

BS EN 50342-7:2015



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Lead acid starter batteries

Part 7: General requirements and methods of tests for motorcycle batteries

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PEL/21, Secondary cells and batteries.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Lead acid starter batteries - Part 7: General requirements and methods of tests for motorcycle batteries

Batteries d'accumulateurs de démarrage au plomb - Partie
7: Exigences générales, méthodes d'essais pour les
batteries d'accumulateurs pour motocycles

Blei-Akkumulatoren-Starterbatterien - Teil 7: Allgemeine
Anforderungen und Prüfungen von Motorradbatterien

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European foreword

This document (EN 50342-7:2015) has been prepared by CLC/TC 21X "Secondary cells and batteries".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2016-06-30
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2018-06-30

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It is due to Commission Regulation (EU) No 1103/2010 of 29 November 2010 establishing, pursuant to Directive 2006/66/EC of the European Parliament and of the Council, rules as regards capacity labelling of portable secondary (rechargeable) and automotive batteries and accumulators (OJ L 313, 30.11.2010, p. 3–7).

It provides precise definitions of the values of accuracy for capacity and cold cranking. For this purpose, the definition of the labelled capacity is clearly identified, and a method of sampling the batteries as well as the degree of compliance is defined. Additionally, the needed marking is described precisely.

1 Scope

This European Standard is applicable to lead-acid batteries used primarily as a power source for the starting of internal combustion engines, lighting and ignition of motorcycles, power sport vehicles and all-terrain vehicles up to a maximum capacity of 35 Ah (C_{10}) (further on referred as batteries). The nominal voltage is 12 V or 6 V.

Test definitions and criteria in this document are written for batteries with a nominal voltage of 12 V only. For batteries with a nominal voltage of 6 V all voltages have to be divided by two.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50342-1, *Lead-acid starter batteries – Part 1: General requirements and methods of test*

EN 61429:1996+A11:1998, *Marking of secondary cells and batteries with the international recycling symbol ISO 7000-1135 and indications regarding directives 93/86/EEC and 91/157/EEC*

IEC 60417, *Graphical Symbols for Use on Equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
flooded or vented batteries
secondary battery having a cover provided with one or more openings through which gaseous products may escape

[SOURCE: EN 50342-1]

3.2
Valve Regulated Lead Acid batteries
VRLA
valve regulated lead-acid batteries are secondary batteries which are closed under normal conditions but which has an arrangement that allows the escape of gas if the internal pressure exceeds a predetermined value

Note 1 to entry: The battery cannot receive addition to the electrolyte. In VRLA batteries the electrolyte is immobilized.

[SOURCE: EN 50342-1]

3.3
activation of dry charged batteries
batteries for motorcycle application are in many cases delivered as dry charged batteries. They have to be filled with a defined amount of electrolyte before usage. If no electrolyte is delivered with the battery and no advice is given by the manufacturer, batteries shall be filled with diluted sulfuric acid of density 1,28 kg/l \pm 0,01 kg/l at 25°C for flooded batteries and 1,32 kg/l \pm 0,01 kg/l at 25 °C for valve regulated batteries

Note 1 to entry: Any other manufacturer instruction for handling after filling and before first usage shall be considered.

4 General requirements

4.1 Identification and labelling

Batteries according to this standard shall bear the following characteristics on at least one of their sides or on the top surface:

- a) identification of manufacturer or supplier;
- b) nominal voltage (12 V or 6 V);
- c) nominal capacity C_{10} (Ah) (see 5.1);
- d) nominal cranking current I_{cc} (A) at -18°C (see 5.1);
- e) six colored symbols as specified in EN 50342-1 Annex A (Safety labelling);
- f) marking for the separate collection and recycling according to EN 61429; and
- g) valve regulated batteries shall be marked using the term "VRLA".

Label size: The capacity C_{10} (Ah) and the cold cranking current I_{cc} (A) shall be displayed on a separate label or as text on a combined label (e.g. together with additional information of the producer or type mark). The size of the label shall be at least 3 % of the largest side of the battery. The character size high should be at least 3 mm. The label must be fixed on one of the four sides or on the lid. A multiple labelling is allowed.

Instead of labels silk printing or similar methods for marking can be used as well. Designated marking areas with corresponding sizes should be realized.

NOTE Batteries may be marked with other information such as the filling and charging date.

4.2 Marking of the polarity

The batteries shall be marked with signs for both polarities that have to be positioned near to the terminals.

The marking of the positive terminals shall take the form of the symbol "+". It shall be in accordance with IEC 60417, Symbol 5005.

The negative terminal shall take the form of the symbol "-". It shall be in accordance with IEC 60417, Symbol 5006.

5 General test condition

5.1 Characteristics and abbreviations

5.1.1 Capacity

The 10 h capacity C_{10} is the electrical charge measured in Ah that a battery can supply with a discharge current of

$$I_{10} [A] = \frac{C_{10n} [Ah]}{10 [h]}$$

at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$.

C_{10n} is the nominal capacity of a battery indicated by the manufacturer.

C_{10e} is the effective capacity of the battery determined by discharge with constant current I_{10} to $U = 10.5\text{ V}$ (see 7.2)

5.1.2 Cold cranking current

The cranking current is the discharge current I_{cc} measured in A to be indicated by the manufacturer which a battery can supply at $-18\text{ }^{\circ}\text{C}$ according to 7.3.

5.1.3 Charge retention

The charge retention is the ability of a battery to maintain the cold cranking performance after open circuit storage for a certain time under increased temperature conditions (see 7.5).

5.1.4 Endurance

The endurance reflects the ability of a battery to perform repeated discharge/recharge cycles under specific test conditions (see 7.4).

5.1.5 Water consumption

The water consumption is the loss in weight of a battery measured in g / (Ah C_{10e}) during overcharge conditions (see 7.6).

5.1.6 Water basin

If a test needs to be carried out in a water basin, the following conditions shall be fulfilled. The terminal base of the battery shall be at least 15 mm, but not more than 25 mm, above the level of the water. If several batteries are in the same water bath, the distance between them and the distance to the walls of the bath shall be at least 25 mm.

5.2 Sampling of batteries

All tests shall be carried out on new battery samples. Samples shall be considered as new no longer than

- 30 days after the acid filling and formation date in the case of filled and charged batteries,
- 60 days after shipment date of the manufacturer in the case of dry-charged batteries.

Out of different production or sampling lots, five batteries shall be selected for testing. Four of these batteries shall be used for the tests. In case of equipment failures or technical deviations, one battery can be replaced to repeat the complete sequence for this battery.

5.3 Measuring instruments

Refer to EN 50342-1.

6 Test sequence

The test sequence for the four required samples is shown in Table 1.

First the batteries have to pass the test steps 1 to 7. The requirements of C_{10} capacity check and cranking performance test have to be fulfilled at least once for each sample. If the requirements are fulfilled in the first or second capacity check / cranking performance test the following capacity checks / cold cranking tests don't have to be completed.

Only if the C_{10} capacity check and the cold cranking test are successful, the test sequence shall be continued with steps 8 to 11. These tests shall commence no later than one week after completion of steps 1 to 7.

Table 1 - Test sequence

Step	Battery	Reference	1	2	3	4
1	Initial charge prior to test	7.1	X	X	X	X
2	1st C _{10e} capacity check	7.2	X	X	X	X
3	1st cranking performance test	7.3	X	X	X	X
4	2nd C _{10e} capacity check	7.2	(X)	(X)	(X)	(X)
5	2nd cranking performance test	7.3	(X)	(X)	(X)	(X)
6	3rd C _{10e} capacity check	7.2	(X)	(X)	(X)	(X)
7	3rd cranking performance test	7.3	(X)	(X)	(X)	(X)
8	Endurance	7.4	X			
9	Charge retention	7.5		X		
10	Water consumption	7.6			X	
11	Vibration resistance	7.7				X

(X) denotes that this test needs to be carried out if the previous same test did not achieve the requirement level. One of the batteries 1 to 4 can be replaced by battery 5 for testing starting from step 1 in case of unexpected deviations below 90 % C_n or test equipment failures during test.

7 Inspections and test procedures

7.1 Charging of batteries

7.1.1 General

All tests shall commence with fully-charged batteries unless stated differently. Batteries shall be considered as fully-charged if they have undergone the following charging procedures.

Prior to start of the complete test sequence (according to Clause 6) the charging time shall be limited to 16h.

In case of recharging after a test for cold cranking performance (according to 7.3) the charging time may be limited to 16 h.

If not specified differently by the manufacturer, the following charging methods shall be used.

7.1.2 Flooded batteries

The battery shall be charged at a voltage of 16,00 V ± 0,10 V for 24 h with the maximum current limited to 2,5 times I₁₀. The battery temperature shall be maintained in the range of 25°C to 35°C. If necessary an appropriate environmental control system like a water bath shall be used.

7.1.3 Valve regulated batteries (VRLA)

The battery shall be charged at a voltage of 14,80 V ± 0,10 V for 24 h with the maximum current limited to 2.5 times I₁₀. The battery temperature shall be maintained in the range of 25°C to 35°C. If necessary an appropriate environmental control system like a water bath shall be used.

7.2 C_{10e} capacity check

7.2.1 Throughout the duration of the tests, the battery shall be placed in a water bath maintained at a temperature of 25 °C ± 2 °C (see 5.1.6).

7.2.2 The battery shall be discharged with the current I₁₀ (calculated according to 5.1.1) kept constant at ± 1 % of the nominal value until the terminal voltage falls to 10,50 V ± 0,05 V. The duration t [h] of this discharge shall be recorded. The beginning of the discharge shall take place within a period of 1 h to 5 h from the time of the end of charging.

7.2.3 The capacity C_e [Ah] is

$$C_{10e} [Ah] = t [h] * I_{10} [A]$$

7.2.4 Requirements

From each test sequence of batteries 1 to 4 the maximum value C_{10e}^{max} is taken to calculate the mean value of the maximum effective C₁₀ capacities as:

$$\overline{C_{10e}^{max}} = \frac{1}{4} \sum_{i=1}^4 C_{10e}^{max} i$$

The standard deviation for this data are calculated as:

$$S = \sqrt{\frac{\sum_{i=1}^4 (C_{10e}^{max} i - \overline{C_{10e}^{max}})^2}{3}}$$

The mean value of the capacity should be as target equal or greater than the labelled capacity C_{10n}.

Due to inevitable statistical deviations the requirement for compliance of C₁₀ capacity is to fulfil the condition

$$\frac{(\overline{C_{10e}^{max}} - S)}{C_{10n}} \geq 0.95$$

7.3 Cranking performance test

7.3.1 After a rest period of up to 72 h after preparation according to 7.1, the battery shall be placed in a cooling chamber with (forced) air circulation at a temperature of -18 °C ± 1 °C until the temperature of the middle cells has reached -18 °C ± 1 °C.

NOTE 1 It is recommended to use a rest period of minimum 24 h to prevent reduced performance during the cranking performance test due to trapped charging gas between the electrodes.

NOTE 2 It is generally accepted that the required temperature will be achieved after a minimum period of 24 h in the cooling chamber.

7.3.2 The battery shall then be discharged, either inside or outside the cooling chamber, within 2 minutes of the end of the cooling period, with a current I_{cc} (see 5.1.2). This current shall be kept constant to within ± 0,5% during the discharge.

7.3.3 After 10 s discharge, the terminal voltage U_f shall be recorded in Volts and the current shall be cut off.

7.3.4 The test shall be continued after a rest time of 10 s ± 1 s.

7.3.5 The battery shall then be discharged at 0.6 I_{cc}. The current shall be kept constant to within ± 0,5 % during the discharge. The discharge shall be terminated when the battery voltage reaches 6,0 V. The discharge time t_{6v} shall be recorded in seconds.

7.3.6 t_{6v} is defined as the duration of the second stage (t'_{6v}) plus the equivalent duration of the first stage discharge if run at $0,6 I_{cc}$, i.e. it is given, in seconds, by the following formula:

$$t_{6v}[s] = t'_{6v}[s] + \frac{10 s}{0.6} = t'_{6v}[s] + 17s$$

7.3.7 Requirements

$U_f \geq 7,50 V$

$t_{6v} \geq 90 s$

7.4 Endurance test

7.4.1 General

The tests shall be carried out on fully charged batteries in accordance with 7.1.

Throughout the whole test period the battery shall be placed in a water bath at a temperature of $40 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ (see 5.1.6).

In the case of flooded batteries, purified water shall be added to the battery as necessary during the test to maintain the electrolyte level in accordance with the manufacturer's recommendations.

The batteries shall be connected to a test device where they undergo a series of cycles. Each cycle consists of the following steps.

7.4.2 Discharge the battery for 2 h with a constant current of $I = 2,5 I_{10}$. Cut off criterion for this test is the voltage during the discharge. If it drops below 10,5 V the test shall be terminated.

7.4.3 Recharge the battery for maximum 5 h with a constant voltage of 15,6 V for flooded batteries and 14,4 V for valve regulated batteries (if not specified differently by the battery manufacturer) and a maximum current of $I_{max} = 2,5 I_{10}$. Record the recharged capacity C_{rch} [Ah] during the charging. Once the charging ratio CR reaches 1,08 (or any lower value specified by the manufacturer) stop the charging.

$$CR = \frac{2 * C_{rch} [Ah]}{C_{10n}}$$

7.4.4 If the ratio $CR < 1,08$ (or any lower value specified by the manufacturer) in step 7.4.3 recharge the battery with a constant current of $I = 0,5 I_{10}$ until the ratio CR reaches 1,08 (or any lower value specified by the manufacturer) or until the maximum duration of 1 h for this step is reached.

7.4.5 Perform steps 7.4.2 to 7.4.4 as long as the voltage during discharge is above the limit.

7.4.6 Requirements

No requirement given. This test procedure is given to be able to compare different batteries.

7.5 Charge retention test

7.5.1 The tests shall be carried out on fully charged batteries in accordance with 7.1. Cell plugs shall be closed but any venting system shall be open.

7.5.2 The battery shall be placed in a climate chamber at $40 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ for 21 days on open circuit. No connecting clamps or cables shall be connected to the terminals.

7.5.3 After the storage time the battery shall be placed in a cooling chamber with (forced) air circulation at a temperature of $-18 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ until the temperature of the middle cells has reached $-18 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$.

NOTE: It is generally accepted that the required temperature will be achieved after a minimum period of 24 h in the cooling chamber.

7.5.4 The battery shall then be discharged at $0,6 I_{cc}$ for 30 s. The current shall be kept constant to within $\pm 0,5 \%$ during the discharge. After 30 s discharge, the terminal voltage U_f shall be recorded in Volts.

7.5.5 Requirements

No requirement given. This test procedure is given to be able to compare different batteries.

7.6 Water consumption test

7.6.1 The fully charged battery (see 7.1) shall be cleaned, dried and the mass W_1 shall be measured in grams to an accuracy of ± 1 g.

7.6.2 The battery shall be placed in a water bath (see 5.1.6) at a temperature of $60 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ and charged at a constant voltage of $14,40 \text{ V} \pm 0,05 \text{ V}$ (measured across the battery terminals) for 21 days without adding water.

7.6.3 Immediately after this overcharging period the battery shall be cleaned, dried and the mass W_2 shall be measured in grams to an accuracy of ± 1 g using the same scale.

7.6.4 The water consumption is calculated as:

$$WL \left[\frac{g}{Ah} \right] = \frac{W_2 [g] - W_1 [g]}{C_{10e}^{max} [Ah]}$$

C_{10e}^{max} is the maximum achieved effective capacity of the battery tested for water consumption in test steps 2, 4 and 6 according to Table 1.

7.6.5 Requirements

No requirement given. This test procedure is given to be able to compare different batteries.

7.7 Vibration resistance test

7.7.1 The fully charged battery (see 7.1) shall be immediately discharged at $0,6 I_{cc}$ at $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ until the battery voltage reaches 6,0 V. The voltage at 60 s ($U(60s)$) and the time to 6 V ($t6V_{bf}$) shall be recorded.

7.7.2 After charging (see 7.1) the battery shall be stored for at least 24 h at a temperature of $25 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$.

7.7.3 The battery shall be fastened rigidly to the table of the vibration tester using base hold downs if available or overhead mountings. Clamping forces have to be chosen to properly fix the battery but to not exceed the maximum surface load according EN 50342-5.

7.7.4 If the battery offers the possibility a vent tube should be attached to collect any spilling electrolyte.

7.7.5 The battery shall be subjected for a period of 2 h to a vertical sinusoidal vibration at a constant frequency of $30 \text{ Hz} \pm 2 \text{ Hz}$ and a constant acceleration of 60 m/s^2 .

7.7.6 The temperature of the battery shall be maintained at $25 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$ during the vibration test.

7.7.7 After a maximum of 5 days from the end of the vibration, the battery shall be discharged (without prior recharge) at a temperature of $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ and a current of $0,6 * I_{cc}$ until 6.0 V is reached. The voltage at 60 s (U_{60}) and the time to 6 V ($t6V_{af}$) shall be recorded.

7.7.8 Requirements

No requirement given. This test procedure is given to be able to compare different batteries.

Annex A (normative)

Correlation between C10 and C20

A.1 Calculation of C₁₀ from C₂₀

For reference, the 10 h capacity C₁₀ can be calculated from the 20 h capacity C₂₀ as used for lead acid batteries according EN 50342-1 by this formula

$$C_{10} [\text{Ah}] = 0.93 * C_{20} [\text{Ah}]$$

A.2 Calculation of C₂₀ from C₁₀

For reference, the 20 h capacity C₂₀ as used for lead acid batteries according EN 50342-1 can be calculated from the 10 h capacity C₁₀ by this formula

$$C_{20} [\text{Ah}] = 1.08 * C_{10} [\text{Ah}]$$

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