BRITISH STANDARD

BS EN
50342:2001

Lead-acid starter batteries — General requirements, methods of test and numbering

The European Standard EN 50342:2001 with the incorporation of amendments A1:2001 and A2:2001 has the status of a British Standard

ICS 29.220.20

National foreword

This British Standard is the official English language version of EN 50342:2001 amendments A1:2001 and amendment 2:2001. It supersedes BS EN 60095-1:1993 which will be withdrawn on 1 April 2003.

The UK participation in its preparation was entrusted to Technical Committee PEL/21, Secondary cells and batteries, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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English version

Lead-acid starter batteries — General requirements, methods of test and numbering

(includes amendments A1:2001 and A2:2001)

Batteries d'accumulateurs de démarrage au plomb — Prescriptions générales, méthodes d'essais et numérotation (inclut les amendements A1:2001 et A2:2001)

Blei-Akkumulatoren Starterbatterien — Allgemeine Anforderungen, Prüfungen und Kennzeichnung (enthält Änderungen A1:2001 und A2:2001)

This European Standard was approved by CENELEC on 2000-08-01. Amendment A1 was approved by CENELEC on 2000-09-01 and amendment A2 was approved by CENELEC on 2001-05-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard and its amendment the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 21X, Secondary cells and batteries.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50342 on 2000-08-01.

This European Standard supersedes EN 60095-1:1993 + A2:1995 + A11:1995 + A12:1999 + A13:1997.

A draft for an amendment was submitted to the Unique Acceptance Procedure and was approved as amendment A1 to EN 50342 on 2000-09-01.

In this document, the text of the amendment is indicated by a vertical line in the left margin of the text.

The following dates were fixed:

- latest date by which the EN and the amendment have to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-10-01
- latest date by which the national standards conflicting with the EN and the amendment have to be withdrawn (dow) 2003-04-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A, B, C and D are normative.

Contents

1 General

1.1 Scope

This standard is applicable to lead-acid batteries with a nominal voltage of 12 V, used primarily as a power source for the starting of internal combustion engines, lighting and also for auxiliary equipment of internal combustion engine vehicles. These batteries are commonly called "starter batteries". Batteries with a nominal voltage of 6 V are also included within the scope of this standard. All referenced voltages have to be divided by two for 6 V batteries.

This standard is applicable to batteries for the following purposes:

- batteries for passenger cars;
- batteries for commercial and industrial vehicles for normal use;
- batteries for commercial and industrial vehicles for severe use.

This standard is not applicable to batteries for other purposes, for example the starting of railcar internal combustion engines.

1.2 Object

The object of this standard is to specify:

- general requirements;
- certain essential functional characteristics, the relevant test methods and results required, for several classes and types of starter batteries.

1.3 Designation of starter batteries — Electrolyte density and open circuit voltage

1.3.1 Batteries are classified according to their types:

- vented (flooded) battery: a secondary battery having a cover provided with one or more openings through which gaseous products may escape;
- valve regulated (with gas recombination) battery: a secondary battery which is closed under normal conditions but which has an arrangement which allows the escape of gas if the internal pressure exceeds a predetermined value. The battery cannot receive addition to the electrolyte.

  In this type of battery, the electrolyte is immobilized.

1.3.2 Electrolyte density and open circuit voltage

The density of the electrolyte in all vented batteries, when fully charged shall be in the range 1,27 kg/l to 1,30 kg/l at 25 °C unless otherwise specified by the manufacturer.

The open circuit voltage (OCV), when fully charged, but after a minimum 24 h stand on open circuit, shall be in the range 12,70 V to 12,90 V for vented batteries and 12,80 V minimum for valve regulated batteries at 25 °C unless otherwise specified by the manufacturer.

Either the manufacturer shall specify the electrolyte density (or OCV) and tolerance, or if such information is not available, vented battery testing shall be carried out with a density of 1,28 kg/l ± 0,01 kg/l at 25 °C or an OCV of 12,76 V ± 0,06 V at 25 °C and valve regulated battery testing shall be carried out with a minimum OCV of 12,80 V.

1.4 Condition on delivery

New vented batteries may be supplied either:

- in a state ready for use, filled with the appropriate electrolyte to the maximum level. After an initial charge (according to 4.2.1), the electrolyte density or OCV shall be within the ranges specified in 1.3;
- in a dry-charged state not filled with electrolyte. The density of the acid to fill such batteries before use shall be in the range 1,27 kg/l to 1,30 kg/l at 25 °C unless otherwise specified by the manufacturer.

Valve regulated batteries are normally supplied in a state ready for use. For these batteries the electrolyte is not accessible and therefore its density cannot be checked.

2 General requirements

2.1 Identification, labelling

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

a) the European type number (see annex A);

b) identification of manufacturer or supplier;

c) the nominal voltage, i.e. 12 V or 6 V;

d) the capacity:
   - either nominal capacity C_n (Ah) (see 3.1.2);
   - or nominal reserve capacity $C_{r,n}$ (min) (see 3.1.2).

   The values of C_n or $C_{r,n}$ for all batteries shall correspond to the electrolyte density or OCV given in 1.3;

e) the nominal cranking current I_{cc} (see 3.1.1);

f) safety labelling: batteries shall be marked with six coloured symbols as described in annex B;

g) the marking for the separate collection and recycling according to EN 61429;

h) valve regulated batteries shall bear a special indication.

NOTE Batteries may be marked with other information such as the filling and charging date (see 4.1).

2.2 Marking of the polarity

According to EN 60095-2 (section 5, clause 14) the positive terminal shall be identified by a + mark on the lid or on the terminal itself.

2.3 Additional designation

Vented starter batteries may be designated as "low water loss" or "very low water loss" according to this European Standard if they comply with the corresponding requirements of 5.7.1 and the requirement in 5.5.2.

3 Functional characteristics

For general definitions of terms see Chapter 486 of the International Electrotechnical Vocabulary (IEV) (IEC 60050-486).

3.1 Electrical characteristics

3.1.1 The *cranking current* is the discharge current I_{cc} to be indicated by the manufacturer which a battery can supply at –18 °C for 10 s to a minimum voltage U_f = 7,50 V and complying with the requirements of 5.3.

3.1.2 The *capacity* of a starter battery is defined for the temperature of 25 °C ± 2 °C.

It may be indicated by the manufacturer either as:

- nominal capacity C_n (Ah); or as
- nominal reserve capacity $C_{r,n}$ (min).

The *nominal capacity* C_n is the electric charge (in Ah) which a battery can supply with a current:

$$I_n = \frac{C_n}{20}$$

to a final voltage U_f = 10,50 V.

The *effective capacity* C_e shall be determined by discharging a battery with constant current I_n to U_f = 10,50 V (see 5.1).

The nominal reserve capacity $C_{r,n}$ is the period of time (in minutes) for which a battery can maintain a discharge of 25 A to a cut-off voltage U_f = 10,50 V.

The *effective reserve capacity* $C_{r,e}$ shall be determined by discharging a battery with the constant current I = 25 A to U_f = 10,50 V (see 5.2).

NOTE For the correlation (relationship) of C_n and $C_{r,n}$ see annex C.

3.1.3 The *charge acceptance* is expressed as the current I_{ca} which a partially discharged battery takes up at 0 °C and at a constant voltage of 14,4 V (see 5.4).

3.1.4 *Charge retention* is defined as the cold cranking performance of the charged and filled battery after storage on open circuit under defined conditions (temperature, time, see 5.5).

3.1.5 *Endurance in cycles* represents the ability of a battery to perform repeated discharge/recharge cycles and long rest periods on open circuit. This ability shall be tested by a series of cycles and rest periods under specified conditions after which the cold cranking performance shall be determined (see 5.6).

3.1.6 *Water consumption* is defined as g/Ah C_e or g/min $C_{r,e}$ (see 3.1.2 and 5.7).

Valve regulated batteries have a very low water consumption and are not intended to receive addition to the electrolyte (see 5.7.2).

3.1.7 *Dry-charged battery*: A new battery may be designated as dry-charged if it can be activated - ready for service - by filling it with the defined electrolyte (see 1.3 and 1.4) and in accordance with any specific instructions from the manufacturer, and if it then conforms to the requirements of 5.10.

3.2 Mechanical characteristics

3.2.1 *Vibration resistance* represents the ability of a battery to maintain service under acceleration forces. Requirements are verified by the test defined in 5.8.

3.2.2 *Electrolyte retention* is the ability of a battery to retain electrolyte under specified mechanical conditions (see 5.9). Valve regulated batteries are submitted to a special test (see 5.9.2).

4 General test conditions

4.1 Sampling of batteries

All tests shall be carried out on new battery samples. Samples shall be considered as new not later 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.

4.2 Preparation of batteries prior to test — Definition of a fully-charged battery

All tests - except that in 5.10 - shall commence with fully-charged batteries.

Batteries shall be considered as fully-charged if they have undergone the charging procedures of 4.2.1 for vented batteries or 4.2.2 for valve regulated batteries.

4.2.1 Charging of vented 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 5 I_n (see 3.1.2). The battery temperature shall be maintained in the range 25 °C to 35 °C. If necessary, an appropriate environmental control system shall be used, e.g. a water bath.

In the case of recharging after a test for cranking performance (according to 5.3) the charging time may be limited to 16 h.

4.2.2 Charging of valve regulated batteries

Unless otherwise recommended by the manufacturer, the battery shall be charged:

- at a constant voltage of 14,4 V for 20 h with the maximum current limited to 5 I_n (see 3.1.2);
- then with a constant current of 0,5 I_n for 4 h.

The temperature shall be maintained in the range 25 °C to 35 °C. If necessary an appropriate environmental control system shall be used, e.g. a water bath.

4.3 Activation of dry-charged batteries

Dry-charged batteries shall be filled with the defined electrolyte (according to 1.4) to the maximum level indicated by internal or external marks or according to the manufacturer's activation instructions. Any additional manufacturer's recommended activation instructions shall be complied with.

4.4 Measuring instruments

4.4.1 Electrical measuring instruments

The range of instruments used shall be appropriate for the magnitude of the voltage or current to be measured.

For analogue instruments the readings shall be taken in the top third of the scale.

- Voltage measurement

The instruments used for measuring voltages shall be voltmeters having an accuracy class of 1 or better. The resistance of the voltmeters shall be at least 300 Ω/V.

- Current measurement

The instruments used for current measurement shall be ammeters having an accuracy class of 1 or better. The assembly of ammeter, shunt and leads shall have an overall accuracy of class 1 or better.

4.4.2 Temperature measurement

The thermometers used for measuring temperatures shall have an appropriate range, and the value of each scale division shall not be greater than 1 K. The accuracy of the calibration of the instruments shall be not less than 0,5 K.

4.4.3 Density measurement

The density of the electrolyte shall be measured with hydrometers furnished with a graduated scale, the value of each division of which is equal at most to 0,005 kg/l. The accuracy of calibration shall be to 0,005 kg/l or better.

4.4.4 Time measurement

The instruments used for measuring time shall be graduated in hours, minutes, seconds, or in hours and centihours, ch $(=\frac{1}{100}\text{h})$. They shall have an accuracy of at least ±1 %.

4.5 Test sequence

4.5.1 Batteries filled and charged

Initially the batteries are subjected to the following series of tests:

1st C_e or $C_{r,e}$ check;
1st Cranking performance test;
2nd C_e or $C_{r,e}$ check;
2nd Cranking performance test;
3rd C_e or $C_{r,e}$ check;
3rd Cranking performance test.

For both C_e or $C_{r,e}$ and the cranking performance, the specified values shall be met in at least one of the relevant discharges above.

NOTE It is not necessary to complete the sequence if the specified values are achieved on the first or second test other than for batteries which will subsequently be tested for charge acceptance.

If, and only if, the initial capacity and cranking tests are successful, the batteries shall be tested in accordance with the remainder of the test sequence given in Table 1.

These tests shall commence not later than one week after completion of the initial tests.

Table 1 — Test sequence

Battery	Subclause	1	2	3	4	5
1st C_e or $C_{r,e}$	5.1 or 5.2	X	X	X	X	X
1st Cranking performance test	5.3	X	X	X	X	X
2nd C_e or $C_{r,e}$	5.1 or 5.2	(X)	(X)	X	(X)	(X)
2nd Cranking performance test	5.3	(X)	(X)	X	(X)	(X)
3rd C_e or $C_{r,e}$	5.1 or 5.2	(X)	(X)	X	(X)	(X)
3rd Cranking performance test	5.3	(X)	(X)	X	(X)	(X)
Endurance	5.6	X				
Charge retention	5.5		X			
Charge acceptance	5.4			X		
Electrolyte retention	5.9			X		
Vibration resistance	5.8				X	
Water consumption	5.7					X
NOTE The test for water consumption should be applied only to "low water loss" vented batteries according to 2.3 and to valve regulated batteries.						

4.5.2 Dry-charged batteries

- Initial cranking performance after filling electrolyte (see 5.10).
- Capacity test (see 5.1) or reserve capacity test (see 5.2).
- Subsequent testing following the sequence defined in 4.5.1.

5 Tests/methods and requirements

5.1 Capacity check C_e

5.1.1 Throughout the duration of the tests, the battery shall be placed in a water bath at a temperature of 25 °C ± 2 °C. 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 then the distance between them and also the distance to the walls of the bath shall be at least 25 mm.

5.1.2 The battery shall be discharged with the current I_n (calculated according to 3.1.2) kept constant at ±2 % 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.

5.1.3 The capacity C_e is $C_e = t \times I_n$ (Ah).

5.2 Reserve capacity check $C_{r,e}$

5.2.1 The battery shall be placed in a water bath according to 5.1.1.

5.2.2 Within a 1 h to 5 h period after the end of charging according to 4.2, the battery shall be discharged with a current of 25 A ± 1 % until the terminal voltage falls to 10,50 V ± 0,05 V. The duration t(min) of the discharge shall be recorded.

5.3 Cranking performance test

5.3.1 After a rest period of up to 24 h after preparation according to 4.2, 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 It is generally accepted that the required temperature will be achieved after a minimum period of 24 h in the cooling chamber.

5.3.2 The battery shall then be discharged - either within or outside the cooling chamber - within 2 min after the end of the cooling period with a current I_{cc} (see 3.1.1). This current shall be kept constant to within ±0,5 % during the discharge.

5.3.3 After 10 s discharge, the terminal voltage U_f shall be recorded and the current shall be cut off. The voltage U_f shall be not less than 7,50 V.

NOTE 5.3.1 to 5.3.3 comprise stage 1 of the cranking performance test.

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

5.3.3.2 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 time shall be terminated when the battery voltage reaches 6 V.

5.3.3.3 The discharge time (t'_{6v}) at 0,6 I_{cc} to 6 V shall be recorded in seconds.

NOTE This period comprises stage 2 of the test.

The discharge time (t'_{6v}) may be used to define the cold cranking capacity (C'_{cc}) in stage 2 in amperehours in the following equation:

$$C'_{cc} = \frac{t'_{6V}}{3600} \times 0{,}6\, I_{cc}$$

The total cold cranking capacity C_{cc} given by stage 1 plus stage 2 is given by the following equation:

$$C_{cc} = C'_{cc} + \frac{10}{3600} I_{cc}$$

i.e.:

$$C_{cc} = \frac{I_{cc}}{3600}(10 + 0{,}6\, t'_{6v})$$

5.3.3.4 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 equation:

$$t_{6v} = t'_{6v} + \frac{10}{0{,}6} = t'_{6v} + 17$$

5.3.3.5 According to battery use, the battery shall comply with the following, as applicable:

Requirement 1

$t_{6v} \geq 90$ s.

Requirement 2

The cold cranking capacity C_{cc} (see 5.3.3.3) shall be $\geq 0{,}2\ C_n$ (alternatively $\geq 0{,}12\ C_{r,n}$).

NOTE This requirement is regarded as fulfilled for batteries giving a discharge time $t_{6v} \geq 150$ s.

5.4 Charge acceptance test

5.4.1 The battery shall be discharged at a temperature of 25 °C ± 2 °C at a current I_o for 5 h where:

$$I_o = \frac{C_e}{10}$$

The value C_e shall either:

- be taken as the maximum value C_e of the previous discharges according to 5.1; or
- be calculated from the maximum value $C_{r,n}$ of the previous discharge(s) according to 5.2 using the correlation formula in annex A.

5.4.2 Within a maximum period of 10 min after the discharge, the battery shall be placed in a cooling chamber and cooled until the temperature of the middle cells is 0 °C ± 1 °C.

NOTE It is generally accepted that the required temperature will be achieved after a minimum period of 15 hours to 24 hours in the cooling chamber.

5.4.3 At this temperature, the battery shall be charged at a constant voltage of 14,40 V ± 0,05 V.

After 10 min, the charging current I_{ca} shall be recorded.

5.4.4 I_{ca} shall be: vented batteries: $\geq 2I_o$;
valve regulated batteries: level 1 $\geq I_o$;
level 2 $\geq 2\ I_o$.

5.5 Charge retention test

5.5.1 Requirement for standard vented batteries

5.5.1.1 A fully-charged battery (according to 4.2) with its vent plugs firmly in place and a clean and dry surface, shall be stored at 40 °C ± 2 °C for 21 days on open circuit. No connecting clamps or cables shall be attached to the terminals.

5.5.1.2 After this storage period the battery shall be submitted, without recharge, to a cold cranking performance test according to 5.3.1 and 5.3.3.2. The voltage after 30 s of discharge shall be not less than 8,0 V.

5.5.2 Requirements for "low water loss" and "very low water loss" vented batteries and valve regulated batteries

Under the same conditions as in 5.5.1 the voltage after 30 s of discharge shall be not less than 8,50 V.

5.6 Endurance test

5.6.1 Batteries shall be tested in accordance with 5.6.2, 5.6.3 or 5.6.4, as applicable, according to the intended battery use.

5.6.2 Requirement 1

5.6.2.1 Corrosion test

5.6.2.1.1 The test shall be carried out on fully charged batteries in accordance with 4.2.

5.6.2.1.2 The battery shall be placed in a water-bath maintained at a temperature of 60 °C ± 2 °C.

The top of the battery case shall emerge not more than 25 mm above the level of the water. A minimum space of 25 mm shall be maintained around each battery.

5.6.2.1.3 The battery, always at 60 °C ± 2 °C, shall be charged at a constant voltage of 14,0 V ± 0,1 V, for a period of 13 days.

5.6.2.1.4 The battery shall be stored on open circuit, still at 60 °C ± 2 °C, for a period of 13 days.

5.6.2.1.5 The battery shall be cooled to ambient temperature. Water shall be added as necessary to maintain electrolyte level in accordance with the manufacturer's recommendations.

5.6.2.1.6 The battery shall then be recharged in accordance with 4.2.

5.6.2.1.7 The battery shall be discharged with a current of 0,6 I_{cc} at 25 °C ± 2 °C.

5.6.2.1.8 The sequence 5.6.2.1.1 to 5.6.2.1.7 constitutes one corrosion test unit.

5.6.2.1.9 The whole sequence 5.6.2.1.1 to 5.6.2.1.7 shall be repeated and the test shall be terminated when the battery voltage reaches 6 V in less than 30 s with a current of 0,6 I_{cc} in cranking test at 25 °C ± 2 °C.

5.6.2.1.10 The number of corrosion test units is four.

5.6.2.2 Cycling test

5.6.2.2.1 Tests shall be carried out on fully charged batteries in accordance with 4.2.

5.6.2.2.2 Throughout the whole test period with the exception of the rapid discharge test at the temperature of −18 °C ± 1 °C, the battery shall be placed in a water bath at a temperature of 25° C ± 2 °C. Water shall be added as necessary during the test to maintain electrolyte level in accordance with the manufacturer's recommendations except for low water consumption batteries.

5.6.2.2.3 The batteries shall be connected to a device where they undergo a series of 180 cycles, each cycle comprising:

a) a discharge for 1 hour at a current in amperes:

$$I = \frac{Cn}{4} (U \geq 10{,}5 \text{ V} \pm 0{,}05 \text{ V})$$

b) immediately followed by a recharge for 2 h and 55 min at a constant voltage of 14,80 V ± 0,05 V, the maximum current in amperes being limited to I_{max} = 10 I_n, and for 5 min at a current in amperes:

$$I = \frac{Cn}{8}$$

5.6.2.2.4 The test shall be terminated when the battery voltage drops below 10,5 V during the discharge prior to completion of 180 cycles.

5.6.2.2.5 When the cycling is over, the battery shall be placed in a cooling chamber with (forced) air circulation at a temperature of −18 °C ± 1 °C for a minimum of 20 h or until the temperature in one of the middle cells has reached −18 °C ± 1 °C.

5.6.2.2.6 The battery shall then be discharged after the end of the cooling period with a current 0,6 I_{cc}.

5.6.2.2.7 After 30 s of discharge, the voltage across the battery terminals shall be measured. It shall not be less than 7,20 V. The discharge shall then be terminated.

NOTE Current accuracy: 2 digits.

EXAMPLE:

$$I = \frac{Cn}{8} = \frac{35}{8} = 4{,}375 \cong 4{,}38$$

5.6.3 Requirement 2

5.6.3.1 Tests shall be carried out on fully charged batteries in accordance with 4.2.

5.6.3.2 Throughout the whole test period, with the exception of the rapid discharge test at the temperature −18 °C, the batteries are placed in a water bath at a temperature of 40 °C ± 2 °C (see 5.6.2.2).

5.6.3.3 The batteries shall be connected to a device where they undergo a continuous series of cycles, each cycle comprising:

a) a charge for 5 h at a constant voltage of 14,80 V ± 0,05 V for vented batteries and 14,40 V ± 0,05 V for valve regulated batteries, the maximum current being limited to:

I_{max} = 5 I_n ± 2 % (A).

b) immediately followed by a discharge for 2 h with a current of 5 I_n.

5.6.3.4 At the end of the discharge of cycle 14, the discharge voltage shall be not less than 10,0 V. After recharging in accordance with 5.6.3.3, the batteries shall be disconnected from the endurance test circuit and allowed to remain on open circuit for a period of 70 h.

5.6.3.5 The whole sequence of 14 cycles followed by the open circuit period constitutes one endurance test unit.

5.6.3.6 Immediately after five endurance test units and without recharge, the batteries shall be removed from the water bath, cooled to an electrolyte temperature of –18 °C ± 1 °C (measured in a central cell, this measurement being not applicable to valve regulated batteries) for at least 20 h and then discharged with a current of 0,6 I_{cc} (see 3.1.1, 5.3.2 and 5.3.3.2).

5.6.3.7 After 30 s ± 1 s of discharge, the voltage across the battery terminals shall be measured. It shall be not less than 7,20 V. The discharge shall then be terminated.

5.6.4 Requirement 3

The test method shall be in accordance with 5.6.3.1 to 5.6.3.7. The number of endurance test units is eight.

5.7 Water consumption test

5.7.1 Vented batteries

5.7.1.1 The battery, after being charged according to 4.2, shall be cleaned, dried and weighed to an accuracy of ±0,05 %.

5.7.1.2 The battery shall be placed in a water-bath maintained at a temperature of 40 °C ± 2 °C (see 5.6.2.2).

5.7.1.3 The battery shall be charged at a constant voltage of 14,40 V ± 0,05 V (measured across the battery terminals) for a period of 21 days without adding water.

5.7.1.4 Immediately after this overcharge period, the battery shall be weighed under the same conditions as in 5.7.1.1 with the same scales.

5.7.1.5 The loss in weight shall not exceed the following values:

- low water loss batteries: 4 g / Ah C_e or 2,7 g / min $C_{r,e}$;
- very low water loss batteries: 1 g / Ah C_e or 0,68 g / min $C_{r,e}$.

The values of C_e and $C_{r,e}$ shall be taken as the maximum achieved when tested in accordance with 4.5 and 5.1 or 5.2.

5.7.2 Valve regulated batteries

5.7.2.1 The battery is charged according to 4.2.

5.7.2.2 The battery shall be placed in a water bath maintained at a temperature of 40 °C ± 2 °C (see 5.6.2.2).

5.7.2.3 The battery shall be charged at a constant voltage of 14,40 V ± 0,05 V (measured across the battery terminals) for a period of 500 h.

5.7.2.4 Immediately after this first period the battery shall be cleaned, dried and weighed to an accuracy of ±0,05 % (weight W_1).

5.7.2.5 The battery shall be placed in a water bath maintained at a temperature of 40 °C ± 2 °C. The top of the battery case shall emerge not more than 25 mm above the level of the water. A minimum space of 25 mm shall be maintained around each battery.

5.7.2.6 The battery shall be charged at a constant voltage of 14,40 V ± 0,05 V (measured across the battery terminals) for a period of 1 000 h.

5.7.2.7 Immediately after this overcharge period, the battery shall be weighed under the same conditions as in 5.7.2.4 with the same scales (weight W_2).

5.7.2.8 The loss in weight divided by 2: $[(W_1 - W_2)/2]$, shall not exceed the value 1 g/Ah C_e (or 0,67 g/min C_{re}).

5.8 Vibration resistance test

5.8.1 The battery charged according to 4.2, shall be immediately discharged at 0,6 I_{cc} at 25 °C ± 2 °C. The times to 7,20 V and 6 V shall be recorded.

After charging according to 4.2 the battery shall be stored for 24 h at a temperature of 25 °C ± 10 °C.

5.8.2 The battery shall be fastened rigidly to the table of the vibration tester. The fastening shall be of the same type as that used on a vehicle and secured by either:

- the bottom hold-downs or ledges on the lower part of the container and suitable hold-down clamps and bolts with M8 thread, tightened to a torque of at least 15 Nm; or
- an angle-iron frame covering the upper edges of the battery case/cover assembly for a minimum width of X mm (see Table 2), connected to the vibration table by four screwed rods with M8 thread, tightened to a torque of at least 8 Nm.

5.8.3 The battery shall be subjected for a period of T(h) (see Table 2) to a vertical vibration of a frequency of 30 Hz to 35 Hz, these vibrations being as nearly sinusoidal as possible.

Requirement 1, 2 or 3 of Table 2 shall be selected according to the use of the battery.

The maximum acceleration on the battery shall reach the value Z (see Table 2).

5.8.4 After a maximum of 4 h from the end of the vibration, the battery shall be subjected - without recharge - to a discharge at a temperature of 25 °C ± 2 °C and a current of 0,6 I_{cc} (see 3.1.1 and 5.3.3.2).

The terminal voltage after 60 s shall be not less than 7,20 V.

Table 2 — Vibration resistance test

Requirement	1	2	3
Minimum width of battery cover/case to be covered, X	15 mm	33 mm	33 mm
Period of vibration, T	2 h	2 h	20 h
Maximum acceleration on the battery, Z	30 ms^{-2}	60 ms^{-2}	60 ms^{-2}

5.9 Electrolyte retention test

5.9.1 Vented batteries

5.9.1.1 A battery charged according to 4.2 shall be stored for 4 h on open circuit at a temperature of 25 °C ± 5 °C.

5.9.1.2 *If necessary* the electrolyte level of each cell shall be adjusted to the maximum with purified water. The external surfaces of the battery shall be cleaned and dried.

5.9.1.3 The battery shall then be tilted in each direction at intervals of not less than 30 s between each tilting as follows:

a) the battery shall be tilted through 55° from the vertical in a maximum period of 1 s;

b) the battery shall be maintained in this position for 3 s;

c) the battery shall be returned to the vertical position in a maximum period of 1 s.

5.9.1.4 After this test, no evidence of liquid shall be visible.

5.9.2 Valve regulated batteries

5.9.2.1 The battery shall be charged according to 4.2.

5.9.2.2 Immediately after the end of charge, the battery shall be placed upside down on a sheet of blotting paper, put on a flat insulated surface, for 6 h at a temperature of 25 °C ± 5 °C.

5.9.2.3 After this test, no evidence of liquid shall be visible on the blotting paper.

5.10 Cranking performance for dry-charged batteries after activation

5.10.1 The dry-charged battery and a sufficient amount of the electrolyte supplied, or according to the manufacturer's specifications, shall be stored at 25 °C ± 2 °C for at least 12 h (before filling).

5.10.2 The electrolyte at 25 °C ± 2 °C shall be filled up to the level indicated by the manufacturer.

5.10.3 After a rest period of 20 min at the same ambient temperature, the battery shall be discharged at a current 0,6 I_{cc} (see 3.1.1 and 5.3.3.2). The cranking performance shall be not less than that defined in 5.3.3.5, as appropriate.

Annex A
(normative)

European type number for starter batteries

Introduction

A single identification system for starter batteries will make the references of the batteries clearer and help the users.

It is in the interest of the user to identify with a single number of batteries from different manufacturers with the same standard level of performance and the same features.

This annex defines the structure and the construction method of the starter battery type number ETN (European type number for starter batteries).

ETN, as an identification number, is part of the marking and may be used by anyone but only for starter batteries that comply with the requirements of this standard.

To keep the ETN updated, administration and maintenance is necessary because three digits of the nine-digit-type-number derive from a set of specification sheets while six digits can be defined by a manufacturer himself. Administration and maintenance means that e.g. geometrical characteristics of a new battery accompanying a request for an ETN have to be checked for identification.

The CENELEC/TC21X is responsible for the administration and maintenance of the ETN. For practical reasons this CLC/TC delegates the day to day operation to an external service company, the address of which is available from CLC/TC21X.

A.1 Structure of the European type number

The ETN consists of nine digits assigned to three groups with three digits in each group. The three groups are designated by the letters A, B, C in the following text.

These three groups of digits are indicative of:

Group A battery voltage and nominal capacity (C_n);

Group B battery geometrical characteristics and requirement levels for specified features of this standard;

Group C battery cold cranking intensity (I_{cc}).

A			B			C		
X	X	X	X	X	X	X	X	X

NOTE Alterations to dimensions, mechanical or electrical characteristics require the creation of a new ETN.

A.2 Construction method for the European type number

A.2.1 Group A

A.2.1.1 Group A construction

Group A consists of three digits identifying battery voltage and nominal capacity.

a) For 6 V batteries, the three digit number is equal to the value of the nominal capacity as described below:

1 Ah up to 499 Ah: $\frac{\textit{Group A}}{001-499}$

b) For 12 V batteries, the three digit number is equal to the value of the nominal capacity increased by 500 as described below:

1 Ah up to 299 Ah: $\frac{\textit{Group A}}{501-799}$

A.2.1.2 Requirements for the assignation of a new number resulting from nominal capacity change for 6 V and 12 V batteries

If digit group B (see A.2.2) and digit group C (see A.2.3) are identical to those of an existing ETN, a new type number will only be assigned if the nominal capacity C_n difference between the existing battery and the proposed new battery is equal to or greater than:

1	Ah	in the range	1	Ah	to	20 Ah
3	Ah	in the range	21	Ah	to	50 Ah
4	Ah	in the range	51	Ah	to	80 Ah
5	Ah	in the range	81	Ah	to	120 Ah
10	Ah	in the range	121	Ah	to	299 Ah

Thus if an ETN exists, e.g.:

A
555 059 042

and new batteries are proposed having identical groups B and C digits, but differing nominal capacities, new ETNs will be issued with group A 551 and 559, but not 552, 553, 554, 556, 557, 558.

A.2.2 Group B

Group B consists of three digits relating to battery geometric characteristics and requirement levels for specified features of this standard.

The three digit group is a serial number generated from a list.

Information contained in the list covers the aspects:

a) Dimensions:

Maximum length	=	L;
Maximum width	=	I;
Maximum overall height	=	H;
Maximum container height	=	h.

Tolerances are not fixed.

The starter batteries to be defined are mainly, but not exclusively, those detailed in European Standards EN 60095-2 and EN 60095-4.

b) assembly: terminal location;

c) terminal types;

d) container type: hold down, handles...;

e) cover type;

f) requirement level to be achieved in the cranking performance test;

g) low water loss battery;

h) requirement level to be achieved in the endurance test;

i) requirement level to be achieved in the vibration test;

j) other characteristics.

A.2.3 Group C

A.2.3.1 Group C construction

Group C consists of a three digit number equal to one tenth of the cold cranking intensity I_{cc}.

Thus, e.g.:	I_{cc} (A)	Group C
	330	033
	420	042
	1 050	105

NOTE The requirement level, in accordance with this standard, to be achieved in the cranking performance test is defined in group B.

A.2.3.3 Scale of fixed values for cold cranking intensity

I_{cc} less than 200 A:	Step 10 A
I_{cc} from 200 to 300 A: (200, 220, 240, 260, 280, 300)	Step 20 A
I_{cc} from 300 to 600 A: (330, 360, 390, 420, 450, 480, 510, 540, 570, 600)	Step 30 A
I_{cc} from 600 to 800 A: (640, 680, 720, 760, 800)	Step 40 A
I_{cc} above 800 A: (850, 900, 950,1 000,1 050 ...)	Step 50 A

Annex B
(normative)

Safety labelling — Definition of the six coloured symbols

The symbols mentioned in 2.1 f) are shown in Figure B.1.

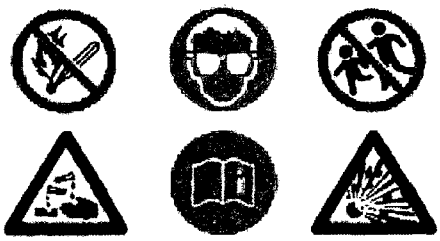

Figure B.1

The symbols shall have common dimensions as shown in Figure B.2 with a minimum dimension of 10 mm.

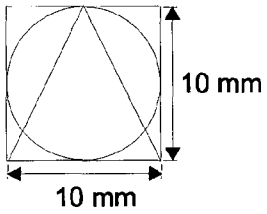

Figure B.2

The symbols shall be located in a group on the top of the battery (for example as shown in Figure B.1).

No text in any language shall be used with the symbols.

In the original equipment market, the meaning of the symbols shall be found in the vehicle manual in the appropriate language.

In the replacement market, the meaning of the symbols shall be in the booklet supplied with the battery which already contains information for warranty, precautions for handling, instructions for use, etc.

The meaning of the symbols is:

(RED)	No smoking, no naked flames, no sparks
(BLUE)	Shield eyes
(RED)	Keep away from children
(YELLOW)	Battery acid
(BLUE)	Note operating instructions
(YELLOW)	Explosive gas

Annex C
(normative)

Correlation between C_n et $C_{r,n}$

The value of $C_{r,n}$(min) may be estimated from C_n(Ah) by the use of the following equation:

$$C_{r,n} = \beta(C_n)^{\alpha}$$

with:

	Flooded batteries	Valve regulated batteries
α =	1,170	1,130
β =	0,830	1,070

Reciprocal equation:

$$C_n = \delta(C_{r,n})^{\gamma}$$

with:

	Flooded batteries	Valve regulated batteries
γ =	0,855	0,885
δ =	1,172	0,942

Annex D
(normative)

Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

Standard	Year	Title
EN 60095-2 +A11	1993 1994	*Lead-acid starter batteries — Part 2: Dimensions of batteries and dimensions and marking of terminals.* (IEC 60095-2:1984, modified)
EN 61429 +A11	1996 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 61429:1995, modified)
IEC 60050-486	1991	*International Electrotechnical Vocabulary* *Chapter 486: Secondary cells and batteries.*

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