Test Report issued under the responsibility of:

# TEST REPORT
# IEC/EN 60896
# Stationary lead-acid batteries —
# Part 21: Valve regulated types — Methods of test
# Part 22: Valve regulated types — Requirements

| | |
|---|---|
| **Report Reference No**.....: | 130800630SHA-001 |
| Date of issue .....: | 2013-10-31 |
| Total number of pages ..... | 58 |
| **Testing Laboratory**.....: | Intertek Testing Services Shanghai |
| Address .....: | Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, China |
| **Applicant's name**.....: | Shanghai C&D Battery Co., Ltd. |
| Address .....: | No.55 LianDu Road, Fengxian, Shanghai 201419, P. R. China |
| **Test specification:** | |
| Standard.....: | IEC/EN 60896-21:2004, IEC/EN 60896-22:2004 |
| Test procedure .....: | SONCVG.2137 |
| Non-standard test method……..: | N/A |
| **Test Report Form No**.....: | TTRF_EN60896_A |
| Test Report Form(s) Originator .....: | Intertek ETL SEMKO shanghai |
| Master TRF .....: | Dated 2010-11 |

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| | |
|---|---|
| **Test item description .....:** | Lead acid battery |
| Trade Mark .....: | |
| Manufacturer .....: | Shanghai C&D Battery Co., Ltd. |
| Model/Type reference .....: | TEL Series, LBT/MPS Series, DNT/MRX Series (See page 4 and 5 for detailed model names) |
| Ratings .....: | 12V, 7Ah~254Ah (C20) |

| Testing procedure and testing location: | | |
|---|---|---|
| ☒ **Testing Laboratory:** | Intertek Testing Services Shanghai | |
| Testing location/ address.....: | Building No.86, 1198 Qinzhou Road (North), Shanghai 200233, China | |
| Tested by (name + signature) .....: | Will Wang | Will Wang |
| Approved by (+ signature).....: | Robin Xu | Robin Xu |
| ☐ Testing procedure: TMP | | |
| Tested by (name + signature) .....: | | |
| Approved by (+ signature).....: | | |
| Testing location/ address.....: | | |
| ☐ Testing procedure: WMT | | |
| Tested by (name + signature) .....: | | |
| Witnessed by (+ signature).....: | | |
| Approved by (+ signature).....: | | |
| Testing location/ address.....: | | |
| ☐ Testing procedure: SMT | | |
| Tested by (name + signature) .....: | | |
| Approved by (+ signature).....: | | |
| Supervised by (+ signature) .....: | | |
| Testing location/ address.....: | | |
| ☐ Testing procedure: RMT | | |
| Tested by (name + signature) .....: | | |
| Approved by (+ signature).....: | | |
| Supervised by (+ signature) .....: | | |
| Testing location/ address.....: | | |

**Copy of marking plate**

C&D TECHNOLOGIES, INC.®
C&D 12-100 LBT
ISO9001
ISO14001
VRLA 12Volts 100Ah
(20hour rate to 1.75VPC@25℃)
IEC Rating:86Ah
(10hour rate to 1.80VPC@20℃)
Float Charge Voltage:
13.5 to 13.8VDC@25℃
Terminal Hardware Torque:
65in.-lbs.(7.4N-m)
Pb
www.cdtechno.com
www.cdtechno.com.cn
400-678-3721 Made in China
LEAD
RETURN
RECYCLE

TEL12-150TFA
QUALITY MANAGEMENT SYSTEM
CERTIFIED BY CQC
ISO 9001\TL 9000
ISO 14001
C&D TRUE FRONT ACCESS®
C&D® TECHNOLOGIES
TEL
TEL12-150TFA
12 Volts 150 Ah
10 hour rate to 1.80VPC
@77°F(25°C)
IEC Rating: 147 Ah
10 hour rate to 1.80VPC
@68°F(20°C)
Terminal Hardware Torque:
160 in. - lbs. (18.0 N-m)
Midtronics
1120 Mhos
Float Charge Voltage
13.5 to 13.8 VDC
@77°F(25°C)
NON-SPILLABLE VRLA
C&D OHMIC RING®
Pb
LEAD
RETURN
RECYCLE
PROPOSITION 65
WARNING
Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.
VENTILATE WELL WHEN IN AN ENCLOSED SPACE AND WHEN CHARGING.
SEE INSTALLATION, MAINTENANCE AND OPERATION INSTRUCTIONS FOR IMPORTANT SAFETY PRECAUTIONS.
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SPH00334

TEL12-170FG
QUALITY MANAGEMENT SYSTEM
CERTIFIED BY CQC
ISO 9001\TL 9000
ISO 14001
Pb
LEAD RETURN RECYCLE
PROPOSITION 65
WARNING
Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.
C&D TRUE FRONT ACCESS®
C&D® TECHNOLOGIES
TEL
TEL12-170FG
Nominal 8 Hr Rate
12 Volts 169 Ah
1.75 VPC@77°F(25°C)
IEC Rating: 169 Ah
10 hour rate to 1.80VPC
@68°F(20°C)
Terminal Hardware Torque:
160 in. - lbs. (18.0 N-m)
Float Charge Voltage
13.5 to 13.8 VDC
@77°F(25°C)
Midtronics
1400 Mhos
NON-SPILLABLE VRLA
C&D OHMIC RING®
VENTILATE WELL WHEN IN AN ENCLOSED SPACE AND WHEN CHARGING.
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SPH00065

TEL12-210FGC
QUALITY MANAGEMENT SYSTEM
CERTIFIED BY CQC
ISO 9001\TL 9000
ISO 14001
PROPOSITION 65
WARNING
Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.
C&D TRUE
FRONT ACCESS®
WITH DCS TECHNOLOGY
C&D TECHNOLOGIES, INC.®
TEL-C
TEL12-210FGC
Nominal 8 Hr Rate
12 Volts 176 Ah
1.75 VPC@77°F(25°C)
IEC Rating: 176 Ah
10 hour rate to 1.80VPC
@68°F(20°C)
Terminal Hardware Torque:
160 in. - lbs. (18 N-m)
Cycle Charge Voltage
14.4 to 14.8 VDC
@77°F(25°C)
Midtronics
1500 Mhos
Float Charge Voltage
13.5 to 13.8 VDC
@77°F(25°C)
NON-SPILLABLE VRLA
C&D OHMIC RING®
VENTILATE WELL WHEN IN AN ENCLOSED SPACE AND WHEN CHARGING.
SEE INSTALLATION, MAINTENANCE AND OPERATION INSTRUCTIONS FOR IMPORTANT SAFETY PRECAUTIONS.
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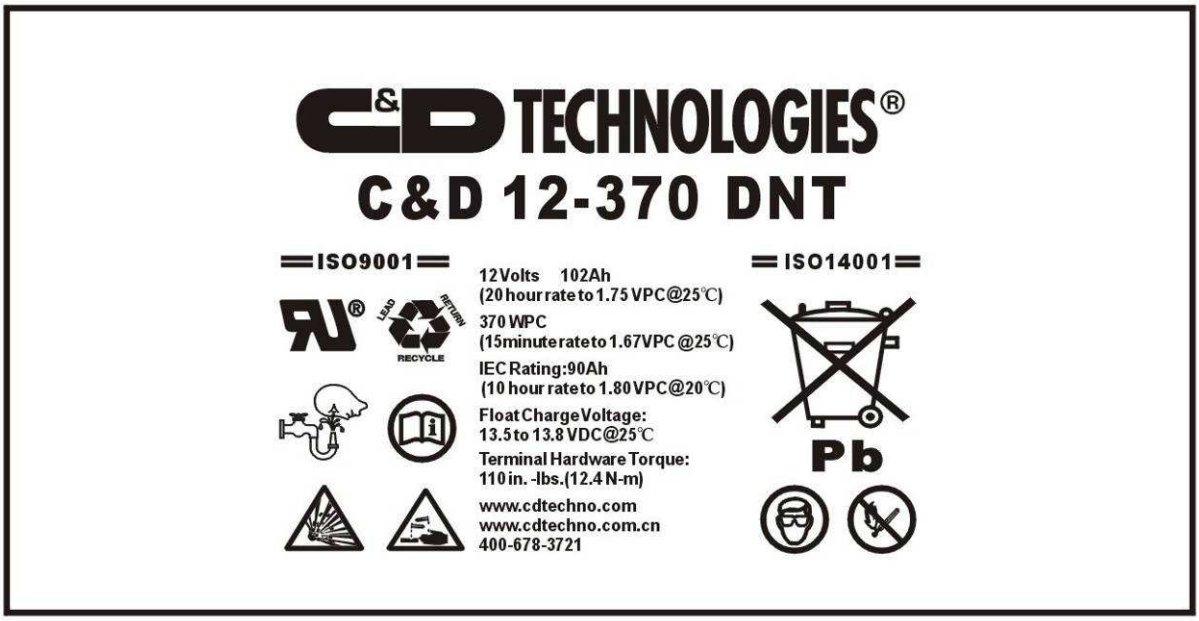


Note1: The first two digital in production code stand for production year, the third digital stands for production month which is from letter A (January) to M (December) and the forth and fifth digital stand for production day.

Note2: The labels listed in above are for example, other models have similar label but with different capacity and model name.

Model list:

**TEL Series**

| Model | AH, C8, 1.75V@ 25°C |
|---|---|
| TEL 12-105FNSG | 100 |
| TEL 12-115FNG | 104 |
| TEL 12-155FG | 148 |
| TEL 12-170FG | 162 |
| TEL 12-190FG | 183 |
| TEL 12-210FG | 195 |
| TEL 12-100 TFA | 100 |
| TEL 12-105 TFA | 104 |
| TEL 12-150 TFA | 148 |
| TEL 12-165 TFA | 162 |
| TEL 12-185 TFA | 183 |
| TEL 12- 200 TFA | 195 |
| TEL 12-105 FNSGC | 88 |
| TEL 12-115 FNGC | 91 |
| TEL 12-170 FGC | 139 |
| TEL 12-210 FGC | 169 |

**LBT/MPS Series**

| Model 1 | Model 2 | AH, C20, 1.75V@ 25°C |
|---|---|---|
| C&D 12-7A LBT | MPS 12-7A | 7 |
| C&D 12-9A LBT | MPS 12-9A | 9 |
| C&D 12-12A LBT | MPS 12-12A | 12 |
| C&D 12-18A LBT | MPS 12-18A | 18 |
| C&D 12-26A LBT | MPS 12-26A | 26 |
| C&D 12-40N LBT | MPS 12-40N | 40 |
| C&D 12-54 LBT | MPS 12-54 | 54 |
| C&D 12-65N LBT | MPS 12-65N | 65 |
| C&D 12-76 LBT | MPS 12-76 | 76 |
| C&D 12-88 LBT | MPS 12-88 | 88 |
| C&D 12-100 LBT | MPS 12-100 | 100 |
| C&D 12-114 LBT | MPS 12-114 | 114 |
| C&D 12-127A LBT | MPS 12-127A | 127 |
| C&D 12-158A LBT | MPS 12-158A | 158 |
| C&D 12-211A LBT | MPS 12-211A | 211 |
| C&D 12-242A LBT | MPS 12-242A | 242 |

**DNT/MRX Series**

| Model 1 | Model 2 | AH, C20, 1.75V@ 25℃ |
|---|---|---|
| C&D 12-25A DNT | | 7 |

| | | |
|---|---|---|
| C&D 12-65A DNT | | 18 |
| C&D 12-100 DNT | UPS 12-100 MRX | 34 |
| C&D 12-130 DNT | UPS 12-130 MRX | 36 |
| C&D 12-150 DNT | UPS 12-150 MRX | 36 |
| C&D 12-200 DNT | UPS 12-200 MRX | 56 |
| C&D 12-220 DNT | UPS 12-220 MRX | 56 |
| C&D 12-280 DNT | UPS 12-280 MRX | 84 |
| C&D 12-320 DNT | UPS 12-320 MRX | 84 |
| C&D 12-370 DNT | UPS 12-370 MRX | 102 |
| C&D 12-400 DNT | UPS 12-400 MRX | 110 |
| C&D 12-440 DNT | UPS 12-440 MRX | 120 |
| C&D 12-475 DNT | UPS 12-475 MRX | 114 |
| C&D 12-490 DNT | UPS 12-490 MRX | 150 |
| C&D 12-520 DNT | UPS 12-520 MRX | 154 |
| C&D 12-550 DNT | UPS 12-550 MRX | 154 |
| C&D 12-600 DNT | UPS 12-600 MRX | 148 |
| C&D 12-630 DNT | UPS 12-630 MRX | 140 |
| C&D 12-675A DNT | | 236 |
| C&D 12-775A DNT | | 248 |
| | UPS 12-410 MRXF | 109 |
| | UPS 12-615 MRXF | 172 |
| | UPS 12-700 MRXF | 201 |
| | UPS 12-1000 MRXF | 254 |

**Possible test case verdicts:**

- test case does not apply to the test object.....: N/A
- test object does meet the requirement.....: P (Pass)
- test object does not meet the requirement.....: F (Fail)

**Testing** .....:

Date of receipt of test item .....: 2013-08-09

Date (s) of performance of tests .....: 2013-08-16 to 2013-10-28

**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.

Throughout this report, model C&D 12-7A LBT, C&D 12-100 LBT, TEL 12-150 TFA, TEL 12-170 FGC, TEL 12-210 FGC, C&D 12-242A LBT and C&D 12-370 DNT are tested as typical models according the construction and component of batteries.

The tests covered by this report were performed according Nigeria safety standard SONCVG.2137. Only the clauses specified in this standard were considered.

**General product information:**

The products are 12V valve regulated type stationary lead-acid batteries. All batteries are divided into TEL Series, LBT/MPS Series and DNT/MRX Series.

| IEC 60896-21:2004, IEC 60896-22:2004 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | | |
|---|---|---|
| **4** | **FUNCTIONAL REQUIREMENTS** | |
| 4.1 | Overview | |
| | The following requirements are grouped into safe operation, performance and durability needs. | |
| 4.2 | Safe operation characteristics | |

| 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 |

4.3 Performance characteristics

| Test Clause | Measures | Purpose |
|---|---|---|
| 6.11 | Discharge capacity | To verify the available capacities at selected discharge rates or discharge durations. |
| 6.12 | Charge retention during storage | To provide storage duration data |
| 6.13 | Float service with daily discharges | To determine cyclic performance under float charge conditions |
| 6.14 | Recharge behaviour | To determine the recovery of capacity or autonomy time after a power outage |

4.4 Durability requirements

| Test Clause | Measures | Purpose |
|---|---|---|
| 6.15 | Service life at an operating temperature of 40 °C | To determine the operational life at elevated temperatures |
| 6.16 | Impact of a stress temperature of 55 °C or 60 °C | To determine the influence of high stress temperatures on cell or monobloc battery life |
| 6.17 | Abusive over-discharge | To determine the expected behaviour when excessive capacity is discharged |
| 6.18 | Thermal runaway sensitivity | To determine the expected times to establish a condition of escalating current and temperature |
| 6.19 | Low temperature sensitivity | To determine the sensitivity toward damage induced by electrolyte freezing |
| 6.20 | Dimensional stability at elevated internal pressure and temperature | To determine the propensity of the cell or monobloc to be deformed by internal gas pressure and at elevated temperatures |
| 6.21 | Stability against mechanical abuse of units during installation | To determine the propensity of the cell or monobloc battery to fracture or leak when dropped. |

4.5 Test result requirements

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 |
| **5** | **TEST SET-UP (IEC 60896-21:2004)** | | 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 Ω/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 ±1 % or better where required. | | P |
| 5.1.5 | Length measurements | | P |
| | The instruments used shall have an accuracy of ±0,1 % or better where required. | | P |
| 5.1.6 | Weight measurements | | P |
| | The instruments used shall have an accuracy of ±1 % or better where required. | | P |
| 5.1.7 | Gas volume measurements | | P |
| | The instruments used shall have an accuracy of ±5 % or better where required. | | P |
| 5.1.8 | Gas pressure measurements | | P |
| | The instruments used shall have an accuracy of ±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 | The number of units to be tested is summarized below | | P |

| 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 |

| IEC 60896-21:2004, IEC 60896-22:2004 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| Test Clause | Measures | Number of test units |
|---|---|---|
| 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 |

P

| Test Clause | Measures | Number of test units |
|---|---|---|
| 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 |

N/A

| | | | |
|---|---|---|---|
| 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 |

| | | | |
|---|---|---|---|
| **6** | **TEST METHODS AND REQUIREMENTS AND CHARACTERISTICS** | | 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 | N/A |
| 6.13 | Float service with daily discharges | Refer to table 6.13 | N/A |
| 6.14 | Recharge behaviour | Refer to table 6.14 | N/A |
| 6.15 | Service life at an operating temperature of 40 °C | Refer to table 6.15 | N/A |
| 6.16 | Impact of a stress temperature of 55 °C or 60 °C | Refer to table 6.16 | N/A |
| 6.17 | Abusive over-discharge | Refer to table 6.17 | N/A |
| 6.18 | Thermal runaway sensitivity | Refer to table 6.18 | N/A |
| 6.19 | Low temperature sensitivity | Refer to table 6.19 | N/A |
| 6.20 | Dimensional stability at elevated internal pressure and temperature | Refer to table 6.20 | N/A |
| 6.21 | Stability against mechanical abuse of units during installation | Refer to table 6.21 | N/A |

| | | | |
|---|---|---|---|
| **ANNEX A** | **(NORMATIVE) USER STATEMENT OF REQUIREMENTS (IEC 60896-22)** | | 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 |

| Product safe operation in service | | Compliance information mandatory | N/A |
|---|---|---|---|
| 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 | |

| Product performance in service | | Compliance information mandatory or on as-needed basis | | | | | | N/A |
|---|---|---|---|---|---|---|---|---|
| 6.11 | Discharge capacity | Data for | $C_{10}$ | $C_8$ | $C_3$ | $C$ | $C_{0.25}$ | |
| 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 | | | | | | |

| Product durability in service | | Compliance information mandatory or on as-needed basis | N/A |
|---|---|---|---|
| 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 |

N/A

| Product safe operation in service | | IEC 60896-21 test clause result | |
|---|---|---|---|
| 6.1 | Gas emission (at the float voltage and at 2,40 Vpc) | | |
| 6.2 | High current tolerance | | |
| 6.3 | Short circuit and d.c. internal resistance | | |
| 6.4 | Internal ignition from external spark sources | | |
| 6.5 | Protection against ground short propensity | | |
| 6.6 | Content and durability of required markings | | |
| 6.7 | Material identification | Case | Cover |
| 6.8 | Valve operation | Before | After |
| 6.9 | Flammability rating of materials | Case | Cover |
| 6.10 | Intercell connector performance | | |

N/A

| Product performance in service | | IEC 60896-21 test clause result | | | | |
|---|---|---|---|---|---|---|
| 6.11 | Discharge capacity | $C_{10}$ | $C_8$ | $C_3$ | $C$ | $C_{0.25}$ |
| 6.12 | Charge retention during storage | | | | | |
| 6.13 | Float service with daily discharges | Cycles | $C_{af}$ | | $C_{ab}$ | |
| 6.14 | Recharge behaviour | 24 h | | 168 h | | |

N/A

| Product durability in service | | IEC 60896-21 test clause result | |
|---|---|---|---|
| 6.15 | Float service life at 40 °C | Days with $C_3$ rate test at 40 °C | |
| 6.16 | Impact of stress temperature of 55 °C or 60 °C | Days with $C_3$ rate test at 55 °C or 60 °C<br>Days with $C_{0.25}$ rate test at 55 °C or 60 °C | |
| 6.17 | Abusive over-discharge | | |
| 6.18 | Thermal runaway sensitivity | | |
| 6.19 | Low temperature sensitivity | | |
| 6.20 | Dimensional stability at elevated internal pressure and temperature | | |
| 6.21 | Stability against mechanical abuse of units during installation | | |

N/A

Company name:
Company officer:
Address/phone/fax/e-mail:
Signature/date/place:
Document established as reply for RFI:

| **Table 6.1** | **Gas emission** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ 0,95 $C_3$ and was fully charged.

**Test A: The normalized gas emission Ge per cell at float charge voltage conditions at 25 °C**:

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 $G_e$. $G_e = V_n / (n \times 168 \times Crt)$, n=1

(Vn 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.)

**Test B: The normalized gas emission Ge per battery at 14.4V charge voltage conditions at 25 °C:**

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 Vn 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 Ge per cell at float charge voltage conditions (14.4V) shall be calculated for each of the four 168 h ± 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 |
|---|---|---|---|---|---|---|---|---|
| | | | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | |
| C&D 12-7A | 7# | 1 | 0 | 0 | 297.8 | 1015 | 0 | No leakage |
| | | 2 | 0 | 0 | 298.0 | 1016 | 0 | |
| | | 3 | 0 | 0 | 297.6 | 1017 | 0 | |
| | | 4 | 0 | 0 | 296.8. | 1016 | 0 | |
| | 8# | 1 | 0 | 0 | 297.8 | 1015 | 0 | No leakage |
| | | 2 | 0 | 0 | 298.0 | 1016 | 0 | |
| | | 3 | 0 | 0 | 297.6 | 1017 | 0 | |
| | | 4 | 0 | 0 | 296.8. | 1016 | 0 | |
| | 9# | 1 | 0 | 0 | 297.8 | 1015 | 0 | No leakage |
| | | 2 | 0 | 0 | 298.0 | 1016 | 0 | |
| | | 3 | 0 | 0 | 297.6 | 1017 | 0 | |
| | | 4 | 0 | 0 | 296.8. | 1016 | 0 | |

| Model name: | Sample No: | Test B | | | | Remark after 24h charging |
|---|---|---|---|---|---|---|
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | |
| C&D 12-7A | 7# | / | 5 | 5.008 | 0.009 | No leakage |
| | 8# | / | 5 | 5.008 | 0.009 | No leakage |
| | 9# | / | 5 | 5.008 | 0.009 | No leakage |

| Model | Sample | 168h | Test A | Remark after 72h |
|---|---|---|---|---|

| name: | No: | cycle | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | float charging |
|---|---|---|---|---|---|---|---|---|
| C&D 12-100 LBT | 7# | 1 | 310 | 311.56 | 296.8 | 1014 | 0.001 | No leakage |
| | | 2 | 280 | 282.15 | 296.6 | 1016 | 0.001 | |
| | | 3 | 240 | 241.9 | 296.8 | 1017 | 0.001 | |
| | | 4 | 210 | 211.19 | 297.2 | 1016 | 0.001 | |
| | 8# | 1 | 420 | 422.11 | 296.8 | 1014 | 0.001 | No leakage |
| | | 2 | 390 | 393.0 | 296.6 | 1016 | 0.001 | |
| | | 3 | 370 | 372.96 | 296.8 | 1017 | 0.001 | |
| | | 4 | 320 | 321.81 | 297.2 | 1016 | 0.001 | |
| | 9# | 1 | 380 | 381.91 | 296.8 | 1014 | 0.001 | No leakage |
| | | 2 | 370 | 372.85 | 296.6 | 1016 | 0.001 | |
| | | 3 | 330 | 332.64 | 296.8 | 1017 | 0.001 | |
| | | 4 | 310 | 311.75 | 297.2 | 1016 | 0.001 | |

| Model name: | Sample No: | Test B | | | | Remark after 24h charging |
|---|---|---|---|---|---|---|
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | |
| C&D 12-100 LBT | 7# | 32 | 1500 | 1521 | 0.225 | No leakage |
| | 8# | 26 | 1846 | 1871.9 | 0.277 | No leakage |
| | 9# | 23 | 2087 | 2116.3 | 0.313 | No leakage |

| Model name: | Sample No: | 168h cycle | Test A | | | | | Remark after 72h float charging |
|---|---|---|---|---|---|---|---|---|
| | | | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | |
| TEL 12-150 TFA | 7# | 1 | 420 | 422.11 | 296.8 | 1014 | 0.0008 | No leakage |
| | | 2 | 360 | 362.77 | 296.6 | 1016 | 0.0007 | |
| | | 3 | 240 | 241.92 | 296.8 | 1017 | 0.0005 | |
| | | 4 | 120 | 120.68 | 297.2 | 1016 | 0.0002 | |
| | 8# | 1 | 300 | 301.51 | 296.8 | 1014 | 0.0006 | No leakage |
| | | 2 | 240 | 241.85 | 296.6 | 1016 | 0.0005 | |
| | | 3 | 150 | 151.2 | 296.8 | 1017 | 0.0003 | |
| | | 4 | 90 | 90.51 | 297.2 | 1016 | 0.0002 | |
| | 9# | 1 | 480 | 482.42 | 296.8 | 1014 | 0.0009 | No leakage |
| | | 2 | 240 | 241.85 | 296.6 | 1016 | 0.0005 | |
| | | 3 | 180 | 181.44 | 296.8 | 1017 | 0.0004 | |
| | | 4 | 150 | 150.85 | 297.2 | 1016 | 0.0003 | |

| Model name: | Sample No: | Test B | | | | Remark after 24h charging |
|---|---|---|---|---|---|---|
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | |
| TEL 12-150 TFA | 7# | / | 240 | 242.7 | 0.022 | No leakage |
| | 8# | / | 180 | 182.0 | 0.016 | No leakage |
| | 9# | / | 300 | 303.3 | 0.027 | No leakage |

| Model name: | Sample No: | 168h cycle | Test A | | | | | Remark after 72h float charging |
|---|---|---|---|---|---|---|---|---|
| | | | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TEL 12-170 FGC | 7# | 1 | 210 | 211.06 | 296.8 | 1014 | 0.0004 | No leakage |
| | | 2 | 190 | 191.46 | 296.6 | 1016 | 0.0003 | |
| | | 3 | 120 | 120.96 | 296.8 | 1017 | 0.0002 | |
| | | 4 | 80 | 80.45 | 297.2 | 1016 | 0.0001 | |
| | 8# | 1 | 190 | 190.96 | 296.8 | 1014 | 0.0003 | No leakage |
| | | 2 | 180 | 181.39 | 296.6 | 1016 | 0.0003 | |
| | | 3 | 160 | 161.28 | 296.8 | 1017 | 0.0003 | |
| | | 4 | 120 | 120.68 | 297.2 | 1016 | 0.0002 | |
| | 9# | 1 | 260 | 261.31 | 296.8 | 1014 | 0.0005 | No leakage |
| | | 2 | 240 | 241.85 | 296.6 | 1016 | 0.0004 | |
| | | 3 | 180 | 181.44 | 296.8 | 1017 | 0.0003 | |
| | | 4 | 100 | 100.57 | 297.2 | 1016 | 0.0002 | |
| Model name: | Sample No: | Test B | | | | | | Remark after 24h charging |
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | | | |
| TEL 12-170 FGC | 7# | / | 480 | 486.7 | 0.041 | | | No leakage |
| | 8# | / | 340 | 344.8 | 0.029 | | | No leakage |
| | 9# | / | 390 | 395.5 | 0.033 | | | No leakage |
| Model name: | Sample No: | 168h cycle | Test A | | | | | Remark after 72h float charging |
| | | | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | |
| TEL 12-210 FGC | 7# | 1 | 2790 | 2804.05 | 296.8 | 1014 | 0.0047 | No leakage |
| | | 2 | 2090 | 2106.08 | 296.6 | 1016 | 0.0036 | |
| | | 3 | 1930 | 1945.45 | 296.8 | 1017 | 0.0033 | |
| | | 4 | 740 | 744.19 | 297.2 | 1016 | 0.0013 | |
| | 8# | 1 | 2105 | 2115.59 | 296.8 | 1014 | 0.0036 | No leakage |
| | | 2 | 1220 | 1229.39 | 296.6 | 1016 | 0.0021 | |
| | | 3 | 1170 | 1179.37 | 296.8 | 1017 | 0.0020 | |
| | | 4 | 460 | 462.6 | 297.2 | 1016 | 0.0008 | |
| | 9# | 1 | 2260 | 2271.38 | 296.8 | 1014 | 0.0038 | No leakage |
| | | 2 | 2010 | 2025.49 | 296.6 | 1016 | 0.0034 | |
| | | 3 | 1500 | 1512.01 | 296.8 | 1017 | 0.0026 | |
| | | 4 | 690 | 693.9 | 297.2 | 1016 | 0.0012 | |
| Model name: | Sample No: | Test B | | | | | | Remark after 24h charging |
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | | | |
| TEL 12-210 FGC | 7# | 15.5 | 3096 | 3140 | 0.23 | | | No leakage |
| | 8# | 14.6 | 3287 | 3334 | 0.26 | | | No leakage |
| | 9# | 14.6 | 3287 | 3334 | 0.26 | | | No leakage |
| Model name: | Sample No: | 168h cycle | Test A | | | | | Remark after 72h float charging |
| | | | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | |
| C&D | 7# | 1 | 310 | 311.78 | 296.8 | 1014 | 0.0004 | No leakage |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 12-242A LBT | | 2 | 280 | 282.15 | 296.6 | 1016 | 0.0004 | |
| | | 3 | 240 | 241.92 | 296.8 | 1017 | 0.0003 | |
| | | 4 | 220 | 221.25 | 297.2 | 1016 | 0.0003 | |
| | 8# | 1 | 260 | 261.49 | 296.8 | 1014 | 0.0003 | No leakage |
| | | 2 | 245 | 246.89 | 296.6 | 1016 | 0.0003 | |
| | | 3 | 215 | 216.72 | 296.8 | 1017 | 0.0003 | |
| | | 4 | 195 | 196.1 | 297.2 | 1016 | 0.0003 | |
| | 9# | 1 | 420 | 422.4 | 296.8 | 1014 | 0.0006 | No leakage |
| | | 2 | 385 | 387.96 | 296.6 | 1016 | 0.0005 | |
| | | 3 | 355 | 357.84 | 296.8 | 1017 | 0.0005 | |
| | | 4 | 310 | 311.75 | 297.2 | 1016 | 0.0004 | |

| Model name: | Sample No: | Test B | | | | Remark after 24h charging |
|---|---|---|---|---|---|---|
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | |
| C&D 12-242A LBT | 7# | / | 500 | 503.48 | 0.031 | No leakage |
| | 8# | / | 430 | 432.99 | 0.027 | No leakage |
| | 9# | / | 790 | 795.5 | 0.049 | No leakage |

| Model name: | Sample No: | 168h cycle | Test A | | | | | Remark after 72h float charging |
|---|---|---|---|---|---|---|---|---|
| | | | Va (ml) | Vn (ml) | Ta (K) | Pa (kPa) | Ge (ml) | |
| C&D 12-370 DNT | 7# | 1 | 200 | 201.0 | 296.8 | 1014 | 0.0006 | No leakage |
| | | 2 | 180 | 181.39 | 296.6 | 1016 | 0.0005 | |
| | | 3 | 140 | 141.12 | 296.8 | 1017 | 0.0004 | |
| | | 4 | 100 | 100.57 | 297.2 | 1016 | 0.0003 | |
| | 8# | 1 | 120 | 120.60 | 296.8 | 1014 | 0.0004 | No leakage |
| | | 2 | 110 | 110.85 | 296.6 | 1016 | 0.0003 | |
| | | 3 | 105 | 105.84 | 296.8 | 1017 | 0.0003 | |
| | | 4 | 85 | 85.48 | 297.2 | 1016 | 0.0003 | |
| | 9# | 1 | 150 | 150.76 | 296.8 | 1014 | 0.0005 | No leakage |
| | | 2 | 140 | 141.08 | 296.6 | 1016 | 0.0004 | |
| | | 3 | 125 | 126.0 | 296.8 | 1017 | 0.0004 | |
| | | 4 | 105 | 105.59 | 297.2 | 1016 | 0.0003 | |

| Model name: | Sample No: | Test B | | | | Remark after 24h charging |
|---|---|---|---|---|---|---|
| | | $t_c$ (h) to 1000ml | Va (ml) | Vn (ml) | Ge (ml) | |
| C&D 12-370 DNT | 7# | 47 | 1021 | 1034.3 | 0.14 | No leakage |
| | 8# | 47 | 1021 | 1034.3 | 0.14 | No leakage |
| | 8# | / | 860 | 871.2 | 0.12 | No leakage |

| **Table 6.2** | **High current tolerance** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |
| Each battery has an actual capacity Ca ≥ $C_3$ and was fully charged.<br>1. The test units shall be discharged for 30 s with a current equal to 3 times the 5 min rate current (to $U_{final}$ 1,80 $V_{pc}$ 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.<br>2. 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. | | | |
| Test result: | | | |

| Sample NO. | 10# | 11# | 12# | Remark |
|---|---|---|---|---|
| Discharge current =(54.9 A、607.2 A、716.7A、840.3A、853.8 A、1358.4A、944.4 A) ($U_{final}$=1.80Vpc) | | | | 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) | 13.133 | 13.111 | 13.141 | C&D 12-7A LBT |
| Voltage after open circuit for 5min (V) | 13.059 | 13.052 | 13.038 | C&D 12-100 LBT |
| Voltage after open circuit for 5min (V) | 12.929 | 12.931 | 12.943 | TEL 12-150 TFA |
| Voltage after open circuit for 5min (V) | 12.975 | 12.985 | 12.985 | TEL 12-170 FGC |
| Voltage after open circuit for 5min (V) | 12.966 | 12.956 | 12.964 | TEL 12-210 FGC |
| Voltage after open circuit for 5min (V) | 13.032 | 13.046 | 13.034 | C&D 12-242A LBT |
| Voltage after open circuit for 5min (V) | 12.913 | 12.932 | 12.931 | C&D 12-370 DNT |

| **Table 6.3** | **Short-circuit current and d.c. internal resistance** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ $C_3$ 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 (Ua, Ia) After 20 s of discharge at the current Ia = 4 x $I_{10}$, 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 (Ub, Ib) After 5 s of discharge at the current Ib = 20 × $I_{10}$, 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 Isc (A) | Internal resistance Ri (mΩ) | Remark |
|---|---|---|---|---|---|---|---|---|
| C&D 12-7A LBT | 1# | 2.68 | 12.587 | 13.4 | 12.083 | 270.4 | 47.0 | Actual capacity Ca > $C_3$ |
| | 2# | 2.68 | 12.558 | 13.4 | 12.034 | 259.6 | 48.9 | |
| | 3# | 2.68 | 12.603 | 13.4 | 12.089 | 265.5 | 47.9 | |
| C&D 12-100 LBT | 1# | 35.52 | 12.197 | 177.6 | 11.455 | 2371.3 | 5.2 | Actual capacity Ca > $C_3$ |
| | 2# | 35.52 | 12.217 | 177.6 | 11.466 | 2347.1 | 5.3 | |
| | 3# | 35.52 | 12.182 | 177.6 | 11.437 | 2359.1 | 5.2 | |
| TEL 12-150 TFA | 1# | 60.0 | 12.163 | 300.0 | 10.815 | 2225.5 | 5.6 | Actual capacity Ca > $C_3$ |
| | 2# | 60.0 | 12.139 | 300.0 | 10.735 | 2135.0 | 5.8 | |
| | 3# | 60.0 | 12.105 | 300.0 | 10.753 | 2208.8 | 5.6 | |
| TEL 12-170 FGC | 1# | 66.4 | 12.426 | 332.0 | 11.006 | 2390.6 | 5.3 | Actual capacity Ca > $C_3$ |
| | 2# | 66.4 | 12.442 | 332.0 | 11.011 | 2375.7 | 5.4 | |
| | 3# | 66.4 | 12.427 | 332.0 | 11.012 | 2399.0 | 5.3 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TEL 12-210 FGC | 1# | 68.8 | 12.387 | 344.0 | 11.074 | 2665.1 | 4.8 | Actual capacity Ca > $C_3$ |
| | 2# | 68.8 | 12.354 | 344.0 | 11.045 | 2666.1 | 4.8 | |
| | 3# | 68.8 | 12.337 | 344.0 | 11.030 | 2666.5 | 4.7 | |
| C&D 12-242A LBT | 1# | 92.84 | 12.301 | 464.2 | 11.163 | 4107.4 | 3.1 | Actual capacity Ca > $C_3$ |
| | 2# | 92.84 | 12.313 | 464.2 | 11.195 | 4185.2 | 3.0 | |
| | 3# | 92.84 | 12.295 | 464.2 | 11.170 | 4151.8 | 3.0 | |
| C&D 12-370 DNT | 1# | 36.96 | 12.382 | 184.8 | 11.771 | 3032.2 | 4.1 | Actual capacity Ca > $C_3$ |
| | 2# | 36.96 | 12.379 | 184.8 | 11.759 | 2988.0 | 4.2 | |
| | 3# | 36.96 | 12.368 | 184.8 | 11.749 | 2990.1 | 4.2 | |

| **Table 6.4** | **Protection against internal ignition from external spark sources** | | **Verdict:** | **Pass** |
|---|---|---|---|---|
| Test method: | | | | |
| 1. The test shall be carried out at an ambient temperature between 15 °C and 30 °C.<br>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.<br>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.<br>4. Within 1 h of charging the gas source battery commence the gassing test or otherwise commence the spark test.<br>5. The valve assembly is deemed to have passed the test when no explosion or rapid combustion event occurred within the test fixture. | | | | |
| Test result: | | | | |
| Sample NO. | 1# | 2# | 3# | Remark: |
| The gas generated by $0.2I_{10}$ current | | | | |
| Spark1st | No fire;<br>No explode;<br>No other issues | No fire;<br>No explode;<br>No other issues | No fire;<br>No explode;<br>No other issues | Testing performed on model C&D 12-7A LBT, C&D 12-100 LBT, TEL 12-150 TFA, TEL 12-170 FGC, TEL 12-210 FGC, C&D 12-242A LBT and C&D 12-370 DNT |
| Spark2st | No fire;<br>No explode;<br>No other issues | No fire;<br>No explode;<br>No other issues | No fire;<br>No explode;<br>No other issues | |

| **Table 6.5** | **Protection against ground short propensity** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ 0,95$C_3$ and was fully charged.

1. The case to cover seal line of the unit shall be placed in contact with a metallic surface.
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 Uflo as specified by the manufacturer, at a room temperature between 20 °C and 25 °C.
3. The units shall be connected, to a circuit which applies a d.c. voltage of at least 500 V ± 5 V between one terminal and the metallic surface (aluminium foil strip) in contact with the seal line.
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.
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.
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.
7. The presence or absence of ground short/leakage phenomena shall be reported.

Test result:

| Model name: | Sample No. | Electrolyte leakage? | Ground short? | Leakage current measured? |
|---|---|---|---|---|
| C&D 12-7A LBT, C&D 12-100 LBT, TEL 12-150 TFA, TEL 12-170 FGC, TEL 12-210 FGC, C&D 12-242A LBT and C&D 12-370 DNT | 13# | No | No | No |

| **Table 6.6** | **Content and durability of required markings** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |

The test shall be carried out on three of the required markings.

Test with water and aliphatic solvent.

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

2. 2# label is rubbed for 15 s with a piece of cloth soaked with a saturated solution of sodium carbonate (Na2CO3) or bicarbonate (NaHCO3) in water, dried in air and then inspected visually.

Test with electrolyte

3. 3# label is rubbed for 15 s with a piece of cloth soaked with a solution of 40 % in weight of H2SO4 in water, washed with water, dried in air and then inspected visually.

Test result:

| Model name: | Sample No. | Phenomena observed |
|---|---|---|
| C&D 12-7A LBT, C&D 12-100 LBT, TEL 12-150 TFA, TEL 12-170 FGC, TEL 12-210 FGC, C&D 12-242A LBT and C&D 12-370 DNT | 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. |

| **Table 6.7** | **Material identification** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |
| Battery cover or case.<br>1. The specified information for material identification shall be selected from the list of abbreviation published in ISO 1043-1.<br>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.<br>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 | PP or ABS | | |
| Battery case | PP or ABS | | |

| **Table 6.8** | **Valve operation** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ 0,95$C_3$ and was fully charged.

1. The units are fully charged and at a temperature between 25 °C.
2. The units are overcharged with a constant voltage between 2.60 $V_{pc}$ to 2.70 $V_{pc}$ for at least 1 h.
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.
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.
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.
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.

Test result:

| Model name: | Sample No: | Gas release detected: | Remark |
|---|---|---|---|
| C&D12-7A LBT, C&D 12-100 LBT, TEL 12-150 TFA, TEL 12-170 FGC, TEL 12-210 FGC, C&D 12-242A LBT and C&D 12-370 DNT | 4# | Emitted gas observed | |
| | 5# | Emitted gas observed | |
| | 6# | Emitted gas observed | |

| **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 | C&D 12-7A LBT | 1.6 | 4.7 | 0.3 | 5.0 | Yes | V-2 |
| | C&D 12-100 LBT | 1.8 | 4.9 | 0.3 | 5.2 | Yes | V-2 |
| | TEL 12-150 | 2.0 | 5.3 | 0.3 | 5.6 | Yes | V-2 |
| | TEL 12-170 FGC | 1.0 | 1.3 | 0.3 | 1.6 | No | V-0 |
| | TEL 12-210 FGC | 1.5 | 1.0 | 0.3 | 1.3 | No | V-0 |
| | C&D 12-242A LBT | 1.7 | 5.2 | 0.3 | 5.5 | Yes | V-2 |
| | C&D 12-370 DNT | 1.1 | 4.0 | 0.3 | 4.3 | Yes | V-2 |
| 70°C | C&D 12-7A LBT | 2.1 | 4.8 | 0.3 | 5.1 | Yes | V-2 |
| | C&D 12-100 LBT | 1.8 | 4.8 | 0.3 | 5.1 | Yes | V-2 |
| | TEL 12-150 | 1.8 | 5.0 | 0.3 | 5.3 | Yes | V-2 |
| | TEL 12-170 FGC | 1.1 | 1.4 | 0.3 | 1.7 | No | V-0 |
| | TEL 12-210 FGC | 1.2 | 1.1 | 0.3 | 1.4 | No | V-0 |
| | C&D 12-242A LBT | 1.9 | 5.3 | 0.3 | 5.6 | Yes | V-2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | C&D 12-370 DNT | 1.0 | 5.0 | 0.3 | 5.3 | yes | V-2 |

| **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. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-7A LBT | Initial temp. of samples (°C) | 24.4 | 24.6 | 24.8 | 25.0 | 24.8 | Discharge current: 12.8A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 35.6 | 36.0 | 35.8 | 35.8 | 36.0 | |
| | Dimension of Connector | Length: 100mm; cross area: 10mm$^2$ | | | | | |

| | Sample No. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-100 LBT | Initial temp. of samples (°C) | 24.8 | 24.6 | 25.0 | 24.8 | 24.8 | Discharge current: 177.5A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 36.4 | 38.2 | 38.8 | 40.4 | 40.2 | |
| | Dimension of Connector | Length: 100mm; cross area: 50mm$^2$ | | | | | |

| | Sample No. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| TEL 12-150 TFA | Initial temp. of samples (°C) | 24.2 | 24.6 | 24.2 | 24.4 | 24.8 | Discharge current: 257.4A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 38.4 | 38.6 | 40.4 | 40.2 | 43.4 | |
| | Dimension of Connector | L×W×T (mm): 100×25×2.5mm | | | | | |

| | Sample No. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| TEL 12-170 FGC | Initial temp. of samples (°C) | 24.6 | 24.8 | 25.0 | 24.4 | 25.0 | Discharge current: 308A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 37.4 | 40.2 | 39.6 | 41.4 | 46.4 | |
| | Dimension of Connector | L×W×T (mm): 100×25×3mm | | | | | |

| | Sample No. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| TEL 12-210 FGC | Initial temp. of samples (°C) | 23.8 | 24.0 | 24.2 | 24.4 | 24.2 | Discharge current: 293.8A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 38.8 | 40.4 | 48.8 | 38.4 | 49.4 | |
| | Dimension of Connector | L×W×T (mm): 100×25×3mm | | | | | |

| | Sample No. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-242A LBT | Initial temp. of samples (°C) | 24.2 | 24.4 | 24.2 | 24.6 | 24.8 | Discharge current: 372.4A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 48.2 | 52.4 | 40.6 | 40.8 | 42.4 | |
| | Dimension of Connector | L×W×T (mm): 110×25×4mm | | | | | |

| | Sample No. | 14# | 15# | 16# | 17# | 18# | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-370 DNT | Initial temp. of samples (°C) | 24.8 | 24.8 | 24.6 | 24.8 | 25.0 | Discharge current: 211A; Discharge till 1.60Vpc; |
| | Highest temp. (°C) | 34.2 | 36.4 | 32.8 | 40.8 | 38.6 | |
| | Dimension of Connector | L×W×T (mm): 100×25×2.5mm | | | | | |

| **Table 6.11** | **Discharge capacity** | **Verdict:** | **Pass** |
|---|---|---|---|
| Test method: | | | |

Capacity $C_{0.25}$ (0,25 h rate)

1. The discharge shall be started within 1 h to 24 h after fully charged.
2. Discharged with a constant current $I_{0.25}$ to $U_{final}$ = 1.60 Vpc.
3. Recorded discharge time and calculated capacity.
4. Corrected the capacity to temperature of 25 °C. θ is the initial temperature,

$$C_{a25\,°C} = C/[1+\lambda(\theta - 25)] \quad \text{in Ah}, \ (\lambda = 0{,}01)$$

Capacity C (1 h rate)

1. The discharge shall be started within 1 h to 24 h after fully charged.
2. Discharged with a constant current $I_1$ to $U_{final}$ = 1.60 Vpc.
3. Recorded discharge time and calculated capacity.
4. Corrected the capacity to temperature of 25 °C. θ is the initial temperature,

$$C_{a25\,°C} = C/[1+\lambda(\theta - 25)] \quad \text{in Ah}, \ (\lambda = 0{,}01)$$

Capacity $C_3$ (3 h rate)

1. The discharge shall be started within 1 h to 24 h after fully charged.
2. Discharged with a constant current $I_3$ to $U_{final}$ = 1.70 Vpc .
3. Recorded discharge time and calculated capacity.
4. Corrected the capacity to temperature of 25 °C. θ is the initial temperature,

$$C_{a25\,°C} = C/[1+\lambda(\theta - 25)] \quad \text{in Ah}, \ (\lambda = 0{,}006)$$

Capacity $C_8$ (8 h rate)

1. The discharge shall be started within 1 h to 24 h after fully charged.
2. Discharged with a constant current $I_8$ to $U_{final}$ = 1.75 Vpc .
3. Recorded discharge time and calculated capacity.
4. Corrected the capacity to temperature of 25 °C. θ is the initial temperature,

$$C_{a25\,°C} = C/[1+\lambda(\theta - 25)] \quad \text{in Ah}, \ (\lambda = 0{,}006)$$

Capacity $C_{10}$ (10 h rate)

1. The discharge shall be started within 1 h to 24 h after fully charged.
2. Discharged with a constant current $I_{10}$ to $U_{final}$ = 1.80 Vpc.
3. Recorded discharge time and calculated capacity.
4. Corrected the capacity to temperature of 25 °C. θ is the initial temperature,

$$C_{a25\,°C} = C/[1+\lambda(\theta - 25)] \quad \text{in Ah}, \ (\lambda = 0{,}006)$$

Test result:

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-7A LBT | 1# | 6.8 | | | | | $I_{10}$= 0.67A $C_{10}$= 6.7Ah |
| | 2# | 6.8 | | | | | |
| | 3# | 6.8 | | | | | |
| | 4# | 6.9 | | | | | |
| | 5# | 6.9 | | | | | |
| | 6# | 6.9 | | | | | |
| | 1# | | 6.6 | | | | $I_8$= 0.79A $C_8$= 6.32A h |
| | 2# | | 6.6 | | | | |
| | 3# | | 6.6 | | | | |
| | 4# | | 6.8 | | | | |
| | 5# | | 6.8 | | | | |
| | 6# | | 6.8 | | | | |
| | 1# | | | 5.8 | | | $I_3$= 1.84A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2# | | | 5.8 | | | $C_3$=5.52Ah |
| | 3# | | | 5.8 | | | |
| | 4# | | | 6.0 | | | |
| | 5# | | | 6.0 | | | |
| | 6# | | | 6.0 | | | |
| | 1# | | | | 4.9 | | $I_1$= 4.67A C= 4.67Ah |
| | 2# | | | | 4.9 | | |
| | 3# | | | | 4.9 | | |
| | 4# | | | | 5.0 | | |
| | 5# | | | | 5.0 | | |
| | 6# | | | | 5.0 | | |
| | 1# | | | | | 3.6 | $I_{0.25}$=12.8A $C_{0.25}$=3.2A h |
| | 2# | | | | | 3.6 | |
| | 3# | | | | | 3.6 | |
| | 4# | | | | | 3.6 | |
| | 5# | | | | | 3.6 | |
| | 6# | | | | | 3.6 | |

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-100 LBT | 1# | 95.1 | | | | | $I_{10}$= 8.88A $C_{10}$= 88.8A h |
| | 2# | 95.1 | | | | | |
| | 3# | 95.1 | | | | | |
| | 4# | 96.3 | | | | | |
| | 5# | 96.3 | | | | | |
| | 6# | 96.3 | | | | | |
| | 1# | | 89.3 | | | | $I_8$= 10.95A $C_8$= 87.6A h |
| | 2# | | 89.3 | | | | |
| | 3# | | 89.2 | | | | |
| | 4# | | 90.6 | | | | |
| | 5# | | 90.5 | | | | |
| | 6# | | 90.7 | | | | |
| | 7# | | | 79.9 | | | $I_3$= 25.7A $C_3$=77.1Ah |
| | 8# | | | 80.0 | | | |
| | 9# | | | 79.9 | | | |
| | 10# | | | 79.6 | | | |
| | 11# | | | 79.7 | | | |
| | 12# | | | 79.7 | | | |
| | 7# | | | | 64.9 | | $I_1$= 64.4A $C_1$=64.4Ah |
| | 8# | | | | 64.9 | | |
| | 9# | | | | 64.9 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 10# | | | | 64.4 | | |
| | 11# | | | | 64.4 | | |
| | 12# | | | | 64.4 | | |
| | 8# | | | | | 44.5 | $I_{0.25}$=177.5 A $C_{0.25}$=44.38Ah |
| | 9# | | | | | 44.4 | |
| | 10# | | | | | 44.5 | |
| | 11# | | | | | 44.5 | |
| | 12# | | | | | 44.4 | |
| | 13# | | | | | 44.4 | |

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| TEL 12-150 TFA | 1# | 162.5 | | | | | $I_{10}$= 15.0A $C_{10}$= 150Ah |
| | 2# | 162.3 | | | | | |
| | 3# | 162.3 | | | | | |
| | 4# | 162.3 | | | | | |
| | 5# | 162.5 | | | | | |
| | 6# | 162.5 | | | | | |
| | 1# | | 157.9 | | | | $I_8$= 18.5A $C_8$= 148Ah |
| | 2# | | 159.7 | | | | |
| | 3# | | 160.2 | | | | |
| | 4# | | 157.5 | | | | |
| | 5# | | 159.4 | | | | |
| | 6# | | 159.4 | | | | |
| | 1# | | | 153.7 | | | $I_3$= 42.5A $C_3$=127.5Ah |
| | 2# | | | 158.6 | | | |
| | 3# | | | 157.9 | | | |
| | 4# | | | 157.9 | | | |
| | 5# | | | 159.2 | | | |
| | 6# | | | 155.9 | | | |
| | 7# | | | | 113.2 | | $I_1$=101.4A $C_1$=101.4Ah |
| | 8# | | | | 114.9 | | |
| | 9# | | | | 114.9 | | |
| | 10# | | | | 114.9 | | |
| | 11# | | | | 113.2 | | |
| | 12# | | | | 114.9 | | |
| | 1# | | | | | 64.9 | $I_{0.25}$=257.4 A $C_{0.25}$=64.35Ah |
| | 2# | | | | | 64.7 | |
| | 3# | | | | | 64.7 | |
| | 6# | | | | | 64.9 | |
| | 10# | | | | | 64.8 | |
| | 13# | | | | | 65.0 | |

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| TEL 12-170 FGC | 1# | 168.0 | | | | | $I_{10}$= 16.6A $C_{10}$= 166A h |
| | 2# | 167.8 | | | | | |
| | 3# | 167.8 | | | | | |
| | 4# | 168.0 | | | | | |
| | 5# | 168.0 | | | | | |
| | 6# | 167.8 | | | | | |
| | 7# | | 165.2 | | | | $I_8$= 20.3A $C_8$= 162.4 Ah |
| | 8# | | 165.4 | | | | |
| | 9# | | 165.2 | | | | |
| | 10# | | 165.0 | | | | |
| | 11# | | 165.4 | | | | |
| | 12# | | 165.2 | | | | |
| | 1# | | | 151.6 | | | $I_3$= 45.7A $C_3$=137.1A h |
| | 2# | | | 155.3 | | | |
| | 3# | | | 156.1 | | | |
| | 4# | | | 154.5 | | | |
| | 5# | | | 153.9 | | | |
| | 6# | | | 153.9 | | | |
| | 7# | | | | 120.4 | | $I_1$= 115A $C_1$= 115Ah |
| | 8# | | | | 120.1 | | |
| | 9# | | | | 116.9 | | |
| | 10# | | | | 121.4 | | |
| | 11# | | | | 121.7 | | |
| | 12# | | | | 121.4 | | |
| | 7# | | | | | 78.0 | $I_{0.25}$= 308A $C_{0.25}$=77Ah |
| | 8# | | | | | 78.1 | |
| | 9# | | | | | 77.4 | |
| | 10# | | | | | 77.9 | |
| | 11# | | | | | 78.1 | |
| | 12# | | | | | 78.0 | |

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| TEL 12-210 FGC | 1# | 197.2 | | | | | $I_{10}$= 17.2A $C_{10}$= 172A h |
| | 2# | 197.2 | | | | | |
| | 3# | 197.0 | | | | | |
| | 4# | 196.7 | | | | | |
| | 5# | 196.7 | | | | | |
| | 6# | 197.0 | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1# | | 188.9 | | | | $I_8$= 21.2A $C_8$= 169.6 Ah |
| | 2# | | 188.9 | | | | |
| | 3# | | 189.2 | | | | |
| | 4# | | 188.7 | | | | |
| | 5# | | 189.2 | | | | |
| | 6# | | 188.9 | | | | |
| | 1# | | | 160.9 | | | $I_3$= 48.9A $C_3$=146.7A h |
| | 2# | | | 161.1 | | | |
| | 3# | | | 160.9 | | | |
| | 4# | | | 160.9 | | | |
| | 5# | | | 160.5 | | | |
| | 6# | | | 160.5 | | | |
| | 1# | | | | 123.9 | | $I_1$= 118.7A $C_1$=118.7A h |
| | 2# | | | | 123.9 | | |
| | 3# | | | | 123.4 | | |
| | 4# | | | | 123.4 | | |
| | 5# | | | | 123.9 | | |
| | 6# | | | | 123.7 | | |
| | 1# | | | | | 79.7 | $I_{0.25}$=293.8 A $C_{0.25}$=73.45Ah |
| | 2# | | | | | 79.9 | |
| | 3# | | | | | 79.6 | |
| | 4# | | | | | 79.7 | |
| | 5# | | | | | 79.9 | |
| | 6# | | | | | 79.7 | |

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-242A LBT | 1# | 242.0 | | | | | $I_{10}$= 23.21 A $C_{10}$=232.1 Ah |
| | 2# | 241.7 | | | | | |
| | 3# | 242.0 | | | | | |
| | 4# | 240.6 | | | | | |
| | 5# | 240.3 | | | | | |
| | 6# | 240.3 | | | | | |
| | 1# | | 238.6 | | | | $I_8$= 27.85A $C_8$= 222.8 Ah |
| | 2# | | 238.3 | | | | |
| | 3# | | 238.6 | | | | |
| | 4# | | 237.1 | | | | |
| | 5# | | 236.8 | | | | |
| | 6# | | 236.8 | | | | |
| | 1# | | | 212.5 | | | $I_3$= 61.8A $C_3$=185.4 Ah |
| | 2# | | | 212.8 | | | |
| | 3# | | | 212.5 | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 4# | | | 210.6 | | | |
| | 5# | | | 210.8 | | | |
| | 6# | | | 210.6 | | | |
| | 1# | | | | 169.5 | | $I_1$= 147.1A $C_1$=147.1Ah |
| | 2# | | | | 168.8 | | |
| | 3# | | | | 168.8 | | |
| | 4# | | | | 165.3 | | |
| | 5# | | | | 165.0 | | |
| | 6# | | | | 165.3 | | |
| | 1# | | | | | 122.5 | $I_{0.25}$=372.4A $C_{0.25}$=93.1Ah |
| | 2# | | | | | 122.2 | |
| | 3# | | | | | 122.2 | |
| | 4# | | | | | 122.0 | |
| | 5# | | | | | 122.2 | |
| | 6# | | | | | 122.5 | |

| Model name: | Sample No: | Capacity $C_{10}$ (Ah) | Capacity $C_8$ (Ah) | Capacity $C_3$ (Ah) | Capacity $C_1$ (Ah) | Capacity $C_{0.25}$ (Ah) | Remark |
|---|---|---|---|---|---|---|---|
| C&D 12-370 DNT | 1# | 99.1 | | | | | $I_{10}$= 9.24A $C_{10}$= 92.4Ah |
| | 2# | 99.0 | | | | | |
| | 3# | 99.0 | | | | | |
| | 4# | 99.1 | | | | | |
| | 5# | 99.0 | | | | | |
| | 6# | 99.1 | | | | | |
| | 1# | | 95.1 | | | | $I_8$= 11.42A $C_8$= 91.36Ah |
| | 2# | | 95.1 | | | | |
| | 3# | | 95.2 | | | | |
| | 4# | | 95.1 | | | | |
| | 5# | | 95.0 | | | | |
| | 6# | | 95.0 | | | | |
| | 1# | | | 84.2 | | | $I_3$= 27.3A $C_3$=81.9Ah |
| | 2# | | | 84.3 | | | |
| | 3# | | | 84.1 | | | |
| | 4# | | | 84.8 | | | |
| | 5# | | | 84.7 | | | |
| | 6# | | | 84.8 | | | |
| | 7# | | | | 76.8 | | $I_1$= 72.8A $C_1$=72.8Ah |
| | 8# | | | | 75.8 | | |
| | 9# | | | | 75.9 | | |
| | 10# | | | | 75.7 | | |
| | 11# | | | | 75.4 | | |
| | 12# | | | | 75.7 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 7# | | | | | 55.9 | $I_{0.25}$= 211A $C_{0.25}$=52.75Ah |
| | 8# | | | | | 56.0 | |
| | 9# | | | | | 55.9 | |
| | 10# | | | | | 56.7 | |
| | 11# | | | | | 55.8 | |
| | 12# | | | | | 55.9 | |

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

| **Table 6.12** | **Charge retention during storage** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ $C_3$ and was fully charged.

1. The units shall be stored at an ambient temperature of 25 °C ± 5 K and fully disconnected from any external circuit.
2. After 90 days of storage the units shall be discharged without any prior recharge so that their actual capacity after storage Cast (3 h – $U_{final}$ 1,70 $V_{pc}$ at the selected reference temperature) can be determined.
3. The charge retention factor Crf shall be expressed as percentage, and is equal to

$$C_{rf} = (C_{ast} \times 100) / C_a \quad (\%)$$

4. The six individual values of Crf shall be reported

| Test result: | | | | | |
|---|---|---|---|---|---|
| Sample No. | | 1# | 2# | 3# | Remark |
| | Ca | | | | |
| | Cast | | | | |
| | Crf | | | | |

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

| **Table 6.13** | **Float service with daily discharges** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ 0,95$C_3$ and was fully charged.

1. A discharge for 2 h with a current of I = 2,0 $I_{10}$ maintained constant within ±1 % where $I_{10}$ = [$C_{10}$] / [10] in A and followed immediately by
2. A charge for 22 h with a current limited to I = 2,0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.
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 $U_{final}$ 1,80 Vpc × n cells per string is reached in a time shorter than 2 h.
4. The unit or string voltages and number of cycles achieved with the discharge–charge cycle routine a) and b) shall be recorded.
5. The units having reached the conditions outlined in c) shall then be subjected for 168 h ± 0,1 h to a charge with a current limited to I = 2,0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.
6. At the end of the 168 h ± 0,1 h of charge, the units shall be subjected to a capacity test with a constant current of I = $I_3$ to $U_{final}$ 1,70 Vpc and the capacity $C_{af}$ corrected to 20 °C or 25 °C and recorded. This value $C_{af}$ 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.
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 I = $I_3$ to $U_{final}$ 1,70 Vpc and the capacity $C_{ab}$ corrected to 20 °C or 25 °C and recorded. This value $C_{ab}$ 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.
8. The test sequence 1) to 7) shall be repeated until, in the steps 6) and 7), the test units show a capacity $C_{af}$ and Cab lower than 80 % of Crt (3 h rate to Ufinal 1,70 Vpc at the selected reference temperature).

Test result:

| 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# | | | | | | | | | |
| 2# | | | | | | | | | |
| 3# | | | | | | | | | |

| Sample No | Number of sequences 1) to 7) | Total number of cycles achieved |
|---|---|---|
| 1# | | |
| 2# | | |
| 3# | | |

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

| **Table 6.14** | **Recharge behaviour** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ $C_{10}$ and was fully charged.

1. Three monobloc batteries in a single string.
2. The string shall be discharged, with unit temperature 25 °C, and a constant current of I = $I_{10}$ to a string voltage $U_{final}$ n × 1.80 $V_{pc}$. This capacity Ca value shall be corrected to 25 °C.
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 I = 2.0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for 25 °C.
4. After 24 h of charge the units shall be immediately discharged again with a current of $I_{10}$ to a string voltage $U_{final}$ n × 1.80 $V_{pc}$. This capacity value $C_{a24}$ shall be corrected to 25 °C.
5. The capacity found after 24 h of charge $C_{a24}$ shall be expressed as percentage of the initial actual capacity (recharge behaviour factor $R_{bf}$) as follows:
   $R_{bf24h} = (C_{a24} \times 100) / C_a$ %
6. The units shall be fully recharged and then again discharged, with unit temperature of 25 °C and a constant current of I = $I_{10}$ to a string voltage of n × 1.80 $V_{pc}$. This capacity Ca value shall be corrected to 25 °C.
7. After the discharge and a 1 h stand in the discharged state, the units shall be recharged with a current limited to I = 2.0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for 25 °C.
8. After 168 h of charge the units shall be discharged again with a current of $I_{10}$ to a string voltage of $U_{final}$ n × 1.80 $V_{pc}$. This capacity value $C_{a168}$ shall be corrected to 25 °C.
9. The capacity found after 168 h $C_{a168}$ shall be expressed as percentage of the initial actual capacity charge (recharge behaviour factor $R_{bf}$) as follows:
   $R_{bf168\,h} = (C_{a168} \times 100) / C_a$ %

Test result:

| Model name: | Sample No: | $C_{a24}$ (Ah) | $C_a$ (Ah) | $R_{bf24h}$ (%) | $C_{a168}$ (Ah) | $C_a$ (Ah) | $R_{bf168h}$ (%) |
|---|---|---|---|---|---|---|---|
| | 1# | | | | | | |
| | 2# | | | | | | |
| | 3# | | | | | | |

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

| **Table 6.15** | **Service life at an operating temperature of 40 °C** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ 0,95$C_3$ and was fully charged.

1. The units shall be float charged at 40 °C with the manufacturer's recommended float voltage for 25 °C.
2. Every 118 days ± 3 days the units shall, after cooling down to room temperature under float charge voltage setting, be subjected within 24 h ± 12 h to a determination of their individual actual capacity $C_a$ ($C_3$).
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 $C_{rt}$. The remaining units continue to be tested until the actual capacity of each unit is less than 0,8 $C_{rt}$.
4. The individual capacity values $C_a$ shall be plotted in a graph as function of days elapsed at 40 °C ± 2 K.
5. For each of the three cells or monobloc batteries, the intersection of the regression line, connecting the individual $C_a$ data points, with a horizontal line representing a capacity level of 0,8 $C_{rt}$ ($C_3$) shall be determined in terms of elapsed days at 40 °C and reported as the three individual values of days elapsed.

Test result:

| Model name: | Sample No: | Ca after each 118 days cycle | Number for 118 days cycles |
|---|---|---|---|
| | 1# | | |
| | 2# | | |
| | 3# | | |

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

| **Table 6.16** | **Impact of a stress temperature of 55 °C or 60 °C** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ 0,95$C_3$ and was fully charged.

1. The units shall be float charged at 55 °C or 60 °C with the manufacturer's recommended float voltage for 25 °C.
2. When tested at 55 °C, the units shall be cooled down, every 42 days ± 3 days, t room temperature under float charge setting and subjected, within 24h ± 12h, to a determination of their individual actual capacity Ca (at the 3 h rate to Ufinal 1,70 Vpc and/or at the 0,25 h rate to Ufinal 1,60 Vpc at the selected reference temperature).
   When tested at 60 °C, the units shall be cooled down, every 30 days ± 3 days, to room temperature under float charge and subjected, within 24 h ± 12 h, to a determination of their individual actual capacity Ca (at the 3 h rate to Ufinal 1,70 Vpc and/or at the 0,25 h rate to Ufinal 1,60 Vpc at the selected reference temperature).
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.

| Test result: | | | |
|---|---|---|---|
| Model name: | Sample No: | Ca after each 42 days cycle (55 °C impact) | Number for 42 days cycles |
| | 1# | | |
| | 2# | | |
| | 3# | | |
| Model name: | Sample No: | Ca after each 30 days cycle (60 °C impact) | Number for 30 days cycles |
| | 1# | | |
| | 2# | | |
| | 3# | | |

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

| **Table 6.17** | **Abusive over-discharge** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ $C_3$ 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.

**unbalanced string over-discharge test (four fully charged batteries string)**

1. This four unit string shall then be discharged, with all unit temperatures between 18 °C to 27 °C, with a current I = $I_{10}$ ($U_{final}$ 1,80 $V_{pc}$) until the voltage of the three, initially fully charged units reach a total voltage of $U_{final}$ of 3 × n × 1,70 $V_{pc}$ where n is the number of cells in this substring.
2. After the discharge and a 24 h ± 0,1 h stand in the discharged state, the four unit string shall be recharged in series for 168 h ± 0,1 h with a current limited to I = 2,0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.
3. At the end of the 168 h ± 0,1 h of charge, the units shall be subjected, as a four unit string, to a capacity test with a constant current of I = $I_3$ to a $U_{final}$ of 4 × n × 1,70 $V_{pc}$ and the capacity Ca corrected to 20 °C or 25 °C.
4. The capacity Ca of the string shall be referenced to the rated capacity Crt (3 h – $U_{final}$ 1,70 Vpc at the selected reference temperature) as shown below and gives the unbalanced over-discharge $C_{aod}$ capacity ratio. This value shall be reported.
   $C_{aod}$ = Ca / Crt

**cyclic over-discharge test (three fully charged batteries string)**

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 I = $I_{10}$ to a voltage $U_{final}$ of n × 1,25 $V_{pc}$ where n is the number of cells per unit or string.
2. After the discharge and a 1 h ± 0,1 h stand in the discharged state, the units shall be recharged for 168 h ± 0,1 h with a current limited to I = 2,0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.
3. The sequence outlined above shall be repeated 5 times.
4. At the end of the fifth 168 h ± 0,1 h of charge, the units or the string shall be
5. subjected to a capacity test with a constant current of I = $I_3$ to $U_{final}$ of n × 1,70 $V_{pc}$ and the capacity Ca corrected to 20 °C or 25 °C.
6. The capacity Ca of each unit or of the string shall be referenced to the rated capacity Crt (3 h – $U_{final}$ 1,70 Vpc at the selected reference temperature) as shown below and gives the cyclic over-discharge $C_{aoc}$ capacity ratio. This value(s) shall be reported
   $C_{aoc}$ = Ca / Crt

Test result:

| Model name: | Sample No: | Ca (Ah) | Crt (Ah) | $C_{aod}$ (%) |
|---|---|---|---|---|
| | | | | |
| | Sample No: | | | $C_{aoc}$ |
| | | | | |

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

| **Table 6.18** | **Thermal runaway sensitivity** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ $C_3$ and was fully charged.

1. The units shall be assembled with the intercell connectors.
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–1.
3. Temperature probes, with a resolution of 1 K and allowing a continuous registration of the temperature (interval between temperature measurements ⩽0,25 h), shall be installed as Figures 7 and 8
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 ⩽0,25 h.
5. The constant charge voltage, measured at the terminals of the string, shall be set to n × 2,45 $V_{pc}$ ± 0,01 Vpc throughout the test, where n is the number of cells in the string.
6. The elapsed time of charge to a unit temperature of 60 °C ± 1 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.
7. The string shall then be cooled down to room temperature in open circuit condition
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 ⩽0,25 h.
9. The constant charge voltage, measured at the terminals of the string, shall be set to n × 2,60 $V_{pc}$ ± 0,01 $V_{pc}$ throughout the test, where n is the number of cells in the string.
10. The elapsed time of charge to a temperature of unit 60 °C ± 1 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.

| Test result: | | | |
|---|---|---|---|
| Model name: | Sample No: | Duration of charge until a unit temperature of 60 °C ± 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 ± 1 K (probe a) is reached or the effective temperature (probe a) after 168 h of charge with 2,60 Vpc |
| | | | |

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

| **Table 6.19** | **Low temperature sensitivity** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

Each battery has an actual capacity Ca ≥ $C_3$ and was fully charged.

1. The units shall be individually discharged with a current of I = $I_{10}$ to an $U_{final}$ of n × 1,80 $V_{pc}$ at a unit temperature between 18 °C and 27 °C.
2. The discharged units shall then be placed in a test chamber with a forced flow of air having a temperature of –18 °C ± 2 K.
3. After 72 h ± 1 h of residence in the test chamber the units shall be withdrawn from the test chamber and, after 24 h ± 1 h of stand at open circuit, charged in a room with an ambient temperature between +18 to +27 °C for 168 h ± 0.1 h with a current limited to I =2.0 $I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C.
4. The units shall then be individually discharged with a current of I =$I_3$ to an $U_{final}$ of n × 1.70 $V_{pc}$ and the actual capacity $C_a$ corrected to 20 °C or 25 °C shall be recorded.
5. The capacity $C_a$ of each unit shall be referenced to the rated capacity $C_{rt}$. (3 h – $U_{final}$ 1.70 Vpc at the selected reference temperature) as shown below and gives the $C_{als}$ capacity ratio.

$$C_{als} = C_a / C_{rt}$$

6. These units shall be individually discharged in this second test, before low temperature exposure, with a current of I = $I_3$ to an $U_{final}$ of n × 1.70 $V_{pc}$ at a unit temperature between 18 °C and 27 °C.

Test result:

| Sample No. | | 20# | 21# | 22# | Remark |
|---|---|---|---|---|---|
| | Ca (Ah) | | | | |
| | Ca 25°C (Ah) | | | | |
| Cals (%) | | | | | |
| Battery status | | | | | |

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

| **Table 6.20** | **Dimensional stability at elevated internal pressures and temperatures** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

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.
2. The maximum outside dimension (width and length) of the cell case shall be measured before pressurization and recorded.
3. The pressurized unit shall be placed into a chamber with recirculating air at a temperature of 50 °C ± 2 K.
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.
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.

Test result:

| Sample No. | | Inner gas pressure/kPa | Temperature in Chamber/°C | Remark |
|---|---|---|---|---|
| | Gas pressure shall be same with maximum valve open pressure provided by manufacturer. Stay in high temperature chamber for 24h±0.1h, record. | | | Keep pressure during staying in high temperature chamber, record every 4hours. |
| | | | | |
| | | | | |
| | | Max Length | Max Width | |
| | Battery dimension before pressuring /mm | | | Measure before pressuring |
| | Battery dimension after pressuring for 24h /mm | | | Measure under 50°C ±2°C condition |
| | Dimension change value/mm | | | |
| | Dimension change rate/ % | | | |

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

| **Table 6.21** | **Stability against mechanical abuse of units during installation** | **Verdict:** | **N/A** |
|---|---|---|---|
| Test method: | | | |

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:
   a) Fall from 100 mm for units weighing up to 50 kg
   b) Fall from 50 mm for units weighing between 50 kg and 100 kg
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.
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.
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.

| Test result: | | | | | |
|---|---|---|---|---|---|
| Sample No. | | | | | |
| | Shortest edge drops | | First time | | |
| | | | Second time | | |
| | Corner drops | | First time | | |
| | | | Second time | | |

**Photos:**

C&D 12-7A LBT

**Photos:**

C&D 12-100 LBT

**Photos:**

TEL 12-150 TFA

**Photos:**

TEL 12-170 FGC

**Photos:**

TEL 12-210 FGC

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

**Photos:**

C&D 12-242A LBT

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

**Photos:**

C&D 12-370 DNT