battery system did not operate as intended during the test.
H - Other (Please explain)

8.2	TABLE: Drop test					P
System						
Model	**OCV at start of test, (Vdc)**	**Mass before test, (g)**	**Mass after test, (g)**	**Drop of height, (cm)**	**Maximum Case Temperature, (°C)**	**Results**
HB051050B	53.330	30705	30704	100	27.2	A, D
Insulation resistance before test,(MΩ)			**Insulation resistance after test, (MΩ)**			
Between battery posotive/ground		＞550	Between battery posotive/ground		＞550	
Between battery negative/ground		＞550	Between battery negative/ground		＞550	

Supplementary information:
Results:
A - No Fire or Explosion, no venting
B - No hazardous surface temperature
C - No flying parts, which can lead to injuries of persons standing around
D - No direct access to active parts above the protective low voltage
E - Fire
F - Explosion
G - Venting
H - Rupture
I - Other (Please explain)

--- End of test report ---