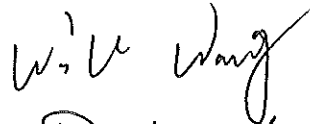





<b>TEST REPORT</b> <b>IEC/EN 60896</b> <b>Stationary lead-acid batteries —</b> <b>Part 21: Valve regulated types — Methods of test</b> <b>Part 22: Valve regulated types — Requirements</b>	
<b>Report Reference No</b> .....	150301279SHA-001
Date of issue.....	2015-03-31
Total number of pages .....	43
<b>Testing Laboratory</b> .....	Intertek Testing Services Shanghai
Address .....	Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, China
<b>Applicant's name</b> .....	Betta Batteries International Pty. Ltd.
Address .....	B07 FLOOR 23, HOVER INDUSTRIAL BUILDING, NO. 26-38 KWAI CHEONG ROAD, N.T, HONG KONG
<b>Test specification:</b>	
Standard .....	IEC/EN 60896-21:2004, IEC/EN 60896-22:2004
Test procedure .....	Testing
Non-standard test method.....	N/A
<b>Test Report Form No</b> .....	TTRF_EN60896_A
Test Report Form(s) Originator .....	Intertek ETL SEMKO shanghai
Master TRF .....	Dated 2010-11
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<b>Test item description</b> .....	Lead acid battery
Trade Mark .....	<b>LEAD CRYSTAL®</b>
Manufacturer .....	Betta Batteries International Pty. Ltd.
Model/Type reference.....	6-HCNFJ-7.2, 6-CNFJ-40, 6-CNFT-55, 6-CNFJ-65, 6-CNFT-170, CNFJ-200, 6-CNFJ-100 (C100), CNFJ-180 (C100), CNFJ-360 (C100)
Ratings .....	12V7.2AH, 12V40AH, 12V55AH, 12V65AH, 12V170AH, 12V200AH , 12V100AH, 2V180AH, 2V360AH

Testing procedure and testing location:	
<input checked="" type="checkbox"/> <b>Testing Laboratory:</b>	Intertek Testing Services Shanghai
Testing location/ address.....:	Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, China
Tested by (name + signature).....:	Will Wang 
Approved by (+ signature) .....	Robin Xu 
<input type="checkbox"/> Testing procedure: TMP	
Tested by (name + signature).....:	
Approved by (+ signature) .....	
Testing location/ address.....:	
<input type="checkbox"/> Testing procedure: WMT	
Tested by (name + signature).....:	
Witnessed by (+ signature).....:	
Approved by (+ signature) .....	
Testing location/ address.....:	
<input type="checkbox"/> Testing procedure: SMT	
Tested by (name + signature).....:	
Approved by (+ signature) .....	
Supervised by (+ signature).....:	
Testing location/ address.....:	
<input type="checkbox"/> Testing procedure: RMT	
Tested by (name + signature).....:	
Approved by (+ signature) .....	
Supervised by (+ signature).....:	
Testing location/ address.....:	

Copy of marking plate

**LEAD  
CRYSTAL<sup>®</sup>  
BATTERIES**

**6-CNFJ-65**  
(12V65Ah/10hr 25°C)

- CAUTION
- Avoid Short Circuit
  - Do Not Charge in Sealed Container
  - Avoid Contact With Fire

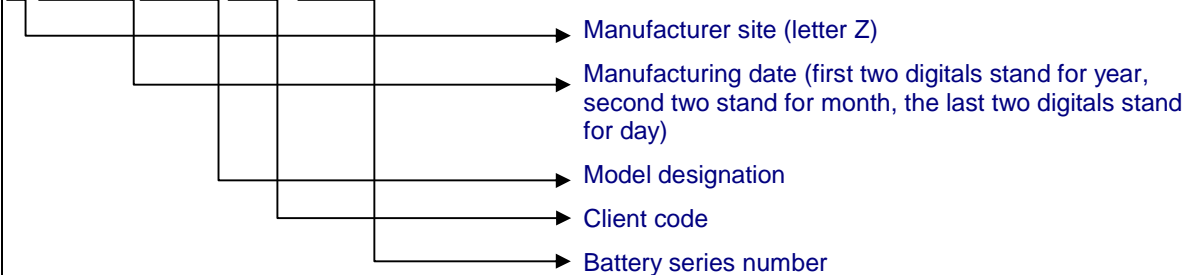
12V Battery Range		
Charging (Constant Voltage)		
Temp	Cycle	Float
20°C - 30°C	14.4V – 14.8V	13.5V – 13.8V
31°C - 40°C	14.25V – 14.65V	13.35V – 13.65V
41°C - 45°C	14.1V – 14.5V	13.2V – 13.5V
End-of-charge Voltage: 10hr U <sub>final</sub> =10.8V (25°C)		



POWERED BY  
**Betta Batteries**  
MADE IN CHINA

The product code as follows

X XXXXXX XXXXX XXX XXX (X)



Note: Other models have similar label except model name and ratings.



**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)
- test is still on running .....: T (Testing now)

---

**Testing** .....

Date of receipt of test item .....: 2013-04-07

Date (s) of performance of tests .....: 2013-04-07 to 2015-03-31

---

**General remarks:**

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.  
 "(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 point is used as the decimal separator.

This test report is based on 130400386SHA-001 and 140800789SHA-001 which some tests were already conducted on model 6-CNFJ-65 already.

All cells have similar construction and belong to same series. All 12V models incorporate cells of same series.

---

**General product information:**

These batteries are a series of 12V valve regulated type stationary lead-acid batteries.

Model	I <sub>3</sub>	I <sub>10</sub>
6-HCNFJ-7.2	2.25A	0.8A
6-CNFJ-40	10A	3.8A
6-CNFT-55	13.75A	5.5A
6-CNFJ-65	16.25A	6.5A
6-CNFT-170	42.5A	17A
CNFJ-200	50A	20A
6-CNFJ-100 (C100)	66A	10A
CNFJ-180 (C100)	112.5A	18A
CNFJ-360 (C100)	225A	36A

IEC 60896-21:2004, IEC 60896-22:2004																																				
Clause	Requirement + Test	Result - Remark	Verdict																																	
<b>4</b>	<b>FUNCTIONAL REQUIREMENTS</b>																																			
4.1	Overview																																			
	The following requirements are grouped into safe operation, performance and durability needs.																																			
4.2	<b>Safe operation characteristics</b> <table border="1"> <thead> <tr> <th>Test clause</th> <th>Measures</th> <th>Purpose</th> </tr> </thead> <tbody> <tr> <td>6.1</td> <td>Gas emission</td> <td>To determine the emitted gas volume</td> </tr> <tr> <td>6.2</td> <td>High current tolerance</td> <td>To verify the adequacy of current conduction cross- sections</td> </tr> <tr> <td>6.3</td> <td>Short circuit current and d.c. internal resistance</td> <td>To provide data for the sizing of fuses in the exterior circuit</td> </tr> <tr> <td>6.4</td> <td>Protection against internal ignition from external spark sources</td> <td>To evaluate the adequacy of protective features</td> </tr> <tr> <td>6.5</td> <td>Protection against ground short propensity</td> <td>To evaluate the adequacy of design features</td> </tr> <tr> <td>6.6</td> <td>Content and durability of required markings</td> <td>To evaluate the quality of the markings and the content of the information</td> </tr> <tr> <td>6.7</td> <td>Material identification</td> <td>To ensure the presence of material identification markings</td> </tr> <tr> <td>6.8</td> <td>Valve operation</td> <td>To ensure the correct opening of safety valves</td> </tr> <tr> <td>6.9</td> <td>Flammability rating of materials</td> <td>To verify the fire hazard class of battery materials</td> </tr> <tr> <td>6.10</td> <td>Intercell connector performance</td> <td>To verify the maximum surface temperatures of the connectors during high rate discharges</td> </tr> </tbody> </table>		Test clause	Measures	Purpose	6.1	Gas emission	To determine the emitted gas volume	6.2	High current tolerance	To verify the adequacy of current conduction cross- sections	6.3	Short circuit current and d.c. internal resistance	To provide data for the sizing of fuses in the exterior circuit	6.4	Protection against internal ignition from external spark sources	To evaluate the adequacy of protective features	6.5	Protection against ground short propensity	To evaluate the adequacy of design features	6.6	Content and durability of required markings	To evaluate the quality of the markings and the content of the information	6.7	Material identification	To ensure the presence of material identification markings	6.8	Valve operation	To ensure the correct opening of safety valves	6.9	Flammability rating of materials	To verify the fire hazard class of battery materials	6.10	Intercell connector performance	To verify the maximum surface temperatures of the connectors during high rate discharges	
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4.5	<b>Test result requirements</b> The test results required to verify the characteristics defined in 6.1 to 6.21																																			

IEC 60896-21:2004, IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	Verdict
<b>5</b>	<b>TEST SET-UP (IEC 60896-21:2004)</b>		P
5.1	Accuracy of measuring instruments		P
5.1.1	Voltage measurements		P
	The instruments used shall be of an accuracy class 0,5 or better where required. The resistance of the voltmeters shall be at least 10 000 $\Omega/V$ .		P
5.1.2	Current measurements		P
	The instruments used shall be of an accuracy class 0,5 or better where required.		P
5.1.3	Temperature measurement		P
	The instruments used shall have a resolution of 1 K. The absolute accuracy of the instruments shall be 1 K or better where required.		P
5.1.4	Time measurements		P
	The time measurements shall have of an accuracy of $\pm 1$ % or better where required.		P
5.1.5	Length measurements		P
	The instruments used shall have an accuracy of $\pm 0,1$ % or better where required.		P
5.1.6	Weight measurements		P
	The instruments used shall have an accuracy of $\pm 1$ % or better where required.		P
5.1.7	Gas volume measurements		P
	The instruments used shall have an accuracy of $\pm 5$ % or better where required.		P
5.1.8	Gas pressure measurements		P
	The instruments used shall have an accuracy of $\pm 10$ % or better where required.		P
5.2	Selection of test units		P
	The units to be used for type testing according to this part of IEC 60896 shall be selected in accordance with the procedures as standard specified		P
5.3	General test features and rules		P
5.3.1	The test units shall not undergo any maintenance operations such as water or electrolyte additions or withdrawals during the entire duration of a test.		P

IEC 60896-21:2004, IEC 60896-22:2004																																				
Clause	Requirement + Test	Result - Remark	Verdict																																	
5.3.2	The test units shall be tested in the position specified by the manufacturer in the relevant technical documentation of the product range except for those cases in which a particular position is specified in the test clause. The position used in any given test shall be reported in the relevant test documentation.		P																																	
5.3.3	The test units shall always be tested fully charged with the method and duration of charge being exclusively that specified by the manufacturer in the relevant technical documentation of the product range except for those cases in which a particular method or duration is specified in the test subclause. The charge methods and duration used in each test shall be reported in the relevant test documentation.		P																																	
5.3.4	Whenever there is a significant change in a specified design feature, material, manufacturing process, relevant quality inspection and test procedures of the manufacturing location(s) of a product range, the relevant type test(s) shall be repeated to ensure that the affected product range continues to be in compliance with the defined Safe operation, Performance and Durability requirements for the intended application.		P																																	
5.3.5	Each test and test set-up shall be documented with photographs that give a clear image of the test units and their identification numbers.		P																																	
5.4	Number of test units		P																																	
5.4.1	<p>The number of units to be tested is summarized below</p> <table border="1"> <thead> <tr> <th>Test Clause</th> <th>Measures</th> <th>Number of test units</th> </tr> </thead> <tbody> <tr> <td>6.1</td> <td>Gas emission</td> <td>6 cells or 3 monobloc batteries</td> </tr> <tr> <td>6.2</td> <td>High current tolerance</td> <td>3 cells or 3 monobloc batteries</td> </tr> <tr> <td>6.3</td> <td>Short circuit current and d.c. internal resistance</td> <td>3 cells or 3 monobloc batteries</td> </tr> <tr> <td>6.4</td> <td>Protection against internal ignition from external spark sources</td> <td>3 valve assemblies</td> </tr> <tr> <td>6.5</td> <td>Protection against ground short propensity</td> <td>1 cell or 1 monobloc battery</td> </tr> <tr> <td>6.6</td> <td>Content and durability of required markings</td> <td>3 samples</td> </tr> <tr> <td>6.7</td> <td>Material identification</td> <td>1 cover or 1 case sample</td> </tr> <tr> <td>6.8</td> <td>Valve operations</td> <td>3 cells or 3 monobloc batteries</td> </tr> <tr> <td>6.9</td> <td>Flammability rating of materials</td> <td>1 sample per material</td> </tr> <tr> <td>6.10</td> <td>Intercell connector performance</td> <td>6 cells or 6 monobloc batteries</td> </tr> </tbody> </table>		Test Clause	Measures	Number of test units	6.1	Gas emission	6 cells or 3 monobloc batteries	6.2	High current tolerance	3 cells or 3 monobloc batteries	6.3	Short circuit current and d.c. internal resistance	3 cells or 3 monobloc batteries	6.4	Protection against internal ignition from external spark sources	3 valve assemblies	6.5	Protection against ground short propensity	1 cell or 1 monobloc battery	6.6	Content and durability of required markings	3 samples	6.7	Material identification	1 cover or 1 case sample	6.8	Valve operations	3 cells or 3 monobloc batteries	6.9	Flammability rating of materials	1 sample per material	6.10	Intercell connector performance	6 cells or 6 monobloc batteries	P
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IEC 60896-21:2004, IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	Verdict

Test Clause	Measures	Number of test units	P
6.11	Discharge capacity	5 x 6 cells or 5 x 6 monobloc batteries	
6.12	Charge retention during storage	6 cells or 6 monobloc batteries	
6.13	Float service with daily discharges	6 cells or 3 monobloc batteries	
6.14	Recharge behaviour	3 cells or 3 monobloc batteries	

Test Clause	Measures	Number of test units	P
6.15	Service life at an operating temperature of 40 °C	3 cells or 3 monobloc batteries	
6.16	Impact of a stress temperature of 55 °C or 60 °C	3 cells or 3 monobloc batteries	
6.17	Abusive over-discharge	4+3 cells or 4+3 monobloc batteries	
6.18	Thermal runaway sensitivity	6 cells or 6 monobloc batteries	
6.19	Low temperature sensitivity	3 cells or 3 monobloc batteries	
6.20	Dimensional stability at elevated internal pressure and temperature	1 cell or 1 monobloc battery	
6.21	Stability against mechanical abuse of units during installation	2 cells or 2 monobloc batteries	

5.5	Suggested test sequence		P
-----	-------------------------	--	---

	Multiple tests on the same units are allowed. However, the test sequence should be planned carefully to ensure that the execution of one test does not disturb or unduly influence the outcome of a subsequent test or cause hidden safety problems. In some cases, a test clause may proscribe a sequence of tests. Separate units may be used for each test unless otherwise specified. The manufacturer makes the final decision on the test sequence. The adopted test sequence shall be recorded in the relevant test documentation.		P
--	---	--	---

5.6	Customer test		N/A
-----	---------------	--	-----

5.6.1	The test units and test to be used for acceptance or commissioning tests shall be selected and defined by a joint agreement between the battery supplier and battery user.		N/A
-------	--	--	-----

	For an acceptance or commissioning capacity test, a discharge at the 3 h rate to a final voltage of 1,70 Vpc or as agreed upon between battery supplier and battery user, shall be selected.		N/A
--	--	--	-----

<b>6</b>	<b>TEST METHODS AND REQUIREMENTS AND CHARACTERISTICS</b>		P
6.1	Gas emission	Refer to table 6.1	P
6.2	High current tolerance	Refer to table 6.2	P
6.3	Short-circuit current and d.c. internal resistance	Refer to table 6.3	P
6.4	Protection against internal ignition from external spark sources	Refer to table 6.4	P
6.5	Protection against ground short propensity	Refer to table 6.5	P

IEC 60896-21:2004, IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	Verdict
6.6	Content and durability of required markings	Refer to table 6.6	P
6.7	Material identification	Refer to table 6.7	P
6.8	Valve operations	Refer to table 6.8	P
6.9	Flammability rating of materials	Refer to table 6.9	P
6.10	Intercell connector performance	Refer to table 6.10	P
6.11	Discharge capacity	Refer to table 6.11	P
6.12	Charge retention during storage	Refer to table 6.12	P
6.13	Float service with daily discharges	Refer to table 6.13	T
6.14	Recharge behaviour	Refer to table 6.14	P
6.15	Service life at an operating temperature of 40 °C	Refer to table 6.15	P
6.16	Impact of a stress temperature of 55 °C or 60 °C	Refer to table 6.16	P
6.17	Abusive over-discharge	Refer to table 6.17	P
6.18	Thermal runaway sensitivity	Refer to table 6.18	P
6.19	Low temperature sensitivity	Refer to table 6.19	P
6.20	Dimensional stability at elevated internal pressure and temperature	Refer to table 6.20	P
6.21	Stability against mechanical abuse of units during installation	Refer to table 6.21	P

<b>ANNEX A</b>	<b>(NORMATIVE) USER STATEMENT OF REQUIREMENTS (IEC 60896-22)</b>		N/A
1)	Application description information		N/A
	Application summary		N/A
	Load (in A or W) and autonomy time profile(s)		N/A
	Minimum and maximum system float voltage		N/A
	Maximum or boost charge system voltage available Y/N If yes what value?		N/A
	Minimum system discharge voltage or low voltage disconnect Y/N If yes what value?		N/A
	Expected minimum and maximum operating temperatures and their duration per year		N/A
	Any other relevant information or operational requirements such as duration and frequency of power outages, of diagnostic discharges and of energy cost saving actions		N/A
2)	Product specification information		N/A

IEC 60896-21:2004, IEC 60896-22:2004				
Clause	Requirement + Test	Result - Remark	Verdict	
	<b>Product safe operation in service</b>		N/A	
	<b>Compliance information mandatory</b>			
	6.1	Gas emission (at float voltage and at 2,40 Vpc)		Data requested
	6.2	High current tolerance		Pass
	6.3	Short circuit current and d.c. internal resistance		Data requested
	6.4	Internal ignition from external spark sources		Pass
	6.5	Protection against ground short propensity		Pass
	6.6	Content and durability of required markings		Pass
	6.7	Material identification		Pass
	6.8	Valve operation		Pass
	6.9	Flammability rating of materials		Data requested
6.10	Intercell connector performance	Data requested		
	<b>Product performance in service</b>		N/A	
	<b>Compliance information mandatory or on as-needed basis</b>			
	6.11	Discharge capacity		Data for C <sub>10</sub> , C <sub>8</sub> , C <sub>3</sub> , C, C <sub>0,25</sub>
	6.12	Charge retention during storage		Pass
	6.13	Float service with daily discharges		Value to be requested as function of service environment
6.14	Recharge behaviour	Pass		
	<b>Product durability in service</b>		N/A	
	<b>Compliance information mandatory or on as-needed basis</b>			
	6.15	Service life at an operating temperature of 40 °C		Value to be requested as function of service environment
	6.16	Impact of a stress temperature of 55 °C or 60 °C		Value to be requested as function of service environment
	6.17	Abusive over-discharge		Value to be requested if service environment warrants
	6.18	Thermal runaway sensitivity		Pass and show data
	6.19	Low temperature sensitivity		Value to be requested if service environment warrants
	6.20	Dimensional stability at elevated internal pressure and temperature		Show data
6.21	Stability against mechanical abuse of units during installation	Pass		

ANNEX B	(NORMATIVE) SUPPLIER STATEMENT OF PRODUCT RANGE TEST RESULTS (IEC 60896-22)	N/A
1)	General product type information	N/A
	Product manufacturer	N/A
	Manufacturing site of tested product	N/A
	Product name	N/A
	Product model range	N/A
	Product comprising the above model range	N/A
	Product tested	N/A
2)	Product test performance information	N/A

IEC 60896-21:2004, IEC 60896-22:2004																																															
Clause	Requirement + Test	Result - Remark	Verdict																																												
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Table 6.1		Gas emission				Verdict:	Pass	
Test method:		Each battery has an actual capacity $C_a \geq 0,95 C_3$ and was fully charged. <b>Test A: The normalized gas emission <math>G_e</math> per cell at float charge voltage conditions at 25 °C:</b> 1. Three batteries in a series string, for 72 h with float charge voltage 6.75V (2.25V / each battery); 2. After 72 h float charge, check whether the battery is leakage or not first. Continue float charging for 168 h and collect gas at the same time. Record $V_a$ value and convert to $V_n$ at 25°C; 3. Four cycles, time for each cycle is 168 h; 4. Calculate normalized gas emission $G_e$ . $G_e = V_n / (n \times 168 \times C_{rt})$ , $n=1$ ( $V_n$ is the total corrected gas volume emitted per test unit in ml $n$ is the number of cells from which the gas was collected in the collection vessel 168 is the number of hours during which the gas was collected $C_{rt}$ is the rated $C_3$ capacity in Ah of the test units from which the gas was collected.) <b>Test B: The normalized gas emission <math>G_e</math> per battery at 14.4V charge voltage conditions at 25 °C:</b> 1. After test A, three batteries in a series string, for 24 h with charge voltage 7.20V (2.4V / each battery); 2. Then collect gas. Stop collecting when the time is up to 48 h or gas is up to 1000ml. 3. Record the cumulative total gas volume ( $V_a$ in ml) collected over one period of 48 h or the time $t_c$ (in hours) to collect 1 000 ml. 4. The corrected volume of gas $V_n$ emitted at the reference temperature of 25 °C and the reference pressure of 101,3 kPa shall be calculated by the formula $V_n = \frac{V_a \times T_r}{T_a} \times \frac{P_a}{P_r}$ 5. The normalized gas emission $G_e$ per cell at float charge voltage conditions (14.4V) shall be calculated for each of the four 168 h $\pm 0,1$ h periods with the formula below: $G_e = V_n / (n \times 168 \times C_{rt})$ in ml per cell, hour and Ah (rated $C_3$ ), $n=1$						
Test result:								
Model name:	Sample No:	168h cycle	Test A					Remark after 72h float charging
			$V_a$ (ml)	$V_n$ (ml)	$T_a$ (K)	$P_a$ (kPa)	$G_e$ (ml)	
6-CNFJ-65	23	1	2325	2322.0	297.5	1010	0.047	No leakage
		2	2280	2275.5	298.0	1011	0.046	
		3	1993	1995.8	297.0	1011	0.041	
		4	1813	1813.7	297.0	1010	0.037	
	24	1	2345	2342.0	297.5	1010	0.048	No leakage
		2	2255	2250.5	298.0	1011	0.046	
		3	1980	1982.7	297.0	1011	0.040	
		4	1810	1810.7	297.0	1010	0.037	
	25	1	2380	2376.9	297.5	1010	0.048	No leakage
		2	2268	2263.5	298.0	1011	0.046	
		3	1960	1962.7	297.0	1011	0.040	
		4	1800	1800.7	297.0	1010	0.037	
Model name:	Sample No:	Test B				Remark after 24h charging		
		$t_c$ (h) to 1000ml	$V_a$ (ml)	$V_n$ (ml)	$G_e$ (ml)			
6-CNFJ-65	23	11.63	4127.3	4115.0	0.29	No leakage		
	24	11.56	4152.2	4140.0	0.29	No leakage		
	25	12.12	3960.4	3948.7	0.28	No leakage		

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Table 6.2	High current tolerance	Verdict:	Pass	
Test method:	<p>Each battery has an actual capacity <math>C_a \geq C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>The test units shall be discharged for 30 s with a current equal to 3 times the 5 min rate current (to <math>U_{final}</math> 1,80 V<sub>pc</sub> at 20 °C or 25 °C) or with a current equal to the maximum allowable discharge current, both as specified by the manufacturer in the relevant technical documentation of the product range.</li> <li>After the completion of the specified discharge duration, the test units shall stand for 5 min in open circuit and their voltage measured and reported.</li> </ol>			
Test result:				
Sample NO.	4#	5#	6#	Remark
Discharge current =(345) A ( $U_{final}=1.80V_{pc}$ )				Discharge/30s
The battery status after large current	No terminal melting; No stripe melting; Exterior appearance normal;	No terminal melting; No stripe melting; Exterior appearance normal;	No terminal melting; No stripe melting; Exterior appearance normal;	
Voltage after open circuit for 5min (V)	13.006	12.990	13.000	

Table 6.3	Short-circuit current and d.c. internal resistance					Verdict:	Pass	
Test method:	Each battery has an actual capacity $C_a \geq C_3$ and was fully charged. 1. The short circuit current shall be defined by determining two data pairs in the following way: a) First data pair ( $U_a, I_a$ ) After 20 s of discharge at the current $I_a = 4 \times I_{10}$ , the voltage and current shall be recorded to give the first data pair. The current shall be interrupted after 25 s maximum and, without recharge and after an open circuit stand of 5 min, the second data pair shall be determined. b) Second data pairs ( $U_b, I_b$ ) After 5 s of discharge at the current $I_b = 20 \times I_{10}$ , the voltage and current shall be recorded to give the second data pair. 2. Short circuit current $I_{sc} = [(U_a \times I_b) - (U_b \times I_a)] / (U_a - U_b)$ in amperes Internal resistance $R_i = (U_a - U_b) / (I_b - I_a)$ in ohms							
Test result:								
Model name:	Sample No:	Ia (A)	Ua (V)	Ib (A)	Ub (V)	Short circuit current I <sub>sc</sub> (A)	Internal resistance Ri (Ω)	Remark
6-CNFJ-65	1#	25.999	37.492	130	33.960	1129.96	0.034	Actual capacity $C_a > C_3$
	2#	26.000	37.486	130	34.112	1181.47	0.032	
	3#	26.000	37.498	130	34.107	1176.04	0.033	
6-HCNFJ-7.2	1#	3.2	12.698	16	12.044	251.7	0.051	Actual capacity $C_a > C_3$
	2#	3.2	12.692	16	12.053	257.4	0.050	
	3#	3.2	12.714	16	12.076	258.3	0.050	
6-CNFJ-40	1#	15.2	12.404	76	11.453	808.2	0.016	Actual capacity $C_a > C_3$
	2#	15.2	12.448	76	11.571	878.2	0.014	
	3#	15.2	12.359	76	11.491	880.9	0.014	
6-CNFT-55	1#	22	12.461	110	11.363	1020.7	0.012	Actual capacity $C_a > C_3$
	2#	22	12.567	110	11.436	999.8	0.013	
	3#	22	12.496	110	11.301	942.2	0.013	
6-CNFT-170	1#	68	12.168	340	10.548	2111.0	0.0060	Actual capacity $C_a > C_3$
	2#	68	12.123	340	10.442	2029.6	0.0062	
	3#	68	12.123	340	10.450	2039.0	0.0062	
6-CNFJ-200	1#	80	2.019	400	1.708	2157.4	$9.7 \times 10^{-4}$	Actual capacity $C_a > C_3$
	2#	80	2.003	400	1.692	2141.0	$9.7 \times 10^{-4}$	
	3#	80	1.830	400	1.530	2032.0	$9.4 \times 10^{-4}$	
6-CNFJ-100 (C100)	1#	40	12.370	200	11.350	1980.4	$6.375 \times 10^{-3}$	Actual capacity $C_a > C_3$
	2#	40	12.430	200	11.420	2009.1	$6.313 \times 10^{-3}$	
	3#	40	12.400	200	11.380	1985.1	$6.375 \times 10^{-3}$	
CNFJ-180 (C100)	1#	72	2.050	360	1.818	2616.8	$0.806 \times 10^{-3}$	Actual capacity $C_a > C_3$
	2#	72	2.046	360	1.800	2467.3	$0.854 \times 10^{-3}$	
	3#	72	2.049	360	1.810	2541.1	$0.823 \times 10^{-3}$	
CNFJ-360 (C100)	1#	144	2.005	720	1.698	3905.8	$0.533 \times 10^{-3}$	Actual capacity $C_a > C_3$
	2#	144	2.011	720	1.688	3730.2	$0.561 \times 10^{-3}$	
	3#	144	2.009	720	1.695	3829.3	$0.545 \times 10^{-3}$	

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<b>Table 6.4</b>	<b>Protection against internal ignition from external spark sources</b>			<b>Verdict:</b>	<b>Pass</b>
Test method:	<ol style="list-style-type: none"> <li>1. The test shall be carried out at an ambient temperature between 15 °C and 30 °C.</li> <li>2. Fill the test fixture with water to a level 3 mm below the underside of the top. Place the hold-down frame over a 0,025 mm thickness of polyethylene film cut as shown in figure 1. Place the frame, with the film in place, over the four studs so that the film covers the open area between the fixture and the frame. Tighten the frame down finger tight with wing nuts to ensure a gas-tight seal around the gasket. Fit the vent system to be tested into the fixture.</li> <li>3. The whole system shall be checked for gas leakage at any place other than the vent opening, for example with a soap solution whilst charging the gas source battery.</li> <li>4. Within 1 h of charging the gas source battery commence the gassing test or otherwise commence the spark test.</li> <li>5. The valve assembly is deemed to have passed the test when no explosion or rapid combustion event occurred within the test fixture.</li> </ol>				
Test result:					
Sample NO.	1#	2#	3#	Remark	
The gas generated by 0.2I <sub>10</sub> current					
Spark1st	No fire; No explode; No other issues	No fire; No explode; No other issues	No fire; No explode; No other issues		
Spark2st	No fire; No explode; No other issues	No fire; No explode; No other issues	No fire; No explode; No other issues		

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Table 6.5	Protection against ground short propensity	Verdict:	Pass
Test method:	<p>Each battery has an actual capacity <math>C_a \geq 0,95C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The case to cover seal line of the unit shall be placed in contact with a metallic surface.</li> <li>2. The unit shall be placed horizontally and sequentially on all four possible faces according to the time schedule in 5 and 6, and float charged, with <math>U_{flo}</math> as specified by the manufacturer, at a room temperature between 20 °C and 25 °C.</li> <li>3. The units shall be connected, to a circuit which applies a d.c. voltage of at least 500 V <math>\pm</math> 5 V between one terminal and the metallic surface (aluminium foil strip) in contact with the seal line.</li> <li>4. The negative terminal of the d.c. voltage source shall be connected to the terminal of the unit(s) and the positive terminal to the aluminium foil strip.</li> <li>5. The unit shall be placed horizontally first on face 1 for 30 days or until either electrolyte leakage or significant ground short current flow (few mA of current) is detected.</li> <li>6. After 30 days of test, the unit shall be placed horizontally for 7 days on face 2, followed by 7 days on face 3 followed by 7 days on face 4 or until either electrolyte leakage or significant ground short current flow is detected.</li> <li>7. The presence or absence of ground short/leakage phenomena shall be reported.</li> </ol>		
Test result:			
Sample NO.	electrolyte leakage?	ground short?	Leakage current measured? Remark
4#	No	No	No

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Table 6.6	Content and durability of required markings	Verdict:	Pass
Test method:			
<p>The test shall be carried out on three of the required markings.            Test with water and aliphatic solvent.</p> <ol style="list-style-type: none"> <li>1. 1# label is rubbed for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit, dried in air and then inspected visually.                Test with neutralizing solutions</li> <li>2. 2# label is rubbed for 15 s with a piece of cloth soaked with a saturated solution of sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) or bicarbonate (NaHCO<sub>3</sub>) in water, dried in air and then inspected visually.                Test with electrolyte</li> <li>3. 3# label is rubbed for 15 s with a piece of cloth soaked with a solution of 40 % in weight of H<sub>2</sub>SO<sub>4</sub> in water, washed with water, dried in air and then inspected visually.</li> </ol>			
Test result:			
Sample NO.	Phenomena observed	Remark	
1#	No obvious change, the label is still visible clearly.		
2#	No obvious change, the label is still visible clearly.		
3#	No obvious change, the label is still visible clearly.		

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Table 6.7	Material identification	Verdict:	Pass
Test method:			
Battery cover or case. 1. The specified information for material identification shall be selected from the list of abbreviation published in ISO 1043-1. 2. The cover and case shall be visually inspected for a marking showing an ISO 1043-1 defined abbreviation of the name of the polymer(s) forming the bulk of the case and/or cover. 3. The stability of the marking shall be tested, if needed, with the test outlined in 6.6.			
Test result:			
Sample NO.	Abbreviation of the name of the polymer(s)	Remark	
Battery cover(8#,9#)	FF FR		
Battery case(8#,9#)	FF FR		

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<b>Table 6.8</b>	<b>Valve operation</b>	<b>Verdict:</b>	<b>Pass</b>
Test method:	<p>Each battery has an actual capacity <math>C_a \geq 0,95C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The units are fully charged and at a temperature between 25 °C.</li> <li>2. The units are overcharged with a constant voltage between 2.60 <math>V_{pc}</math> to 2.70 <math>V_{pc}</math> for at least 1 h.</li> <li>3. A gas collection cover shall be placed sequentially onto each valve opening in such a way that all gas released from that valve is captured.</li> <li>4. If the valve openings are hidden by, or integrated in a gas collection cover or manifold, gas flowing from the outlet of this cover or manifold shall be collected.</li> <li>5. A tubing shall carry the gas from this collection cover to the bubble detection device such as for example an U-shaped glass tubing of about 15 mm diameter and with the bottom of the U filled with water.</li> <li>6. The opening of each valve, at a test temperature of 25 °C shall be verified visually by detecting the released gas bubbling through the liquid at the bottom of the U shaped glass tubing.</li> </ol>		
Test result:			
Model name:	Sample No:	Gas release detected:	Remark
6-CNFJ-65	7#	Emitted gas observed	
	8#	Emitted gas observed	
	9#	Emitted gas observed	

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Table 6.9	Requirement for definition of the flammability rating of the materials	Verdict:	Pass				
Test method:							
1. The test shall be carried out with appropriately sized samples of the material used for the manufacture of the cell or monobloc battery case and, if different, also of the cell or monobloc battery cover. 2. The test shall be carried out by an appropriate test laboratory 3. The test method used shall be in accordance with IEC 60707 and IEC 60695-11-10 or equivalent test methods for all of the above. 4. The test result and the resulting flammability classification of the material shall appear on a dated and signed test certificate.							
Test result:							
Precondition temperature	Sample No:	t1 (s)	t2 (s)	t3 (s)	t2+t3 (s)	cotton ignited	Flammability rate level
25°C	A	18	25	0	25	yes	V-2
	B	15	20	0	20	yes	V-2
	C	17	25	0	25	yes	V-2
	D	19	20	0	20	yes	V-2
	E	13	25	0	25	yes	V-2
70°C	A	18	20	0	20	yes	V-2
	B	19	25	0	25	yes	V-2
	C	20	25	0	25	yes	V-2
	D	17	25	0	25	yes	V-2
	E	19	24	0	24	yes	V-2

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Table 6.10	Requirement for performance of the intercell connector	Verdict:	Pass				
Test method:							
1. The test shall be carried out with the cells and monobloc batteries destined for the test of 6.11 (discharge capacity at the $C_{0,25}$ or 0,25 h rate with a current $I_{0,25}$ to $U_{final}=1,60 V_{pc}$ ) or alternatively with the highest discharge current for a particular unit and intercell connector size as specified/allowed by the manufacturer in the relevant technical documentation of the product range The temperature of the units at the start of the test shall be between 20 °C and 25 °C. 2. The shape, size and construction details and the maximum temperature reached of the intercell connectors during this discharge test shall be reported.							
Test result:							
	Sample No.	26#	27#	28#	29#	30#	Remark
6-CNFJ-65	Initial temp. of samples (°C)	22.4	22.4	22.4	22.4	22.4	Discharge current: 100A; Discharge till 1.60Vpc;
	Highest temp. (°C)	52.210	55.078	60.642	47.083	54.71	
	Dimension of Connector	Length: 400mm; cross area: 10mm <sup>2</sup> ;					

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Table 6.11	Discharge capacity	Verdict:	Pass				
Test method:							
<p>Capacity C<sub>0,25</sub> (0,25 h rate)</p> <ol style="list-style-type: none"> <li>The discharge shall be started within 1 h to 24 h after fully charged.</li> <li>Discharged with a constant current I<sub>0,25</sub> to U<sub>final</sub> = 1.60 Vpc.</li> <li>Recorded discharge time and calculated capacity.</li> <li>Corrected the capacity to temperature of 25 °C. θ is the initial temperature,  <math>C_{a25\text{ }^{\circ}\text{C}} = C / [1 + \lambda (\theta - 25)]</math> in Ah, (λ = 0,01)</li> </ol> <p>Capacity C (1 h rate)</p> <ol style="list-style-type: none"> <li>The discharge shall be started within 1 h to 24 h after fully charged.</li> <li>Discharged with a constant current I<sub>1</sub> to U<sub>final</sub> = 1.60 Vpc.</li> <li>Recorded discharge time and calculated capacity.</li> <li>Corrected the capacity to temperature of 25 °C. θ is the initial temperature,  <math>C_{a25\text{ }^{\circ}\text{C}} = C / [1 + \lambda (\theta - 25)]</math> in Ah, (λ = 0,01)</li> </ol> <p>Capacity C<sub>3</sub> (3 h rate)</p> <ol style="list-style-type: none"> <li>The discharge shall be started within 1 h to 24 h after fully charged.</li> <li>Discharged with a constant current I<sub>3</sub> to U<sub>final</sub> = 1.70 Vpc .</li> <li>Recorded discharge time and calculated capacity.</li> <li>Corrected the capacity to temperature of 25 °C. θ is the initial temperature,  <math>C_{a25\text{ }^{\circ}\text{C}} = C / [1 + \lambda (\theta - 25)]</math> in Ah, (λ = 0,006)</li> </ol> <p>Capacity C<sub>8</sub> (8 h rate)</p> <ol style="list-style-type: none"> <li>The discharge shall be started within 1 h to 24 h after fully charged.</li> <li>Discharged with a constant current I<sub>8</sub> to U<sub>final</sub> = 1.75 Vpc .</li> <li>Recorded discharge time and calculated capacity.</li> <li>Corrected the capacity to temperature of 25 °C. θ is the initial temperature,  <math>C_{a25\text{ }^{\circ}\text{C}} = C / [1 + \lambda (\theta - 25)]</math> in Ah, (λ = 0,006)</li> </ol> <p>Capacity C<sub>10</sub> (10 h rate)</p> <ol style="list-style-type: none"> <li>The discharge shall be started within 1 h to 24 h after fully charged.</li> <li>Discharged with a constant current I<sub>10</sub> to U<sub>final</sub> = 1.80 Vpc.</li> <li>Recorded discharge time and calculated capacity.</li> <li>Corrected the capacity to temperature of 25 °C. θ is the initial temperature,  <math>C_{a25\text{ }^{\circ}\text{C}} = C / [1 + \lambda (\theta - 25)]</math> in Ah, (λ = 0,006)</li> </ol>							
Test result:							
Model name:	Sample No:	Capacity C <sub>10</sub> (Ah)	Capacity C <sub>8</sub> (Ah)	Capacity C <sub>3</sub> (Ah)	Capacity C <sub>1</sub> (Ah)	Capacity C <sub>0,25</sub> (Ah)	Remark
6-CNFJ-65	1#	67,74	/	/	/	/	I <sub>10</sub> = 6.5A C <sub>10</sub> = 65Ah
	2#	67.20	/	/	/	/	
	3#	65.51	/	/	/	/	
	5#	65.04	/	/	/	/	
	4#	66.80	/	/	/	/	
	6#	67.41	/	/	/	/	
	12#	/	/	61.89	/	/	I <sub>8</sub> = 7.7A C <sub>8</sub> = 61.6A h
	11#	/	/	62.42	/	/	
	10#	/	/	62.50	/	/	
	9#	/	/	62.94	/	/	
	8#	/	/	63.01	/	/	
	7#	/	/	62.85	/	/	/
	19#	/	/	/	51.75	/	/

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	18#			52.51			$C_3 = 48.75Ah$
	17#			52.57			
	16#			52.16			
	15#			53.97			
	14#			54.68			
	25#				42.07		$I_1 = 35.70A$ $C = 35.7Ah$
	24#				40.49		
	23#				40.20		
	22#				39.23		
	21#				40.07		
	20#				40.67		
	six cells in series					26.7	$I_{0.25} = 100.0A$ $C_{0.25} = 25Ah$

Note: The following parameters were provided by manufacturer.

Fully charging method: constant float charge current 10A, to  $U_{final} = 14.1V$ , maximum 12h.

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Table 6.12	Charge retention during storage	Verdict:	Pass				
Test method:	<p>Each battery has an actual capacity <math>C_a \geq C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The units shall be stored at an ambient temperature of <math>25\text{ }^\circ\text{C} \pm 5\text{ K}</math> and fully disconnected from any external circuit.</li> <li>2. After 180 days of storage the units shall be discharged without any prior recharge so that their actual capacity after storage <math>C_{ast}</math> (<math>3\text{ h} - U_{final} 1,70\text{ V}_{pc}</math> at the selected reference temperature) can be determined.</li> <li>3. The charge retention factor <math>C_{rf}</math> shall be expressed as percentage, and is equal to</li> </ol> $C_{rf} = (C_{ast} \times 100) / C_a \quad (\%)$ <ol style="list-style-type: none"> <li>4. The six individual values of <math>C_{rf}</math> shall be reported</li> </ol>						
Test result:							
Sample No.		1#	2#	3#	4#	5#	6#
6-CNFJ-65	Ca	51.66	54.68	53.97	52.39	54.51	53.88
	Cast	40.78	46.22	45.14	42.14	45.67	44.75
	Crf	78.94%	84.53%	83.64%	80.44%	83.78%	83.05%

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<b>Table 6.13</b>	<b>Float service with daily discharges</b>	<b>Verdict:</b>	<b>Pass and still testing</b>						
Test method:									
<p>Each battery has an actual capacity <math>C_a \geq 0,95C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. A discharge for 2 h with a current of <math>I = 2,0 I_{10}</math> maintained constant within <math>\pm 1 \%</math> where <math>I_{10} = [C_{10}] / [10]</math> in A and followed immediately by</li> <li>2. A charge for 22 h with a current limited to <math>I = 2,0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>3. The cells and monobloc batteries shall be operated at a temperature between 18 °C and 27 °C and the discharge–charge cycle routine a) and b) continued until, during a discharge of step a), a voltage of <math>U_{final} 1,80 Vpc \times n</math> cells per string is reached in a time shorter than 2 h.</li> <li>4. The unit or string voltages and number of cycles achieved with the discharge–charge cycle routine a) and b) shall be recorded.</li> <li>5. The units having reached the conditions outlined in c) shall then be subjected for 168 h <math>\pm 0,1</math> h to a charge with a current limited to <math>I = 2,0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>6. At the end of the 168 h <math>\pm 0,1</math> h of charge, the units shall be subjected to a capacity test with a constant current of <math>I = I_3</math> to <math>U_{final} 1,70 Vpc</math> and the capacity <math>C_{af}</math> corrected to 20 °C or 25 °C and recorded. This value <math>C_{af}</math> represents the residual capacity available when units, after numerous cycles, are then subjected to a prolonged period of charge with a charge voltage equivalent to the float voltage.</li> <li>7. At the conclusion of the capacity test outlined in f), the units shall be fully charged and then subjected to an equalization or boost charge according to the manufacturer’s specifications. At the conclusion of this equalization or boost charge treatment the units shall be subjected to a capacity test with a constant current of <math>I = I_3</math> to <math>U_{final} 1,70 Vpc</math> and the capacity <math>C_{ab}</math> corrected to 20 °C or 25 °C and recorded. This value <math>C_{ab}</math> represents the residual capacity available when the units, after numerous cycles and a prolonged charge with float voltage settings, are subjected to a manufacturer specific equalization or boost charge treatment.</li> <li>8. The test sequence 1) to 7) shall be repeated until, in the steps 6) and 7), the test units show a capacity <math>C_{af}</math> and <math>C_{ab}</math> lower than 80 % of <math>C_{rt}</math> (3 h rate to <math>U_{final} 1,70 Vpc</math> at the selected reference temperature).</li> </ol>									
Test result:	For 6-CNFJ-65								
Sample No.	Sequence 1) to 7) No.1			Sequence 1) to 7) No.2			Sequence 1) to 7) No.3		
	Value a) Number of 2 h cycles	Value b) Caf	Value c) Cab	Value a) Number of 2 h cycles	Value b) Caf	Value c) Cab	Value a) Number of 2 h cycles	Value b) Caf	Value c) Cab
1#	185	-	-	-	-	-	-	-	-
2#	185	-	-	-	-	-	-	-	-
3#	185	-	-	-	-	-	-	-	-
Sample No	Number of sequences 1) to 7)			Total number of cycles achieved					
1#	-			-					
2#	-			-					
3#	-			-					
<p>Note 1: The batteries are discharged for step 1 and step 2. The end voltage of final 2 h cycle discharging is 11.997V (1#), 12.005V (2#) and 12.038V (3#), more than end condition 10.8V.</p> <p>Note 2: Verdict is based on current test results.</p>									

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Table 6.13		Float service with daily discharges (continued)			Verdict:	Pass and stop testing			
Test method:		<p>Each battery has an actual capacity <math>C_a \geq 0,95C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. A discharge for 2 h with a current of <math>I = 2,0 I_{10}</math> maintained constant within <math>\pm 1 \%</math> where <math>I_{10} = [C_{10}] / [10]</math> in A and followed immediately by</li> <li>2. A charge for 22 h with a current limited to <math>I = 2,0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>3. The cells and monobloc batteries shall be operated at a temperature between 18 °C and 27 °C and the discharge–charge cycle routine a) and b) continued until, during a discharge of step a), a voltage of <math>U_{final} 1,80 V_{pc} \times n</math> cells per string is reached in a time shorter than 2 h.</li> <li>4. The unit or string voltages and number of cycles achieved with the discharge–charge cycle routine a) and b) shall be recorded.</li> <li>5. The units having reached the conditions outlined in c) shall then be subjected for 168 h <math>\pm 0,1</math> h to a charge with a current limited to <math>I = 2,0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>6. At the end of the 168 h <math>\pm 0,1</math> h of charge, the units shall be subjected to a capacity test with a constant current of <math>I = I_3</math> to <math>U_{final} 1,70 V_{pc}</math> and the capacity <math>C_{af}</math> corrected to 20 °C or 25 °C and recorded. This value <math>C_{af}</math> represents the residual capacity available when units, after numerous cycles, are then subjected to a prolonged period of charge with a charge voltage equivalent to the float voltage.</li> <li>7. At the conclusion of the capacity test outlined in f), the units shall be fully charged and then subjected to an equalization or boost charge according to the manufacturer’s specifications. At the conclusion of this equalization or boost charge treatment the units shall be subjected to a capacity test with a constant current of <math>I = I_3</math> to <math>U_{final} 1,70 V_{pc}</math> and the capacity <math>C_{ab}</math> corrected to 20 °C or 25 °C and recorded. This value <math>C_{ab}</math> represents the residual capacity available when the units, after numerous cycles and a prolonged charge with float voltage settings, are subjected to a manufacturer specific equalization or boost charge treatment.</li> <li>8. The test sequence 1) to 7) shall be repeated until, in the steps 6) and 7), the test units show a capacity <math>C_{af}</math> and <math>C_{ab}</math> lower than 80 % of <math>C_{rt}</math> (3 h rate to <math>U_{final} 1,70 V_{pc}</math> at the selected reference temperature).</li> </ol>							
Test result:	For 6-CNFT-170								
Sample No.	Sequence 1) to 7) No.1			Sequence 1) to 7) No.2			Sequence 1) to 7) No.3		
	Value a) Number of 2 h cycles	Value b) $C_{af}$	Value c) $C_{ab}$	Value a) Number of 2 h cycles	Value b) $C_{af}$	Value c) $C_{ab}$	Value a) Number of 2 h cycles	Value b) $C_{af}$	Value c) $C_{ab}$
1#	36	-	-	36	-	-	36	-	-
2#	36	-	-	36	-	-	36	-	-
3#	36	-	-	36	-	-	36	-	-
Sample No	Number of sequences 1) to 7)			Total number of cycles achieved					
1#	-			-					
2#	-			-					
3#	-			-					
<p>Note 1: The batteries are discharged for step 1 and step 2. The end voltage of final 2 h cycle discharging is 12.054V (1#), 12.059V (2#) and 12.063V (3#), more than end condition 10.8V.</p> <p>Note 2: Verdict is based on current test results.</p>									

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Table 6.14	Recharge behaviour	Verdict:	Pass				
Test method:							
<p>Each battery has an actual capacity <math>C_a \geq C_{10}</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. Three monobloc batteries in a single string.</li> <li>2. The string shall be discharged, with unit temperature 25 °C, and a constant current of <math>I = I_{10}</math> to a string voltage <math>U_{final} n \times 1.80 V_{pc}</math>. This capacity <math>C_a</math> value shall be corrected to 25 °C.</li> <li>3. After the discharge and a 1 h stand in the discharged state, the units shall be recharged, with unit temperature of 25 °C, with a current limited to <math>I = 2.0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for 25 °C.</li> <li>4. After 24 h of charge the units shall be immediately discharged again with a current of <math>I_{10}</math> to a string voltage <math>U_{final} n \times 1.80 V_{pc}</math>. This capacity value <math>C_{a24}</math> shall be corrected to 25 °C.</li> <li>5. The capacity found after 24 h of charge <math>C_{a24}</math> shall be expressed as percentage of the initial actual capacity (recharge behaviour factor <math>R_{bf}</math>) as follows:  <math display="block">R_{bf24h} = (C_{a24} \times 100) / C_a \%</math> </li> <li>6. The units shall be fully recharged and then again discharged, with unit temperature of 25 °C and a constant current of <math>I = I_{10}</math> to a string voltage of <math>n \times 1.80 V_{pc}</math>. This capacity <math>C_a</math> value shall be corrected to 25 °C.</li> <li>7. After the discharge and a 1 h stand in the discharged state, the units shall be recharged with a current limited to <math>I = 2.0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for 25 °C.</li> <li>8. After 168 h of charge the units shall be discharged again with a current of <math>I_{10}</math> to a string voltage of <math>U_{final} n \times 1.80 V_{pc}</math>. This capacity value <math>C_{a168}</math> shall be corrected to 25 °C.</li> <li>9. The capacity found after 168 h <math>C_{a168}</math> shall be expressed as percentage of the initial actual capacity charge (recharge behaviour factor <math>R_{bf}</math>) as follows:  <math display="block">R_{bf168h} = (C_{a168} \times 100) / C_a \%</math> </li> </ol>							
Test result:							
Model name:	Sample No:	$C_{a24}$ (Ah)	$C_a$ (Ah)	$R_{bf24h}$ (%)	$C_{a168}$ (Ah)	$C_a$ (Ah)	$R_{bf168h}$ (%)
6-CNFJ-65	1#	64.9	64.8	100.2	66.5	66.3	100.3
	2#						
	3#						

Note: The following parameters were provided by manufacturer.

Fully charging method: constant float charge current 10A, to  $U_{final}=14.4V$ , maximum 12h.

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<b>Table 6.15</b>	<b>Service life at an operating temperature of 40 °C</b>	<b>Verdict:</b>	<b>Pass and stop testing</b>
Test method:			
<p>Each battery has an actual capacity <math>C_a \geq 0,95C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The units shall be float charged at 40 °C with the manufacturer's recommended float voltage for 25 °C.</li> <li>2. Every 118 days <math>\pm</math> 3 days the units shall, after cooling down to room temperature under float charge voltage setting, be subjected within 24 h <math>\pm</math> 12 h to a determination of their individual actual capacity <math>C_a</math> (<math>C_3</math>).</li> <li>3. No charge with voltages beyond the float charge voltage is admissible before or after such a capacity determination. After capacity determination, the units are returned to float charge in the hot air enclosure as in 6.15.6 for another 118 days at 40 °C. The test of a unit is terminated when the individual actual capacity of that unit is less than 0,8 <math>C_{rt}</math>. The remaining units continue to be tested until the actual capacity of each unit is less than 0,8 <math>C_{rt}</math>.</li> <li>4. The individual capacity values <math>C_a</math> shall be plotted in a graph as function of days elapsed at 40 °C <math>\pm</math> 2 K.</li> <li>5. For each of the three cells or monobloc batteries, the intersection of the regression line, connecting the individual <math>C_a</math> data points, with a horizontal line representing a capacity level of 0,8 <math>C_{rt}</math> (<math>C_3</math>) shall be determined in terms of elapsed days at 40 °C and reported as the three individual values of days elapsed.</li> </ol>			
Test result:			
Model name:	Sample No:	Ca after each 118 days cycle	Number for 118 days cycles
6-CNFJ-65	1#	49.62 > 39 (1 <sup>st</sup> cycle)	1
	2#	51.80 > 39 (1 <sup>st</sup> cycle)	1
	3#	50.71 > 39 (1 <sup>st</sup> cycle)	1
6-CNFT-170	1#	115.49 > 102 (1 <sup>st</sup> cycle)	1
	2#	123.84 > 102 (1 <sup>st</sup> cycle)	1
	3#	122.23 > 102 (1 <sup>st</sup> cycle)	1
<p>Note 1: <math>0.8C_3 = 0.8 \cdot 48.75 \text{ Ah} = 39 \text{ Ah}</math> (6-CNFJ-65); <math>0.8C_3 = 0.8 \cdot 127.5 \text{ Ah} = 102 \text{ Ah}</math> (6-CNFT-170)</p> <p>Note 2: Verdict is based on current test results. One 118 days cycle conducted.</p>			

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<b>Table 6.16</b>	<b>Impact of a stress temperature of 55 °C or 60 °C</b>	<b>Verdict:</b>	<b>Pass (1 cycle for 6-CNFJ-65 and 2 cycles for 6-CNFT-170)</b>
Test method:			
<p>Each battery has an actual capacity <math>C_a \geq 0,95C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The units shall be float charged at 55 °C or 60 °C with the manufacturer's recommended float voltage for 25 °C.</li> <li>2. When tested at 55 °C, the units shall be cooled down, every 42 days <math>\pm</math> 3 days, to room temperature under float charge setting and subjected, within 24h <math>\pm</math> 12h, to a determination of their individual actual capacity <math>C_a</math> (at the 3 h rate to <math>U_{final}</math> 1,70 Vpc and/or at the 0,25 h rate to <math>U_{final}</math> 1,60 Vpc at the selected reference temperature). When tested at 60 °C, the units shall be cooled down, every 30 days <math>\pm</math> 3 days, to room temperature under float charge and subjected, within 24 h <math>\pm</math> 12 h, to a determination of their individual actual capacity <math>C_a</math> (at the 3 h rate to <math>U_{final}</math> 1,70 Vpc and/or at the 0,25 h rate to <math>U_{final}</math> 1,60 Vpc at the selected reference temperature).</li> <li>3. After capacity determinations, the units are returned to float charge in the hot air enclosure as in 6.16.6 for another 42 days at 55 °C (or 30 days at 60 °C). The test is terminated for a unit when the individual actual capacity of that unit is less than 0,8Crt. At the 3 h and/or the 0,25 h rate The remaining units continue to be tested until the actual capacity of each unit is less than 0,8Crt.</li> </ol>			
Test result:			
Model name:	Sample No:	Ca after each 42 days cycle (55 °C impact)	Number for 42 days cycles
6-CNFJ-65	1#		
	2#		
	3#		
Model name:	Sample No:	Ca after each 30 days cycle (60 °C impact)	Number for 30 days cycles
6-CNFJ-65	1#	41.3 > 39 (1 <sup>st</sup> cycle); 31.0 < 39 (2 <sup>nd</sup> cycle)	1
	2#	41.4 > 39 (1 <sup>st</sup> cycle); 34.2 < 39 (2 <sup>nd</sup> cycle)	1
	3#	45.4 > 39 (1 <sup>st</sup> cycle); 34.6 < 39 (2 <sup>nd</sup> cycle)	1
Model name:	Sample No:	Ca after each 42 days cycle (55 °C impact)	Number for 42 days cycles
6-CNFT-170	1#		
	2#		
	3#		
Model name:	Sample No:	Ca after each 30 days cycle (60 °C impact)	Number for 30 days cycles
6-CNFT-170	1#	83.5 > 47.6 (1 <sup>st</sup> cycle); 56.5 > 47.6 (2 <sup>nd</sup> cycle); 32.4 < 47.6 (3 <sup>rd</sup> cycle)	2
	2#	85.8 > 47.6 (1 <sup>st</sup> cycle); 58.6 > 47.6 (2 <sup>nd</sup> cycle); 36.6 < 47.6 (3 <sup>rd</sup> cycle)	2
	3#	86.2 > 47.6 (1 <sup>st</sup> cycle); 58.6 > 47.6 (2 <sup>nd</sup> cycle); 38.9 < 47.6 (3 <sup>rd</sup> cycle)	2
<p>Note 1: passed current cycle and more cycles on running.          Note 2: 6-CNFJ-65 tested according 3 h discharging rate (<math>C_3=48.75Ah</math>); 6-CNFT-170 tested according 0.25 h discharging rate (<math>C_{0,25}=59.5Ah</math>). 80%Crt limits of above capacity considered as end condition.          Note 3: Verdict is based on current test results.</p>			

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Table 6.17	Abusive over-discharge	Verdict:	Pass	
Test method:				
<p>Each battery has an actual capacity <math>C_a \geq C_3</math> and was fully charged.            One of the 4 units shall be discharged, at a unit temperature of 18 °C to 27 °C, with a current of I10 for 3 h and then connected to the remaining 3 fully charged units in series and with the intercell connectors giving, between each units, an air gap of 10 mm or as specified in the appropriate technical documentation of the product range.</p> <p><b>unbalanced string over-discharge test (four fully charged batteries string)</b></p> <ol style="list-style-type: none"> <li>1. This four unit string shall then be discharged, with all unit temperatures between 18 °C to 27 °C, with a current <math>I = I_{10}</math> (<math>U_{final} 1,80 V_{pc}</math>) until the voltage of the three, initially fully charged units reach a total voltage of <math>U_{final}</math> of <math>3 \times n \times 1,70 V_{pc}</math> where n is the number of cells in this substring.</li> <li>2. After the discharge and a <math>24 h \pm 0,1 h</math> stand in the discharged state, the four unit string shall be recharged in series for <math>168 h \pm 0,1 h</math> with a current limited to <math>I = 2,0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>3. At the end of the <math>168 h \pm 0,1 h</math> of charge, the units shall be subjected, as a four unit string, to a capacity test with a constant current of <math>I = I_3</math> to a <math>U_{final}</math> of <math>4 \times n \times 1,70 V_{pc}</math> and the capacity <math>C_a</math> corrected to 20 °C or 25 °C.</li> <li>4. The capacity <math>C_a</math> of the string shall be referenced to the rated capacity <math>C_{rt}</math> (<math>3 h - U_{final} 1,70 V_{pc}</math> at the selected reference temperature) as shown below and gives the unbalanced over-discharge <math>C_{aod}</math> capacity ratio. This value shall be reported.  <math>C_{aod} = C_a / C_{rt}</math></li> </ol> <p><b>cyclic over-discharge test (three fully charged batteries string)</b></p> <ol style="list-style-type: none"> <li>1. The units shall be discharged individually or as a string, with all unit temperatures between 18 °C to 27 °C and with a constant current of <math>I = I_{10}</math> to a voltage <math>U_{final}</math> of <math>n \times 1,25 V_{pc}</math> where n is the number of cells per unit or string.</li> <li>2. After the discharge and a <math>1 h \pm 0,1 h</math> stand in the discharged state, the units shall be recharged for <math>168 h \pm 0,1 h</math> with a current limited to <math>I = 2,0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>3. The sequence outlined above shall be repeated 5 times.</li> <li>4. At the end of the fifth <math>168 h \pm 0,1 h</math> of charge, the units or the string shall be</li> <li>5. subjected to a capacity test with a constant current of <math>I = I_3</math> to <math>U_{final}</math> of <math>n \times 1,70 V_{pc}</math> and the capacity <math>C_a</math> corrected to 20 °C or 25 °C.</li> <li>6. The capacity <math>C_a</math> of each unit or of the string shall be referenced to the rated capacity <math>C_{rt}</math> (<math>3 h - U_{final} 1,70 V_{pc}</math> at the selected reference temperature) as shown below and gives the cyclic over-discharge <math>C_{aoc}</math> capacity ratio. This value(s) shall be reported  <math>C_{aoc} = C_a / C_{rt}</math></li> </ol>				
Test result:				
Model name:	Sample No:	Ca (Ah)	Crt (Ah)	$C_{aod}$ (%)
6-CNFJ-65	four fully charged batteries string (16#/17#/18#/19#)	50.9	48.75	1.04
	Sample No:			$C_{aoc}$
	three fully charged batteries string (10#/11#/12#)	63.7 / 63.3 / 64.0	60	1.06 / 1.06 / 1.07

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<b>Table 6.18</b>	<b>Thermal runaway sensitivity</b>	<b>Verdict:</b>	<b>Pass</b>
Test method:			
<p>Each battery has an actual capacity <math>C_a \geq C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The units shall be assembled with the intercell connectors.</li> <li>2. The ambient temperature shall be between 20 °C to 25 °C during the test and any natural airflow across the units shall be slower than 0,5 m.s<sup>-1</sup>.</li> <li>3. Temperature probes, with a resolution of 1 K and allowing a continuous registration of the temperature (interval between temperature measurements <math>\leq 0,25</math> h), shall be installed as Figures 7 and 8</li> <li>4. The string shall be charged with a source of d.c. current and with a voltage as specified below. The current flowing through the string shall be monitored with an appropriate resolution and at an interval, between measurements, of <math>\leq 0,25</math> h.</li> <li>5. The constant charge voltage, measured at the terminals of the string, shall be set to <math>n \times 2,45 V_{pc} \pm 0,01 V_{pc}</math> throughout the test, where n is the number of cells in the string.</li> <li>6. The elapsed time of charge to a unit temperature of 60 °C <math>\pm 1</math> K, measured with the probe a) at the surface or the temperature reached after 168 h continuous charge, shall be recorded and the test stopped whichever comes first.</li> <li>7. The string shall then be cooled down to room temperature in open circuit condition</li> <li>8. The previously utilized string shall be charged with a source of d.c. current and with a voltage as specified below. The current flowing through the string shall be monitored with an appropriate resolution at an interval between measurements of <math>\leq 0,25</math> h.</li> <li>9. The constant charge voltage, measured at the terminals of the string, shall be set to <math>n \times 2,60 V_{pc} \pm 0,01 V_{pc}</math> throughout the test, where n is the number of cells in the string.</li> <li>10. The elapsed time of charge to a temperature of unit 60 °C <math>\pm 1</math> K, measured with the probe a) at the surface or the temperature reached after 168 h continuous charge, shall be recorded and the test stopped whichever comes first.</li> </ol>			
Test result:			
Model name:	Sample No:	Duration of charge until a unit temperature of 60 °C $\pm 1$ K (probe a) is reached or the effective temperature (probe a) after 168 h of charge with 2,45 Vpc	Duration of charge until a unit temperature of 60 °C $\pm 1$ K (probe a) is reached or the effective temperature (probe a) after 168 h of charge with 2,60 Vpc
6-CNFJ-65	Six batteries string (26#~31#)	24.6°C	27.3°C

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Table 6.19	Low temperature sensitivity	Verdict:	Pass		
Test method:					
<p>Each battery has an actual capacity <math>C_a \geq C_3</math> and was fully charged.</p> <ol style="list-style-type: none"> <li>1. The units shall be individually discharged with a current of <math>I = I_{10}</math> to an <math>U_{final}</math> of <math>n \times 1,80 V_{pc}</math> at a unit temperature between 18 °C and 27 °C.</li> <li>2. The discharged units shall then be placed in a test chamber with a forced flow of air having a temperature of <math>-18 \text{ °C} \pm 2 \text{ K}</math>.</li> <li>3. After <math>72 \text{ h} \pm 1 \text{ h}</math> of residence in the test chamber the units shall be withdrawn from the test chamber and, after <math>24 \text{ h} \pm 1 \text{ h}</math> of stand at open circuit, charged in a room with an ambient temperature between +18 to +27 °C for <math>168 \text{ h} \pm 0.1 \text{ h}</math> with a current limited to <math>I = 2.0 I_{10}</math> and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.</li> <li>4. The units shall then be individually discharged with a current of <math>I = I_3</math> to an <math>U_{final}</math> of <math>n \times 1.70 V_{pc}</math> and the actual capacity <math>C_a</math> corrected to 20 °C or 25 °C shall be recorded.</li> <li>5. The capacity <math>C_a</math> of each unit shall be referenced to the rated capacity <math>C_{rt}</math>. (<math>3 \text{ h} - U_{final} 1.70 \text{ Vpc}</math> at the selected reference temperature) as shown below and gives the <math>C_{als}</math> capacity ratio.  <math display="block">C_{als} = C_a / C_{rt}</math> </li> <li>6. These units shall be individually discharged in this second test, before low temperature exposure, with a current of <math>I = I_3</math> to an <math>U_{final}</math> of <math>n \times 1.70 V_{pc}</math> at a unit temperature between 18 °C and 27 °C.</li> </ol>					
Test result:					
Sample No.		20#	21#	22#	Remark
6-CNFJ-65	Ca (Ah)	58.249	58.671	58.118	Ca>Crt
	Ca 25°C (Ah)	58.96	59.38	58.82	Ca>Crt
Cals (%)		121	122	121	>80%
Battery status		No rupture; No bulge			

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<b>Table 6.20</b>	<b>Dimensional stability at elevated internal pressures and temperatures</b>	<b>Verdict:</b>	<b>Pass</b>	
Test method:				
<ol style="list-style-type: none"> <li>1. The test unit, inclusive eventual standard structural stabilizing features, shall be adapted with a pressure regulator to maintain a pressure in all interior cavities of the test unit equal to the maximum valve opening pressure present in units and as specified by the manufacturer. This value shall be measured and reported. This specified pressure shall be maintained throughout the test.</li> <li>2. The maximum outside dimension (width and length) of the cell case shall be measured before pressurization and recorded.</li> <li>3. The pressurized unit shall be placed into a chamber with recirculating air at a temperature of 50 °C ± 2 K.</li> <li>4. After 24 h ± 0,1 h of residence in the test chamber and under pressure, the maximum outside dimension (width and length) of the cell case shall be measured and recorded at a temperature as close as possible to 50 °C ± 2 K.</li> <li>5. The increase in the cell case dimensions after 24 h ± 0,1 h at 50 °C ± 2 K shall be reported both as percentage deviation from the value before the test and as measured change in mm.</li> </ol>				
Test result:				
Sample No.	Inner gas pressure/kPa	Temperature in Chamber/°C	Remark	
1#	Gas pressure shall be same with maximum valve open pressure provided by manufacturer. Stay in high temperature chamber for 24h±0.1h, record.	20-35kPa	Keep pressure during staying in high temperature chamber, record every 4hours.	
2#		50.0		
3#		50.0		
	20-35kPa	50.1		
	Max Length	Max Width		
6-CNFJ-65	Battery dimension before pressuring /mm	348	165	Measure before pressuring
	Battery dimension after pressuring for 24h /mm	348	165	Measure under 50°C ±2°C condition
	Dimension change value/mm	0	0	
	Dimension change rate/ %	0	0	

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Table 6.21	Stability against mechanical abuse of units during installation			Verdict:	Pass
Test method:					
<p>1. The units shall be dropped according to the height prescriptions of IEC 60068-2-32 and amendment. Two "Free Fall", for resistance against leakages caused by two drops each onto a smooth, level concrete floor from drop heights as specified below:</p> <p style="margin-left: 20px;">a) Fall from 100 mm for units weighing up to 50 kg</p> <p style="margin-left: 20px;">b) Fall from 50 mm for units weighing between 50 kg and 100 kg</p> <p>2. The drop test conditions shall assure, with test arrangements as shown in Figures 9, 10 and 11 below, reproducible impact points for the shortest edge drop impact and the corner impact. The two impacts, per impact type, shall be on the same corner and on the same shortest edge.</p> <p>3. For the corner and edge drops, the unit shall be oriented in such a fashion that a straight line drawn through the struck corner/edge and the unit geometric centre is approximately perpendicular to the impact surface.</p> <p>4. Each of the units shall be inspected, after the two consecutive drops, for gas and liquid leaks with adequate and sensitive means such as a high voltage (2 kV to 5 kV) dielectric breakdown test, helium leak detectors, hydrogen detectors, pH indicator paper and the like and the findings documented and reported.</p>					
Test result:					
Sample No.					
5#	Shortest edge drops	Whether there is container broken or leakage trend	First time	No broken or leakage trend	Free drop from 50mm height
6#			Second time	No broken or leakage trend	
5#	Corner drops		First time	No broken or leakage trend	
6#			Second time	No broken or leakage trend	

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Photos:

Model 6-CNFJ-65



Model 6-CNFJ-65



IEC 60896-21:2004, IEC 60896-22:2004

Photos:

Model 6-HCNFJ-7.2



Model 6-HCNFJ-7.2



IEC 60896-21:2004, IEC 60896-22:2004

Photos:

Model 6-CNFJ-40



Model 6-CNFJ-40



IEC 60896-21:2004, IEC 60896-22:2004

Photos:

Model 6-CNFT-55



Model 6-CNFT-55



IEC 60896-21:2004, IEC 60896-22:2004

Photos:

Model 6-CNFT-170



Model 6-CNFT-170



IEC 60896-21:2004, IEC 60896-22:2004

**Photos:**

Model CNFJ-200



Model CNFJ-200



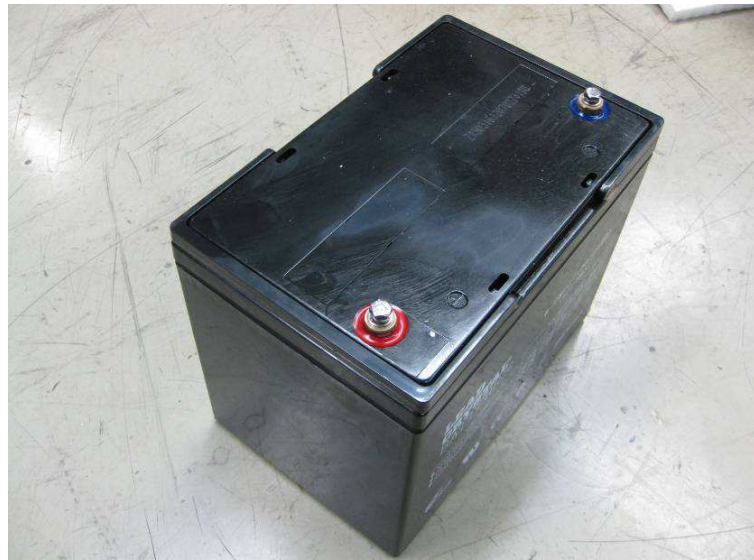
IEC 60896-21:2004, IEC 60896-22:2004

Photos:

6-CNFJ-100 (C100)



6-CNFJ-100 (C100)



IEC 60896-21:2004, IEC 60896-22:2004

Photos:

CNFJ-180 (C100)



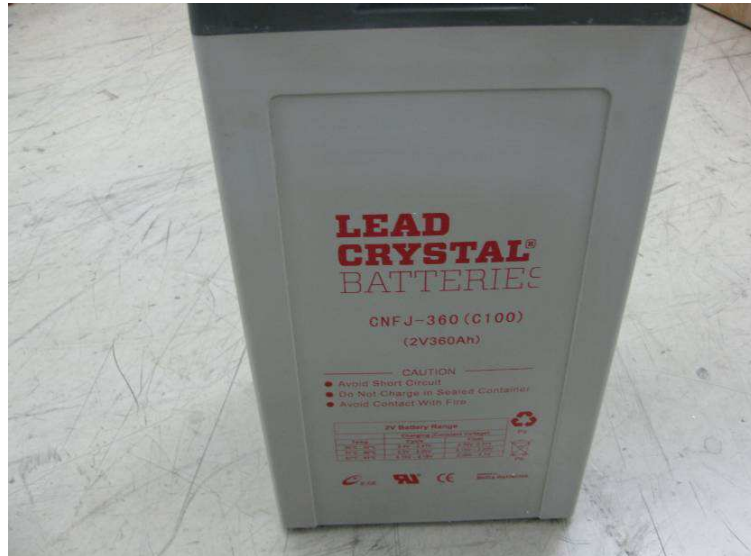
CNFJ-180 (C100)



IEC 60896-21:2004, IEC 60896-22:2004

**Photos:**

CNFJ-360 (C100)



CNFJ-360 (C100)

