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Instruction for storage, control and recharging of SLI batteries produced by UPOWER

1. Lead-acid accumulating battery (shortly called herein below LAB) is an open electric chemical system, the parameters of which are NOT constant and depend on the downtime, on the temperature, same as on other external and internal factors;
2. LAB manufactured by UPOWER are flooded and fully charged (an exception are the dry charged LAB), whereas these have been developed in concordance with all requirements, stipulated in standard EN 50342-1:2016;
3. Depending on the track, the construction and the technology of the production, UPOWER AD'S LAB are ensuring the assigned electrical characteristics or the same possess technological reserve for partial compensation of the temperature or temporal deviations of the parameters while stored;

4. Tension (U) of fully charged LAB:

No.p.p.	**LAB Type**	**Performance**	**Tension U, V**	**Umin, V**
1	SLI	Normal	**12,70-12,90**	≤ **12,5**
2	SLI	Tropical	**12,4-12,60**	≤ **12,2** B
3	SLI	Arctic	**13,00-13,20**	≤ **12,7**
4	VRLA	Normal	**12,80-13,00**	≤ **12,6**

The charging is implemented on the bases of calculation of the degree of charging (shortly called SOC) and the quantity of electricity C_{CHA} (Ah), needed for a charge conforming to Enclosure No. 1. In this case the current

size is I_{CHA} =0.1Cn (A), whereas Cn is nominal capacity of LAB (indicated on the label). The charge time $T_{CHA}=C_{CHA}/I_{CHA}$.

5. The CCA parameter, indicated on the label, ensures the construction of the LAB and this confirms the real laboratory tests at -18^{0}C pursuant to EN 50342-1:2016.
6. The results from the measuring of CCA parameter in any other way, including and by means of portable testers, CANNOT be the cause for reclamation claims from the point of view of their indirect character;
7. With the measuring of CCA by means of a portable tester (indirect method) deviations from the assigned values of CCA are allowed in the range of ± 10% with SOC 100% and electrolyte temperature in the battery 25^{0}C, whereas it should also be noted that the allowed measuring mistake of ± 5%, which is indicated in the user guide from the manufacturers of portable testers.

   In the case of CCA measuring with portable testers, in the technical characteristics of which there is no availability of whatever data about allowable values of the mistake when measuring the CCA, whereas the results from the measuring are of referential character only.

Remark: *In case of decrease in the CCA parameter is more than 10%, this witnesses an increased resistance of LAB, needed to persuade us in the correctness of the conducted measuring (SOC 100%, temperature 25^{0}C).Decreasing of SOC may occur as a result of auto charge (with durable storing) or partial discharge (with incorrect exploitation).*

8. In case of impossibility to observe the temperature requirements when measuring the CCA by means of portable testers, for the correlating of the results it is recommended to use the data from Enclosure No.2;

9. When measuring the CCA with portable testers with SOC smaller than 100% (due to storing of LAB in warehouse), for the purpose of correlation of the measured data Enclosure No. 3 is used;
10. For the purpose of reducing the life cycle of LAB and of reducing the CCA parameter caused by corrosion of the positive grid while storing LAB in discharged state, recharging should be accomplished at least once in every 6 months (with storage temperature not more than 25^0C). With storage temperature higher than 25^0C it is necessary to observe the tension in LAB conforming to p.4.
11. With the storage of LAB, excessive moisture and direct sun light should be avoided. The storage premises should be well ventilated. For longer storage period of LAB without float charge, it is necessary to ensure temperature not higher than 25^0C.

- **This document has been worked out by specialists from UPOWER AD jointly with BAS (Bulgarian Academy of Sciences).**

Date: 06.04.2017

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SOC=f(T,ρ)

Appendix 1

Temp °C	U, V.										
-50	12.750	12.630	12.510	12.396	12.282	12.168	12.060	11.952	11.850	11.748	11.646
-45	12.756	12.636	12.516	12.402	12.288	12.174	12.066	11.958	11.856	11.754	11.652
-40	12.762	12.642	12.522	12.408	12.294	12.180	12.072	11.964	11.862	11.760	11.658
-35	12.768	12.648	12.528	12.414	12.300	12.186	12.078	11.970	11.868	11.766	11.664
-30	12.774	12.654	12.534	12.420	12.306	12.192	12.084	11.976	11.874	11.772	11.670
-25	12.780	12.660	12.540	12.426	12.312	12.198	12.090	11.982	11.880	11.778	11.676
-20	12.786	12.666	12.546	12.432	12.318	12.204	12.096	11.988	11.886	11.784	11.682
-15	12.792	12.672	12.552	12.438	12.324	12.210	12.102	11.994	11.892	11.790	11.688
-10	12.798	12.678	12.558	12.444	12.330	12.216	12.108	12.000	11.898	11.796	11.694
-5	12.804	12.684	12.564	12.450	12.336	12.222	12.114	12.006	11.904	11.802	11.700
0	12.810	12.690	12.570	12.456	12.342	12.228	12.120	12.012	11.910	11.808	11.706
5	12.816	12.696	12.576	12.462	12.348	12.234	12.126	12.018	11.916	11.814	11.712
10	12.822	12.702	12.582	12.468	12.354	12.240	12.132	12.024	11.922	11.820	11.718
15	12.828	12.708	12.588	12.474	12.360	12.246	12.138	12.030	11.928	11.826	11.724
20	12.834	***12.714***	12.594	12.480	12.366	12.252	12.144	12.036	11.934	11.832	11.730
25	12.840	12.720	12.600	12.486	12.372	12.258	12.150	12.042	11.940	11.838	11.736
30	12.846	12.726	12.606	12.492	12.378	12.264	12.156	12.048	11.946	11.844	11.742
35	12.852	12.732	12.612	12.498	12.384	12.270	12.162	12.054	11.952	11.850	11.748
40	12.858	12.738	12.618	12.504	12.390	12.276	12.168	12.060	11.958	11.856	11.754
45	12.864	12.744	12.624	12.510	12.396	12.282	12.174	12.066	11.964	11.862	11.760
50	12.870	12.750	12.630	12.516	12.402	12.288	12.180	12.072	11.970	11.868	11.766
55	12.876	12.756	12.636	12.522	12.408	12.294	12.186	12.078	11.976	11.874	11.772
60	12.882	12.762	12.642	12.528	12.414	12.300	12.192	12.084	11.982	11.880	11.778
ρ sp.gr.	1.3	1.28	1.26	1.24	1.22	1.2	1.18	1.16	1.14	1.12	1.1
SOC %	112.5	100	87.5	75	62.5	50	37.5	25	12.5	0	

U,V (-50) = 2,105V cell voltage, or 12,63V per battery.

U,V (60) = 2,127V cell voltage, or 12,76B per battery.

Δ =0,132V. **ΔV/ ∇ T = 0,132/110 = 0,0012V**

C_{CHA}=1,2C_n * (100-SOC)/100 (Ah); **I_{CHA}= 0.1Cn;** **t_{CHA}=C_{CHA}/ I_{CHA}.**

C_{CHA} - (Ah) for charge.

SOC - % of charge; **C_n - nominal capacity, (Ah);** **t_{CHA}** - time charge, (h)

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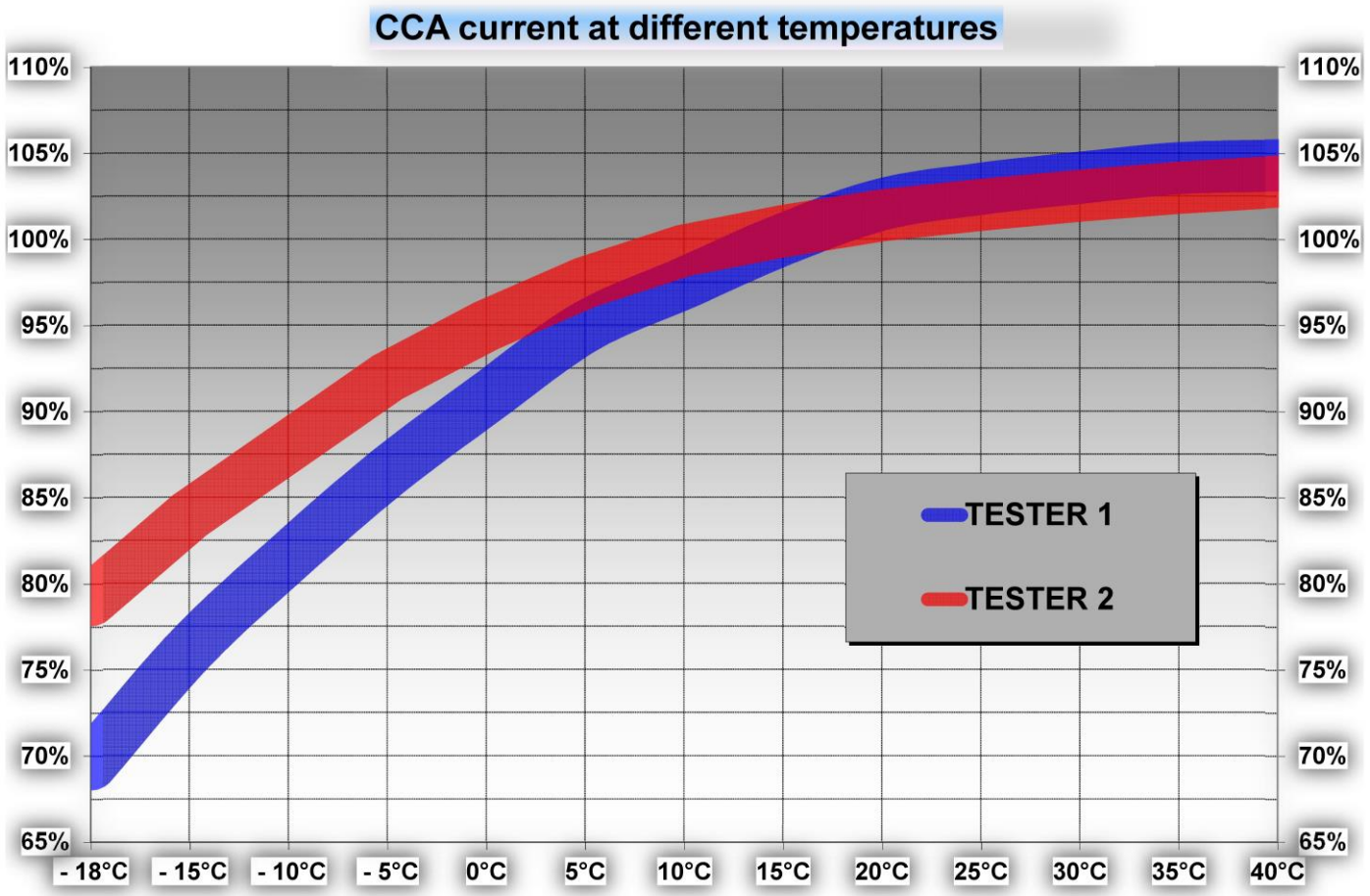
Appendix 2 – CCA performance against temperature factor



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Appendix 3 – CCA performance against storage time in days