



# TEST REPORT

**REPORT NO.....: HST201203-0443**

**NAME OF SAMPLE.....: Valve regulated Lead Acid Battery**

**MODEL NAME .....: See Table 1**

**APPLICANT NAME.....: Leoch International Technology Limited**

**CLASSIFICATION.....: Entrusted**

**PREPARED BY.....: Guangzhou Huesent Testing Service Co., Ltd.**



REPORT No: HST201203-0443

CNAS L2885

# TEST REPORT

IEC 60896.11-2002 IEC 61056.1-2012.

Report Reference No.: HST201203-0443

Tested by (+ signature): Jeff

Reviewed by (+ signature): Louis

Approved by (+ signature): Henry

Date of issue: August 22, 2022



## Client

Applicant: Leoch International Technology Limited

Address: 5th Floor, Xinbaohui Bldg., Nanhai Blvd., Nanshan, Shenzhen, China.

Manufacturer: Leoch International Technology Limited

Address: 5th Floor, Xinbaohui Bldg., Nanhai Blvd., Nanshan, Shenzhen, China.

## Testing laboratory

Name: Guangzhou Huesent Testing Service Co., Ltd.

Address: HST Testing Centre, No.91, Dongguanzhuang Road, Tianhe District, Guangzhou, China

Laboratory Qualification: Laboratory has been accredited by CNAS (China National Accreditation Service for Conformity Assessment) and CMA (China Metrology Accreditation), The CNAS registration number is L2885. The CMA registration number is 2008191614Z.

## Test specification

Standard: IEC 60896.11-2002 IEC 61056.1-2012

Sample Received Date: March 20, 2022

Test Duration: March 20, 2022 ~ August 22, 2022

Conformity: ☒ Yes ☐ No

## Test item

Description: Valve regulated Lead Acid Battery

Trademark: LEOCH

Model and/or type reference: See table 1

Remark: There are two hundred and sixty five models (see table 1) for application, shown in this report, with the difference being the outer sizes and capacity. All of the tests were performed on LPL12-250 (12V250AH) and LPX12-7.0(12V7.0Ah), and the results complied with the requirement of above standards. The item of Protection against internal ignition from external spark sources was tested by Guangdong Testing Institute of Product Quality Supervision, Report number No.QJ1201872.

Test Items and Description please refer to page four



## ITEMS FOR ATTENTION

1. It would be invalid test report without specific stamp for test institute or the authority.
2. It would be invalid duplicated report without specific stamp for test institute or the authority.
3. It would be invalid test report without all the signatures of compilation, reviewer and approver.
4. It would be invalid test report, if there is any scrawl in the test report without official authorization.
5. Any disputes about the report must be submitted for test institute within 15 days from the day when the report is received, otherwise that would be invalid out of expiry.
6. Generally, the responsible is only for the samples in entrusted test.

Remark: Possible test case verdicts:

Test case does not apply to the test object.....:N(.A.)

Test item does meet the requirement.....:P(ass)

Test item does not meet the requirement.....:F(ail)

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| Test item |                                                                     |                                                                                                                             |
|-----------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 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 feature                                                                              |
| 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                                    |
| 6.11      | Discharge capacity                                                  | To verify the available capacities at selected discharge rates or discharge durations.                                      |
| 6.13      | Float service with daily discharge                                  | 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                                                 |
| 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 battery to be deformed by internal pressure and at elevated temperature |
| 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.                               |



Table 1: Models for application

| No  | Model       | No  | Model       | No  | Model     | No  | Model      | No  | Model      |
|-----|-------------|-----|-------------|-----|-----------|-----|------------|-----|------------|
| 1   | DJW12-0.8   | 2   | DJW12-1.2   | 3   | DJW12-1.5 | 4   | DJW12-1.9  | 5   | DJW12-2.0C |
| 6   | DJW12-2.0C1 | 7   | DJW12-2.0NP | 8   | DJW12-2.1 | 9   | DJW12-2.3  | 10  | DJW12-2.3C |
| 11  | DJW12-2.5   | 12  | DJW12-2.6   | 13  | DJW12-2.8 | 14  | DJW12-2.9  | 15  | DJW12-3.0  |
| 16  | DJW12-3.5   | 17  | DJW12-3.2   | 18  | DJW12-3.5 | 19  | DJW12-4.0  | 20  | DJW12-4.0L |
| 21  | DJW12-2.0   | 22  | DJW12-4.5   | 23  | DJW12-5.0 | 24  | DJW12-5.0H | 25  | DJW12-5.4  |
| 26  | DJW12-5.5   | 27  | DJW12-6.0   | 28  | DJW12-6.5 | 29  | DJW12-7.8  | 30  | DJW12-7.0  |
| 31  | DJW12-7.0L  | 32  | DJW12-7.2   | 33  | DJW12-7.5 | 34  | DJW12-7.6  | 35  | DJW12-8.0  |
| 36  | DJW12-8.5   | 37  | DJW12-9.0   | 38  | DJW12-10  | 39  | DJW12-10H  | 40  | DJW12-12   |
| 41  | DJW12-14    | 42  | DJW12-15    | 43  | DJW12-17  | 44  | DJW12-18   | 45  | DJW12-20   |
| 46  | DJW12-22    | 47  | DJW12-24    | 48  | DJW12-24H | 49  | DJW12-26   | 50  | DJW12-26H  |
| 51  | DJW12-28    | 52  | DJW12-30    | 53  | DJW12-33  | 54  | DJW12-35   | 55  | DJM1238    |
| 56  | DJM1240     | 57  | DJM1245     | 58  | DJM1250   | 59  | DJM1255    | 60  | DJM1260    |
| 61  | DJM1265     | 62  | DJM1270     | 63  | DJM1272   | 64  | DJM1275    | 65  | DJM1275H   |
| 66  | DJM1280     | 67  | DJM1290     | 68  | DJM12100  | 69  | DJM12110   | 70  | DJM12120   |
| 71  | DJM12140    | 72  | DJM12150    | 73  | DJM12180  | 74  | DJM12200   | 75  | DJM12230   |
| 76  | DJM12250    | 77  | LP12-0.8    | 78  | LP12-1.2  | 79  | LP12-1.9   | 80  | LP12-2.0NP |
| 81  | LP12-2.0C1  | 82  | LP12-2.3    | 83  | LP12-2.3C | 84  | LP12-2.8   | 85  | LP12-2.9   |
| 86  | LP12-3.0    | 87  | LP12-3.2    | 88  | LP12-4.0L | 89  | LP12-4.0   | 90  | LP12-4.5   |
| 91  | LP12-5.0    | 92  | LP12-5.4    | 93  | LP12-6.0  | 94  | LP12-6.0H  | 95  | LP12-6.0L  |
| 96  | LP12-6.5    | 97  | LP12-7.0    | 98  | LP12-7.2  | 99  | LP12-7.5   | 100 | LP12-7.8   |
| 101 | LP12-8.5    | 102 | LP12-10     | 103 | LP12-10H  | 104 | LP12-12    | 105 | LP12-14    |
| 106 | LP12-15     | 107 | LP12-18     | 108 | LP12-20   | 109 | LP12-24    | 110 | LP12-24H   |
| 111 | LP12-26     | 112 | LP12-28     | 113 | LP12-28H  | 114 | LP12-30    | 115 | LP12-30H   |
| 116 | LP12-33     | 117 | LP12-35     | 118 | LP12-38   | 119 | LP12-40    | 120 | LP12-45    |
| 121 | LP12-50     | 122 | LP12-55     | 123 | LP12-60   | 124 | LP12-65    | 125 | LP12-70    |
| 126 | LP12-75     | 127 | LP12-80     | 128 | LP12-90   | 129 | LP12-90H   | 130 | LP12-100   |
| 131 | LP12-120    | 132 | LP12-135    | 133 | LP12-150  | 134 | LP12-180   | 135 | LP12-200   |
| 136 | LP12-250    | 137 | LPX12-2.2   | 138 | LPX12-3.2 | 139 | LPX12-5.4  | 140 | LPX12-6.0  |
| 141 | LPX12-6.5   | 142 | LPX12-7.0   | 143 | LPX12-7.6 | 144 | LPX12-12   | 145 | LPX12-17   |
| 146 | LPX12-18    | 147 | LPX12-20    | 148 | LPX12-24  | 149 | LPX12-35   | 150 | LPX12-38   |
| 151 | LPX12-65    | 152 | LPX12-72    | 153 | LPX12-100 | 154 | LPX12-120  | 155 | LPX12-150  |
| 156 | LPX12-200   | 157 | LPX12-250   | 158 | LPC12-3.5 | 159 | LPC12-5.6  | 160 | LPC12-7.2  |
| 161 | LPC12-8.0   | 162 | LPC12-13    | 163 | LPC12-18  | 164 | LPC12-20   | 165 | LPC12-24   |
| 166 | LPC12-24H   | 167 | LPC12-26    | 168 | LPC12-33  | 169 | LPC12-38   | 170 | LPC12-45   |
| 171 | LPC12-50    | 172 | LPC12-55    | 173 | LPC12-75  | 174 | LPC12-90H  | 175 | LPC12-100  |
| 176 | LPC12-120   | 177 | LPC12-150   | 178 | LPC12-200 | 179 | LPL12-4.5  | 180 | LPL12-6.0  |
| 181 | LPL12-7.0   | 182 | LPL12-12    | 183 | LPL12-18  | 184 | LPL12-24H  | 185 | LPL12-24   |
| 186 | LPL12-26    | 187 | LPL12-28H   | 188 | LPL12-28  | 189 | LPL6-100   | 190 | LPL6-150   |
| 191 | LPL6-200    | 192 | LPL12-38    | 193 | LPL12-45  | 194 | LPL12-55   | 195 | LPL12-60   |
| 196 | LPL12-65    | 197 | LPL12-70    | 198 | LPL12-75  | 199 | LPL12-90H  | 200 | LPL12-100  |



|     |             |     |             |     |            |     |             |     |             |
|-----|-------------|-----|-------------|-----|------------|-----|-------------|-----|-------------|
| 201 | LPL12-120   | 202 | LPL12-140   | 203 | LPL12-150  | 204 | LPL12-200   | 205 | LPL12-250   |
| 206 | LPS12-7.5   | 207 | LPS12-18    | 208 | LPS12-20   | 209 | LPS12-30    | 210 | LPS12-36    |
| 211 | LPS12-40    | 212 | LPS12-45FT  | 213 | LPS12-50   | 214 | LPS12-55    | 215 | LPS12-60FT  |
| 216 | LPS12-75    | 217 | LPS12-85FT  | 218 | LPS12-85   | 219 | LPS12-90    | 220 | LPS12-100FT |
| 221 | LPS12-115   | 222 | LPS12-115FT | 223 | LPS12-135  | 224 | LPS12-145FT | 225 | LPS12-160   |
| 226 | LPS12-170FT | 227 | LPS12-230   | 228 | LPS12-285  | 229 | LPF12-40    | 230 | LPF12-55    |
| 231 | LPF12-70    | 232 | LPF12-75    | 233 | LPF12-90   | 234 | LPF12-90H   | 235 | LPF12-100A  |
| 236 | LPF12-100B  | 237 | LPF12-100H  | 238 | LPF12-125  | 239 | LPF12-150A  | 240 | LPF12-150B  |
| 241 | LPF12-180   | 242 | XP12-100    | 243 | XP12-150   | 244 | XP12-210    | 245 | XP12-300    |
| 246 | XP12-350    | 247 | XP12-400    | 248 | XP12-490LP | 249 | XP12-490    | 250 | XP12-540    |
| 251 | EP12-590FT  | 252 | EP12-470FT  | 253 | EP12-430FT | 254 | EP12-360FT  | 255 | EP12-450    |
| 256 | EP12-400    | 257 | EP12-82     | 258 | EP100FT    | 259 | EP140FT     | 260 | EP160FT     |
| 261 | EP195FT     | 262 | EP110       | 263 | EP100      | 264 | EP12-17     | 265 | LP12-2.2    |

| No.                                                | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Result - Remark                                                                                                                                     | Verdict |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------------------------------------------|-----------------------------|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6                                                  | Requirements and characteristics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.1                                                | Requirements for gas emission information                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.1.1                                              | The purpose of this requirement (see Table 4) is the determination of gas emission volumes under normal float and overcharge voltage conditions.                                                                                                                                                                                                                                                                                                                                                                                            | LPL12-250<br>(12V250Ah):<br>float charge:<br>$G_e=0,0037\text{ml per cell, hour and Ah}$                                                            | -       |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.1.2                                              | The result of this test documents the amount of gas, reported as hydrogen, released during the float- and overcharge conditions.<br>This value can be used by designers of equipment and facilities to validate if adequate air exchange exists in accordance with national or international standards for battery room ventilation.                                                                                                                                                                                                        | $G_e=0,033\text{ ml per cell, hour and Ah}$                                                                                                         |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.1.3                                              | <table><tr><th colspan="3">Table 4 – Requirement for gas emission information</th></tr><tr><th rowspan="2">Requirement and application</th><th colspan="2">Measure gas volumes<br/>(6.1 of IEC 60896-11)</th></tr><tr><th>At the rated float charge voltage</th><th>At 2,40 V pc overcharge voltage conditions</th></tr><tr><td>State data for all applications</td><td>ml gas per cell, h and Ah at 20° or 25 °C</td><td>ml gas per cell, h and Ah at 20° or 25 °C</td></tr></table>                                                       | Table 4 – Requirement for gas emission information                                                                                                  |         |                                                  | Requirement and application | Measure gas volumes<br>(6.1 of IEC 60896-11) |                                                                                                                                                | At the rated float charge voltage | At 2,40 V pc overcharge voltage conditions                                                                                                                              | State data for all applications | ml gas per cell, h and Ah at 20° or 25 °C | ml gas per cell, h and Ah at 20° or 25 °C | LPX12-7.0<br>(12V7,0Ah):<br>float charge:<br>$G_e=0,0017\text{ml per cell, hour and Ah}$<br>overcharge:<br>$G_e=0,019\text{ml per cell, hour and Ah}$ |
| Table 4 – Requirement for gas emission information |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| Requirement and application                        | Measure gas volumes<br>(6.1 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
|                                                    | At the rated float charge voltage                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | At 2,40 V pc overcharge voltage conditions                                                                                                          |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| State data for all applications                    | ml gas per cell, h and Ah at 20° or 25 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ml gas per cell, h and Ah at 20° or 25 °C                                                                                                           |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.2                                                | Requirement for high current tolerance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.2.1                                              | The purpose of this requirement (see Table 5) is the verification that the design of the internal current conducting components is robust enough so to withstand short periods of abnormally high discharge current which may occur before current limiting devices in the exterior circuit activate (fuses etc.)                                                                                                                                                                                                                           | LPL12-250<br>(12V250Ah):<br>$U=2,16\text{Vpc}$<br>It has no any damage<br><br>LPX12-7.0<br>(12V7,0Ah)<br>$U=2,13\text{Vpc}$<br>It has no any damage | P       |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| 6.2.2                                              | The result of this test documents the condition of the top-lead and of the terminals after 30 s of high current flow at a level below the maximum short circuit current of the tested unit.                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
|                                                    | <table><tr><th colspan="2">Table 5 – Requirement for high current tolerance</th></tr><tr><th>Requirement and application</th><th>Measure unit voltage, inspect and document the status of the top-lead and terminals of each unit after 30 s current flow (6.2 of IEC 60896-11)</th></tr><tr><td>Pass for all applications</td><td>Voltage of unit <math>&gt;2,0\text{ V pc}</math><br/>Show evidence of no incipient melting or of no loss of electrical continuity after 30 s of high current flow (value to be stated)</td></tr></table> |                                                                                                                                                     |         | Table 5 – Requirement for high current tolerance |                             | Requirement and application                  | Measure unit voltage, inspect and document the status of the top-lead and terminals of each unit after 30 s current flow (6.2 of IEC 60896-11) | Pass for all applications         | Voltage of unit $>2,0\text{ V pc}$<br>Show evidence of no incipient melting or of no loss of electrical continuity after 30 s of high current flow (value to be stated) |                                 |                                           |                                           |                                                                                                                                                       |
| Table 5 – Requirement for high current tolerance   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| Requirement and application                        | Measure unit voltage, inspect and document the status of the top-lead and terminals of each unit after 30 s current flow (6.2 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |
| Pass for all applications                          | Voltage of unit $>2,0\text{ V pc}$<br>Show evidence of no incipient melting or of no loss of electrical continuity after 30 s of high current flow (value to be stated)                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                     |         |                                                  |                             |                                              |                                                                                                                                                |                                   |                                                                                                                                                                         |                                 |                                           |                                           |                                                                                                                                                       |

| No.                                                                                       | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Result - Remark                                                                                                                           | Verdict |                                                                                           |  |                             |                                                                                                                                  |
|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------------------------------------------------------------------------|--|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| 6.3                                                                                       | Requirement for short-circuit current and d. c. internal resistance information                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| 6.3.1                                                                                     | The purpose of this requirement (see Table 6) is to provide data about the possible short circuit current flowing from the unit into an exterior circuit of negligible resistance compared to that of the unit itself.                                                                                                                                                                                                                                                                                          | LPL12-250<br>(12V250Ah):<br>$I_{sc}=4350A$<br>$R_i=0,0029\ \Omega$<br>LPX12-7.0<br>(12V7,0Ah):<br>$I_{sc}=267.6A$<br>$R_i=0,0486\ \Omega$ | -       |                                                                                           |  |                             |                                                                                                                                  |
| 6.3.2                                                                                     | The result of this test documents the current delivery capability of the units and can be used to determine the size and suitable type of safety devices such as fuses or circuit breakers. The values have an accuracy of $\pm 10\%$ . The test also yields, at the same time and using the same method, the internal d. c. resistance of the units.                                                                                                                                                           |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
|                                                                                           | <table><tr><td colspan="2">Table 6 – Requirement for short-circuit current and d. c. internal resistance information</td></tr><tr><td>Requirement and application</td><td>Define prospective short-circuit value <math>I_{sc}</math> and internal resistance <math>R_i</math> of all units of a type range (6.3 of IEC 60896-11)</td></tr><tr><td>State data for all applications</td><td>Short-circuit current (<math>I_{sc}</math>) in A<br/>Internal resistance (<math>R_i</math>) in ohms</td></tr></table> |                                                                                                                                           |         | Table 6 – Requirement for short-circuit current and d. c. internal resistance information |  | Requirement and application | Define prospective short-circuit value $I_{sc}$ and internal resistance $R_i$ of all units of a type range (6.3 of IEC 60896-11) |
| Table 6 – Requirement for short-circuit current and d. c. internal resistance information |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| Requirement and application                                                               | Define prospective short-circuit value $I_{sc}$ and internal resistance $R_i$ of all units of a type range (6.3 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| State data for all applications                                                           | Short-circuit current ( $I_{sc}$ ) in A<br>Internal resistance ( $R_i$ ) in ohms                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| 6.4                                                                                       | Requirement for protection against internal ignition from external spark sources                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| 6.4.1                                                                                     | The purpose of this requirement (see Table 7) is to evaluate the adequacy of protective features such as the valve/flame barrier assembly as a safeguard against the ignition of gases, within the volume enclosed by the valve, from an external ignition source. The external ignition source shall be in the form of sparks generated between two auxiliary electrodes.                                                                                                                                      | Compliant                                                                                                                                 | P       |                                                                                           |  |                             |                                                                                                                                  |
| 6.4.2                                                                                     | The results of this test documents the protection afforded by the flame barrier at the valve/flame barrier assembly when a defined hydrogen gas volume emission occurs and sparks are generated near the gas-venting opening.                                                                                                                                                                                                                                                                                   |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
|                                                                                           | <table><tr><td colspan="2">Table 7 – Requirement for protection against internal ignition from external spark source</td></tr><tr><td>Requirement and application</td><td>Induce sparks near representative valve/barrier assemblies during gas emission (6.4 of IEC 60896-11)</td></tr><tr><td>Pass for all applications</td><td>No evidence of rapid combustion or explosion beyond valve/barrier assemblies</td></tr></table>                                                                                |                                                                                                                                           |         | Table 7 – Requirement for protection against internal ignition from external spark source |  | Requirement and application | Induce sparks near representative valve/barrier assemblies during gas emission (6.4 of IEC 60896-11)                             |
| Table 7 – Requirement for protection against internal ignition from external spark source |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| Requirement and application                                                               | Induce sparks near representative valve/barrier assemblies during gas emission (6.4 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |
| Pass for all applications                                                                 | No evidence of rapid combustion or explosion beyond valve/barrier assemblies                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                           |         |                                                                                           |  |                             |                                                                                                                                  |

| No. | Requirement – Test | Result - Remark | Verdict |
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|                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| 6.18                                                                                                                  | Requirements for information on thermal runaway sensitivity                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
| 6.18.1                                                                                                                | The purpose of the requirement (see Table 22) is to elicit standardized information about how soon units may enter thermal runaway conditions when exposed to higher than normal voltages under specified conditions.                                                                                                                                                                                                                                                                                             | LPL12-250<br>(12V250Ah):<br>Ultimate temperature after 168 h at 2,45 Vpc:                             | P                                                            |                                                                                                                                                                                                |                                                                                                                       |
| 6.18.2                                                                                                                | The result of this test documents the elapsed time and the current associated before reaching elevated temperatures with standardized battery layouts. This facilitates the evaluation if a particular unit design shows increased sensitivity toward escalating temperature and current conditions.                                                                                                                                                                                                              | $T_a=40^{\circ}\text{C}$<br>Ultimate temperature after 168 h at 2,60 Vpc:                             |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|                                                                                                                       | <b>Table 22 – Requirements for information on thermal runaway sensitivity</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|                                                                                                                       | <table><tr><td>Requirement and application</td><td>Determine temperature evolution of units with the duration of charge at 2,45 Vpc<br/>Determine temperature evolution of units with the duration of charge at 2,60 Vpc<br/>(6.18 of IEC 60896-11)</td></tr><tr><td>Comply for all applications</td><td>Achieve at least 1 week below 60 °C at 2,45 Vpc and at least 24 h below 60 °C at 2,60 Vpc<br/>Show ultimate time to 60 °C or ultimate temperature after 168 hat 2,45 Vpc and 2,60 Vpc.</td></tr></table> | Requirement and application                                                                           |                                                              | Determine temperature evolution of units with the duration of charge at 2,45 Vpc<br>Determine temperature evolution of units with the duration of charge at 2,60 Vpc<br>(6.18 of IEC 60896-11) | Comply for all applications                                                                                           |
| Requirement and application                                                                                           | Determine temperature evolution of units with the duration of charge at 2,45 Vpc<br>Determine temperature evolution of units with the duration of charge at 2,60 Vpc<br>(6.18 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                    |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
| Comply for all applications                                                                                           | Achieve at least 1 week below 60 °C at 2,45 Vpc and at least 24 h below 60 °C at 2,60 Vpc<br>Show ultimate time to 60 °C or ultimate temperature after 168 hat 2,45 Vpc and 2,60 Vpc.                                                                                                                                                                                                                                                                                                                             |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | $T_a=38^{\circ}\text{C}$<br>Ultimate temperature after 168 h at 2,60 Vpc:<br>$T_b=45^{\circ}\text{C}$ |                                                              |                                                                                                                                                                                                |                                                                                                                       |
| 6.19                                                                                                                  | Requirement for the impact of low temperature service on capacity                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
| 6.19.1                                                                                                                | The purpose of this requirement (see Table 23) is to ensure that units experiencing abusive low temperature conditions during service life show a minimum of mechanical stability against freezing induced forces and adequate capacity recovery under specified conditions.                                                                                                                                                                                                                                      | LPL12-250<br>(12V250Ah):                                                                              | P                                                            |                                                                                                                                                                                                |                                                                                                                       |
| 6.19.2                                                                                                                | The result of this test documents how a particular unit design is capable of withstanding electrolyte freezing which may be encountered in installations without adequate thermal protection and mains supply stability.                                                                                                                                                                                                                                                                                          | $C_{als} = 0.97 C_{rt(3h \text{ rate})}$<br>No mechanical damages                                     |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|                                                                                                                       | <b>Table 23 – Requirement for the impact of low temperature service on capacity</b>                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|                                                                                                                       | <table><tr><td rowspan="2">Requirement and service environment</td><td>Determine capacity of units(6.19 of IEC 60896-11)</td></tr><tr><td>Show abusive low temperature service capacity (<math>C_{als}</math>) of all units and report eventual freezing induced damages</td></tr></table>                                                                                                                                                                                                                        | Requirement and service environment                                                                   |                                                              | Determine capacity of units(6.19 of IEC 60896-11)                                                                                                                                              | Show abusive low temperature service capacity ( $C_{als}$ ) of all units and report eventual freezing induced damages |
|                                                                                                                       | Requirement and service environment                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                       | Determine capacity of units(6.19 of IEC 60896-11)            |                                                                                                                                                                                                |                                                                                                                       |
| Show abusive low temperature service capacity ( $C_{als}$ ) of all units and report eventual freezing induced damages |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |
|                                                                                                                       | <table><tr><td>Battery may experience freezing temperatures</td><td>&gt;0,95 and no mechanical damages<br/>(see Notes 1 and 2 below)</td></tr></table>                                                                                                                                                                                                                                                                                                                                                            | Battery may experience freezing temperatures                                                          | >0,95 and no mechanical damages<br>(see Notes 1 and 2 below) | $C_{als} = 0.96 C_{rt(3h \text{ rate})}$<br>No mechanical damages                                                                                                                              |                                                                                                                       |
| Battery may experience freezing temperatures                                                                          | >0,95 and no mechanical damages<br>(see Notes 1 and 2 below)                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                       |                                                              |                                                                                                                                                                                                |                                                                                                                       |



| No. | Requirement – Test | Result - Remark | Verdict |
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|                                          |                                                                                                                                                                                                                                                                                                                                                                                                 |                                           |   |                             |                                                                                        |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---|-----------------------------|----------------------------------------------------------------------------------------|
| 6.5                                      | Requirement for protection against ground short propensity                                                                                                                                                                                                                                                                                                                                      |                                           |   |                             |                                                                                        |
| 6.5.1                                    | The purpose of this requirement (see Table 8) is to confirm the satisfactory resistance of the units toward phenomena enhancing ground shorts such as the occurrence of an electrolyte break-through at seals, joints or at terminals. An electrolyte break-through can be enhanced by gravity (horizontal position operation mode) and d. c. voltage gradients (electrocapillarity phenomena). | Absence of ground short/leakage phenomena | P |                             |                                                                                        |
| 6.5.2                                    | The result of this test documents if a particular operating orientation results inconductive paths of electrolyte causing ground short current flow conditions and associated fire risks                                                                                                                                                                                                        |                                           |   |                             |                                                                                        |
|                                          | <div>Table 8 – Requirement for protection against ground short propensity</div> <table><tr><td>Requirement and application</td><td>Operate units in different orientations and apply d. c. gradient (6.5 of IEC 60896-11)</td></tr><tr><td>Pass for all applications</td><td>No evidence of ground short and leakage phenomena</td></tr></table>                                                |                                           |   | Requirement and application | Operate units in different orientations and apply d. c. gradient (6.5 of IEC 60896-11) |
| Requirement and application              | Operate units in different orientations and apply d. c. gradient (6.5 of IEC 60896-11)                                                                                                                                                                                                                                                                                                          |                                           |   |                             |                                                                                        |
| Pass for all applications                | No evidence of ground short and leakage phenomena                                                                                                                                                                                                                                                                                                                                               |                                           |   |                             |                                                                                        |
| 6.6                                      | Requirement for content and durability of required markings                                                                                                                                                                                                                                                                                                                                     |                                           |   |                             |                                                                                        |
| 6.6.1                                    | The purpose of this requirement (see Tables 9 and 10) is to ensure the presence of essential product and safety information on each unit and their legibility after exposure to a set of chemicals.                                                                                                                                                                                             | Information remain readable               | P |                             |                                                                                        |
| 6.6.2                                    | The result of this test documents the presence of a minimum of information content and stability against chemicals                                                                                                                                                                                                                                                                              |                                           |   |                             |                                                                                        |
|                                          | <div>Table 9 – Requirement for content and durability of required markings – Requirement a)</div> <table><tr><td>Requirement and application</td><td>Expose information to chemicals (6.6 of IEC 60896-11)</td></tr><tr><td>Pass all substances for all applications</td><td>Information shall remain readable after exposure to chemicals and remain in place</td></tr></table>                |                                           |   | Requirement and application | Expose information to chemicals (6.6 of IEC 60896-11)                                  |
| Requirement and application              | Expose information to chemicals (6.6 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                           |                                           |   |                             |                                                                                        |
| Pass all substances for all applications | Information shall remain readable after exposure to chemicals and remain in place                                                                                                                                                                                                                                                                                                               |                                           |   |                             |                                                                                        |



| No.                                                                                     | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Result - Remark                                                                         | Verdict |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|---------|-----------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------|---------------------------------|---------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|---------|-------------------|--------------------------|---------------------|-------------------|--------------------------------------------------------------|------------------|-----------------------|--|---|
|                                                                                         | <table><tr><th colspan="2">Table 10 – Requirement for content and durability of required markings – Requirement b)</th></tr><tr><td>Requirement and application</td><td>Inspect for the following minimum of information to be present (6.6 of IEC 60896-11)</td></tr><tr><td rowspan="18">Requested information to be present for all applications</td><td>Technical information to be present</td></tr><tr><td>Polarity sign at the positive terminal(s) with a + symbol radius of at least 6 mm</td></tr><tr><td>Manufacturer and/or vendor name</td></tr><tr><td>Country of origin of unit</td></tr><tr><td>Type designation of unit</td></tr><tr><td>At least one rated capacity and its final voltage in Vpc or V per unit at a rate listed in 6.11 of IEC 60896-2-1</td></tr><tr><td>Rated temperature (20 °C or 25 °C) for the capacity value</td></tr><tr><td>at voltage in V pc or V per unit at a rated temperature of 20 °C and/or 25 °C</td></tr><tr><td>Date of manufacture(see Note1below ) in clear unequivocal mm. yyyy format</td></tr><tr><td>ISO warning symbols to be present with 11 mm diameter minimum size and in two contrasting colours (See Note 2 and 3 below)</td></tr><tr><td>Warning</td></tr><tr><td>Electrical danger</td></tr><tr><td>No open fires and sparks</td></tr><tr><td>Wear eye protection</td></tr><tr><td>Read instructions</td></tr><tr><td>Environmental protection and recycling symbols to be present</td></tr><tr><td>Recycling symbol</td></tr><tr><td>Crossed out waste bin</td></tr></table> | Table 10 – Requirement for content and durability of required markings – Requirement b) |         | Requirement and application | Inspect for the following minimum of information to be present (6.6 of IEC 60896-11) | Requested information to be present for all applications | Technical information to be present | Polarity sign at the positive terminal(s) with a + symbol radius of at least 6 mm | Manufacturer and/or vendor name | Country of origin of unit | Type designation of unit | At least one rated capacity and its final voltage in Vpc or V per unit at a rate listed in 6.11 of IEC 60896-2-1 | Rated temperature (20 °C or 25 °C) for the capacity value | at voltage in V pc or V per unit at a rated temperature of 20 °C and/or 25 °C | Date of manufacture(see Note1below ) in clear unequivocal mm. yyyy format | ISO warning symbols to be present with 11 mm diameter minimum size and in two contrasting colours (See Note 2 and 3 below) | Warning | Electrical danger | No open fires and sparks | Wear eye protection | Read instructions | Environmental protection and recycling symbols to be present | Recycling symbol | Crossed out waste bin |  | P |
| Table 10 – Requirement for content and durability of required markings – Requirement b) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
| Requirement and application                                                             | Inspect for the following minimum of information to be present (6.6 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
| Requested information to be present for all applications                                | Technical information to be present                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Polarity sign at the positive terminal(s) with a + symbol radius of at least 6 mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Manufacturer and/or vendor name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Country of origin of unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Type designation of unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | At least one rated capacity and its final voltage in Vpc or V per unit at a rate listed in 6.11 of IEC 60896-2-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Rated temperature (20 °C or 25 °C) for the capacity value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | at voltage in V pc or V per unit at a rated temperature of 20 °C and/or 25 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Date of manufacture(see Note1below ) in clear unequivocal mm. yyyy format                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | ISO warning symbols to be present with 11 mm diameter minimum size and in two contrasting colours (See Note 2 and 3 below)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Warning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Electrical danger                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | No open fires and sparks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Wear eye protection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Read instructions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Environmental protection and recycling symbols to be present                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Recycling symbol                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
|                                                                                         | Crossed out waste bin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
| 6.7                                                                                     | Requirement for material identification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |
| 6.7.1                                                                                   | The purpose of this requirement (see Table 11) is to enhance the recycling of material for environmental protection by ensuring that the plastic materials used for the units are clearly identified with the ISO 1043-1 material symbol and legible throughout the service life.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         |         |                             |                                                                                      |                                                          |                                     |                                                                                   |                                 |                           |                          |                                                                                                                  |                                                           |                                                                               |                                                                           |                                                                                                                            |         |                   |                          |                     |                   |                                                              |                  |                       |  |   |

| No.   | Requirement – Test                                                                                                                                                                                                                                 | Result - Remark                                                                                             | Verdict |                                                                                                                                         |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 6.7.2 | The result of this test documents the presence of correct and legible material identification.                                                                                                                                                     | All the symbol remain readable                                                                              | P       |                                                                                                                                         |
|       | <b>Table 11 – Requirement for material identification</b>                                                                                                                                                                                          |                                                                                                             |         |                                                                                                                                         |
|       | Requirement and application                                                                                                                                                                                                                        |                                                                                                             |         | Inspect case and/or cover for ISO 1043-1 materials symbol. Expose to chemicals.(6.6 and 6.7 of IEC 60896-11)                            |
|       | Pass for all applications                                                                                                                                                                                                                          |                                                                                                             |         | ISO symbol present on the outside of the cover or/and case Symbol shall remain readable after exposure to chemicals and remain in place |
| 6.8   | <b>Requirement for the operation of the valve</b>                                                                                                                                                                                                  |                                                                                                             |         |                                                                                                                                         |
| 6.8.1 | The purpose of this requirement (see Table 12) is to ensure that each valve on the unit is opening and releasing gas before and after the high temperature (55 °C or 60 °C) stress test.                                                           | The valve adequate opening<br><br>Gas release detected before and after stress temperature impact test      | P       |                                                                                                                                         |
| 6.8.2 | The result of this test documents that the valve of the cell will function properly as a one-way vent over the service life of the unit.                                                                                                           |                                                                                                             |         |                                                                                                                                         |
|       | <b>Table 12 – Requirement for the operation of the valve</b>                                                                                                                                                                                       |                                                                                                             |         |                                                                                                                                         |
|       | Requirement and application                                                                                                                                                                                                                        |                                                                                                             |         | Overcharge units and detect gas flow from the valve (6.8 of IEC 60896-11)                                                               |
|       | Pass all substances for all applications                                                                                                                                                                                                           | Gas release detected before and after stress temperature impact test                                        |         |                                                                                                                                         |
| 6.9   | <b>Requirement for definition of the flammability rating of the materials</b>                                                                                                                                                                      |                                                                                                             |         |                                                                                                                                         |
| 6.9.1 | The purpose of this requirement (see Table 13) is to ensure that the burning properties of the non-metallic materials of the case/cover have been defined in accordance with international standards by completing an appropriate laboratory test. | LPL12-250<br><br>(12V250Ah):<br><br>HB 75, V-0<br><br><br><br>LPX12-7.0<br><br>(12V7,0Ah):<br><br>HB 75,V-0 | -       |                                                                                                                                         |
| 6.9.2 | The result of this test documents the burning and self-extinguishing property levels resulting from the plastic material of the units so to plan adequate fire safety measures.                                                                    |                                                                                                             |         |                                                                                                                                         |
|       | <b>Table 13 – Requirement for definition of the flammability rating of the materials</b>                                                                                                                                                           |                                                                                                             |         |                                                                                                                                         |
|       | Requirement and application                                                                                                                                                                                                                        |                                                                                                             |         | Determine flammability rating of case and cover material(6.9 of IEC 60896-11)                                                           |
|       | State data for all applications                                                                                                                                                                                                                    | State the flammability rating level for samples of thickness equivalent to that of case and cover           |         |                                                                                                                                         |

| No.                                                                                                                                                                         | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Result - Remark                                                                                                                                                                                                                                                                                          | Verdict         |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------------|-------------------------------------------------------------------------------------------|---------------------------------|-----------------------------------|-----------------------------|-----------------------------------------------------|--|--|--|--|----------------------------------------------------------------------------------|--|--|--|--|-----------------|----------------|-----------------|-----------------|--------------------|-----------------------------|-----------------------------------------------|--|--|--|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.10                                                                                                                                                                        | Requirement for performance of the intercell connector                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| 6.10.1                                                                                                                                                                      | The purpose of this requirement (see Table 14) is to show the maximum temperature reached by the specified intercell connector (the external conductor that connects individual units or monoblocs to form a battery) under the high current conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | LPL12-250<br>(12V250Ah):<br>the maximum<br>temperature:48°C                                                                                                                                                                                                                                              | -               |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| 6.10.2                                                                                                                                                                      | The result of this test documents if a high temperature (T > 70 °C) hazard exists on the connector during a high rate discharge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | LPX12-7.0<br>(12V7,0Ah)<br>the maximum<br>temperature:43°C                                                                                                                                                                                                                                               |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                             | <table><tr><td colspan="2">Table 14 – Requirement for performance of the intercell connector</td></tr><tr><td>Requirement and application</td><td>Measure and report maximum intercell connector temperature reached (6.10 of IEC 60896-11)</td></tr><tr><td>State data for all applications</td><td>State maximum temperature reached</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Table 14 – Requirement for performance of the intercell connector                                                                                                                                                                                                                                        |                 | Requirement and application | Measure and report maximum intercell connector temperature reached (6.10 of IEC 60896-11) | State data for all applications | State maximum temperature reached |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| Table 14 – Requirement for performance of the intercell connector                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| Requirement and application                                                                                                                                                 | Measure and report maximum intercell connector temperature reached (6.10 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| State data for all applications                                                                                                                                             | State maximum temperature reached                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| 6.11                                                                                                                                                                        | Requirement for discharge capacity performance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| 6.11.1                                                                                                                                                                      | The purpose of this requirement (see Table 15) is to confirm the capacity to a specific end-voltage at the selected discharge rate or rates, at the moment of unit dispatch.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | LPL12-250<br>(12V250Ah):<br>C <sub>10</sub> =262,5 Ah<br>(C <sub>rt</sub> =250Ah)<br>C <sub>8</sub> =256,3Ah<br>(C <sub>rt</sub> = 245,6Ah)<br>C <sub>3</sub> =222,2Ah<br>(C <sub>rt</sub> =195 Ah)<br>C=175Ah<br>(C <sub>rt</sub> =155Ah)<br>C <sub>0,25</sub> =104,7Ah<br>(C <sub>rt</sub> =101,275Ah) | P               |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| 6.11.2                                                                                                                                                                      | The result of this test documents the level of compliance of the actual capacity with the rated capacity at the moment of dispatch of a sample of six units at five separate discharge rates.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                             | <table><tr><td colspan="6">Table 15 – Requirement for discharge capacity performance</td></tr><tr><td rowspan="3">Requirement and application</td><td colspan="5">Determine actual capacity Ca (6.11 of IEC 60896-11)</td></tr><tr><td colspan="5">Ca to be at least X % of C<sub>rt</sub> with all units at all rates shown below</td></tr><tr><td>10 h<br/>1,80Vpc</td><td>8 h<br/>1,75Vpc</td><td>3 h<br/>1,70 Vpc</td><td>1 h<br/>1,60 Vpc</td><td>0.25 h<br/>1,60 Vpc</td></tr><tr><td>Comply for all applications</td><td colspan="5">Ca ≥ 95 % C<sub>rt</sub><br/>(see note below)</td></tr><tr><td colspan="6">NOTE The requirement of Ca ≥95 % C<sub>rt</sub> applies not to the average but to each individual capacity of each of the 6 units tested with a particular discharge rate.</td></tr></table> | Table 15 – Requirement for discharge capacity performance                                                                                                                                                                                                                                                |                 |                             |                                                                                           |                                 |                                   | Requirement and application | Determine actual capacity Ca (6.11 of IEC 60896-11) |  |  |  |  | Ca to be at least X % of C <sub>rt</sub> with all units at all rates shown below |  |  |  |  | 10 h<br>1,80Vpc | 8 h<br>1,75Vpc | 3 h<br>1,70 Vpc | 1 h<br>1,60 Vpc | 0.25 h<br>1,60 Vpc | Comply for all applications | Ca ≥ 95 % C <sub>rt</sub><br>(see note below) |  |  |  |  | NOTE The requirement of Ca ≥95 % C <sub>rt</sub> applies not to the average but to each individual capacity of each of the 6 units tested with a particular discharge rate. |  |  |  |  |  | LPX12-7.0<br>(12V7,0Ah):<br>C <sub>10</sub> =8,3 Ah<br>(C <sub>rt</sub> =7,2Ah)<br>C <sub>8</sub> =8,4Ah<br>(C <sub>rt</sub> = 7Ah)<br>C <sub>3</sub> =8,0Ah<br>(C <sub>rt</sub> =5,97 Ah)<br>C=6,7Ah<br>(C <sub>rt</sub> = 5,91Ah)<br>C <sub>0,25</sub> =4,7Ah<br>(C <sub>rt</sub> =4,2Ah) |
| Table 15 – Requirement for discharge capacity performance                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| Requirement and application                                                                                                                                                 | Determine actual capacity Ca (6.11 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                             | Ca to be at least X % of C <sub>rt</sub> with all units at all rates shown below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
|                                                                                                                                                                             | 10 h<br>1,80Vpc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 8 h<br>1,75Vpc                                                                                                                                                                                                                                                                                           | 3 h<br>1,70 Vpc | 1 h<br>1,60 Vpc             | 0.25 h<br>1,60 Vpc                                                                        |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| Comply for all applications                                                                                                                                                 | Ca ≥ 95 % C <sub>rt</sub><br>(see note below)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |
| NOTE The requirement of Ca ≥95 % C <sub>rt</sub> applies not to the average but to each individual capacity of each of the 6 units tested with a particular discharge rate. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                          |                 |                             |                                                                                           |                                 |                                   |                             |                                                     |  |  |  |  |                                                                                  |  |  |  |  |                 |                |                 |                 |                    |                             |                                               |  |  |  |  |                                                                                                                                                                             |  |  |  |  |  |                                                                                                                                                                                                                                                                                             |

| No.                                        | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Result - Remark                                                                                                                                                  | Verdict                                             |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--|--|------------------------------------------------------------------------|--|--|-----------------------------------------------------------------------------------------------|--|--|--------------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-----------------------------|------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------|-------------------|------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| <b>6.13</b>                                | <b>Requirement for float service with daily discharges</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| 6.13.1                                     | The purpose of this requirement (see Table 17) is to define the aggregate capacity and cycling behaviour of the battery undergoing very frequent or even daily discharges such as experienced in areas with irregular or insufficient main supply, and where recharge can be carried out only under float voltage settings conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| 6.13.2                                     | The result of this test documents the capability of the particular battery design to operate satisfactorily for extended periods with a very limited amount of overcharge following each discharge.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | LPL12-250<br>(12V250Ah):<br>Cycle number=102<br>Float charge:<br>$C_{af}=84\% C_{rt(3h \text{ rate})}$<br>Boost charge:<br>$C_{ab}=89\% C_{rt(3h \text{ rate})}$ |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
|                                            | As such operation may result, depending on battery design, in a temporary or permanent capacity loss, the corrective effects of prolonged charge with float voltage settings and with the manufacturer's suggested equalization or boost charge condition will be also quantified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
|                                            | <p><b>Table 17 – Requirement for float service with daily discharges</b></p> <table> <tr> <td rowspan="4"><b>Requirement and service environment</b></td><td colspan="3">Determine number of cycles to low residual capacity</td></tr> <tr> <td colspan="3">Determine capacity available under float voltage settings (<math>C_{af}</math>)</td></tr> <tr> <td colspan="3">Determine capacity available under boost voltage settings (<math>C_{ab}</math>) (6.13 of IEC 60896-11)</td></tr> <tr> <td>Number of 2 h discharge cycles to 1,80 V<sub>pc</sub></td><td><math>C_{af}</math><br/>Capacity available in % of <math>C_{rt}</math></td><td><math>C_{ab}</math><br/>Capacity available in % of <math>C_{rt}</math></td></tr> <tr> <td><b>Reliable mains power</b></td><td>No unit below 50</td><td rowspan="3">Report data and total number of cycles achieved</td><td rowspan="3">Report data and total number of cycles achieved</td></tr> <tr> <td><b>Unreliable mains power</b></td><td>No unit below 150</td></tr> <tr> <td><b>Very unreliable mains power</b></td><td>No unit below 300</td></tr> </table> | <b>Requirement and service environment</b>                                                                                                                       | Determine number of cycles to low residual capacity |  |  | Determine capacity available under float voltage settings ( $C_{af}$ ) |  |  | Determine capacity available under boost voltage settings ( $C_{ab}$ ) (6.13 of IEC 60896-11) |  |  | Number of 2 h discharge cycles to 1,80 V <sub>pc</sub> | $C_{af}$<br>Capacity available in % of $C_{rt}$ | $C_{ab}$<br>Capacity available in % of $C_{rt}$ | <b>Reliable mains power</b> | No unit below 50 | Report data and total number of cycles achieved | Report data and total number of cycles achieved | <b>Unreliable mains power</b> | No unit below 150 | <b>Very unreliable mains power</b> | No unit below 300 | LPX12-7.0<br>(12V7,0Ah):<br>Cycle number=79<br>Float charge:<br>$C_{af}=83\% C_{rt(3h \text{ rate})}$<br>Boost charge:<br>$C_{ab}=91\% C_{rt(3h \text{ rate})}$ | P |
| <b>Requirement and service environment</b> | Determine number of cycles to low residual capacity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
|                                            | Determine capacity available under float voltage settings ( $C_{af}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
|                                            | Determine capacity available under boost voltage settings ( $C_{ab}$ ) (6.13 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
|                                            | Number of 2 h discharge cycles to 1,80 V <sub>pc</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | $C_{af}$<br>Capacity available in % of $C_{rt}$                                                                                                                  | $C_{ab}$<br>Capacity available in % of $C_{rt}$     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| <b>Reliable mains power</b>                | No unit below 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Report data and total number of cycles achieved                                                                                                                  | Report data and total number of cycles achieved     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| <b>Unreliable mains power</b>              | No unit below 150                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| <b>Very unreliable mains power</b>         | No unit below 300                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| <b>6.14</b>                                | <b>Requirement for recharge behaviour</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| 6.14.1                                     | The purpose of this requirement (see Table 18) is to define the capacity once more available following a long duration discharge with both short (24 h) and long (168 h) periods of recharge under float voltage settings.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |
| 6.14.2                                     | The result of this test documents the effective available capacity, as a percent of the original capacity after a recharge for 24 h or 168 h using only the recommended float voltage setting.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                  |                                                     |  |  |                                                                        |  |  |                                                                                               |  |  |                                                        |                                                 |                                                 |                             |                  |                                                 |                                                 |                               |                   |                                    |                   |                                                                                                                                                                 |   |

| No. | Requirement – Test | Result - Remark | Verdict |
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|                                                                                             |                                                                                                                                                                                                                                                                                                                |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                             | <b>Table 18 – Requirement for recharge behaviour</b>                                                                                                                                                                                                                                                           |                                                    |                                                        |                                                    | LPL12-250<br>(12V250Ah):<br>Rbf <sub>24h</sub> =92.46%Ca<br>Rbf <sub>168h</sub> =98.73%Ca<br>LPX12-7.0<br>(12V7,0Ah):<br>Rbf <sub>24h</sub> =90.38%Ca<br>Rbf <sub>168h</sub> =98.28%Ca | P |
| Requirement and application                                                                 | Determine capacity after recharge (6.14 of IEC 60896-11)                                                                                                                                                                                                                                                       |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
|                                                                                             | Rbf <sub>24h</sub><br>24 h Recharge behaviour factor                                                                                                                                                                                                                                                           |                                                    | Rbf <sub>168h</sub><br>168 h Recharge behaviour factor |                                                    |                                                                                                                                                                                        |   |
|                                                                                             | ≥90 %<br>(see note below)                                                                                                                                                                                                                                                                                      |                                                    | ≥98 %<br>(see note below)                              |                                                    |                                                                                                                                                                                        |   |
| NOTE The requirement applies not to the average but to each of the individual tested units. |                                                                                                                                                                                                                                                                                                                |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
| 6.16                                                                                        | Requirement for the impact of a stress temperature of 55 °C or 60 °C                                                                                                                                                                                                                                           |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
| 6.16.1                                                                                      | The purpose of the requirement (see Table 20) is to elicit information on how long units perform under elevated temperature stress conditions. These stress conditions degrade the performance of the units very rapidly as increased water loss and grid corrosion will result in increasing capacity losses. |                                                    |                                                        |                                                    | At 55 °C:<br>LPL12-250<br>(12V250Ah):<br>Duration=126 days<br>C <sub>0.25h rate</sub> =92.14Ah<br><br>LPX12-7.0<br>(12V7,0Ah):<br>Duration=126 days<br>C <sub>0.25h rate</sub> =4,32Ah | P |
| 6.16.2                                                                                      | The result of this test documents how sensitive a particular design is towards abusive high operating temperature conditions and, if the units are operated close to such conditions, which design will tolerate these conditions for longer.                                                                  |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
| <b>Table 20 – Requirement for the impact of a stress temperature of 55 °C or 60 °C</b>      |                                                                                                                                                                                                                                                                                                                |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
| Requirement and service environment                                                         | Determine capacity behavior<br>(6.16 of IEC 60896-11)                                                                                                                                                                                                                                                          |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
|                                                                                             | Days at elevated temperature, on float charge, of the units to a residual capacity of 0,8 C <sub>rt</sub>                                                                                                                                                                                                      |                                                    |                                                        |                                                    |                                                                                                                                                                                        |   |
|                                                                                             | at 55 °C                                                                                                                                                                                                                                                                                                       |                                                    | at 60 °C                                               |                                                    |                                                                                                                                                                                        |   |
|                                                                                             | Capacity monitored with 3 h rate discharge test                                                                                                                                                                                                                                                                | Capacity monitored with 0,25 h rate discharge test | Capacity monitored with 3 h rate discharge test        | Capacity monitored with 0,25 h rate discharge test |                                                                                                                                                                                        |   |
| Brief duration exposure time                                                                | ≥150 days                                                                                                                                                                                                                                                                                                      | ≥75 days                                           | ≥105 days                                              | ≥55 days                                           |                                                                                                                                                                                        |   |
| Medium duration exposure time                                                               | ≥250 days                                                                                                                                                                                                                                                                                                      | ≥125 days                                          | ≥175 days                                              | ≥90 days                                           |                                                                                                                                                                                        |   |
| Long duration exposure time                                                                 | ≥350 days                                                                                                                                                                                                                                                                                                      | ≥175 days                                          | ≥250 days                                              | ≥125 days                                          |                                                                                                                                                                                        |   |



| No.                                                 | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           |           |           | Result - Remark                                                                                                                                                                                                                                                                                                                                                                                                                                                | Verdict |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
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|                                                     | <div>Very long duration exposure time</div> <div>NOTE The requirement applies not to the average but to each of the individual tested units.</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ≥500 days | ≥250 days | ≥350 days | ≥175 days |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| 6.17                                                | Requirement for the impact of abusive over-discharges                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| 6.17.1                                              | The purpose of the requirement (see Table 21) is to ensure that units, undergoing abusive over-discharges during the service life, show a minimum of capacity recovery under specified conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |           |           |           |           | LPL12-250<br>(12V250Ah):<br><br>Unbalanced string over-discharge capacity $C_{aod}$ :<br>$C_{aod} = 0.86 C_{rt(3h \text{ rate})}$<br>Cyclic over-discharge capacity $C_{aoc}$ :<br>$C_{aoc} = 0.93 C_{rt(3h \text{ rate})}$<br><br>LPX12-7.0<br>(12V7,0Ah):<br><br>Unbalanced string over-discharge capacity $C_{aod}$ :<br>$C_{aod} = 0.85 C_{rt(3h \text{ rate})}$<br>Cyclic over-discharge capacity $C_{aoc}$ :<br>$C_{aoc} = 0.90 C_{rt(3h \text{ rate})}$ | P       |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| 6.17.2                                              | The results of these tests documents the available capacity<br>a) after a severely capacity-unbalanced string has been discharged and recharged, and<br>b) after repetitive discharges with large active mass utilization factors to a low end-of discharge voltage.<br>Such conditions may arise when units with irregular charge levels are used as replacements of failed units in a string or where low voltage disconnects are not available or have failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
|                                                     | <div>Table 21 – Requirement for the impact of abusive over-discharges</div> <table><tr><td rowspan="2">Requirement and service environment</td><td>Determine capacity ratio <math>C_{aod}</math><br/>(6.17.4 of IEC 60896-11)</td></tr><tr><td>Unbalanced string over-discharge capacity <math>C_{aod}</math></td></tr><tr><td>Good battery replacement and service infrastructure</td><td>Not applicable</td></tr><tr><td>Poor battery replacement &amp; service infrastructure</td><td>≥0,80 (for the string)</td></tr><tr><td colspan="2"></td></tr><tr><td rowspan="2">Requirement and service environment</td><td>Determine capacity ratio <math>C_{aoc}</math><br/>(6.17.10 of IEC 60896-11)</td></tr><tr><td>Cyclic over-discharge capacity <math>C_{aoc}</math></td></tr><tr><td>Reliable mains supply and E.o.d voltage control</td><td>Not applicable</td></tr><tr><td>Poor mains supply and E.o.d voltage control</td><td>≥0,90 (for the string)</td></tr><tr><td colspan="2">NOTE E.o.d = end-of-discharge.</td></tr></table> |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         | Requirement and service environment | Determine capacity ratio $C_{aod}$<br>(6.17.4 of IEC 60896-11) | Unbalanced string over-discharge capacity $C_{aod}$ | Good battery replacement and service infrastructure | Not applicable | Poor battery replacement & service infrastructure | ≥0,80 (for the string) |  |  | Requirement and service environment | Determine capacity ratio $C_{aoc}$<br>(6.17.10 of IEC 60896-11) | Cyclic over-discharge capacity $C_{aoc}$ | Reliable mains supply and E.o.d voltage control | Not applicable | Poor mains supply and E.o.d voltage control | ≥0,90 (for the string) |
| Requirement and service environment                 | Determine capacity ratio $C_{aod}$<br>(6.17.4 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
|                                                     | Unbalanced string over-discharge capacity $C_{aod}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| Good battery replacement and service infrastructure | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| Poor battery replacement & service infrastructure   | ≥0,80 (for the string)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
|                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| Requirement and service environment                 | Determine capacity ratio $C_{aoc}$<br>(6.17.10 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
|                                                     | Cyclic over-discharge capacity $C_{aoc}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| Reliable mains supply and E.o.d voltage control     | Not applicable                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| Poor mains supply and E.o.d voltage control         | ≥0,90 (for the string)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |
| NOTE E.o.d = end-of-discharge.                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           |           |           |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |         |                                     |                                                                |                                                     |                                                     |                |                                                   |                        |  |  |                                     |                                                                 |                                          |                                                 |                |                                             |                        |

| No. | Requirement – Test | Result - Remark | Verdict |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Requirements for information on thermal runaway sensitivity                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| 6.18.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The purpose of the requirement (see Table 22) is to elicit standardized information about how soon units may enter thermal runaway conditions when exposed to higher than normal voltages under specified conditions.                                                                                | LPL12-250<br>(12V250Ah):<br>Ultimate temperature after 168 h at 2,45 Vpc:<br>$T_a=40^{\circ}\text{C}$<br>Ultimate temperature after 168 h at 2,60 Vpc:<br>$T_b=53^{\circ}\text{C}$<br>LPX12-7.0<br>(12V7,0Ah):<br>Ultimate temperature after 168 h at 2,45 Vpc:<br>$T_a=38^{\circ}\text{C}$<br>Ultimate temperature after 168 h at 2,60 Vpc:<br>$T_b=45^{\circ}\text{C}$ | P |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| 6.18.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The result of this test documents the elapsed time and the current associated before reaching elevated temperatures with standardized battery layouts. This facilitates the evaluation if a particular unit design shows increased sensitivity toward escalating temperature and current conditions. |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| <b>Table 22 – Requirements for information on thermal runaway sensitivity</b> <table><tr><td><b>Requirement and application</b></td><td>Determine temperature evolution of units with the duration of charge at 2,45 Vpc<br/>Determine temperature evolution of units with the duration of charge at 2,60 Vpc<br/>(6.18 of IEC 60896-11)</td></tr><tr><td><b>Comply for all applications</b></td><td>Achieve at least 1 week below 60 °C at 2,45 Vpc and at least 24 h below 60 °C at 2,60 Vpc<br/>Show ultimate time to 60 °C or ultimate temperature after 168 hat 2,45 Vpc and 2,60 Vpc.</td></tr></table> |                                                                                                                                                                                                                                                                                                      | <b>Requirement and application</b>                                                                                                                                                                                                                                                                                                                                       |   | Determine temperature evolution of units with the duration of charge at 2,45 Vpc<br>Determine temperature evolution of units with the duration of charge at 2,60 Vpc<br>(6.18 of IEC 60896-11) | <b>Comply for all applications</b>                  | Achieve at least 1 week below 60 °C at 2,45 Vpc and at least 24 h below 60 °C at 2,60 Vpc<br>Show ultimate time to 60 °C or ultimate temperature after 168 hat 2,45 Vpc and 2,60 Vpc. |
| <b>Requirement and application</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Determine temperature evolution of units with the duration of charge at 2,45 Vpc<br>Determine temperature evolution of units with the duration of charge at 2,60 Vpc<br>(6.18 of IEC 60896-11)                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| <b>Comply for all applications</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Achieve at least 1 week below 60 °C at 2,45 Vpc and at least 24 h below 60 °C at 2,60 Vpc<br>Show ultimate time to 60 °C or ultimate temperature after 168 hat 2,45 Vpc and 2,60 Vpc.                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| 6.19                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Requirement for the impact of low temperature service on capacity                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| 6.19.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The purpose of this requirement (see Table 23) is to ensure that units experiencing abusive low temperature conditions during service life show a minimum of mechanical stability against freezing induced forces and adequate capacity recovery under specified conditions.                         | LPL12-250<br>(12V250Ah):<br>$C_{als}=0.97\ C_{rt(3h\ rate)}$<br>No mechanical damages                                                                                                                                                                                                                                                                                    | P |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| 6.19.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | The result of this test documents how a particular unit design is capable of withstanding electrolyte freezing which may be encountered in installations without adequate thermal protection and mains supply stability.                                                                             |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| <b>Table 23 – Requirement for the impact of low temperature service on capacity</b> <table><tr><td><b>Requirement and service environment</b></td><td>Determine capacity of units(6.19 of IEC 60896-11)<br/>Show abusive low temperature service capacity (<math>C_{als}</math>) of all units and report eventual freezing induced damages</td></tr><tr><td><b>Battery may experience freezing temperatures</b></td><td>&gt;0,95 and no mechanical damages<br/>(see Notes 1 and 2 below)</td></tr></table>                                                                                                    |                                                                                                                                                                                                                                                                                                      | <b>Requirement and service environment</b>                                                                                                                                                                                                                                                                                                                               |   | Determine capacity of units(6.19 of IEC 60896-11)<br>Show abusive low temperature service capacity ( $C_{als}$ ) of all units and report eventual freezing induced damages                     | <b>Battery may experience freezing temperatures</b> | >0,95 and no mechanical damages<br>(see Notes 1 and 2 below)                                                                                                                          |
| <b>Requirement and service environment</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Determine capacity of units(6.19 of IEC 60896-11)<br>Show abusive low temperature service capacity ( $C_{als}$ ) of all units and report eventual freezing induced damages                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |
| <b>Battery may experience freezing temperatures</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | >0,95 and no mechanical damages<br>(see Notes 1 and 2 below)                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                          |   |                                                                                                                                                                                                |                                                     |                                                                                                                                                                                       |



| No.                                                                                                                                                                                                                                                  | Requirement – Test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                | Result - Remark                                                                                                                                                                                                  | Verdict |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------|--------------------------------------------------------------|-------------------------------------------------|---------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                                                                                                                                                                                                                                                      | Battery will not Experience freezing temperatures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Not applicable |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| 6.20                                                                                                                                                                                                                                                 | Requirement for dimensional stability at elevated internal pressures and temperatures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| 6.20.1                                                                                                                                                                                                                                               | The purpose of this requirement (see Table 24) is to provide an indication of the susceptibility of the unit to “balloon out” or expand under certain conditions and may be of interest where cells/monoblocs are to be installed in areas of restricted space.                                                                                                                                                                                                                                                                                                                                                                                                 |                | LPL12-250<br>(12V250Ah):<br>Change in:<br>Length:0,96% +5mm<br>Width:1,49% +4mm<br>Height:0,91% +2mm<br><br>LPX12-7.0<br>(12V7,0Ah):<br>Change in:<br>Length:1,33% +2mm<br>Width:1,56% +1mm<br>Height:1,08% +1mm | -       |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| 6.20.2                                                                                                                                                                                                                                               | The result of the test documents for the designer of battery installations the potential deformations of the units to be expected and related clearances needed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
|                                                                                                                                                                                                                                                      | <b>Table 24 – Requirement for dimensional stability at elevated internal pressures and temperatures</b> <table><tr><td rowspan="2">Requirement and application</td><td>Determine size change<br/>(6.20 of IEC 60896-11)</td></tr><tr><td>Show dimensional change in percentage and in mm</td></tr><tr><td>State data for all applications</td><td>Show data</td></tr><tr><td colspan="2">NOTE This test is not relevant for battery designs where steel enclosures ensure a very high degree of dimensional stability. A replacement of cells within these steel enclosures is assured when carried out based on manufacturer's instructions.</td></tr></table> |                |                                                                                                                                                                                                                  |         | Requirement and application | Determine size change<br>(6.20 of IEC 60896-11)              | Show dimensional change in percentage and in mm | State data for all applications | Show data                                       | NOTE This test is not relevant for battery designs where steel enclosures ensure a very high degree of dimensional stability. A replacement of cells within these steel enclosures is assured when carried out based on manufacturer's instructions. |  |
| Requirement and application                                                                                                                                                                                                                          | Determine size change<br>(6.20 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
|                                                                                                                                                                                                                                                      | Show dimensional change in percentage and in mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| State data for all applications                                                                                                                                                                                                                      | Show data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| NOTE This test is not relevant for battery designs where steel enclosures ensure a very high degree of dimensional stability. A replacement of cells within these steel enclosures is assured when carried out based on manufacturer's instructions. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| 6.21                                                                                                                                                                                                                                                 | Requirements for stability against mechanical abuse of units during installation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| 6.21.1                                                                                                                                                                                                                                               | The purpose of this requirement (see Table 25) is to ensure that the unit design is mechanically robust enough to withstand standardized mechanical stresses during unpacked transport and installation.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                | No leakage                                                                                                                                                                                                       | P       |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| 6.21.2                                                                                                                                                                                                                                               | The result of the test documents if impact forces on unit edges and corners will lead to electrolyte leakages. This test does not replace seismic or other specific vibration tests.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
|                                                                                                                                                                                                                                                      | <b>Table 25 – Requirements for stability against mechanical abuse of units during installation</b> <table><tr><td rowspan="2">Requirement and application</td><td>Drop test and inspect for leakages<br/>(6.21 of IEC 60896-11)</td></tr><tr><td>Show leakage inspection results</td></tr><tr><td>Comply for all applications</td><td>No leakage detectable after two times two drops</td></tr></table>                                                                                                                                                                                                                                                         |                |                                                                                                                                                                                                                  |         | Requirement and application | Drop test and inspect for leakages<br>(6.21 of IEC 60896-11) | Show leakage inspection results                 | Comply for all applications     | No leakage detectable after two times two drops |                                                                                                                                                                                                                                                      |  |
| Requirement and application                                                                                                                                                                                                                          | Drop test and inspect for leakages<br>(6.21 of IEC 60896-11)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
|                                                                                                                                                                                                                                                      | Show leakage inspection results                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |
| Comply for all applications                                                                                                                                                                                                                          | No leakage detectable after two times two drops                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                |                                                                                                                                                                                                                  |         |                             |                                                              |                                                 |                                 |                                                 |                                                                                                                                                                                                                                                      |  |

**Photo(s) of the tested samples**

LPL12-250(12V250Ah)



LPL12-250(12V250Ah)

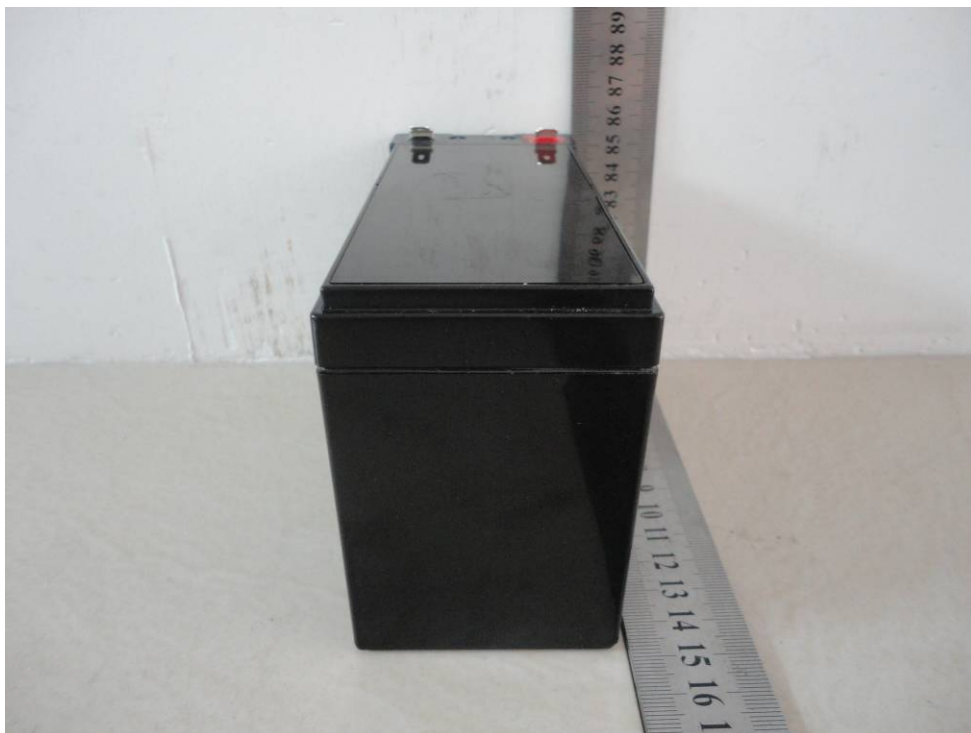


**Photo(s) of the tested samples**

LPX12-7.0(12V7.0Ah)



LPX12-7.0(12V7.0Ah)



\*\*\*End of Report\*\*\*