Information sheet 100.3

Determination of the parameters from Article 10 Annex IV according to Battery Regulation for industrial batteries

According to Article 10 of the battery regulation (BattR) 2023/1542, statements on the performance and durability of industrial batteries are required in order to enable better comparability of battery technologies (e.g. for the battery passport).

To determine these statements, the legislator stipulates in Article 10 (1) that the battery parameters shall be measured, calculated or estimated. Since, depending on the application, the required statement is of little relevance in practice, the battery parameters and their determination are not or only insufficiently described in the current standardisation.

Standardised parameters that already exist today have been specified for the respective practical application. In contrast, the BattR only focusses on the general comparability of battery parameters for performance and durability regardless of the application.

Application-relevant battery parameters are already defined for non-lithium-based industrial batteries (e.g. for traction batteries for industrial applications IEC 60254-1 or for stationary batteries IEC 60896-11 and -21). However, the BattR requires the specification of further parameters.

A detailed examination of the BattR reveals that most of the newly required parameters are only relevant in practice in the field of electromobility (EV batteries). As EV batteries rely almost exclusively on lithium-ion technologies due to the specific requirements of the applications (battery EV and hybrid EV), the parameters and determination procedures described in EV standards are focused on lithium-ion batteries. However, these parameters cannot be applied to all industrial battery applications and technologies.

For EV batteries, the required parameters can be deduced from the data sheets of the cells (derived from IEC 62660-1). For lithium-based industrial batteries, in general, similar methods can be used to obtain the battery parameters. In order to meet the requirements of the BattR from August 18th 2024, it appears to be appropriate to use this data, even if it has little practical relevance for industrial batteries.

In contrast, no comparable database is available for lead-based industrial batteries. In order to generate this data, old application-related standards must be amended, or new standards must be created, e.g. based on Draft EN 18060. In preparation for standards yet to be created, or existing standards the be amended, the following table describes determination methods that make it possible to obtain a complete data set in accordance with Article 10 BattR Annex IV.

Battery Regulation Art. 10 (1), Annex IV

	Traction Battery	Stationary Application	Ammendment & comments
1. a) Rated capacity (in Ah)	C5 according IEC 60254-1 chapter 3.1	C10 according IEC 60896-11 chapter 7 (VLA) & IEC 60896-21 chapter 6.11 (VRLA)	for batteries the capacity shall be stated with reference temperature.
1. b) Capacity fade (in %)	20 % of nominal capacity (chapter 3.1) according IEC 60254-1 chapter 3.4, End of Life (EOL)	20% of rated capacity C10 (Chapter 7 and 6.11) according to IEC 60896-11 (VLA) and IEC 60896-21 (VRLA) at end of life (EOL). See also point 5. Expected life-time of the battery (based on cycles and calendar years) and note 2.	EOL Lithium Batteries IEC 62620 (mimimum requirement 60% of rated capacity after 500 cycles) for traction and stationary
2. a) Power (in W)	I5 according IEC 60254-1 chapter 3.1.2; I5 multiplied with average discharge voltage (5h discharge)	P10h (or P3h) in analogy to rated capacity in IEC 60896-21 clause 6.11 "Discharge capacity" or IEC 60896-11 clause 7 "Capacity" and clause 14 "Capacity test"	
2. b) Power fade (in %)	$P_{fade_{EOL}} = \left(1 - \frac{P_{EOL}}{P_{BOL}}\right) \cdot 100\ \%$ EOL according IEC 60254-1 chapter 3.1 at 80 % C_5	$P_{fade_{EOL}} = \left(1 - \frac{P_{EOL}}{P_{BOL}}\right) \cdot 100\ \%$ EOL according IEC 60896-11/-21 at 80 % C_n Determination analogous to "loss of capacity" (see above). Note: Because the power consumption of a battery-powered load does not decrease over battery life but remains constant, life tests should be performed at constant power. EOL is reached when the discharge time has fallen to 80% of the discharge time at BOL. The reduction in discharge time (in %) compared to BOL should be expressed in relation to the time elapsed in the life test.	In consideration for traction application: 500 cycles and power measurement (JRC Stakeholder consultation on secondary legislation concerning Article 10 from February 22nd 2024)
3. a) Internal resistance (in Ω)	I5 pulses (or multiples) for 10 seconds at 30 degree celsius, OCV versus voltage after pulse (derived from JRC136381 chapter 2.1.3/prEN 18060) $R_{DC} = \frac{\Delta U}{I_{pulse}}$ or based on IEC 60896-21 chapter 6.3	Based on IEC 60896-21 clause 6.3 "Short-circuit current and d.c. internal resistance" (VRLA) or IEC 60896-11 clause 19 "Short-circuit current and internal resistance determination" (VLA)	
3. b) Internal resistance increase (in %)	$R_{increase_{EOL}} = \left(\frac{R_{EOL}}{R_{BOL}} - 1\right) \cdot 100\ \%$ Internal resistance BOL versus EOL according IEC 60254-1 (derived from JRC136381 chapter 2.1.3)	$R_{increase_{EOL}} = \left(\frac{R_{EOL}}{R_{BOL}} - 1\right) \cdot 100\ \%$ Internal resistance BOL versus EOL according IEC 60896-21 and 11. The internal resistance at EOL or at any time during life test should be determined like the internal resitance at BOL. Note: For lead batteries the DC internal resistance is generally used for the sizing of overcurrent protection devices.	
4. a) Energy round trip efficiency (in %) where applicable	EN 16796-1 A.3.3; DCDC Battery; after the first 10 cycles	based on DCDC efficiency I10; for float not applicable	
4. b) Energy round trip efficiency fade (in %) where applicable	$RTE_{fade_{EOL}} = \left(1 - \frac{RTE_{EOL}}{RTE_{BOL}}\right) \cdot 100\ \%$ kWh balance (derived from JRC136381 chapter 2.1.4)	for cyclic applications only $RTE_{fade_{EOL}} = \left(1 - \frac{RTE_{EOL}}{RTE_{BOL}}\right) \cdot 100\ \%$ kWh balance	
5. Expected life-time of the battery (based on cycles and calendar years)	Based on IEC 60254-1 chapter 5.5 (cycle life)	**Non-cyclic application:** The EOL can be estimated using an accelerated life test in accordance with IEC 60896-21clause 6.16 "Effect of a load temperature of 55 °C or 60 °C" and the test result can be converted to the life expectancy at 20 °C. As a rule of thumb, life expectancy is reduced by 50% when the battery temperature increases by +10°C, which is generally accepted. Optional: For VLAB following IEC 60896-11 clause 15 "Test of suitability for floating battery operation". In the case the fade of C10 capacity (in %) after a certain time in float test related to the time in float test, but minimum 6 months, should be stated. For batteries that have not yet been on the market long enough to be able to rely on full lifespan tests, the decrease in capacity at any point in an ongoing lifespan test can alternatively be stated in relation to the elapsed time in the lifespan test. Lifespan information should be converted to 20°C using the rule of thumb mentioned above (-50%/+10°C). **For cyclic application**: Depending on the application, e.g. based on IEC 61427 or for VRLA: IEC 60896-2:1995 (Withdrawn / Replaced) clause 5.3 "Endurance in cycles" for VLAB: IEC 60896-11 clause 16 "Endurance in discharge-charge cycles"	For motive power the expected life-time is dominated by the cyclic usage, calendric aging usually can be neglected

Note 1: Parameters to be measured, calculated or estimated on battery, cell or bloc level

Note 2: Any statement of parameter loss or increase should ideally be stated in terms of time to EOL or in terms of a specific elapsed time in the life test if life tests to EOL are not yet available because the battery product is not yet available on the market long enough.

References:

IEC 60254-1:2005 Lead-acid traction batteries - Part 1: General requirements and methods of tests	IEC 60896-11:2002 Stationary lead-acid batteries - Part 11: Vented types; General requirements and methods of test	IEC 62620:2014 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for use in industrial applications
JRC136381 Performance and Durability Requirements in the Batteries Regulation Part 1: General assessment and data basis Szczuka, C., Sletbjerg, P., Bruchhausen, M. 2024	IEC 60896-21:2004 Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test	
EN 16796-1:2016 Energy efficiency of Industrial trucks - Test methods - Part 1: General	IEC 60896-22:2004 Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements	
	IEC 61427-1:2013 Secondary cells and batteries for renewable energy storage - General requirements and methods of test - Part 1: Photovoltaic off-grid application	
	IEC 60896-2:1995 Withdrawn / Replaced Stationary lead-acid batteries - General requirements and methods of test - Part 2: Valve regulated types	

Abbreviations:

VLA = Vented Lead-acid battery (DE: geschlossene Bleibatterie)
VRLA = Valve-regulated lead-acid battery (DE: verschlossene Bleibatterie)
BOL = Beginning-of-life
EOL = End-of-life

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