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12V VRLA ACCUMULATORS FOR POWERING REMOTE-CONTROL DEVICE OF SECONDARY SUBSTATIONS

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1. SCOPE

The scope of this document is to provide the technical requirements for the supply of the 12V VRLA accumulators for powering remote-control device in the secondary substations of the Enel Group Distribution companies listed below:

- Ampla (Brazil)
- Chilectra (Chile)
- Codensa (Colombia)
- Coelce (Brazil)
- Edelnor (Perú)
- Edesur (Argentina)
- Endesa Distribución Eléctrica (Spain)
- Enel Distributie Banat (Romania)
- Enel Distributie Dobrogea (Romania)
- Enel Distributie Muntenia (Romania)
- Enel Distribuzione (Italy)

Note: the indication "LATAM" refers to the Enel Group Distribution companies in South America.

Some requirements are applicable only to one or more companies. Therefore, depending on the destination, the supplied equipment shall comply with these specific requirements.

2. APPLICATION FIELD

This document shall be used for the purchasing process and for the conformity and quality verification.

3. UNIT OF MEASUREMENT

The unit of measurement for this component is the number of specimens.

4. REFERENCE LAWS AND STANDARDS

4.1 Laws

LATAM

4.1.1.1 Brazil

NR-10 - segurança em instalações e serviços em eletricidade.

4.1.1.2 Chile

NCH Elec 4/2003 – Instalaciones de consumo en baja tensión.

NSEG 5. E.n.71 - Reglamento de Instalaciones Eléctricas de Corrientes Fuertes.

4.1.1.3 Colombia

RETIE - Reglamento Técnico de Instalaciones Eléctricas.


Resolución 0372 de 2009, Ministerio de Medio Ambiente - Establece los elementos que deben contener los planes de gestión de devolución de productos posconsumo de baterías usadas plomo acido.

4.1.1.4 Perú

CNE – Suministro – Código Nacional de Electricidad – Suministro 2011

Italy – Romania - Spain

Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006.

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Directive 2004/108/EC electromagnetic compatibility.

Italy

D.Lgs n. 81 of the 9th of April 2008 and subsequent modifications.

Decreto Ministeriale Ambiente n. 20 – 25 Gen. 2011

Romania

Legea securității și sănătății în muncă nr.319/2006, cu modificările și completările ulterioare.

Ordonanța de Urgență nr. 195/22.12.2005 privind protecția mediului, cu toate modificările și completările în vigoare.

Legea nr. 211/25.11.2011 privind regimul deșeurilor.

H.G. 856/2002 privind evidența gestiunii deșeurilor și pentru aprobarea listei cuprinzând deșeurile, inclusiv deșeurile periculoase, completată de HG 210/2007.

H.G. 1037/03.11.2010 privind deșeurile de echipamente electrice și electronice.

H.G. nr. 1132/18.09.2008 privind regimul bateriilor și acumulatorilor și al deșeurilor de baterii și acumulatori.

Spain

R.D. 337/2014, de 9 de mayo, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en instalaciones eléctricas de alta tensión y sus Instrucciones Técnicas Complementarias ITC-RAT 01 a 23.

R.D. 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico.

Ley 22/2011, de 28 de julio, de residuos y suelos contaminados.

R.D. 106/2008, de 1 de febrero, sobre pilas y acumuladores y la gestión ambiental de sus residuos.

R.D. 943/2010, de 23 de julio, por el que se modifica el Real Decreto 106/2008, de 1 de febrero, sobre pilas y acumuladores y la gestión ambiental de sus residuos.

R.D. 710/2015, de 24 de julio, por el que se modifica el Real Decreto 106/2008, de 1 de febrero, sobre pilas y acumuladores y la gestión ambiental de sus residuos.


4.2 Standards

4.2.1 Common standards

The below listed reference documents shall be intended in the in-force edition at the contract date (amendments included). Unless otherwise specified, these documents are valid until the new editions replace them.

For Latin America destinations the reference standards are the IEC/ISO, whilst for Europe destinations the reference standards are the correspondent European ones (EN).

Standards	Edition
IEC 60896-21	2004-02
IEC 60896-22	2004-02
IEC 60695-11-10	2013-05
IEC 60707	1999-03
EN 50272-2	2001-06
EN 61429/A11	1998-10
ISO 2859-1	1999-11

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4.2.2 Specific standards

Unless otherwise specified, these standards are valid until the new editions replace them.

4.2.2.1 Enel Distribuzione

Standards	Revision
DY1050	6
DY1056	4
DY1053	1
DY3005	2
GSTR001/1	0
PVR001	2
PVR006 + allegato alla N.O. PVR006	2
Istruzioni per installazione di accumulatori 12 V su Unità Periferiche	1
Packaging, transport and delivery requirements	2

5. IDENTIFICATION COMPONENTS

In Secondary Substation accumulators are used in pairs, connected in series to do 24V battery; within ENEL they are identified as follows (single accumulator):

Enel Group Distribution	Number
Ampla (Brazil)	6808858
Chilectra (Chile)	6808858
Codensa (Colombia)	6808858
Coelce (Brazil)	6808858
Edelnor (Perú)	6808858
Edesur (Argentina)	0130-0076
Endesa Distribución Eléctrica (Spain)	6711561
Enel Distributie Banat (Romania)	162068
Enel Distributie Dobrogea (Romania)	162068
Enel Distributie Muntenia (Romania)	162068
Enel Distribuzione (Italy)	162068

Below the maximum dimensions that the 12 V battery shall comply are shown:

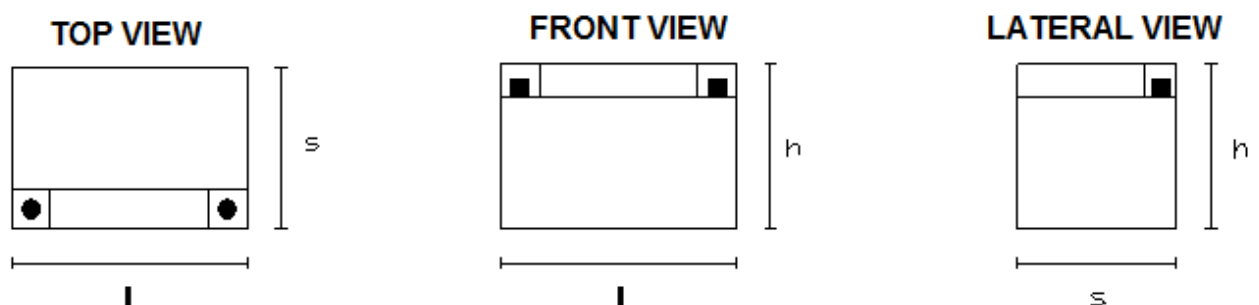



Fig. 1 - 12 V Accumulators dimensions

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The only possible installations are

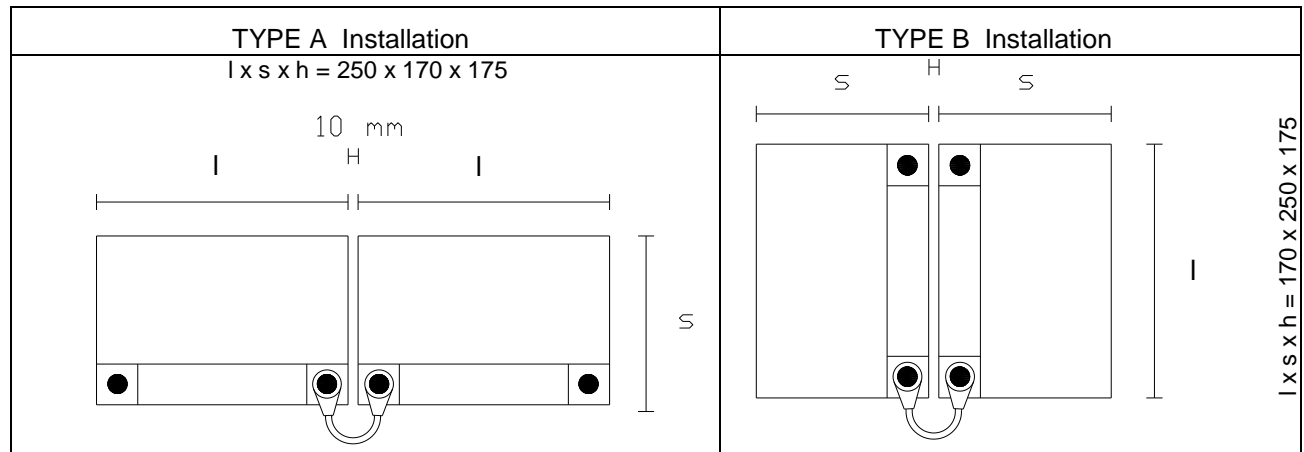



Fig. 2 - 24 V Battery dimensions

The pair of 12 V accumulators is installed in the compartment of the rack cabinet DY3005 of secondary substation or, alternatively, on board of the Peripheral Unit (UP) (in a special compartment segregated from the rest of the apparatus - GSTR001/1) as shown in the picture below:



Fig. 3 - Installation of 24 V battery on board of UP

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The battery will be kept charged, in float operation, by a rectifier (following the DY1056 specifications) contained inside the UP, which, in addition to charging the battery, must provide energy, continuously, to a load that absorbs a constant current of about 0.5 A and, intermittently, to another load represented by motors of the type described in the technical specifications DY1050 and DY1053.

The adjustment of the float voltage to the temperature will be performed using a temperature sensor, connected to the rectifier, located on the side of the accumulator that is located in the most critical position as far as cooling is concerned.

6. TECHNICAL FEATURES

Accumulators shall fully comply with the requirements set out in the documents listed in the previous section 4; they also shall meet the following requirements:

TECHNICAL SPECIFICATIONS FOR ACCUMULATORS AND ACCESSORIES		
Accumulator type		Accumulators must be stationary a VRLA (valve regulated lead-acid) with AGM (electrolyte absorbed in a microporous fiberglass support) or GEL technology.
Life expectancy	(years)	≥ 12 "Long life"
Maximum dimensions		
l x t x h (length x thickness x height) The maximum height refers to a fully equipped 24 V battery (including terminals and terminal covers)	(mm)	250 x 170 x 175 (or 170 x 250 x 175)
Maximum weight	(kg)	15
Number of cells per battery		6
Rated voltage	(V)	12
Voltage for equalizing charge at 20 °C	(V/el)	$U_{flo} = 2,26 \div 2,30$
Rated capacity		
- C ₁₀ (10.8 V) capacity at 20 °C, at 10h rate of discharge and final discharge voltage of 10.8 V (U _f =1.8 V per cell)	(Ah)	25 ± 10%
- C ₃ (10.8 V) capacity at 20 °C, at 3h rate of discharge and final discharge voltage of 10.8 V (U _f =1.8 V per cell)	(Ah)	≥ 76% of C ₁₀ (10.8 V)
- C ₃ (10.2 V) capacity at 20 °C, at 3h rate of discharge and final discharge voltage of 10.2 V (U _f =1.7 V per cell)	(Ah)	≥ 78% of C ₁₀ (10.8 V)
Recharge diagram		The type represented in Fig. 4
Reference ambient conditions		
- operating temperature	(°C)	-20 ÷ +50
- storage and transport temperature	(°C)	-25 ÷ +70
- atmospheric pressure	(kPa)	70 ÷ 106
- relative humidity		≤ 95%



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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 60896-21)
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
	Float voltage in Vpc or V per unit at a rated temperature of 20 °C and/or 25 °C
	Date of manufacture (see Note 1 below) 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>NOTE 1 For the purpose of this standard the "date of manufacture" is defined as the date of final inspection of the units in the factory of origin.</p> <p>NOTE 2 When the physical dimensions of the units do not allow to apply the symbols on the unit itself then a separate label to be affixed near the battery or on the battery operating instructions is acceptable.</p> <p>NOTE 3 The background colour is considered to be one colour.</p>	

The international recycling symbol ISO 7000-1135 is indicated by the EN 61429/A11.

On each accumulator the value of the torque (N/m) of the bolts on the poles must be indicated.


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8. REQUIREMENTS FOR THE SUPPLY OF BATTERIES

Accumulators shall be supplied in single packaging, in corrugated cardboard boxes (or similar), so as to ensure proper protection during transport and storage. The box should include all elements and accessories required for the supply. Specifically, each package should contain:

- N. 2 accumulators respectively with the same date of construction and charge (charge must have been performed within a maximum of 90 days since the date of the transport document);
- N. 1 accessory for the series connection of the two monoblocks, consisting of a section of single-core flexible cable insulated in PVC 300 / 450V from 6÷16 mm²; the cable must be equipped with proper terminations;
- N. 4 caps for insulating the battery terminals (these insulating caps shall not be provided in case of recessed poles covered with insulating casing material forming an integral part of the container or of the lid of the accumulator);
- N. 2 eye lugs for cable section $\geq 4 \text{ mm}^2$ (DY1056) to connect the two poles of the battery;
- Markings and self-adhesive plates, containing information and symbols described in the previous paragraph 7.3;
- Documentation relating to the safety recommendations (including an indication of the volume of electrolyte, in liters, contained in each battery - DMA n. 20), operation and maintenance, all in italian, spanish, portuguese and romanian languages;
- N. 2 barcodes for traceability in the field and collateral management of batteries to 12 V, as specified in the PVR 006. The barcode will be placed on the two batteries in a visible position during the installation;
- Instruction manual for the use of the accumulator with the relevant safety instructions and any other document / accessory that manufacturer believes that it's needed (written in the in italian, spanish, portuguese and romanian languages).

For transport and handling in storage ENEL Group shall use packaging compliant to "Packaging, transport and delivery requirements - rev. 2".

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9. GENERAL INFORMATION

The 12-V accumulator shall be compliant with the requirements shown in the previous chapters and the requirements of the standard IEC 60896-21 and IEC 60896-22.

In the following chapters, the series connection of two 12 V accumulators is indicated as “24 V battery” (or simply “battery”).

For the technical definitions, see chapter 3 of the standard IEC 60896-21.

In the text below, the set of batteries completely equipped and ready for acceptance tests at the manufacturer is called a "batch".

10. DESCRIPTION AND CLASSIFICATION OF TESTS

The tests are divided into:

- **Type tests** - designed to ensure the total conformity of an exemplary product (prototype) with the requirements contained in this document during the activities of approval / homologation.
- **Evidence of compliance with the approved type** - intended to verify the compliance of specimens randomly selected during the supply, compared to document of Approval / Homologation.
- **Acceptance tests** - performed on a sample randomly chosen out of the batch.

10.1 List of type tests

Type test for verifying charge retention and general specification;

Type test of suitability for floating battery operation;

Type test of operation under conditions of high thermal stress


10.2 List of acceptance tests

Visual inspection;

Capacity tests;

Charging tests;

Determination of short-circuit current and internal resistance;

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11. REQUIREMENTS FOR PERFORMANCE OF TESTS


The accumulators must be subjected to testing in the way indicated by the IEC 60896-21 unless otherwise specified in this document.

Accumulators must be compliant to the safe operation requirements listed in table 1 of IEC 60896-22:

Table 1 – Safe operation requirements

Test Clause	Measures	Purpose
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 features
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

For performance and durability requirements, the prescription of this document substitute the IEC 60896-22 table 2 and 3.

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12. TYPE TESTS

The manufacturer shall establish not less than 50 accumulators, each accumulator shall be uniquely identified (e.g., serial number). All accumulators shall have the same date of manufacture.

The accumulators shall never have been previously subjected to any charge/discharge or special treatment other than standard manufacturing.

Three sets of three batteries each (18 accumulators) will be randomly chosen out of the 50 accumulators and marked, as indicated in point 5.2.d of IEC 60896-21.

Each battery shall be tested individually.

The sequence of type test, distinguished for each set of batteries, is the following:

Tests	SET		
	1	2	3
Visual inspection	X	X	X
Content and durability of required markings	X		
Capacity test	C ₁₀ (10,8V _f)	C ₃ (10,8V _f)	C ₃ (10,2V _f)
Verification of the voltage drop on the connection between contiguous poles	X		
Charge retention test	X		
Test of suitability for floating battery operation		X	
Calculation of the short-circuit current and the internal resistance			X
Test of operation under conditions of the high thermal stress			X

Before the execution of the tests, the manufacturer can charge the batteries to recover any self-discharge due to the storage as provided for in p.to 5.2 of standard IEC 60896-21.

A negative result will lead to suspension of the test program.


12.1 SET 1: tests on general specifications and charge retention

The first set of three batteries - completely arranged – will be submitted to this sequence of tests, performed individually on each battery according to paragraphs 6.11 and 6.12 of standard IEC 60896-21 with the requirements and additions below.

Tests specified in paragraphs 12.1.1 to 12.1.5 shall be performed in that order. During the tests and between one test and the following one, treatments of any kind on the batteries are not allowed.

12.1.1 Visual inspection

The compliance of each battery with the requirements contained in the previous chapters 6 and 7 shall be verified, including accumulators dimensions and weight, suitability of terminals and cable for series

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connection of the two accumulators, absence of visible manufacturing defects and construction precision must be verified.

12.1.2 Marking content and durability

The presence on each accumulator of the essential technical information on the product and of safety and recycling warnings shall be verified. The content and characteristics of the marking shall be compliant to the previous paragraph 7.3.

The marking shall be clearly legible, before and after exposure to the chemicals stated in paragraph 6.6 of IEC 60896-21. A certificate issued on the same family accumulators by accredited bodies in accordance with IEC 17020 can eventually be accepted.

12.1.3 Capacity test SET 1

The test consists in a discharge of capacity for the determination of the effective capacity (C_a) of the unit under test.

The discharge test is performed according to point 6.11 of IEC 60896-21 with the details below.

The test includes a first discharge step and any subsequent stages of charge and discharge. The following describes the rules for the implementation of the discharge phase

Discharge phase method

The current shall be $0,1 C_{10}$ (10,8 V) A.

The reference value is the declared capacity (C_{rt}) at $20^\circ C$, 10 h rate, final voltage $U_f = 1.8 V_{pc}$ on each element.

The capacity of one of the two accumulators must be measured when the voltage at its terminals reaches 10.8 V. The discharge must continue, with the same current, until the voltage at the terminals of the remaining accumulator also reaches 10.8 V. The two capacity values thus obtained shall not be less than $0.95 C_{rt}$ (for the first discharge) and shall not differ from each other by more than 10% of the lower of the two.

In the case that, **already at the first discharge, the capacity values measured are higher than, or equal to, C_{rt} , the test is considered passed** and the test in paragraph 6.1.3 shall be performed.

In the case that, at the first discharge, the capacity values measured are not less than $0.95 C_{rt}$ but less than C_{rt} , other discharges (to a maximum of 5 discharges in all) of the type indicated in phase "a" must be carried out. The battery must be completely recharged between one discharge and the next.

By the fifth discharge, the two capacity values measured must be at least equal to C_{rt} and must not differ from each other by more than 10% of the lower of the two.


12.1.4 Check for voltage drop connection

During the test, it must also be verified that the voltage drop on the connection between contiguous poles is kept within 6 mV.

12.1.5 Test for charge retention

The battery must be completely recharged (according to CEI EN 60896-21, par. 5.2) after test 12.1.3.

Following the charge, the accumulators must remain disconnected from any circuit for a period of 90 days, during which average ambient temperature must be $25^\circ C \pm 5K$. After these 90 days of storage without connection to any external circuit, the battery must be subjected to a capacity test with the method at point 12.1.3 of this specification, performing a single discharge. **The test will be considered passed if the measured capacity (C_{as}) of each accumulator is at least 85% of the capacity measured (C_a) in the course of the last discharge of the test in point 6.1.2 of this Global Standard.**

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12.2 Test of suitability for floating battery operation

The 3 completely equipped batteries of the second of the 3 sets prepared must be subjected to these tests individually and independently.

The tests required in subsequent points 12.2.1, 12.2.2 and 12.2.3 must be performed in that order. The batteries shan't be conditioned in any way during the tests, and between one test and another.

12.2.1 Visual inspection

The instructions in point 12.1.1 of this Global Standard shall be applied.

12.2.2 Capacity test SET 2

The instructions in point 12.1.2 of this Global Standard shall be applied, with reference to the capacity C_3 (10.8 V) rather than C_{10} (10.8 V).

The unit under test must have, before starting the next test, a capacity C_a at least equal at the declared value C_{rt} for C_3 (10,8V) that is (3h discharged – $U_{final} = 1,80V$ at 20°C) and must be full charged.

12.2.3 Test of floating operation and capacity retention

To perform this test, reference is made to the first part of the test described in paragraph 6.13 of the standard IEC 60896-21. For the whole period of the test, the ambient temperature chosen ($25\text{ °C} \pm 5K$) of the test room must be maintained at a fixed value (with a tolerance of $\pm 2\text{ °C}$). The floating charge voltage must be equal at the value of the retention charge voltage declared U_{f10} (adjusted in function of the temperature of the test room).

To verify the capacity retention, after six months in floating operation, the battery must be subjected to a capacity test using the methods in point 12.1.3 of this Global Standard, by performing a single discharge and making reference to capacity C_3 (10.8 V) rather than C_{10} (10.8 V). **The test will be considered passed if the measured capacities of the two batteries are at least to the same of the declared value of C_3 (10.8 V).**

12.3 Test of operation under conditions of high thermal stress

The 3 completely equipped batteries of the third of the 3 sets prepared must be subjected to these tests individually and independently. For the execution of the test, reference is to paragraphs 6.16 of the standard IEC 60896-21 and 6.16 of the standard IEC 60896-22 with the clarifications and additions shown below.

The tests required in subsequent points 12.3.1, 12.3.2 and 12.3.3 must be performed in that order. The batteries shan't be conditioned in any way during the tests, and between one test and another.

12.3.1 Visual inspection

The instructions in point 12.1.1 of this Global Standard shall be applied.

12.3.2 Capacity test SET 3


The instructions in point 12.1.2 of this Global Standard shall be applied, with reference to the capacity C_3 (10.2 V) rather than C_{10} (10.8 V).

The unit under test must have, before starting the next test, a capacity C_a at least equal at the declared value C_{rt} for C_3 (10,2 V) that is (3h discharged – $U_{final} = 1,70\text{ V}$ at 20°C) and must be full charged.

12.3.3 Determination of the short-circuit current and of the internal resistance

After test 12.3.2 the battery must be completely recharged according to CEI EN 60896-21, par. 5.2 .

After charging, the discharge characteristics of the two accumulators must be determined (each one individually). These characteristics must be determined by two data, using the methods shown in paragraph 6.3 of the IEC 60896-21 and with currents equal to $I_a = 4 \times I_{10}$ e $I_b = 20 \times I_{10}$

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The values determined for each accumulator, whether short-circuit current (I_{sc}) or internal resistance (R_i), shall fall within $\pm 10\%$ of those declared by the manufacturer.

12.3.4 Endurance test under conditions of high thermal stress (60°C)

To perform the test, reference is made to the test described in paragraph 6.16 of the Standard IEC 60896-21 with the following requirements.

After the test of the previous point 12.3.3, the battery fully charged shall be put into a climatic chamber at $60\text{ °C} \pm 2\text{ K}$ with a floating voltage U_{flo} whose value shall be equal to the retention charge voltage at 25 °C . Periodic test discharges (30 days \pm 3 days) must refer to the capacity C_3 (10.2 V).

To pass the test, the battery must demonstrate that it supports a long exposure time, equal to, or higher than, the declared value (minimum value = 250 days).

Subsequently, the test must not be interrupted in order to evaluate the actual capability of the battery. This characterisation will continue until the capacity measured during one of the periodic test discharges is lower than 80% of C_3 (10.2 V) and, in any case, not beyond the discharge after the 350th day in the climatic chamber.

13. FINAL DOSSIER

At the end of the process of homologation, the Manufacturer shall produce a documentation (Final Dossier) that contains the technical description of the batteries and all certificates of the test reports; the minimum documentation consists of the following list; each document of the dossier must be printed and signed by the manufacturer and by Certification Authority in the case of certification:

- Type test reports (with reference to the sections of this Global Standard);
- List of documents in the dossier;

Doc. A-type

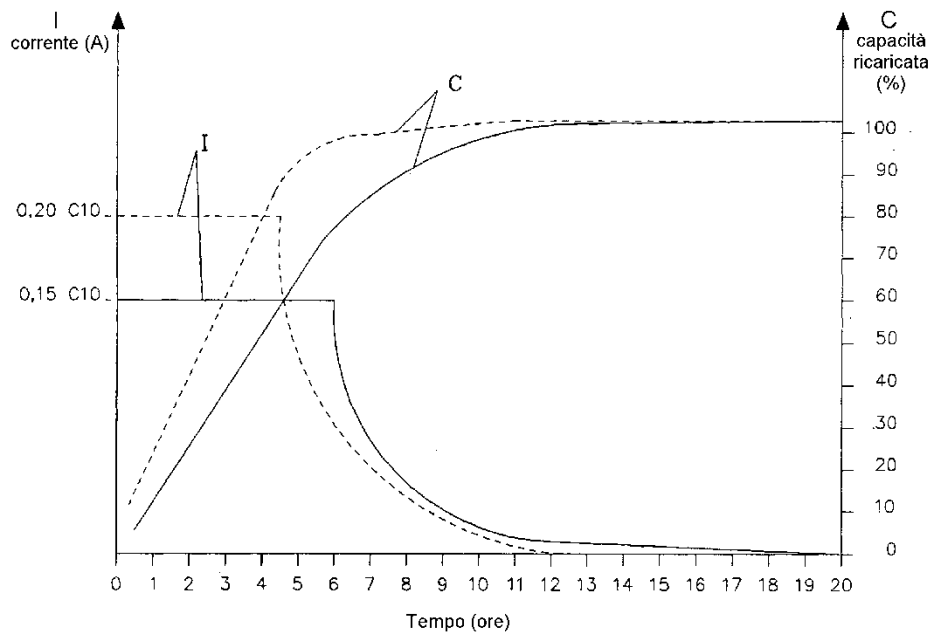
- Declaration of the compliance of the accumulators with the requirements set out in paragraph 7.1 with note (1);
- Declaration on the purity from Pb;
- Drawings of together accumulator (listed) with weight
- Color photos of the accumulator;
- Photo labels, markings, safety symbols, symbols of recycling, key date of construction/plant and date of charge;
- Rated capacity declared C_{rt} in the regimes C_{10} (10,8V); C_3 (10,8 V) and C_3 (10,2V) a 20 °C
- Typical values I_{cs} e R_i
- Main characteristics of the case (material, color, degree flame retardant, valve over-pressure, etc);
- Value of the pressure of the safety valves and break of the case;
- Drawings of terminals;
- Key features of the plates, the separator and the electrolyte;
- Voltage floating curve U_{flo} (T) (or table values) and declaration value of the voltage U_{flo} at 25 °C ;
- Parameters to define the charging process according to DIN 41773 (shown in next fig. 4);




- Maximum value of the temperature at which the charging process should be interrupted, or otherwise varied, in order to avoid thermal runaway;
- Value of the voltage drop of the connection poles of the accumulators;
- Value the rated torque of the terminals (N/m);
- List of materials contained in packaging.

Doc. B-type

- Full list of the drawings of the individual components of the accumulator (drawing number and revision date) in order to approve the project of the accumulator in test (drawings are available only at manufacturer's factory and must be printed and signed by ENEL during homologation);
- Negative/positive plate: size and weight (the declared weight must be taken dry with uncertainty of 5%);

**Fig. 4 - Charge diagram**

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14. ACCEPTANCE TESTS

The tests shall be performed statistically controlling the attributes of the sample, in compliance with the requirements of ISO 2859-1 for the reduced single sampling plan with LQA=1.0%.

To define the number of samples to be taken from each batch (i.e. the number of 24 V batteries), refer to current testing level I.

If a batch is refused, ENEL reserves the right, for the subsequent batches, to perform statistical testing but with a ordinary single sampling plan with LQA=1.0%.

The tests to be performed are described in following paragraph 14.1.

14.1 Verification of the general characteristics

The following tests verify the general characteristics:

- visual inspection;
- capacity test;
- charging test;
- determination of the short-circuit current and the internal resistance.

Two completely equipped batteries, among those of the sample for acceptance tests, shall be subjected to the tests individually. The remaining batteries can be tested, at the manufacturer's option, in a single series (measuring the voltage of each single accumulator, where applicable), in several series (measuring the voltage of each accumulator, where applicable) or as 24 V batteries individually.

Before performing the tests, manufacturer may charge the batteries to recover any self-discharging due to storage.

The tests required in subsequent points 14.1.1, 14.1.2, 14.1.3 and 14.1.4 must be performed in that order. The batteries shan't be conditioned in any way during the tests, and between one test and another.

14.1.1 Visual inspection

The compliance of each battery with the documents approved by Enel shall be tested; in particular, the dimensions and weight of the batteries, the instructions shown on the self-adhesive plate, the consistency of the terminals and the cable for series connection of two accumulators and the absence of visible manufacturing defects and construction precision must be verified.


Also the content in the box ready for transportation shall be checked (see chapter 8).

14.1.2 Capacity test

The test is performed, in a single discharge, in the way shown in previous paragraph 12.1.3 at a current, in Amps, of $0.1 C_{10}$ (10.8 V).

The capacity of one of the two accumulators must be measured when the voltage at its terminals reaches 10.8 V. The discharge must continue, with the same current, until the voltage at the terminals of the remaining accumulator also reach 10.8 V. **In addition to not being less than 0.95 Crt, the two capacity values thus obtained must not differ from each other by more than 10% of the lower of the two.**

During the test, it must be verified that the voltage drop on the connection between contiguous poles is kept within 6 mV.

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14.1.3 Charge test

After test 14.1.2, the battery must be recharged following the diagram in the standard DIN 41773 shown in Fig. 4. The manufacturer must provide the values of the parameters that characterize this recharge (value of the current in the first phase, the voltage in the second phase and the method of changing from the first to the second phase) but the charge voltage in the second phase must not be higher than that set for the retention charge at the temperature of the test chamber.

In a time ≤ 10 h, the battery must recovery at least 80% of its rated capacity. The check is made with a subsequent discharge test at a current, in Amps, of $0.1 C_{10}$ (10.8 V).

14.1.4 Determination of the short-circuit current and the internal resistance

After test in 14.1.3 the battery must be completely recharged.

After charging, the discharge characteristics of the two accumulators taking individually must be determined using the methods shown in paragraph 6.3 of the IEC 60896-21 standard and with currents equal to $I_a = 4 \times I_{10}$ e $I_b = 20 \times I_{10}$

The values determined for each accumulator, whether short-circuit current (Isc) or internal resistance (Ri), shall fall within $\pm 10\%$ of those declared by the manufacturer.