

ENGINEERING SHEET (CONFIDENTIAL)

Serial No. SLELA2020- 003

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DATE January 8, 2020

CUSTOMER Hitachi Ltd.

TYPE Industrial lithium ion battery

SUBJECT Specification & characteristics of CH90-6

1. Specification

table 1. Specification of CH90-6

Items		Specifications
Nominal capacity		90 Ah / 0.2 ItA
Nominal voltage		22.2 V (3.7 V/cell×6 Series)
Operation voltage range		16.2 V ~ 25.2 V (2.7~4.2 V/cell)
Operation temperature range		-20 degC ~ 50 degC on battery surface (Capacity will decline at low temperature, below 0 °C)
Max. current	Discharge	Continuous: 225 A(2.5 ItA)
	Charge	Continuous: 300 A(3.3 ItA)
		※Cell surface temperature must not exceed 50°C
Mass		Approx. 24 kg
Dimension		W: 228×D: 475×H: 151 mm(without battery fixture)
Functions of battery monitoring system		•Monitoring max. and min. cell voltage. •Monitoring cell temperature. •Detection and alerting of abnormal status. •Periodical equalization of cell voltage. •BCU for CH90-6 is the same as for CH75-6.
External appearance		

Hitachi Chemical Co., Ltd.

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2. Characteristics

2.1 Charge characteristics

Test condition (Single cell test result)

Temperature : 25 degC $\pm$ 3 degC

Discharge : Discharge current 18A(0.2 ItA), lower limit voltage 2.7V.

Charge :Upper voltage 4.2 V

Current 45A(0.5 ItA), 90A(1 ItA), 180A(2 ItA),and 225A(2.5 ItA)

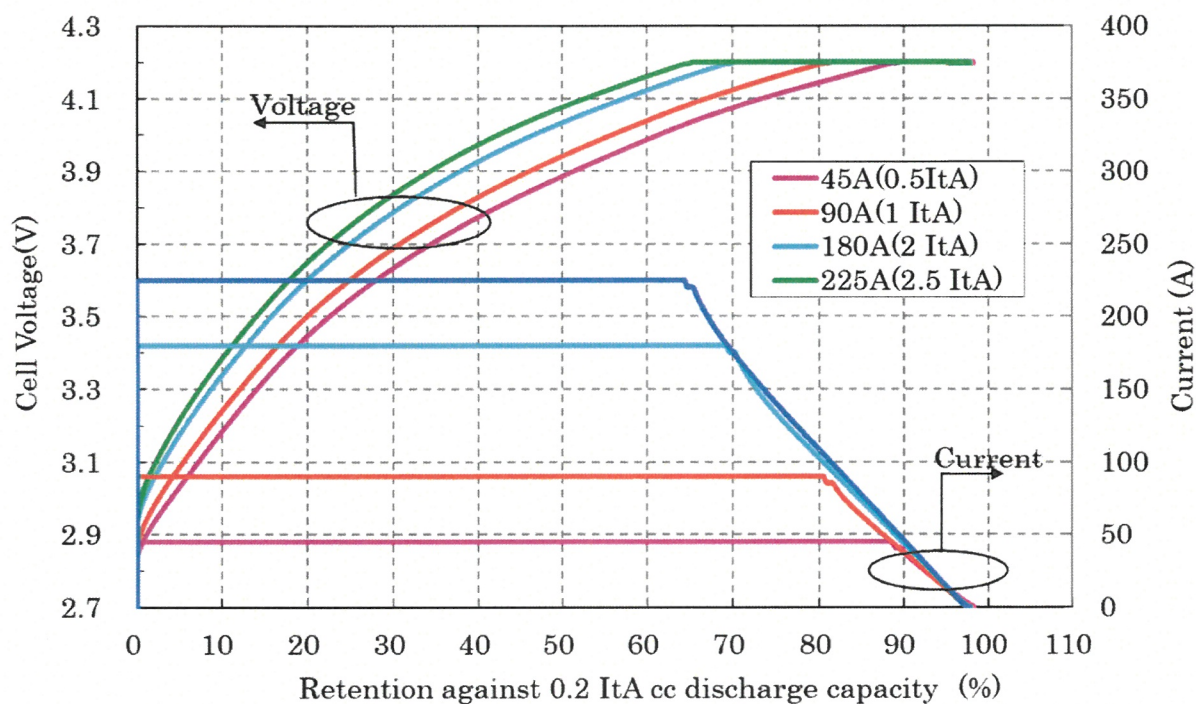


Fig. 1. Charge voltage and current curve.

2.2 Discharge characteristics

Test condition (Single cell test result)

Temperature : $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Charge : Upper voltage 4.2 V, current 45A(0.5 ItA), cut off 1.8 A

Discharge : Current 18 A, 45 A, 90A, 180A, and 225A.

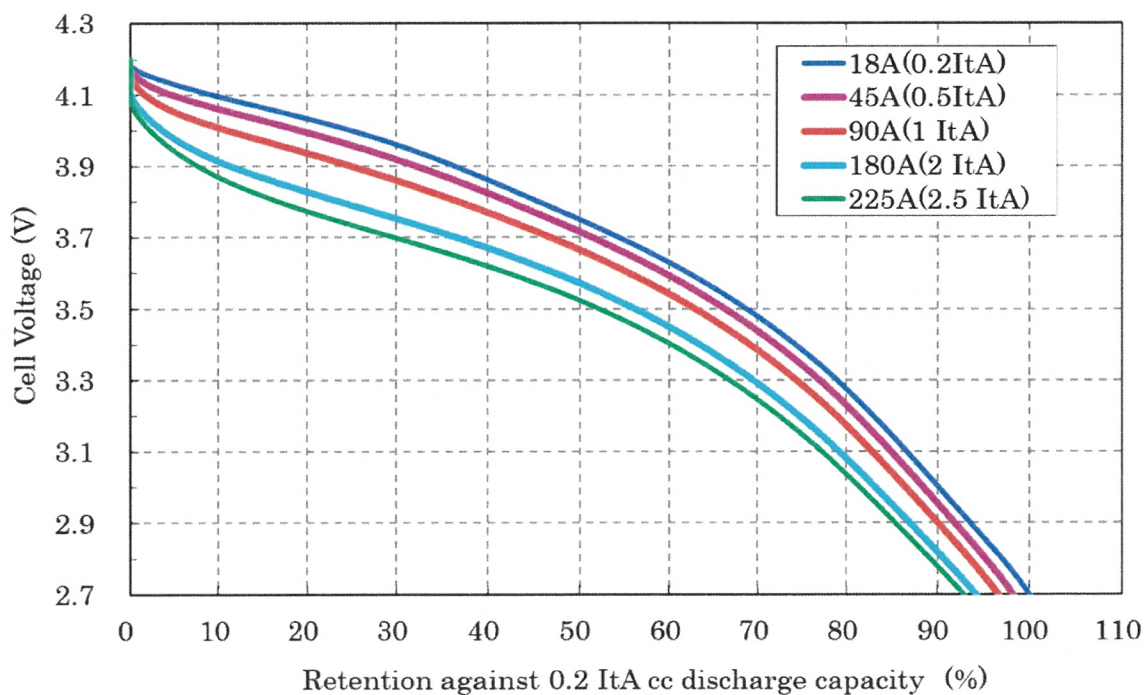


Fig. 2. Discharge voltage curve.

※Data in this sheet is experimental one, and does not constitute a guarantee or warranty.

2.3 SOC-OCV relationship.

Test condition (Single cell test result)

Temperature : -20 degC $\pm$ 3 degC, 25 degC $\pm$ 3 degC, and 50 degC $\pm$ 3 degC,

Current : 30 A(1/3 ItA)

Voltage range: 2.7~4.2 V

Charge or Discharge: Every 10 % charge or discharge between voltage range.

OCV measurement: OCV at 2h after stopping charge or discharge.

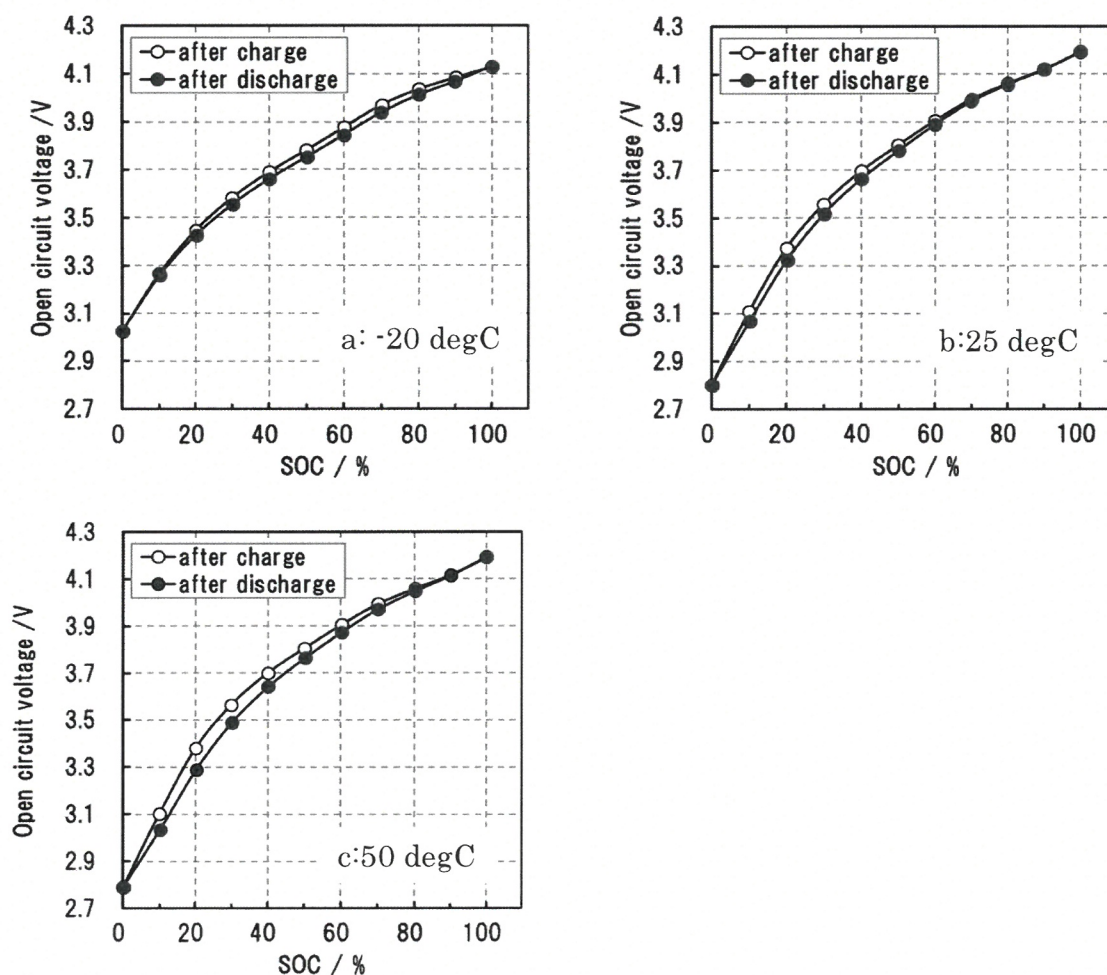
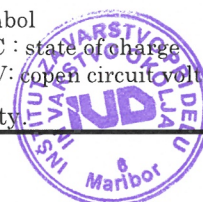


Fig. 3. SOC-OCV curve.
(a: -20 degC, b:25 degC, and c:50 degC)

Symbol
SOC : state of charge
OCV: open circuit voltage

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2.4 Voltage-Capacity relationships

Test condition (Single cell test result)

Temperature : -20 degC $\pm$ 3 degC, 0 degC $\pm$ 3 degC, 25 degC $\pm$ 3 degC, and 50 degC $\pm$ 3 degC,

Charge characteristic

1) Charge : Upper voltage 4.2V

Current 18A(0.2 ItA), 45A(0.5 ItA), 90A(1 ItA), 180A(2 ItA),and 225A(2.5 ItA)

cut off 1.8 A

2) Discharge : Lower voltage 2.7 V

Current 90A(1 ItA)

Discharge characteristic

1) Charge : Upper voltage 4.2V

Current 45A(0.5 ItA)

cut off 3h

2) Discharge : Lower voltage 2.7 V

Current 18A(0.2 ItA), 45A(0.5 ItA), 90A(1 ItA), 180A(2 ItA),and 225A(2.5 ItA)

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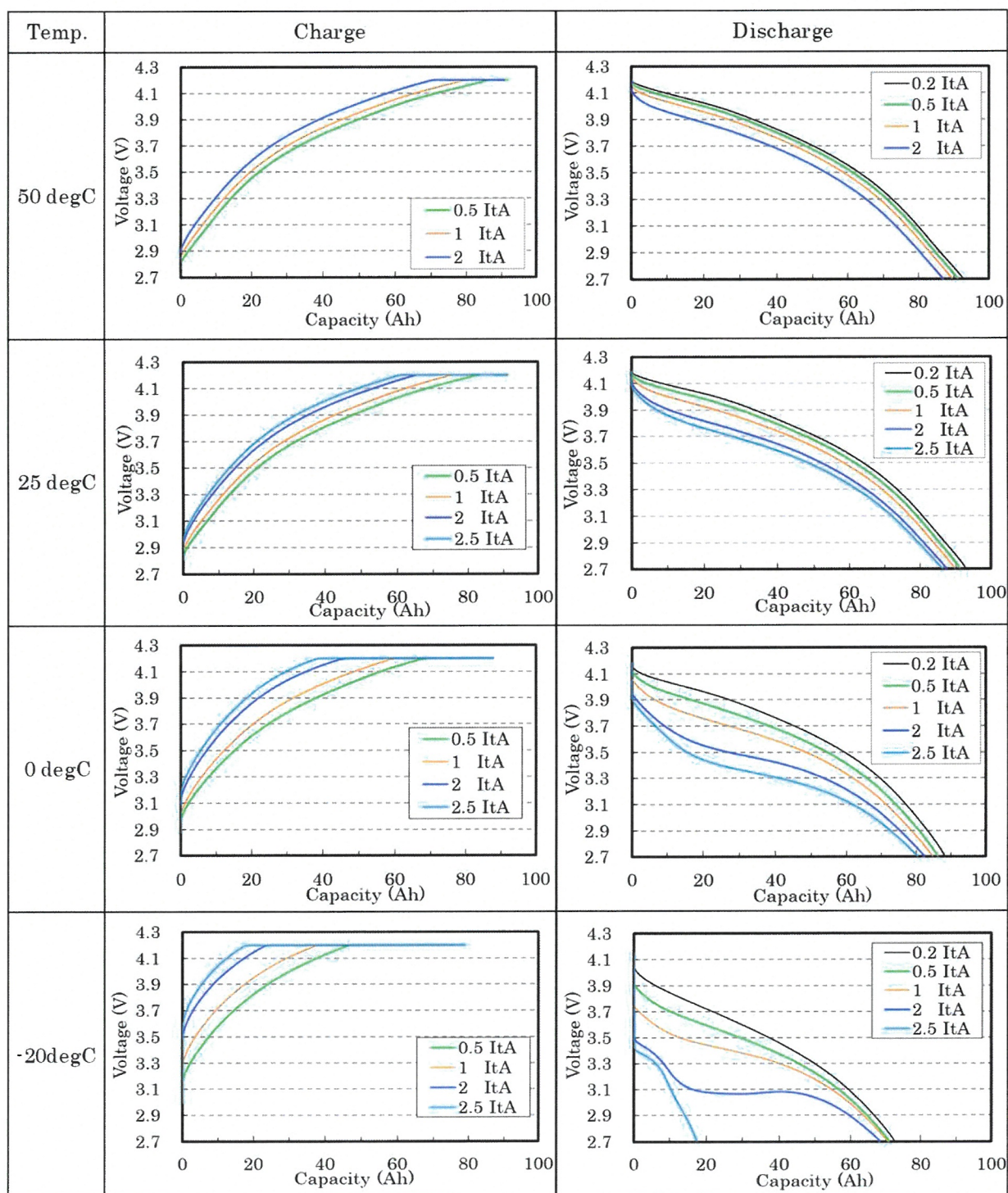


Fig. 4. Voltage-Capacity relationships.

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3. Safety test result of CH90 cell and pack

Table 2. Safety test result of CH90 cell and pack described in IEC62619 ed1.0 method.

Test item			Test procedure	Acceptance criteria	Result	
					CH90 Cell	CH90-6 pack
7.2.1	External short-circuit test		Temp. : 25 ± 5 °C SOC : 100 % Total external resistance : 30±10 mΩ Testing time : 6 h or until the case temperature declines by 80 % of the maximum temperature rise, whichever is the sooner.	No fire, no explosion	Pass	N/A
7.2.2	Impact test		Temp. : 25 ± 5 °C SOC : 50 % Diameter of the load : 15.8 mm Mass of the load : 9.1 kg Drop height : 610 ± 25 mm	No fire, no explosion	Pass	N/A
7.2.3	Drop test (whole)	Less than 7kg	Temp. : 25 ± 5 °C SOC : 100 % Drop height : 1,000 mm Testing time : 1 h after drop	No fire, no explosion	Pass	N/A
	Drop test (Edge and corner)	20-50kg	Temp. : 25 ± 5 °C SOC : 100 % Drop height : 100 mm	No fire, no explosion	N/A	Pass
7.2.4	Thermal abuse test		SOC : 100 % Temp. : 25 ± 5 °C → 85 ± 5 °C Temp. rising rate : 5 ± 2 °Cmin ⁻¹ Testing time : 3 h at 85 ± 5 °C	No fire, no explosion	Pass	N/A
7.2.5	Overcharge test		Temp. : 25 ± 5 °C SOC : 0 % Current : Max. charging current specified by supplier. Final voltage : Max. voltage value that is possible under the condition where the original charging control does not work.	No fire, no explosion	N/A ^{※1}	N/A
7.2.6	Forced discharge test		Temp. : 25 ± 5 °C SOC : 0 % Current : 90A Testing time : 90min	No fire, no explosion	Pass	N/A
7.3.3	Against thermal runaway test (choose either)	Internal short-circuit test (Cell)	Temp. : 25 ± 5 °C SOC : 0 % Nickel particle may be inserted into a discharged electrode element then the cell is assembled and fully charged. Applying pressure : max. 800N until the cell voltage drops within 50mV.	No fire, no explosion	Choose propagation test	N/A
		Propagation test (battery system)	Temp. : 25 ± 5 °C SOC : 100 % one of the cell of the battery system is made a thermal runaway.	No fire, no explosion, and no rupture (except thermal runaway cell)	N/A	Pass
8.2.2	Overcharge control of voltage		Temp. : 25 ± 5 °C SOC : 0 % The system is charged to 10% larger than upper limit charging voltage by max. charge current.	No fire, no explosion after 1h that BMU terminates the charging before reaching 110 % of the upper limit charging voltage	N/A	Pass ^{※2}
8.2.3	Overcharge control of current		Temp. : 25 ± 5 °C SOC : 0 % The system is charged by 20% larger than max. charge current.	No fire, no explosion after 1h that BMU detects overcharging current and shall control the charging below the max. charging current.	N/A	Pass ^{※2}
8.2.4	Overheating control		Temp. : 25 ± 5 °C SOC : 0 % The battery system is charged to SOC 50%, and a cell temp. of the battery system shall be increased to 5 °C above the max. operating temperature.	No fire, no explosion after 1h that BMU detects overheating temp. and shall terminate charging.	N/A	Pass ^{※2}

※1: Provided with two or more independent protection(s) or control(s) for the charging voltage control, this test may be waived.

※2: 1P1S configuration.



Table 3. Safety test result of CH90 cell and pack based on UN Manual of Tests And Criteria 6th revised edition, Part III, Subsection 38.3

Test		SOC (%)	Requirement	Result	
				Cell	Battery
T.1	Altitude simulation	100	Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure.	Pass	Pass
T.2	Thermal test	100	Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure.	Pass	Pass
T.3	Vibration	100	Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery directly after testing in its third perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure.	Pass	Pass
T.4	Shock	100	Cells and batteries meet this requirement if there is no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure.	Pass	Pass
T.5	External short circuit	100	Cells and batteries meet this requirement if their external temperature does not exceed 170 deg C and there is no disassembly, no rupture and no fire during the test and within six hours after the test.	Pass	Pass
T.6	Impact / Crush	50	Cells and component cells meet this requirement if their external temperature does not exceed 170 deg C and there is no disassembly and no fire during the test and within six hours after this test.	Pass	Pass
T.8	Forced discharge	0	Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.	Pass	N/A