CONTENTS

THE HEAD OF NETWORK COMPONENTS
Fabrizio GASBARRI

1 DOCUMENT AIMS AND APPLICATION AREA

The aim of this document is to provide technical requirements for the supply of HV Voltage Transformers of the Enel Group Distribution Companies, listed below:

Country	Distribution Company
Argentina (AR)	Edesur
Brazil (BR)	Enel Distribuição Rio Enel Distribuição Ceará Enel Distribuição São Paulo
Colombia (CO)	Enel Colombia
Italy (IT)	e-distribuzione
Peru (PE)	Enel Distribución Perú
Romania (RO)	Enel Distributie Banat Enel Distributie Dobrogea Enel Distributie Muntenia
Spain (ES)	e-distribución

Table 1CP

This document shall be implemented and applied to the extent possible within the Enel Grids Business Line and in compliance with any applicable laws, regulations and governance rules, including any stock exchange and unbundling-relevant provisions, which in any case prevail over the provisions contained in this document.

1.1 RELATED DOCUMENTS TO BE IMPLEMENTED AT COUNTRY LEVEL

Additional prescriptions or integration to the main **Common Part (CP)** are reported in the respective **Local Sections** with the same corresponding clause or sub-clause number, providing the specific requirements of each Enel Group Distribution Company at country level.

Please, note that in case of unclear information or contradictions, the Local Section prevails over the Common Part.

Anyway, each Enel Grids Company can issue, under the supervision of Enel Grids Global Network Components a detailed document, according to the provisions of the present document and in case of specific needs.

2 DOCUMENT VERSION MANAGEMENT

Version	Date	Main changes description
01	30/06/2023	Issuing of Global E&C – GSCT014 – HV VOLTAGE TRANSFORMERS

3 UNITS IN CHARGE OF THE DOCUMENT

Responsible for drawing up the document:

- Enel Grids: Engineering & Construction/Network Components unit;

Responsible for authorizing the document:

- Enel Grids: Head of Network Components unit
- Enel Grids: Head of Quality unit.

4 REFERENCES

- *Integrated Policy for Quality, Health and Safety, Environment, Anti-Bribery, and Information Security.*
- *Stop Work Policy.*
- *GSCG002 - TECHNICAL CONFORMITY ASSESSMENT (Enel's Global Standard).*

Group Pillar References:

- *Code of Ethics of Enel Group.*
- *Enel Human Right Policy.*
- *The Enel Group Zero Tolerance of Corruption (ZTC) Plan.*
- *Organization and management model as per Legislative Decree No. 231/2001.*
- *Enel Global Compliance Program (EGCP).*

4.1 ENEL GRIDS INTERNATIONAL LAWS

Here below is reported the list of applicable reference laws applicable for European countries:

- *Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC and amending Regulation (EC) No 1907/2006.*
- *Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).*
- *Commission Directive 98/98/EC, of 15 December 1998 adapting to technical progress for the 25th time Council Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging, and labelling of dangerous substances.*
- *Directive 2008/98/EC of the European Parliament and of the council of 19 November 2008 on waste and repealing certain Directives.*
- *Council Directive 1999/13/EC, of 11 March 1999, on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations.*
- *CE Marking (Directive 2006/42/EC)*

4.2 ENEL GRIDS COUNTRY REFERENCE LAWS

3.2.1. Argentina

- *Ley 19587: - Higiene y seguridad en el trabajo.*

- *Law No. 19587, on Hygiene and Safety at Work and its Regulatory Decree 351/79.*
- *Ley 24051: - Residuos peligrosos*

3.2.2. Brazil

- *NR-10 – Segurança em instalações e serviços em eletricidade.*
- *RESOLUÇÃO ANP Nº 900, DE 18 DE NOVEMBRO DE 2022 - DOU DE 23-11-2022.*
- *RESOLUÇÃO ANP Nº 834, DE 26 DE NOVEMBRO DE 2020.*

3.2.3. Colombia

- *RETIE – Reglamento Técnico de Instalaciones Eléctricas.*
- *Ley 400 de 1997 (Modificada Ley 1229 de 2008).*
- *Decreto 926 del 19 de marzo de 2010.*
- *NSR – 10 (Reglamento Colombiano De Construcción Sismo Resistente).*

3.2.4. Italy

- *"D.lgs. n. 81 of the 9 of April 2008 -Testo unico in materia di sicurezza sul lavoro"* and subsequent modifications.
- *Nota Operativa PVR001 – Rev. 2 – Ott. 2012 - Gestione Garanzie dei materiali di ENEL Distribuzione.*
- *GUI 101 "Caratteristiche generali e prescrizioni di impiego del pallet in legno da utilizzare per imballo di trasporto".*
- *D.lgs. n. 52/1997 n. 52 - Classificazione, imballaggio ed etichettatura delle sostanze pericolose*
- *D.lgs. n. 209/1999 "Attuazione della direttiva 96/59/CE relativa allo smaltimento dei policlorodifenili e dei policlorotrifenili"*
- *D.M. 11/10/2001 "Condizioni per l'utilizzo dei trasformatori contenenti PCB in attesa della decontaminazione o dello smaltimento".*
- *D.M. 28/04/1997 "Attuazione dell'art. 37, commi 1 e 2, del decreto legislativo 3 febbraio 1997, n. 52, concernente classificazione, imballaggio ed etichettatura delle sostanze pericolose".*
- *Direttiva 98/98/CE recante venticinquesimo adeguamento al progresso tecnico della direttiva 67/548/CEE del Consiglio concernente il ravvicinamento delle disposizioni legislative, regolamentari ed amministrative relative alla classificazione, all'imballaggio e all'etichettatura delle sostanze pericolose.*
- *"Decreto legislativo 3 dicembre 2010, n. 205 recante Disposizioni di attuazione della direttiva 2008/98/CE del Parlamento europeo e del Consiglio del 19 novembre 2008 relativa ai rifiuti"* and subsequent modifications/integrations.

3.2.5. Peru

3.2.6. Romania

- *Prescriptia Energetica PE 101/85 – Normativ pentru construcţia instalaţiilor electrice de conexiuni şi transformare cu tensiuni peste 1 kV.*
- *GUI 101RO "Caracteristicile generale și cerințele de utilizare ale paletului de lemn care urmează să fie utilizat pentru ambalarea de transport.*

- *L 319/2006 – Occupational health and safety act, as amended and supplemented.*
- *L 265/2006 - Environmental Protection Act, as amended and supplemented.*

3.2.7. Spain

- *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;*
- *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.*
- *Real Decreto 679/2006, de 2 de junio, que regula la gestión de los aceites industriales usados - SIGAUS: Sistema Integrado de Gestión (SIG) de Aceites Usados (AUS), que garantiza la recogida y correcto tratamiento del aceite industrial usado de toda España.*

4.3 ENEL GRIDS INTERNATIONAL REFERENCE STANDARDS

Reference documents listed below (amendments included) shall be the edition in-force at the contract date.

IEC 61869-1	Instrument transformers - Part 1: General Requirements.
IEC 61869-3:	Instrument transformers - Part 3: Additional Requirement for Voltage Transformers.
IEC 60270	High-voltage test techniques – Partial Discharge Measurements.
IEC 60068-3-3	Environmental testing - Part 3-3: Supporting documentation and guidance - Seismic test methods for equipment.
IEC 60071-1	Insulation co-ordination – Part 1: Definitions, principles, and rules.
IEC 60071-2	Insulation co-ordination - Part 2: Application guidelines.
IEC 60507	Artificial pollution tests on high-voltage ceramic and glass insulators to be used on A.C. systems.
IEC 60695-2-10	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure.
IEC 62155	Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V.
IEC 60137	Insulated bushings for alternating voltages above 1000 V.
IEC 61462	Composite hollow insulators - Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V - Definitions, test methods, acceptance criteria and design recommendations.
IEC 60529	Degrees of protection provided by enclosures (IP Code).
IEC 60815	Guide for the selection and dimensioning of high-voltage insulators for polluted conditions.
IEC 60296	Fluids for electrotechnical applications - Unused mineral insulating oils for transformers and switchgear.
IEC 62770	Fluids for electrotechnical applications - Unused natural esters for transformers and similar electrical equipment.
IEC 61099	Insulating liquids - Specifications for unused synthetic organic esters for electrical purposes.

IEC 60422	Mineral insulating oils in electrical equipment - Supervision and maintenance guidance.
IEC 60599	Mineral oil impregnated in electrical equipment in service - Guide to the interpretation of dissolved and free gases analysis.
IEC 61198	Mineral insulating oils - Methods for the determination of 2-furfural and related compounds.
IEC 60666	Detection and determination of specified additives in mineral insulating oils.
IEC 62535	Insulating liquids - Test method for detection of potentially corrosive sulphur in used and unused insulating oil.
IEC 60721-2-1	Classification of environmental conditions - Part 2-1: Environmental conditions appearing in nature - Temperature and humidity.

---o---

ISO 12944 series	Paints and varnishes - Corrosion protection of steel structures by protective paint systems.
ISO 19840	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces.
ISO 8501	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness.
ISO 2178	Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method.
ISO 14713 -1&2	Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures -.
ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
ISO 9001:2015	Quality Management System – Requirements.
ISO 14001:2015	Environmental Management System - Requirements with guidance for use.
ISO 45001:2018	Occupational Health and Safety Management System - Requirements with guidance for use.
ISO 37001:2016	Anti-bribery Management System - Requirements with guidance for use.
ISO 27001	Information Security Management System – Requirements.
ISO/IEC 17000	Conformity assessment – Vocabulary and general principles.
ISO/IEC 17020	General criteria for the operation of various types of bodies performing inspection.
ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories.
ISO/IEC 17050-1	Conformity assessment - Supplier's declaration of conformity - Part 1: General requirements (ISO/IEC 17050-1:2004, corrected version 2007-06-15).
ISO/IEC 17050-2	Conformity assessment - Supplier's declaration of conformity - Part 2: Supporting documentation (ISO/IEC 17050-2:2004).
ISO/IEC 17065	Conformity assessment – Requirements for bodies certifying products, processes and services.

---o---

ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM 1275-15	Standard Test Method for Corrosive Sulphur in Electrical Insulating Liquids.
---o---	
EN 60068-3-3	Environmental testing - Part 3: Guidance - Seismic test methods for equipment.
---o---	
IEEE Std. C57.13	Standard Requirements for Instrument Transformers.
IEEE Std. 693	Recommended Practice for Seismic Design of Substations.

When the date of issue is not mentioned in the list above, the date to be taken as reference is that of the standard in force when the present document has been issued.

4.4 ENEL GRIDS COUNTRY REFERENCE STANDARDS AND OTHER RELEVANT DOCUMENTS

3.4.1. Argentina

The equipment and/or materials will therefore be designed to operate in a tropical climate and where the atmosphere has medium level contamination, according to table I of the IRAM 2405 and IEC 60815 standards.

- IRAM 2289 Cables agrupados en haces.
- IRAM 2405 Aisladores para uso en condiciones de contaminación ambiental.
- IRAM 5106 Arandelas de presión comunes.
- IRAM 5107 Arandelas planas redondas.
- IRAM 5139 Tuercas hexagonales con rosca métrica ISO.
- IRAM 5305 Tornillos de cabeza hexagonal totalmente roscados.
- IRAM 9590 Carretes de madera para cables.
- IRAM-DEF D 1054 Carta de colores para pinturas de acabado brillante y mate.

3.4.2. Brazil

- ABNT NBR 6855. Transformador de potencial indutivo - especificação e ensaios.
- ABNT NBR 5426. Planos de amostragem e procedimentos na inspeção por atributos.
- ABNT NBR 6855. Transformador de potencial indutivo - especificação e ensaios.
- ABNT NBR 7397. Produto de aço e ferro fundido galvanizado por imersão a quente - determinação da massa do revestimento por unidade de área - método de ensaio.
- ABNT NBR 7398. Produto de aço ou ferro fundido galvanizado por imersão a quente - verificação da aderência do revestimento - método de ensaio.
- ABNT NBR 7399. Produto de aço ou ferro fundido galvanizado por imersão a quente - verificação da espessura do revestimento por processo não destrutivo – método de ensaio.
- ABNT NBR 7400. Galvanização de produtos de aço ou ferro fundido por imersão a quente - verificação da uniformidade do revestimento - método de ensaio.

- ABNT NBR 10576. Óleo mineral isolante de equipamentos elétricos - diretrizes para supervisão e manutenção.
- ABNT NBR 11003. Tintas – Determinação da aderência.
- ABNT NBR 11388. Sistemas de pintura para equipamentos e instalações de subestações elétricas.
- ABNT NBR 13882. Líquidos isolantes elétricos - determinação do teor de bifenilas policloradas (PCB).
- ABNT NBR 15218. Critérios para qualificação e certificação de inspetores de pintura industrial.
- ABNT NBR 15422. Óleo vegetal isolante para equipamentos elétricos.
- ABNT NBR IEC 60270: Técnicas de ensaios elétricos de alta-tensão - Medição de descargas parciais.
- ABNT NBR IEC 60529. Graus de proteção providos por invólucros (códigos IP).
- ABNT NBR IEC 62271-1. Manobra e comando de alta tensão – Parte 1: Especificações comuns para equipamentos de manobra e comando em corrente alternada.
- Fornecimento de Energia Elétrica – Tensão de Subtransmissão 88/138 kV, da ELETROPAULO.
- Especificação Técnica EST-027 – Código de Barras para Equipamentos de Medição, da ELETROPAULO.
- TES-EM-002 – TC e TP – Distância de Segurança

3.4.3. Colombia

- Resolución CREG038 de 2014: Código de Medida.
- Reglamento Colombiano de Construcción Sismo Resistente (NSR-10. Norma Sismo Resistente).

3.4.4. Italia

3.4.5. Peru

3.4.6. Romania

The voltage transformers shall comply with the provisions of the "Official list of measuring instruments subject to mandatory state metrological control" approved by the Order of the Romanian Bureau of Legal Metrology in force and will have the model approval obtained from BRML.

Since voltage transformers are an integral part of a measurement group classified according to art. 7 of the Electricity Measurement Code, the accuracy class of the measurement windings shall comply with the specific provisions.

3.4.7. Spain

- UNE 23727. Ensayos de reacción al fuego de los materiales de construcción. Clasificación de los materiales utilizados en la construcción.
- UNE-EN 60085. Aislamiento eléctrico. Evaluación y designación térmica.
- UNE-EN 60505. Evaluación y calificación de los sistemas de aislamiento eléctrico.

Note:
For items not covered by the above-mentioned standards and technical specification, the SUPPLIER may adopt other standards provided that these documents be indicated explicitly in the proposal, which shall be submitted for approval to the purchaser.

5 ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY

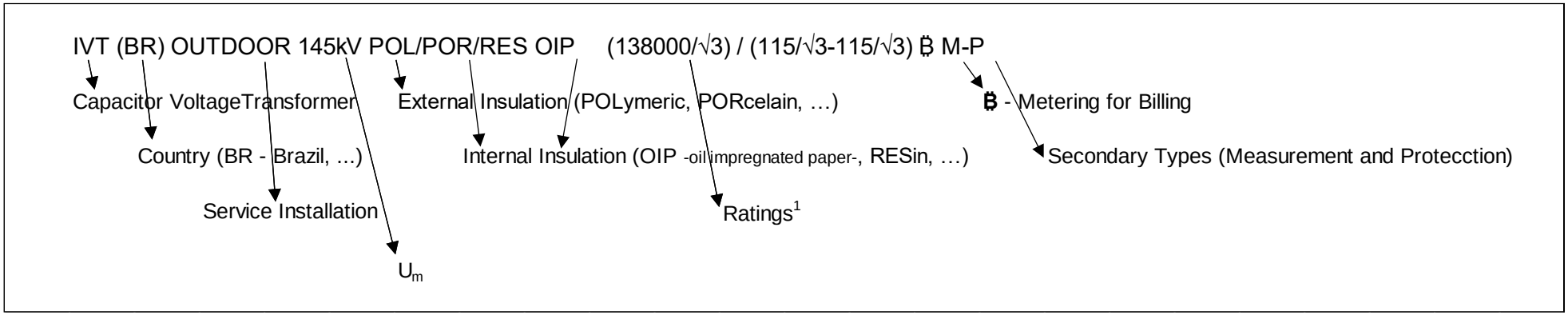
Value Chain/Process Area: Engineering and Construction
Macro Process: Devices and Components Development
Process: Standard Catalog Management

6 DEFINITIONS AND ACRONYMS

Acronym and Key Words	Description
IEC	International Electrotechnical Commission.
ISO	International Organization for Standardization.
IEEE	Institute of Electrical and Electronics Engineers.
ASTM	American Society for Testing and Materials.
AQL	Acceptable Quality Limit.
IP	Ingress Protection.
IRAM	Argentinian technical standard and certification institute.
ABNT	Brazilian technical standard association.
NBR	Brazilian standard.
SIS	Swedish institute for standards.
NTE	Technical local standard of DSO: AES ELETROPAULO.
List of Components	List of devices intended to provide an easy component selection of technicians
Datasheets	Document containing the data of a specific component of the standard.
Check List	A form, associated to the datasheet for these components, to be filled out by the manufacturer as a Technical Offer or specific Supplier-Datasheet.
Voltage Transformer (VT)	Instrument transformer designed for use in the measurement or control of voltage. Instrument transformer in which the secondary voltage, in normal conditions of use, is substantially proportional to the primary voltage and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections.

Acronym and Key Words	Description
Rated Primary Voltage	Value of the primary voltage on which the performance of the transformer is based
Rated Secondary Voltage	Value of the secondary voltage on which the performance of the transformer is based

Short description adopted for this technical specification (Datasheets & Check List):



[1] Ratings Symbology

/	Indicates the rated current ratios
|	Indicates the fact that there are several primary currents by changing secondary turns.
:	Indicates the rated current ratio (for CO, BR)
-	Indicates current ratios achieved by changing primary turns -series, parallel, both-
x	To join cores with the same rating or several primary currents by changing primary turns -series, parallel, both-
&	To join different cores

7 DESCRIPTION (COMMON PART – (CP))

This Common Part (CP) compiles the main common technical characteristics that apply to the components under this technical specification.

This standard is structured as follows:

- The “Common Part” with the common requirements for all the Enel Group Distribution Companies.
- The “List of Components” (Annex A) with the Type Code/GS Code for each transformer of the Enel Group Distribution Companies. The “List of Components” corresponding to each Local Section may be revised without revision of this Standard.”
- The “Datasheets” (information at Annex B) with the main ratings and requirements of each transformer type. Datasheets for the required transformers are attached to the Local Sections.
- The “Local Sections” with the specific requirements of each Enel Group Distribution Company for every country.

7.1 DOCUMENT/SECTION SCOPE

The scope of this section/part is to define the Common Part to provide the technical standard requirements for the Voltage Transformers of ENEL GRIDS.

7.2 LIST OF COMPONENTS

For the List of Components, please refer to ANNEX A

7.3 SERVICE CONDITIONS

Unless otherwise specified the normal service conditions defined in IEC 61869-1 apply with the exceptions indicated in the following *Table 3CP*.
The Humidity level shall follow the Standard IEC 60721-2-1.

Country / DSO	*Max Altitude (m)*	*Pollution level (IEC 60815)*	*RUSCD (mm/kV)*	*Seismic Req (1) (g)*	*Network Frequency (Hz)*	*Ambient Temp. (Min/Max) (°C)*	*Corrosivity (ISO 12944)*
Argentina	-	Medium	34,7	-	50	-10 / +40	C3
Brazil/Ceará	-	Very Heavy	53,7	-	60	0 / +40	C5
Brazil/Rio	-	Very Heavy	53,7	-	60	0 / +40	C5
Brazil/São Paulo	-	Medium	34,7	-	60	0 / +40	C3
Colombia	2650 (2)	Medium	34,7	0,5	60	-10 / +40	C3
Italy	-	Heavy	43,3	0,5	50	-25 / +40	C4
Peru	-	Very Heavy	53,7	0,5	60	0 / +40	C5
Romania	-	Heavy	43,3	0,5	50	-30 / +40	C4
Spain	-	Heavy Very Heavy (3)	43,3 53,7 (3)	-	50	-25 / +40	C4 C5 (3)

Table 3CP

Note:
(1) Indications of the specific seismic qualification are given in local sections.
(2) The creepage distance of the instrumentation transformers specified for Enel Colombia will have a correction factor according to IEC 60137 (k_a), taking 1000 meters above sea level (m.a.s.l.) as a reference.
(3) Balearic and Canary Islands.

7.4 TECHNICAL CHARACTERISTICS

For definitions see IEC-61698-1 and IEC-61698-3 or IEEE Std. C57.13 whenever required in Local Sections.

6.4.1. Type of Voltage Transformers

This document is applicable for inductive voltage transformers w/o selectable ratio for use with electrical measuring instruments and/or electrical protective devices at frequencies from 15 Hz to 100 Hz.

For further details see Local section.

6.4.2. Number of Cores and Windings

See Datasheets.

6.4.3. Rated Insulation Levels

See Datasheets.

6.4.4. Rated Output

See Datasheets.

6.4.5. Rated Accuracy Class VT

See Datasheets.

6.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

6.4.7. Rated Secondary Voltage U_{sr}

See Datasheets.

6.4.8. Rated Voltage Factor F_v

See Datasheets.

6.4.9. Rated Thermal Limiting Output

See Local Sections.

6.4.10. Static Withstand Load (F_R)

See Datasheets.

6.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

6.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3 or IEEE Std. C57.13 whenever required in Local Sections.

6.4.13. Seismic Qualification

See Local Sections.

6.4.14. Short Circuit Withstand Capability and Secondary Current

See Local Sections.

7.5 CONSTRUCTION CHARACTERISTICS.

The active part of the instrumentation transformers shall be placed in the metal bodies.

For further design details see Local Sections.

6.5.1. Internal Insulation

The internal insulating medium of the HV voltage transformers shall be in liquid and paper or proper resin material for transformers for outdoor installation. Other types of insulation shall be subject to ENEL approval.

Liquid-insulated equipment shall be provided with a metal liquid expansion chamber with metal bellows, in order to absorb thermal contractions and expansions of the liquid.

The insulating liquid used shall be mineral oil naphthenic-based, without inhibitors or additives, free of PCBs and shall comply with the requirements of the IEC-60296 Standard. Absence of corrosive sulfur shall be verified according to ASTM 1275 and IEC 62535.

Alternatively insulating liquids, as natural and synthetic ester, can be specified, according to IEC 62770 or IEC 61099. In such a case, it is possible to reference to IEC 60076-14. Any part of the transformer which is in contact with the insulating liquid shall be compatible with it.

The solid insulation material used shall comply to class “A” of IEC 60085 or higher. The evaluation of the material should be carried out in accordance with the IEC 60641-2.

Further specific requirements are requested in Local Sections.

6.5.2. External Insulation

The external materials for the bushings of the Instruments Transformers shall be porcelain or composite material.

Composite insulators shall be made of light grey inorganic composite material, with HTV (High Temperature Vulcanization) or LSR (Liquid Silicone Rubber) silicone rubber, without EPDM or other organic rubber, in accordance with IEC 61462 for mechanical testing and IEC 61109 for dielectric testing and electrical-environmental accelerated ageing test.

Other types of insulation will be subject to ENEL approval.

The creepage distance of the bushings shall be in accordance with the level of pollution requested by ENEL.

For further details see Local Sections.

6.5.3. Overall Dimensions and Layouts

See Local Sections.

6.5.4. Metal Surface Treatment

The non-energized metallic surfaces of the Instruments Transformers shall be made of painted iron, hot dip galvanized steel, stainless steel or aluminum.

The external painting of transformers and metallic components made of iron materials, shall use paints and varnishes according to ISO 12944 (standardized paint systems) or powder coating (guaranteed equivalent corrosivity and durability).
For different pollution levels please follow the next table:

Pollution Levels	Corrosivity	Durability	Painting Category
Medium	C3	Medium	C3M
Heavy	C4	Medium-High	C4M or C3H
Very Heavy	C5	Medium- High	C5M or C4H

Table 4CP

The thicknesses of galvanized surface shall comply with the provisions of the respective standards (very high contamination) for different sheet thicknesses and environmental conditions.

All painted surfaces shall be prepared by manufacturer with a suitable sandblasting or chemical cleaning (degreasing) treatments, specific for the painting cycle adopted. The effectiveness of surface preparation work shall be assessed using standards from series ISO 8501: “Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness “.

The paint shall be free of lead oxides or chromates. The safety and technical data sheets of the painting shall be provided by the Manufacturer.

The color to be used is prescribed in Local Section.

The Coating System/Painting cycle shall be:

- Totally defined in terms of products, typologies, and processes.
- Certified with the reference to tests carried out by independent laboratories, in compliance to ISO 12944, with a clear indication of Corrosivity and Durability levels.

6.5.5. Accessories

See Local Sections for details.

6.5.5.1. Primary Outer Terminals

See Local Sections.

Terminals shall have clearly distinguishable polarity markings.

6.5.5.2. Secondary Terminals

Secondary Terminals (secondary terminal boxes) should be preferably equipped with overvoltage protection devices proposed by the manufacturers, in order to abate the

electrocution risks for operators. Enel reserves the right to evaluate the feasibility and suitability of solutions proposed.

Terminals should have clearly distinguishable polarity markings.

See Local Sections.

6.5.5.3. Grounding Terminals

The manufacturer shall supply terminals to connect the VTs to the substation ground system. For further details see Local Sections.

6.5.5.4. VT Support Base

See Local Sections.

6.5.5.5. Secondary Terminals Box

See Local Sections.

6.5.5.6. Liquid Level Gauge

See Local Sections.

6.5.5.7. Overpressure Relief Device

See Local Sections.

6.5.5.8. Liquid Sampling Device

See Local Sections.

6.5.5.9. Lifting Lugs

Placed to facilitate lifting of VT.

6.5.5.10. Rating Plate

A stainless-steel rating plate in local language shall be included.
This plate shall follow the IEC 61869 Standards, a plate with the connection diagram of the windings shall also be included.
The rating plate with indelible indication shall have also the following information (located on the L.V. side of the tank):

- ENEL code
- Weight (kg), brand and type of insulating liquid

The rating plate on each voltage transformer shall be in local languages of the country of destination of the voltage transformer.
The rating plates shall be resistant to atmospheric conditions and made of waterproof material.
The connection diagram shall be indelibly printed.

Likewise, the rating plate shall support the service conditions indicated in the section and will be printed with the name of ENEL.

For further details see Local Sections.

6.5.5.11. Terminal Markings

See local sections.

6.5.5.12. Capacitive Tap

See local sections.

6.5.5.13. Ferroresonance Prevention

See local sections.

7.6 TESTING

6.6.1. Type Test

Required tests are indicated in section 7 of IEC 61869-1 and IEC 61869-3.

They are those that shall be carried out only once in the product approval process and which are listed in *Table 5CP* below:

TYPE TESTS	**Subclause** IEC 61869-1 IEC 61869-3
Temperature rise test	7.2.2
Impulse voltage withstand test on primary terminals	7.2.3
Wet test for outdoor type transformers	7.2.4
Electromagnetic compatibility test	7.2.5
Test for accuracy	7.2.6
Verification test of the degree of protection of the enclosures	7.2.7
Short-circuit withstand capability test	7.2.301

Table 5CP

In addition to the above tests, a compliance check to the specification requirements shall be done.

For further details see Local Sections.

6.6.2. Routine/Acceptance test

Required tests are indicated in section 7 of IEC 61869-1 and IEC 61869-3.

The routine tests shall be performed on each voltage transformer, and they are listed in the below (*Table 6CP*):

ROUTINE TESTS	**Subclause** IEC 61869-1 IEC 61869-3
Power-frequency voltage withstand tests on primary terminals	7.3.1
Partial discharge measurement	7.3.2
Power-frequency voltage withstand tests between sections	7.3.3
Power-frequency voltage withstand test on secondary terminals	7.3.4
Test for accuracy	7.3.5
Verification of markings	7.3.6
Enclosure tightness test at ambient temperature	7.3.7.2
Visual and Dimensional checks (including VT base support where requested)	-
Painting check	-

Table 6CP

In addition to the above tests the checking of the correspondence with the approved prototype shall be done.

For further details see Local Sections.

6.6.3. Special test

Required tests are indicated in section 7 of IEC 61869-1 and IEC 61869-3.

These tests shall be exceptionally required in the product approval process, and they are listed in *Table 7CP*, below:

SPECIAL TESTS	**Subclause** IEC 61869-1 IEC 61869-3
Chopped impulse voltage withstand test on primary terminals	7.4.1
Multiple chopped impulse test on primary terminals	7.4.2
Measurement of capacitance and dielectric dissipation factor	7.4.3
Transmitted overvoltage test	7.4.4
Mechanical tests	7.4.5
Internal arc fault test	7.4.6
Corrosion test	7.4.9
Fire hazard test	7.4.10

Table 7CP

For further details see Local Sections.

6.6.4. Sample Tests

In order to monitor the required adequacy of the production series, the manufacturer should define, execute and document the sample test program according to the production quantities (e.g., every 300 units of the same type defined by the same type test reports).
Generally, the recommended sample test is the lightning impulse test on the primary terminals and some other tests are listed in *Table 8CP*, below:

SAMPLE TESTS	Subclause IEC 61869-1
Determination of the remanence factor	Annex D

Table 8CP

7.7 CONDITIONS OF SUPPLY

6.7.1. Warranty

The technical guarantee will be five (5) years, counted from the date of delivery to Enel's warehouses.

The expenses involved in any failure that occurs in the Instrument Transformer, due to manufacturing defects, will be fully covered by the manufacturer. At the end of this period of guarantee, there it shall not be rust on more than 1% of the entire painted surface; this compares to a rusting level not above the Ri3 (see ISO 4628-3).

6.7.2. Reception Control

The protocols of the acceptance tests indicated in section 7.6.2 will be delivered with each lot.

6.7.3. Technical Information Required

The technical data sheets are reproducible and shall be properly and completely filled out, signed, stamped, and included for the offer, as well as to keep a proper description of the specific device of every supplier for the TCA process.
The drawings and diagrams of the equipment described in this document will be provided in PDF, AutoCAD and IFC formats, for their subsequent implementation in BIM modeling.

- Guaranteed technical data of the equipment and its components, describing its characteristics, dimensions, performance, and technical operating parameters, in Excel and pdf format.
- Convenient scale plans, plan, elevation, and perspective of the equipment.

- Descriptive memory of the equipment, construction details, materials used, form of installation, maintenance, possibility of replacement of different components and other specifications.
- Good resolution photographic record of the equipment.
- Additional information that you consider provides an explanation for your design (drawings, details, operating characteristics, dimensions, and weights of the equipment offered).
- Updated original catalog of the equipment offered.

6.7.4. Packaging and Transport

According to IEC 61869-1, Annex B.

The packaging for the transport of the measuring instruments shall be carried out in a manner suitable for the type of product and the type of transport according to the manufacturer's instructions.

For further details see Local Sections.

It is essential that the transportation, storage, and installation of Instruments Transformers, as well as their operation and maintenance in service, be carried out in accordance with the instructions given by the manufacturer.

Consequently, the manufacturer shall provide timely instructions for the transportation, storage, installation, operation, and maintenance of instrument transformers.

The supplier will carry out the appropriate packaging of the transformers to ensure their protection during transport by sea, land, or air.

In the packaging, filling material will be used to ensure good protection in case the boxes containing the materials suffer blows or damage during the loading and unloading maneuvers.

To protect the materials from moisture, airtight covers or bags containing hygroscopic material should be used.

Each drawer shall have the following information printed:

- Type of material and quantity
- Net and gross weight
- Date

The supplier will be responsible for transporting the transformers to ENEL's warehouses, unless otherwise indicated in the purchase order.

6.7.5. Installation, Operation, Maintenance and Disassembling

According to IEC 61869-1, Annex B.

For each type of Instruments Transformer, the installation instructions provided by the manufacturer shall include at least the items listed below:

- Information required for safe unpacking and lifting
- Assembly diagram and marking of the parts
- Instructions for the assembly of measuring transformers, auxiliary and operating devices
- Instructions for connecting conductors, auxiliary circuits, liquid systems, grounding connections and the manufacturer's recommendation of the type of cable to be connected to the secondary terminals
- Provide instructions for inspection and tests to be performed after the instrument transformer has been installed and all connections have been completed.
- Instruction for disassembling

6.7.6. Technical Conformity Assessment (TCA)

Technical compliance is issued by Enel and shall be supported by carrying out all the, Type, Routine tests and some Special tests indicated for each type of instrument transformer -.

Type tests and some Special tests are performed once, during the TCA process.

The Enel's Global Standard: GSCG002 - TECHNICAL CONFORMITY ASSESSMENT shall manage the TCA for such components. The detailed documents to be presented fo the TCA Dossier and the process to be followed is indicated in the procedure document issued by Enel.

ANNEX A – LIST OF COMPONENTS (ENEL CODES)

GS CODE	Country Code	COUNTRY	Highest Voltage (Um) [kV]	Power Frequency Voltage primary winding (AC) [kV]	Lightning Impulse (LI) [kV]	Rated Frequency [Hz]	Rated voltage ratio (Kv = UPr / USr)	Secondaries Features
GSCT014/001	536725	ITALY	145	275	650	50	(132000/V3) / (100/V3)	M&P (40 VA - 0,2-3P)
GSCT014/002	536735	ITALY	170	325	750	50	(150000/V3) / (100/V3)	M&P (40 VA - 0,2-3P)
GSCT014/003	530628	SPAIN	245	460	1050	50	(220000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/004	530634	SPAIN	245	460	1050	50	(220000/√3) / (110/√3-110/√3-110/√3)	M (20 VA - 0,2) M&P (30 VA - 0,5-3P) M&P (30 VA - 0,5-3P)
GSCT014/005	530654	SPAIN	145	275	650	50	(110000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/006	530666	SPAIN	145	275	650	50	(110000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/007	530648	SPAIN	145	275	650	50	(132000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/008	530660	SPAIN	145	275	650	50	(132000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/009	530682	SPAIN	145	275	650	50	(110000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/010	530674	SPAIN	145	275	650	50	(132000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/011	530694	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/012	530056	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/013	530688	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/014	530701	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/015	530072	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P)
GSCT014/016	530064	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P)
GSCT014/017	110087	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/018	110009	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/019	530807	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/020	110008	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/021	530078	SPAIN	52	95	250	50	(46200/√3) / (110/√3-110/√3-110/3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) P (10 VA - 6P)
GSCT014/022	530084	SPAIN	52	95	250	50	(46200/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)
GSCT014/023	530092	SPAIN	52	95	250	50	(46200/√3) / (110/√3-110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P) M&P (25 VA - 0,5-3P)

GSCT014/024	530586	SPAIN	145	275	650	50	(110000/√3) / (110/√3-110/3)	M (25 VA - 0,2) P (10 VA - 6P)
GSCT014/025	530589	SPAIN	145	275	650	50	(110000/√3) / (110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P)
GSCT014/026	530580	SPAIN	145	275	650	50	(132000/√3) / (110/√3-110/3)	M (25 VA - 0,2) P (10 VA - 6P)
GSCT014/027	530595	SPAIN	145	275	650	50	(132000/√3) / (110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P)
GSCT014/028	530607	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/3)	M (25 VA - 0,2) P (10 VA - 6P)
GSCT014/029	530619	SPAIN	72,5	140	325	50	(55000/√3) / (110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P)
GSCT014/030	530604	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/3)	M (25 VA - 0,2) P (10 VA - 6P)
GSCT014/031	530613	SPAIN	72,5	140	325	50	(66000/√3) / (110/√3-110/√3)	M (25 VA - 0,2) M&P (25 VA - 0,5-3P)
GSCT014/032	530196	BRAZIL	72,5	140	325	60	(60000/√3) / (110/√3)	M (50 VA - 0,2)
GSCT014/033	530197	BRAZIL	145	275	650	60	(138000/√3) / (110/√3)	M (50 VA - 0,2) M&P (50 VA - 3P)
GSCT014/034	530994	PERU	72,5	140	325	60	(60000/√3) / (110/√3)	M (30 VA - 0,5)
GSCT014/035	530995	PERU	72,5	140	325	60	(60000/√3) / (110/√3)	M (30 VA - 0,5)
GSCT014/036	531055	PERU	72,5	140	325	60	(60000/√3) / (110/√3-110/√3)	M (30 VA - 0,2) P (30 VA - 3P)
GSCT014/037	531086	PERU	72,5	140	325	60	(60000/√3) / (110/√3-110/√3)	M (30 VA - 0,2) P (30 VA - 3P)
GSCT014/038	110824	PERU	72,5	140	325	60	(60000/√3) / (110/√3-110/√3)	M (30 VA - 0,5) P (30 VA - 3P)
GSCT014/039	531087	PERU	72,5	140	325	60	(220000/√3) / (110/√3-110/√3)	M (30 VA - 0,5) P (30 VA - 3P)
GSCT014/040	530996	PERU	72,5	140	325	60	(220000/√3) / (110/√3-110/√3)	M (30 VA - 0,5) P (30 VA - 3P)
GSCT014/041	531044	PERU	72,5	140	325	60	(220000/√3) / (110/√3-110/√3)	M (30 VA - 0,5) P (30 VA - 3P)
GSCT014/042	110832	PERU	72,5	140	325	60	(60000/√3) / (110/√3)	M (30 VA - 0,2)
GSCT014/043	Pending	COLOMBIA	145	275	650	60	(115000/√3) / (110/√3-110/√3-110/3)	P (10 VA - 3P) M (10 VA - 0,2) P (10 VA - 3P)
GSCT014/044	Pending	COLOMBIA	145	275	650	60	(115000/√3) / (110/√3-110/√3-110/3)	P (10 VA - 3P) M (10 VA - 0,2) P (15 VA - 3P)
GSCT014/045	Pending	COLOMBIA	145	275	650	60	(115000/√3) / (110/√3-110/√3-110/3)	P (15 VA - 3P) M (10 VA - 0,2) P (25 VA - 3P)
GSCT014/046	Pending	COLOMBIA	245	460	1050	60	(230000/√3) / (110/√3-110/√3-110/3)	P (10 VA - 3P) M (10 VA - 0,2) P (10 VA - 3P)
GSCT014/047	Pending	COLOMBIA	245	460	1050	60	(230000/√3) / (110/√3-110/√3-110/3)	P (15 VA - 3P) M (10 VA - 0,2) P (10 VA - 3P)
GSCT014/048	Pending	COLOMBIA	245	460	1050	60	(230000/√3) / (110/√3-110/√3-110/3)	P (30 VA - 3P) M (10 VA - 0,2) P (10 VA - 3P)
GSCT014/049	Pending	COLOMBIA	72,5	140	140	60	(57500/√3) / (110/√3-110/√3-110/3)	P (10 VA - 3P) M (10 VA - 0,2) P (10 VA - 3P)
GSCT014/050	Pending	COLOMBIA	72,5	140	140	60	(57500/√3) / (110/√3-110/√3-110/3)	P (15 VA - 3P) M (10 VA - 0,2) P (10 VA - 3P)
GSCT014/051	Pending	COLOMBIA	245	460	1050	60	(230000/√3) / (110/√3-110/√3-110/3)	M&P (15 VA - 0,2 - 3P) M&P (10 VA - 0,2 - 3P) M&P (10 VA - 0,2 - 3P)

ANNEX B – DATASHEET AND CHECK LIST (EXAMPLE)

COMPONENT ID		ENEL REQUIREMENT	SUPPLIER DATA
Type of Instrument Transformer		IVT - Inductive Voltage Transformer	
Country			
GS Code			
Country Code			
Old Country Reference Code			
SERVICE CONDITIONS			
Installation Conditions			
Service Conditions Type			
Temperature category	[°C]		
Daily Average Amb. Temperature	[°C]		
Altitude (maximum)	[m]		
Seismic Qualification Level according to IEC 60068-3-3			
RUSCD (Reference Unified Specific Creepage Distance)	[mm/kV]		
ELECTRICAL RATINGS			
Highest voltage for equipment (U_m)	[kV]		
Rated lightning impulse withstand voltage	[kV]		
Rated power frequency withstand voltage	[kV]		
Rated frequency (f_R)	[Hz]		
Metering for Billing (Ƀ)			
Rated Voltage Factor (VF)			
Number of Secondaries	[nr.]		
Secondary Winding #1			
Function			
Primary Voltage - Secondary Winding #1	[V]		
Rated secondary Voltage	[V]		
Rated output (S_r)	[VA]		
Accuracy class			
Secondary Winding #2			
Function			
Primary Voltage - Secondary Winding #2	[V]		
Rated secondary Voltage	[V]		
Rated output (S_r)	[VA]		
Accuracy class			
COMPONENT GENERAL REQUIREMENTS			
External Insulation	[POLymeric, RESin, PORcelain, OTHer]		
Internal Insulation	[OIP, RESin, SF6, OTHers]		

Arc Distance	[mm]	To be indicated by supplier		
Creepage Distance	[mm]			
Overall Dimensions (hxwxl)	[mm]			
Fixing holes - Diameter	[mm]			
Fixing holes - Distances (wxl)	[mm]			
Total Weight	[kg]			
Internal Insulation Class	[Oil, Cycloaliphatic Resin, SF_6 GAS]	To be indicated by supplier		
Internal Insulation (Type & Manufacturer)		To be indicated by supplier		
Internal Insulation Weight or Volume	[kg] or [liters]	To be indicated by supplier		
Oil Level Indicator/Gas Pressure indicator	[YES, NO, NA]			
Pressure Relief system	[YES, NO, NA]			
Oil Sampling tap	[YES, NO, NA]			
Primary Terminal Type				
Secondary Terminal Type				
Earthing Terminal Type				
MECHANICAL REQUIREMENTS				
Static withstands test load (Fr)	[N]			
Specific Horizontal force applied (in a specific area)	[N]			
Specific Vertical force applied (in a specific area)	[N]			
ADDITIONAL REQUIREMENTS/COMMENTS				
DRAWINGS (OVERALL/DETAILED INDICATIONS)				

CONTENTS

ANNEX LOCAL SECTION ARGENTINA (AR)

7.1 DOCUMENT/SECTION SCOPE

The scope of this Local Section is to integrate the Common Part to provide the technical standard requirements for the voltage transformers of Edesur transmission network.

The purpose of this document is to establish the conditions that inductive voltage transformers shall satisfy for their construction and testing, intended for measurement and/or protection, from 33 kV to 220 kV. The transformers that are the subject of this Technical Specification are installed in the Transformer Substations of the Edesur transmission network. This document applies to Enel Grids Argentina. In accordance with all applicable laws, regulations, and corporate governance standards, including the provisions related to the stock market or the separation of assets, which in any case prevail over the provisions contained in this document.

7.2 LIST OF COMPONENTS

See ANNEX A.

7.3 SERVICE CONDITIONS

They are used in permanent service and with variable load.

The installation can be inside or outside.

The climate is hot and humid, unfavourable for the conservation of insulating materials.

The external temperature in the shade varies between -5 °C and 40 °C and the humidity of the air frequently reaches saturation values.

The equipment and/or materials shall therefore be designed to operate in a tropical climate and where an atmosphere has a medium level contamination, according to the IEC 60815-1 standards; 60815-2; 60815-3 and 60815-4, "Selection and sizing of high-voltage insulators intended for use in polluted conditions - Part 1, 2, 3 and 4.

Insulating oil in transformers shall not contain PCBs (polychlorinated biphenyls), PCTs (polychlorinated triphenyls) and PBBs (polybrominated biphenyls).

Waste substances and articles that contain or are contaminated with the aforementioned fluids, labelled as Y10 in Law 24051 on "Hazardous Waste", Chapter XI, Article 64, Annex 1, as a Category subject to Control, are not accepted as insulating liquids of the transformers acquired by Edesur, regardless of their mode of use.

7.4 TECHNICAL CHARACTERISTICS

For definitions IEC 61869-1, IEC 61869-3 apply.

7.4.1. Type of Voltage Transformers

See Datasheets.

7.4.2. Number of Cores and Windings

See Datasheets.

7.4.3. Rated Insulation Levels

See Datasheets.

7.4.4. Rated Output

See Datasheets.

7.4.5. Rated Accuracy Class VT

See Datasheets.

7.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

7.4.7. Rated Secondary Voltage U_{sr}

See Datasheets.

7.4.8. Rated Voltage Factor F_v

See Datasheets.

7.4.9. Rated Thermal Limiting Output

7.4.10. Static Withstand Load (F_R)

See Datasheets.

7.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

7.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3.

7.4.13. Seismic Qualification

A seismic certification is required for the severity level AF5 according to IEC 60068-3-3, for VT and support assembled.

The seismic certification can be based on the calculations according to the above-mentioned standard.

7.4.14. Short Circuit Withstand Capability and Secondary Current

7.5 CONSTRUCTION CHARACTERISTICS

The transformers must be insulated in oil or ester, in addition for 33 kV they can be encapsulated in cast synthetic resin (cycloaliphatic epoxy), with non-hygroscopic and self-extinguishing characteristics.

Devices with the same characteristics, as well as parts with the same denomination included in the construction of the transformers, must be interchangeable with each other, in such a way that a reserve set can be used without distinction, regardless of the place where it shall be installed.

All the parts in which it is necessary to avoid oxidation or corrosion must be made with pieces of stainless steel, bronze, aluminium, or suitable alloys or have anticorrosive protection of ferrous surfaces by zinc plating, according to the equivalent method.

7.5.1. Internal Insulation

The internal insulating liquid used (oil or ester) shall comply with the requirements indicated in the Data Sheet included in Annex B.

In case of mineral oil use, it shall be free of polychlorinated biphenyls (PCBs) and meet the requirements of the IEC 60296 Standard.

In case of ester use, it shall meet the requirements of the IEC 62770 Standard.

7.5.2. External Insulation

Each external bushing shall be built in a single piece, that is, without glued joints; Insulators are only allowed to be joined through metal flanges. They shall meet the requirements of IEC 62155 "Hollow pressurized and unpressurized ceramic and glass bushings for use in electrical equipment with rated voltages greater than 1000 V". It should preferably have a capacitive tap for measuring the dissipation factor (tg δ).

7.5.3. Overall Dimensions and Layout

7.5.4. Metal Surface Treatment

7.5.5. Accessories

7.5.5.1. Primary outer Terminals

They shall be of the cylindrical bolt type, copper or bronze, preferably with one of the dimensions indicated in the corresponding guaranteed data sheets. They shall be identified by stainless steel or bronze plates, riveted and with the inscription in low relief.

All voltage transformers shall have a clear and clearly visible identification of their terminals, using the letter "A" for the high voltage terminal and the letter "N" for the neutral terminal, which must be connected to service grounding for normal operation.

The neutral terminal shall be isolated from the tank and withstand a non-permanent voltage of 10 kV at industrial frequency for testing purpose.

In addition, the "A" terminal and its counterpart, and the "P1" (or K) terminal and its counterpart shall be marked with a clearly visible dot.

7.5.5.2. Secondary Terminals

They shall be made up of screws of suitable length, diameter and materials. Each terminal shall have at least 2 (two) washers and 2 (two) nuts, also bronze.

The transformers shall carry a clear and clearly visible identification of these terminals, using the letters “a” and “n” for voltage transformers.

The terminals shall be separated enough so that the eyelet connectors of the interconnection cables with the substation have a distance of at least 3 mm.

The different cores shall be numbered correlatively, so the measurement cores shall be designated with the first numbers and the protection ones with the following.

For example, the terminals of a voltage transformer should bear the following markings: “a1” (measurement core), “a2” (protection core) and “n”.

7.5.5.3. Grounding Terminals

Voltage transformers shall have a safety grounding terminal to which they are connected: the tank, the metallic base, the rating plate and any other identification plate when applicable.

It should be located in such a way that once the transformer is installed it is easily visible from ground level. The dimensions of the terminals shall be suitable for connecting copper bars or cables of the following sections:

RATING VOLTAGE (kV)	COPPER IRON (mm)		CABLE SECTION (mm^2)
	SAFETY	DUTY	
33	25 x 5	25 x 5	1 x 120
132	25 x 5	25 x 5	1 x 120
220	25 x 5	40 x 5	1 x 240

Table 1AR

7.5.5.4. CT Support Base

7.5.5.5. Secondary Terminals Box

The box shall have a degree of mechanical protection IP 54. To open or close the lid that covers it, the use of any type of special tool shall not be required.
The box shall have a through grounding terminal on one of its sides and the terminal block shall be provided with a link-type copper plate with a minimum section of 70 mm^2, for each secondary winding, so that it can be connected to the aforementioned grounding terminal.

Any change from this technical specification is subject to Edesur's approval.

7.5.5.6. Liquid Level Gauge

Fluid-insulated transformers shall have a level indicator at the top that allows reading it with the naked eye, from a distance of approximately 9 meters. The transparent window shall be made of glass or polycarbonate; any other type of material is subject to the approval of Edesur. Said window is mechanically fixed, not glued. In case of using cork float, it shall be protected on the surface in such a way that it does not lose its buoyancy.

7.5.5.7. Overpressure Relief Device

A hermetic closing device (membrane or bellows) to compensate the volume variations of the insulating oil of the Transformer (if applicable) shall be a metallic bellows or a synthetic rubber membrane with or without internal reinforcement of synthetic fabric impregnated with the same rubber. Any other system is subject to Edesur's approval.

7.5.5.8. Liquid Sampling Device

Liquid-insulated transformers shall have a plug for filling and another that allows emptying. Likewise, liquid-insulated transformers shall have a means for taking oil samples, consisting of a valve or a quick coupling and finally a closing plug that prevents possible liquid leaks, or another similar device that fulfills the function required.

7.5.5.9. Lifting Lugs

7.5.5.10. Rating Plate

In addition to the data required in the corresponding specifications, the following shall be indicated on the same rating plate or on others:

• The manufacturing VT model and serial number

• The diagram of the primary and secondary windings. This sheet shall be located close to the terminal block, so that the diagram can be easily compared with the actual layout of the terminals.

• The electrical resistance of the secondary winding(s) referred to 75°C

• The dissipation factor (tg δ) maximum admissible in service

• The sentence: "Contains PCB-free mineral oil", with the following table:

30
1270

Table 2AR

7.5.5.11. Terminal Marking

In accordance with IEC 61869-3.

Transformers that have double ratio, both shall be achieved by varying the location of mobile plates.

In no case should the connection plates of each relationship overlap the indications that the corresponding primary terminals had engraved. In the case of an unused plate (for one of the ratios), it should be located in the transformer itself.

The ratio shall be indicated with numbers and letters at least 20 mm high, painted on two opposite sides of the appliance and not covered by the rating plate.

This requirement does not replace the indication of the transformation ratio that shall appear on the rating plate.

7.5.5.12. Capacitive Tap

In voltage transformers where its design allows it, the magnetic core and the internal screens shall be at earth potential, not connected internally to the tank, but rather coming out of it through external insulators and jumpers that allow their connection to the safety ground, in normal operation. These bridges shall be removable, made of copper, and the insulators shall withstand a non-permanent voltage of 10 kV at industrial frequency for the purposes of carrying out tests to verify the dissipation factor (tg δ).

7.5.5.13. Ferroresonance Prevention

During the opening of certain 220 kV switches, the primary of the voltage transformers is connected in series with the voltage equalizer capacitors belonging to the switches mentioned above (about 1300 pF).

To avoid the phenomenon of ferroresonance that may occur between inductive voltage transformers and the named equalization capacitors, the manufacturer shall provide for every two transformers two inductors, one to install in the secondary terminal box and one as a backup.

These saturable inductors shall satisfy the required damping conditions, without their load (VA) representing any decrease in the required performance of the transformer.

In addition, they must have nominal inductance control sockets to adapt their damping characteristics for values of capacitance above 1300 pF, but common in circuit breaker equalizer capacitors (between 1000 pF and 1500 pF).

7.6 TESTING

7.6.1. Type Tests

According to clause 7.6.1 Common Part.

7.6.2. Routine/Acceptance Tests

According to clause 7.6.2 Common Part.

In addiction the following tests shall be performed:

- Verification of the physical-chemical characteristics, chromatography and absence of PCBs of the insulating oil, according to ASTM D 4059 "Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography".
- Visual inspection.
- No load curve (with voltage range between 10% and 200% of the rated voltage).

7.6.3. Special Tests

According to clause 7.6.3 Common Part.

7.6.4. Sample Tests

According to clause 7.6.4 Common Part.

7.7 CONDITIONS OF SUPPLY

7.7.1. Warranty

7.7.2. Reception Control

7.7.3. Technical Information Required

7.7.4. Packaging and Transport

7.7.5. Installation, Operation, Maintenance and Disassembling

Manual for installation, operation, maintenance, and disassembling shall be provided in Spanish.

7.7.6. Technical Conformity Assessment (TCA)

CONTENTS

ANNEX LOCAL SECTION BRASILE (BR)

7.1 DOCUMENT/SECTION SCOPE

The scope of this Local Section is to integrate the Common Part to provide the technical standard requirements for the Inductive Voltage transformers (VT) of Enel Distribuição Rio, Enel Distribuição Ceará and Enel Distribuição São Paulo.

This document applies to Brazilian Distribution Infrastructures and Networks.

7.2 LIST OF COMPONENTS

See ANNEX A.

7.3 SERVICE CONDITIONS

The VT shall be single phase, for outdoor use and immersed in insulating mineral oil as per ABNT NBR 10576 or immersed in insulating vegetable oil as per ABTN NBR 15422:2015. The electrical system to which the Voltage transformers shall be connected is solidly grounded.

7.4 TECHNICAL CHARACTERISTICS

For definitions IEC 61869-1, IEC 61869-3 and ABTN NBR 6855 apply.

7.4.1. Type of Voltage Transformers

Voltage transformers intended to be connected to HV grid for measuring and protection scope.

7.4.2. Number of Cores and Windings

See Datasheets.

7.4.3. Rated Insulation Levels

See Datasheets.

7.4.4. Rated Output

See Datasheets.

7.4.5. Rated Accuracy Class VT

See Datasheets.

7.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

7.4.7. Rated Secondary Voltage U_{sr}

See Datasheets.

7.4.8. Rated Voltage Factor F_v

See Datasheets.

7.4.9. Rated Thermal Limiting Output

7.4.10. Static Withstand Load (F_R)

See Datasheets.

7.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

7.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3.

7.4.13. Seismic Qualification

7.4.14. Short Circuit Withstand Capability and Secondary Current

7.5 CONSTRUCTION CHARACTERISTICS

7.5.1. Internal Insulation

Equipment insulated in oil and ester shall be provided with a fluid expansion chamber with metal bellows, in order to absorb thermal contractions and expansions of the fluid. The oil used shall be without inhibitors or additives, be free of polychlorinated biphenyls (PCBs) and shall meet the requirements of the IEC 60296 Standard. Its main characteristics shall be indicated, its typical composition, indicating the percentage of aromatics, isoparaffins and naphthenics.
The ester used shall meet the requirements of the IEC 62770 Standard.

7.5.2. External Insulation

The external insulation of the instrumentation transformers shall be porcelain, resin, or silicone rubber. Creepage distance of the bushings shall be in accordance with the pollution level indicated in Table 3 (par. 7.3, Common Part).

The active part of the Voltage transformers shall be located in the metal bodies (upper or lower, as the case may be).

Design with active part located inside the porcelain shall not be accepted.

7.5.3. Overall Dimensions and Layout

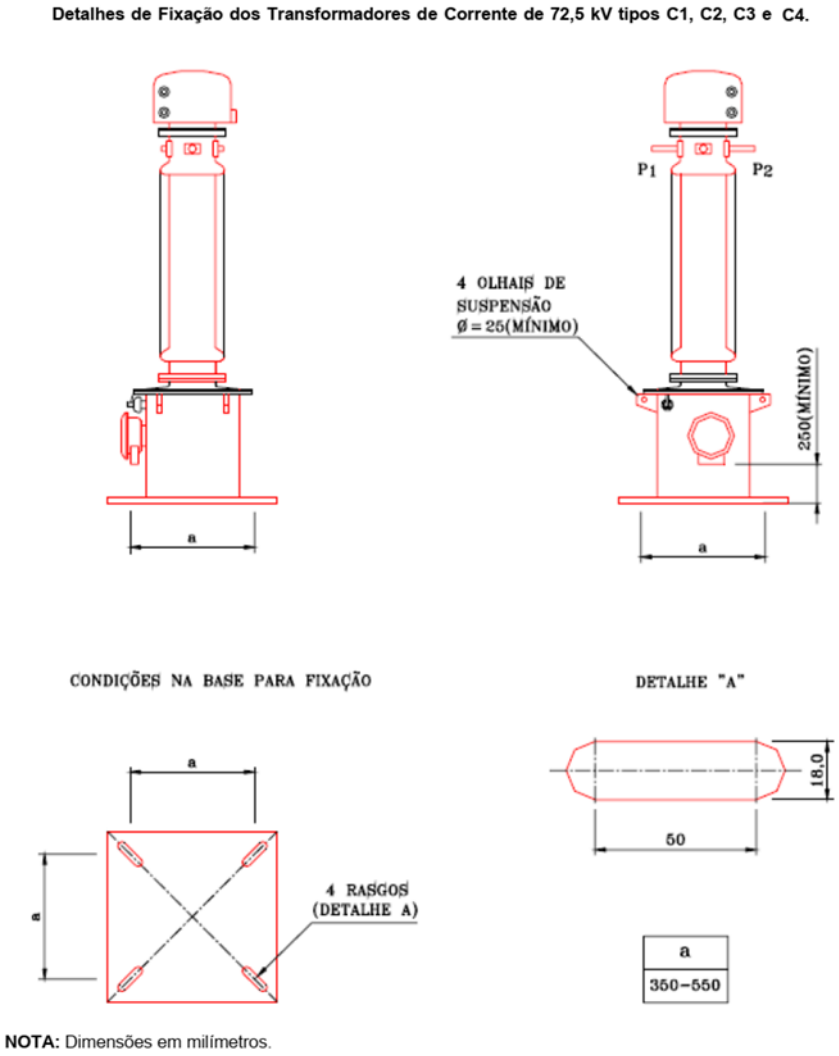


Figure 1BR

7.5.4. Metal Surface Treatment

Painting and galvanization shall be suitable for the environmental conditions indicated in Table 3 (par 7.3, Common Part).

Thickness of galvanization shall be conformed to the following Table 1BR:

Tipo de Tanque	Pintura interna	Pintura externa				
		Metalização	Wash-primer	Epoxi-poliamina	Tinta de acabamento	Total
Aço galvanizado com zinco (à quente)	30 µm	80 µm	10-15 µm	70 µm	70 µm	230 µm

Table 1BR

The non-energized metal surfaces of Voltage transformers shall be made of steel and/or hot dip galvanized or painted.

Moreover, all De-energized metal surfaces, such as tanks, secondary terminal boxes and other components, shall meet the following requirements:

a) all welds must be performed in such a way as to ensure complete fusion with the base metal.

b) welds shall not be cracked, discontinuous and corrosion-free.

c) elimination of all weld spatter, slag and burrs.

d) sharp edges and corners shall be rounded.

e) degreasing of all plates and supports.

f) blasting with clean sand or shot, free of salts, moisture, oil or any other foreign component. The blasting must completely eliminate rust and rolling scale, reaching the Sa 3 degree of SIS 05 5900-67. The blast profile shall be between 40 and 60 µm.

g) thermal spraying of all sheets and supports immediately after blasting. The zinc layer shall meet the requirements of ISO-R 2063/1971 with a minimum layer thickness of 80 µm (Zn 80).

At the stage of performing the painting, the VT's supplier shall keep in his plant, full-time, a qualified industrial paint inspector, according to ABNT NBR 15218.

The qualified inspector shall record, in a painting report, all the results of the steps and observations performed, as well as fill out a report of nonconformities. The paint shall meet the NBR 11388 standard. The finishing paint shall be light grey, MUNSELL notation 6.5. Every surface to be energized should be red, according to MUNSELL 5R4/14.

7.5.5. Accessories

7.5.5.1. Primary Outer Terminals

The primary terminals can be made of aluminum, tinned copper or silver. The terminal type can be the flat bar type (2N) or (4N) as shown in Figure 1.

Terminals shall have clearly distinct terminal and polarity markings. The supplier must inform in his proposal the characteristics of the terminals of the offered equipment.

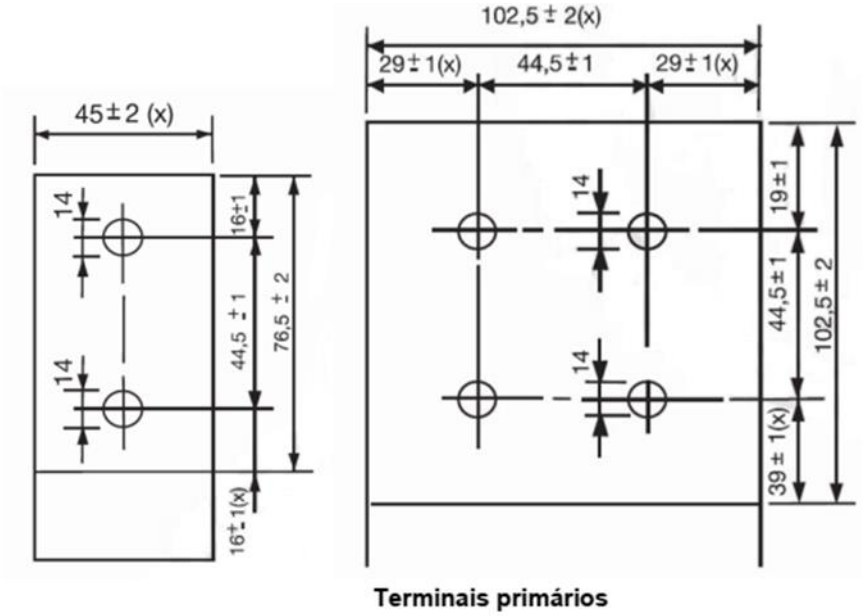


Figure 2BR

7.5.5.2. Secondary Terminals

The secondary terminals must be phosphorous bronze and shall be connected to the terminals located inside a box. This box should be suitable for outdoor use, with protection grade IP54 according to IEC 60529 and allow external cable connections from the bottom or side of the box.

All terminals shall be eyelet type and clearly marked. The terminals of the secondary winding must be protected by weatherproof housing with devices for sealing seal placement, with a hole of 50 mm in diameter and area required for connection of 2" bushings and washers.

Voltage transformers shall have a separate connection box for all metering cores to be sealed by the purchaser. The supplier shall provide an antifraud terminal block with a plate made of transparent insulating material, installed on top of the terminals with a place where affix a seal, subject to customer approval.

7.5.5.3. Grounding Terminals

The manufacturer shall provide terminals to connect the Voltage transformers to the grounding system substation. The connections to the ground mesh shall be made through a copper cable with a section between 70 and 240 mm^2 or a 3x40 mm copper plate. The housing grounding terminal shall be provided with a connector from 35 mm^2 to 150 mm^2 copper cable.

7.5.5.4. VT Support Base

The supplier shall provide all necessary technical information to design the support base to fix the VT structure, as well as the bolts, nuts and adjustment washers, necessary for this purpose.

The minimum distances between live parts on primary side and support base of the transformer shall ensure the safety distance as specified in the publication "Electric Power Supply - Sub transmission Voltage 88/138 kV" of ELETROPAULO.

The minimum distance from the bottom of the secondary terminal box to the mounting base shall be 300 mm. If the manufacturer's design does not meet this Item, a subbase shall be provided for the specified minimum distance.

Fixing base shall respect the dimensions indicated in the following picture:

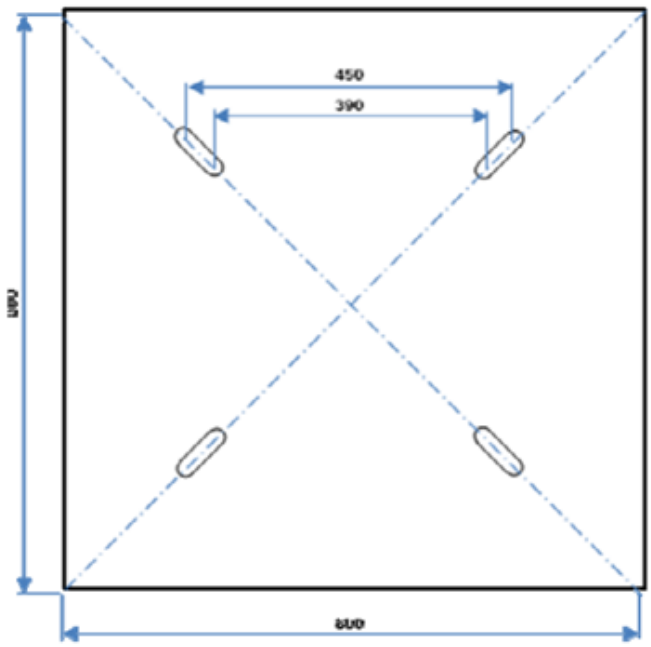


Figure 3BR (Dimensions in mm)

7.5.5.5. Secondary Terminals Box

7.5.5.6. Liquid Level Gauge

The device for checking the liquid level shall indicate whether the liquid level is within the operating range, during operation and must be clearly readable from ground.

7.5.5.7. Overpressure Relief Device

The mechanical protective action can be performed by liquid expansion chamber.

VT shall be designed in such a way that if an internal failure occurs in the main insulation, any overpressure originating in the internal part can be only released upwards, avoiding the breakage and projection of the porcelain.

7.5.5.8. Liquid Sampling Device

VT shall be equipped with a following valves:

- Drain valve with a hermetic liquid sampling device.
- A valve for oil filling in the upper part of VT.

Note: For VT hermetically sealed the two above mentioned valves are not requested.

7.5.5.9. Lifting Lugs

Placed to facilitate lifting of VT.

7.5.5.10. Rating Plate

Rating plate shall be made of stainless steel, in Portuguese and all information shall be marked in an indelible manner.

In addition to the markings defined in IEC 61869-1 and IEC 61869-3, the following minimum information shall be indicated in the rating plate:

- “Placa de identificação conforme norma ABNT NBR 6855”
- “Placa com o diagrama de conexão dos enrolamentos”

“NOTA: Para Enel SP devem ser fornecidas placas de identificação com código de barras no padrão EAN 128, conforme imagens abaixo”.

Padrão de identificação dos equipamentos de medição (medidas em milímetros)

Escala 1:1

Figure 4BR

All VT shall have an identification plate (according to NBR-10022) and a connection plate made of stainless steel, placed in a clear visible position, with at least the following information, permanently engraved:

a) expressão "TRANSFORMADOR DE POTENCIAL INDUTIVO".
b) nome do fabricante.
c) ano de fabricação (ANO).
d) número de série (Nº).
e) tipo ou modelo (TIPO).
f) número do manual de instruções (MANUAL).
g) uso: para interior ou para exterior (USO).
h) tensão(ões) primária(s) ou secundária(s) nominal(is) (Up ou Us) em V e relação(ões) nominal(is) (Rn)
i) tensão máxima do equipamento (Umax), em kV.
j) nível de isolamento (NI____/____/____), em kV.
k) frequência nominal (f), em Hz.
l) potência térmica nominal (Pterm) em VA.
m) exatidão: classe e carga (EXATIDÃO).
n) grupo de ligação (GRUPO) ou fatores de sobretensão (Fstcont e Fst30s).
a) kA/s.
o) massa total (Mtotal), em kg.
p) tipo e massa do líquido isolante, em kg;
q) norma e ano da sua edição (NORMA/ANO);
r) diagrama de ligações;
s) encomenda (ENCOM) - Número e data do pedido de compra;
t) código do material, código de barras, logotipo e número patrimonial, conforme Especificação Técnica EST-027

7.5.5.11. Terminal Marking

All terminals shall be permanently marked according to as ABTN NBR-6855.

7.5.5.12. Capacitive Tap

7.5.5.13. Ferroresonance Prevention

7.6 TESTING

7.6.1.Type Tests

They are those that will be carried out only once in the product approval process.

All these tests shall be performed in accordance with ABTN NBR 6855 or ABTN NBR 61869-1 and ABNT NBR 61869-3 when they are not mentioned in ABTN NBR 6855.

In addition to the tests detailed on clause 7.6.1 Common Part, the following tests shall be performed:

- Switching impulse test.
- Measurement of windings resistance.
- No load current and no load losses.
- Short circuit impedance.
- All acceptance tests according to par. 7.6.2.

7.6.2. Routine/Acceptance Tests

All these tests shall be performed in accordance with ABTN NBR 6855 or ABTN NBR 61869-1 and ABNT NBR 61899-3 when they are not mentioned in ABTN NBR 6855.

In addition to the tests detailed on clause 7.6.2 Common Part, the following tests shall be performed:

- Painting checks according to par. 7.5.4.
- Check of zinc coating protection according to ABTN NBR 7398 (Aderência) – 7399 (Espessura) – 7400 (Uniformidade).
- Insulating oil tests: Water content, breakdown voltage, DDF, interfacial tension and total acidity.
- Insulating mineral oil tests according to *Resolução ANP Nº 900, De 18 De Novembro De 2022 - Dou De 23-11-2022*.
- Insulating ester oil tests according to ABNT NBR 15422
- Measurement of capacitance and dielectric dissipation factor.
- Measurement of windings resistance for TV with Um >=72,5kV.

7.6.3. Special Tests

These tests shall be required exceptionally in the product approval process. All these tests shall be performed in accordance with ABTN NBR 6855 or ABTN NBR 61869-1 and ABNT NBR 61899-3 when they are not mentioned in ABTN NBR 6855.

In addition to the tests detailed on clause 7.6.3 Common Part, for transformers with Um>52kV all pertinent tests mentioned in ABNT NBR 6855 shall be performed.

7.6.4. Sample Tests

According to ABNT NBR 6855.

7.7 CONDITIONS OF SUPPLY

7.7.1. Warranty

7.7.2. Reception Control

7.7.3. Technical Information Required

7.7.4. Packaging and Transport

The supplier will carry out the appropriate packaging of the Voltage transformers to ensure their protection during transport by sea, land or air. In the packaging, padding material will be used to ensure good protection in the event that the boxes containing the materials are hit or damaged during loading and unloading maneuvers.

To protect materials from moisture, airtight covers or bags containing hygroscopic material shall be used.

Each drawer shall have the following information printed on it:

- Net and gross weight
- Date
- Type of material and quantity

The supplier will be responsible for transporting the transformers to ENEL's warehouses, unless otherwise indicated in the purchase order.

Each package shall contain only one unit. Packaging must be suitable to support operations.

Like normal loading, unloading and eventual stacking of different packages.

Each package must include facilities to lift it by means of belts.

For export maritime transport, the manufacturer shall obtain the approval of the packaging by the transport companies before dispatching the equipment from the factory.

All packaging shall contain all necessary details about identification and handling, clearly and indelibly, related to the contents and the Purchase Order.

The type of packaging and its identification shall be submitted for the client's or his representative approval before dispatch from the factory. If not all of the specified conditions are compiled the request for dispatching may be rejected.

The SUPPLIER shall issue a Packing list for all the supplied equipment and components. A copy must accompany the invoice, a second copy must be placed inside the packaging and a

Third copy must be protected with plastic casing on the outside of the package, indicating only the materials of the package.

After the inspection, a copy of the packing list must be issued for checking and approval by the purchaser, before dispatching.

7.7.5. Installation, Operation, Maintenance and Disassembling

Manual for installation, operation, maintenance and disassembling shall be provided in Portuguese.

The instruction manual shall contain at least the following items:

- General Index.
- Provide an overview of the equipment and all its components along with their operating principle.
- Indicate the basics of the equipment and its components related to the activities like "commissioning, operation and maintenance", such as:
    - Information that characterizes and identifies the equipment, such as: manufacturer, serial number, type, code, model, lot, Purchase order, etc., including alternatives from other accepted manufacturers in the project.
    - Design characteristic of equipment and accessories, such as: weight, dimensions, fixing point, illustrative drawings, materials, etc.
    - Electrical characteristics of the main equipment and its components such as: voltage, Voltage, frequency, diagrams electrical schematics, interconnection and block diagram, points connection, etc.
- Any and all necessary graphics.
- Drawings:
    - All final and revised drawings as manufactured, including drawings and technical characteristics of all gaskets used.
- Test reports:
    - All test results requested in this specification.
- Spare Parts:
    - A material list containing the list of parts or components of the equipment, recommended as a spare part and the one supplied with the equipment, duly specified, indicating its basic characteristics, reference number and its location on the equipment.
- Instructions for assembly:
    - Assembly of equipment and accessories.
    - Lifting and movement of the parts.
- Instructions for commissioning and operation:
    - Recommendations for commissioning.
    - Permissible Long and short duration overload.
    - Inspections and verifications.

- Adjustments and measurements.
- Cleaning and lubrication.
- Tests.

- Instructions for maintenance:
  - Recommendations for transport and storage.
  - Recommendations for disassembly and assembly.
  - Torques table for all flanges.
  - Preventive maintenance.
  - Equipment and instruments required for maintenance.
  - Tests and verifications.
  - Maintenance frequency.
  - Cleaning.
  - Care to be taken with painting and retouching instructions.
- Photos of the equipment during the manufacturing process.
- Copy of the Packing list.

7.7.6. Technical Conformity Assessment (TCA)

CONTENTS

ANNEX LOCAL SECTION COLOMBIA (CO)

7.1 DOCUMENT/SECTION SCOPE

The scope of this Local Section is to integrate the Common Part to provide the technical standard requirements for the voltage transformers (VTs) of Enel Colombia.

7.2 LIST OF COMPONENTS

See ANNEX A.

7.3 SERVICE CONDITIONS

7.4 TECHNICAL CHARACTERISTICS

For definitions IEC 61869-1, IEC 61869-3 apply.

7.4.1. Type of Voltage Transformers

Inductive transformers are preferred for 72,5kV voltage classes. Voltage transformers shall be single primary winding, while up to two shall be allowed secondary windings.

For more details see Datasheets.

7.4.2. Number of Cores and Windings

Voltage transformers will be single primary winding, and up to two secondary windings

See Datasheets.

7.4.3. Rated Insulation Levels

See Datasheets.

7.4.4. Rated Output

Rated output shall be 25 VA.

For details see Datasheets.

7.4.5. Rated Accuracy Class VT

Excepting for CODENSA, winding accuracy may be specified in the following three ways:

- Class 0.5%: For windings intended for measurement (accuracy class for VTs intended for billing purpose shall be 0,2% or 0,5%)
- Class 3P: For windings intended for protection.
- Class 0,5/3P: For windings intended for protection and/or measurement (preferably capacitive).

For CODENSA winding accuracy may be specified in the following two ways:

- Class 0,2% for windings intended for measurement

Class 3P: for windings intended for protection.

The accuracy class shall be specified according to IEC 61689-1 & IEC 61689-3, whereby the supplier shall ensure winding accuracy between 80% and 120% of the nominal primary voltage,

for measurement; and between 0.5% and 120% of the nominal primary voltage, for protection. In case the winding is intended for both functions, supplier shall ensure the accuracy of both. Likewise, the supplier shall guarantee the accuracy of the transformer, either for measurement or protection, from 25% to 100% of the nominal load.

In case the Customer requires equipment for the replacement of voltage transformers in existing substations, or, for those cases where the protection equipment and/or measurement is electromechanical, VTs may be required with nominal loads up to 200VA. However, the accuracy class for measurement and/or protection shall be in accordance with the values mentioned in this paragraph.

For more details see Datasheets.

7.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

7.4.7. Rated Secondary Voltage U_{sr}

See Datasheets.

7.4.8. Rated Voltage Factor F_v

See Datasheets.

7.4.9. Rated Thermal Limiting Output

Thermal power of the voltage transformers shall be 500 (VA) for both protection and measurement cores. Codensa and Edesur shall use a thermal input value equal to the nominal load value or burden indicated in the Datasheets.

7.4.10. Static Withstand Load (F_R)

See Datasheets.

7.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

7.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3.

7.4.13. Seismic Qualification

The equipment supplied to Enel Colombia shall comply with the seismic requirements indicated in the Colombian standard NSR 10.

7.4.14. Short Circuit Withstand Capability and Secondary Current

7.5 CONSTRUCTION CHARACTERISTICS

7.5.1. Internal Insulation

The internal insulation of HV voltage transformers shall be oil, ester, paper or resin or some composite material. In case of indoor application, the insulation will preferably be resin or oil/paper. Other types of insulation will be subject to customer approval.

Internal insulation may be of paper and/or polypropylene.

Equipment insulated in oil and ester shall be provided with a fluid expansion chamber with metal bellows, in order to absorb thermal contractions and expansions of the fluid. The oil used shall be without inhibitors or additives, be free of polychlorinated biphenyls (PCBs) and shall meet the requirements of the IEC 60296 Standard. Its main characteristics shall be indicated, its typical composition, indicating the percentage of aromatics, isoparaffins and naphthenics.
The ester used shall meet the requirements of the IEC 62770 Standard.

7.5.2. External Insulation

The external insulation of the voltage transformers shall be porcelain, resin, or silicone rubber.

The active part of the voltage transformers shall be located in the metallic bodies (upper or lower, as appropriate). Designs with the active part located inside the porcelain will not be accepted.

7.5.3. Overall Dimensions and Layout

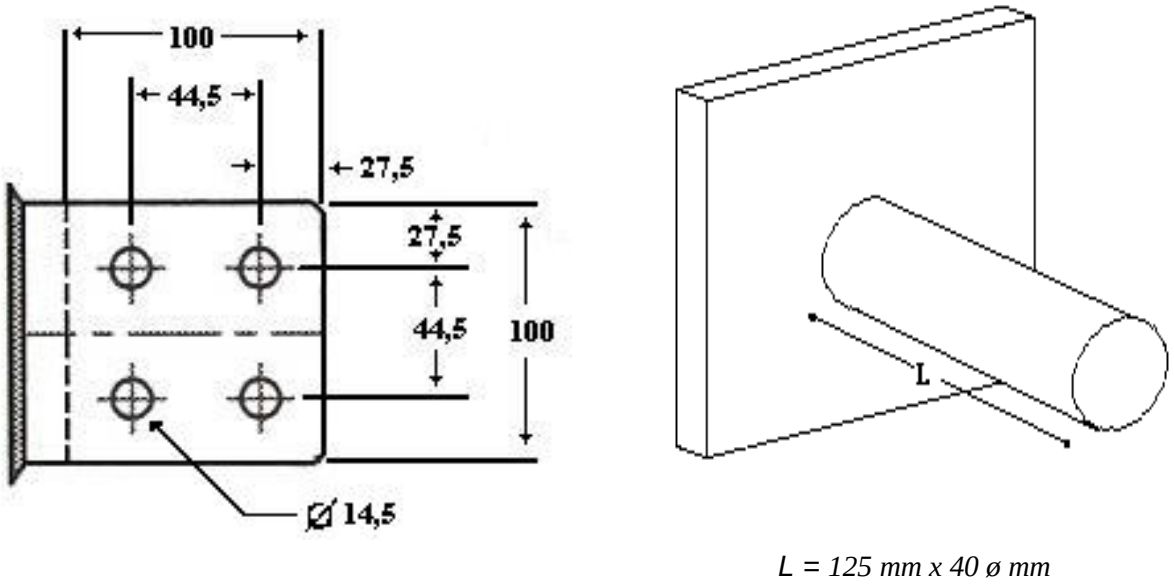
7.5.4. Metal Surface Treatment

Painting and galvanization shall be suitable for the environmental conditions indicated in Common Part, clause 7.3, *Table 3CP*. The thicknesses of the galvanized parts shall comply with Annex B for the different thicknesses of sheets and environmental conditions. The non-energized metallic surfaces of the voltage transformers shall be made of steel hot-dip galvanized and/or painted or aluminum, as indicated in Annex B. The painting and galvanization processes described in this specification shall not be applied to the composite material insulators of voltage transformers.

7.5.5. Accessories

7.5.5.1. Primary Outer Terminals

The primary terminals of the voltage transformers shall be made of aluminum, tinned or silver-plated copper. The type of terminal can be plate (4N) or cylinder without wire, as indicated in Annex B. Terminals shall have clearly distinguishable terminal and polarity markings. The supplier shall inform in his proposal the characteristics of the terminals of the offered equipment.



L = 125 mm x 40 ø mm

Figure 1CO

The VT for Edesur shall bear the following identification: the letter "A" for the high voltage terminal and the letter "N" for the neutral terminal.

The manufacturer shall inform in his proposal the characteristics of the terminals of the equipment offered.

7.5.5.2. Secondary Terminals

In case of outdoor application, the secondary terminals shall be made of phosphor bronze, and they shall be wired to terminal blocks located inside a box. This box shall be suitable for outdoor use, with a protection degree IP54, according to the IEC standard, and shall allow external cable connections from below or laterally. Secondary terminals shall have clearly distinguishable terminal and polarity markings.

The VT for Edesur shall bear the following identification: the letters "a" and "n".

Edesur does not require the installation of ultrafast thermomagnetic switches in the transformers, as they are installed in separate boxes and at the height of an operator located at floor level.

7.5.5.3. Grounding Terminals

The manufacturer shall supply terminals to connect the voltage transformers to the substation ground system. The connections to the ground mesh shall be cable type made of tinned copper with a section between 70 and 240 mm², or copper plate type with a section of 3 x 40 mm.

Where their design permits, the magnetic core and the internal screens will be at ground potential, not connected to the tank internally, but they shall be grounded by

means of external insulators and bridges for safety grounding connection, during normal operation. Such bridges shall be copper made and removable while the bushings shall withstand a non-permanent voltage of 10 kV at industrial frequency for testing purpose.

7.5.5.4. VT Support Base

7.5.5.5. Secondary Terminals Box

7.5.5.6. Liquid Level Gauge

This element shall have a maximum and minimum level indication and shall be easily readable for an operator standing on the floor.

7.5.5.7. Overpressure Relief Device

7.5.5.8. Liquid Sampling Device

The voltage transformer shall have a pad lockable device to take liquid samples.

7.5.5.9. Lifting Lugs

7.5.5.10. Rating Plate

A stainless steel or aluminum rating plate shall be included in Spanish. This rating plate shall comply with the provisions of IEC 61869-1 & IEC 61869-3 standards. Moreover, a plate shall be included with the winding connection diagram.

7.5.5.11. Terminal Marking

In accordance with IEC 61869-3.

7.5.5.12. Capacitive Tap

7.5.5.13. Ferroresonance Prevention

During the opening of certain 220 kV switches, the primary of the voltage transformers is connected in series with the voltage equalizer capacitors belonging to the switches mentioned above (about 1300 pF).

To avoid the phenomenon of ferroresonance that may occur between inductive voltage transformers and the named equalization capacitors, the manufacturer shall provide for every two transformers two inductors, one to install in the secondary terminal box and one as a backup.

These saturable inductors shall satisfy the required damping conditions, without their load (VA) representing any decrease in the required performance of the transformer.

In addition, they must have nominal inductance control sockets to adapt their damping characteristics for values of capacitance above 1300 pF, but common in circuit breaker equalizer capacitors (between 1000 pF and 1500 pF).

7.6 TESTING

All voltage transformers included in the supply shall be tested by the manufacturer, in the presence of the client or his representative.

The manufacturer of voltage transformers shall submit test protocols applied to the bushings used in their equipment.

The test method and acceptance criteria of the bushings will be described in the IEC 62155 or 61462 standard. If any voltage transformer does not meet any of the specified tests, the manufacturer shall take the necessary actions to detect the failures and correct them. Once the necessary corrections have been put in place, the manufacturer shall repeat all the tests to demonstrate that the said transformer fully complies with the specifications. All such events shall be recorded in a failure test report. Once all the acceptance tests have been carried out, the manufacturer shall deliver a complete and certified report of the same. This report will be submitted for final approval to the client.

7.6.1.Type Tests

According to clause 7.6.1 Common Part.

7.6.2. Routine/Acceptance Tests

According to clause 7.6.2 Common Part.

The routine tests indicated in the IEC standard, and those indicated below, will be part of the acceptance tests:

- Measurement of capacitance and dielectric dissipation factor.
- Verification of painting and galvanizing.
- Visual inspection.

7.6.3. Special Tests

7.6.4. Sample Tests

7.7 CONDITIONS OF SUPPLY

7.7.1. Warranty

7.7.2. Reception Control

7.7.3. Technical Information Required

7.7.4. Packaging and Transport

7.7.5. Installation, Operation, Maintenance and Disassembling

Manual for installation, operation, maintenance, and disassembling shall be provided in Spanish. Each voltage transformer and its accessories shall be packed appropriately for sea and land transportation, in order to prevent damages (blows, corrosion, moisture absorption, etc.) and theft.

Each package shall just contain one unit.

The packaging shall be adequate to support the normal operations of loading, unloading, and the eventual stacking of one package on top of another. Each of the packages shall include facilities to lift it by means of straps.

For export maritime transport, the manufacturer shall obtain the approval of the packaging by the transport companies before dispatching the equipment from the factory.

All packages shall bear the necessary identification and handling details, clearly and indelibly, both of their content and of the details of the purchase order especially of the recipient company.

The type of packaging and its identification shall be submitted for the client's or his representative approval before dispatch from the factory. If not all of the specified conditions are complied, the request for dispatching may be rejected.

7.7.6. Technical Conformity Assessment (TCA)

CONTENTS

ANNEX LOCAL SECTION ITALY (IT)

7.1 DOCUMENT/SECTION SCOPE

The scope of this Local Section is to integrate the Common Part to provide the technical standard requirements for the current transformers of e-distribuzione.

7.2 LIST OF COMPONENTS

See ANNEX A.

7.3 SERVICE CONDITIONS

The VT shall be single phase, for outdoor use and immersed in insulating mineral oil.

7.4 TECHNICAL CHARACTERISTICS

For definitions IEC 61869-1, IEC 61869-3 apply.

7.4.1. Type of Voltage Transformers

Voltage transformers intended to be connected to HV grid for measuring and protection scope with Um 145kV or 170 kV.

7.4.2. Number of Cores and Windings

See Datasheets.

7.4.3. Rated Insulation Levels

See Datasheets.

7.4.4. Rated Output

See Datasheets.

7.4.5. Rated Accuracy Class VT

See Datasheets.

7.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

7.4.7. Rated Secondary Voltage U_{sr}

See Datasheets.

7.4.8. Rated Voltage Factor F_v

See Datasheets.

7.4.9. Rated Thermal Limiting Output

7.4.10. Static Withstand Load (F_R)

See Datasheets.

7.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

7.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3

7.4.13. Seismic Qualification

A seismic certification is required for the severity level AF5 according to IEC 60068-3-3, for CT and support assembled.

The seismic certification can be based on the calculations according to the above-mentioned standard.

7.4.14. Short Circuit Withstand Capability and Secondary Current

7.5 CONSTRUCTION CHARACTERISTICS

7.5.1. Internal Insulation

Voltage transformer shall be oil type.

7.5.2. External Insulation

Insulators shall be made exclusively of light grey inorganic composite material, with HTV (Hight Temperature Vulcanization) or LSR (Liquid Silicone Rubber) silicone rubber, without EPDM or other organic rubber, in accordance with IEC 61462 for mechanical testing and IEC 61109 for dielectric testing and electrical-environmental accelerated ageing test which shall be performed for 5000h.

7.5.3. Overall Dimensions and Layout

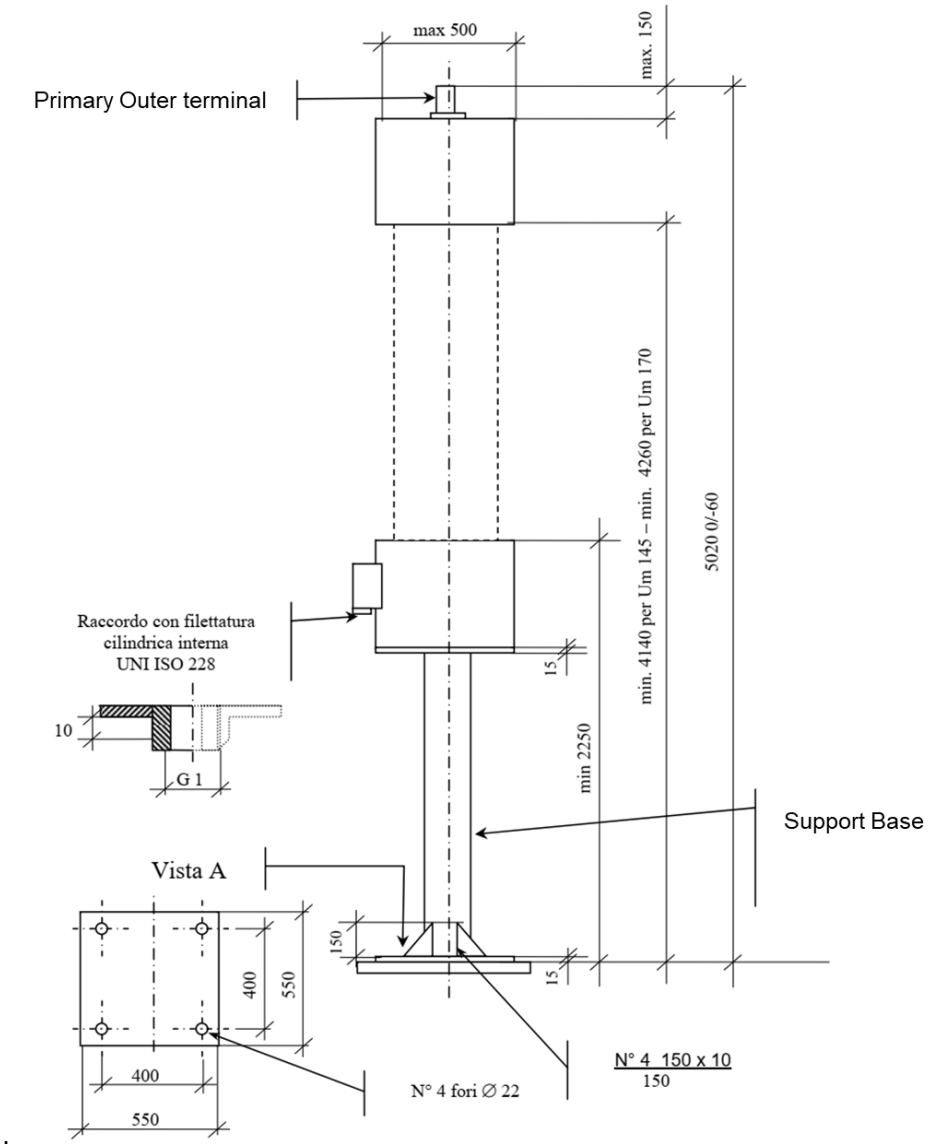


Figure 1IT

7.5.4. Metal Surface Treatment

All parts made of iron that come into direct contact with the atmosphere shall be hot-dip galvanized (EN ISO 1461); bolts with Ø < 8 mm, nuts, and screws for assembling of the electrical and mechanical components shall be made of stainless steel AISI 304 or higher quality. No external coating is requested for stainless steel parts.

7.5.5. Accessories

7.5.5.1. Primary Outer Terminal

The VT primary outer terminal features are detailed in the following picture:

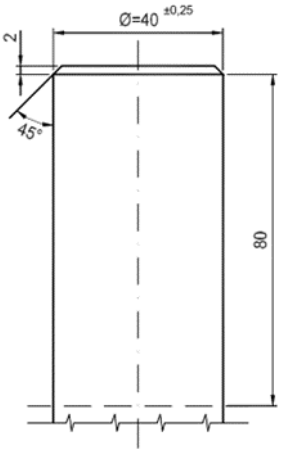


Figure 2IT (Primary Terminal)

Material can be aluminum, aluminum alloy, copper, or copper alloy.
All materials used shall be resistant or made corrosion resistant. Outer terminal made of copper or copper alloy shall be properly treated, to connect with aluminum or aluminum alloy fittings. For mechanical load IEC 61869 shall be applied.

7.5.5.2. Secondary Terminals

Secondary terminals shall be suitable for connecting cable lugs M6/M8, or with cage clamps (screw clamps) up to 6mm^2.

7.5.5.3. Grounding Terminals

For transformer grounding a ϕ14 mm hole shall be provided in a suitable position to allow easy connection, equipped with a stainless steel M12 bolt included in the supply. For grounding connection of secondary winding, a bolt shall be provided inside secondary terminals box and suitable to connect cable lugs with M6/M8. This connection shall be directly connected to above-mentioned transformer grounding connection.

7.5.5.4. VT Support Base

Every Voltage transformer shall be supplied with his own support, adjustable in height to obtain a suitable height to connect VT's primary outer terminal with HV connection lead. For details see the following drawing:

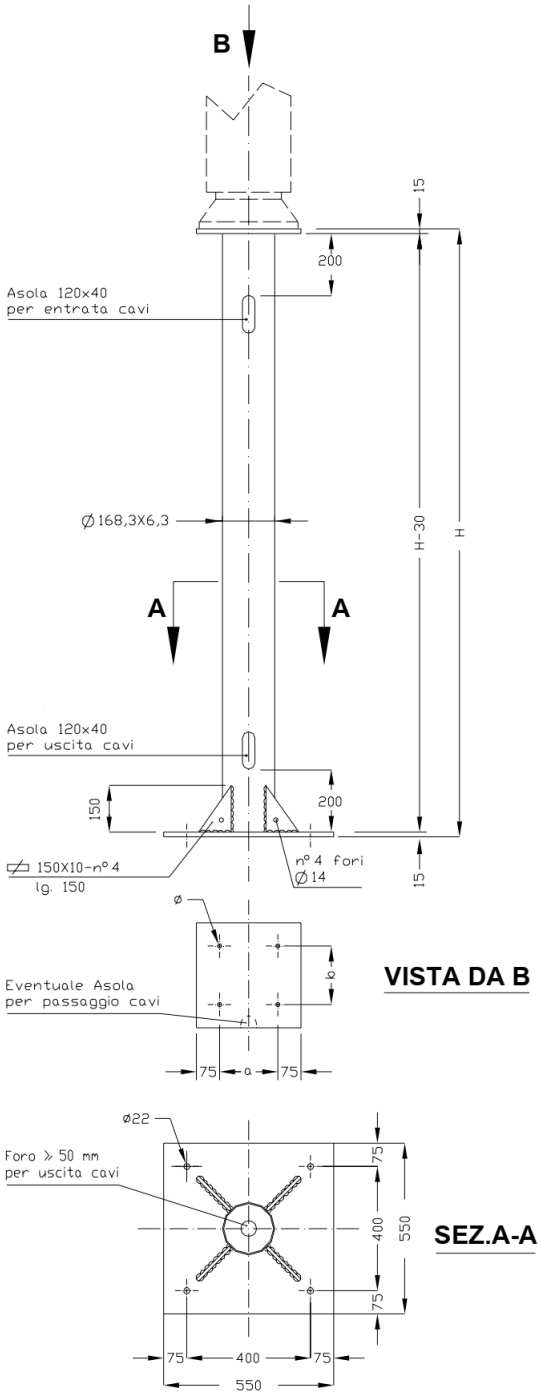


Figure 3IT

With reference to the above drawing, the following manufacturing details shall be implemented:

- Provide suitable loops for entry and exit of cables, equipped with special metal closures and waterproof material resistant to corrosion from weathering and suitable to be drilled on-site for the placement of cable glands.
- Provide the hole for the cable outlet at the bottom of the base plate at the inner circumference of the tube which will limit the maximum size allowed.
- If necessary, to facilitate the passage of cables from the component to the cable entry of the support, a buttonhole shall be placed on the upper plate.
- The materials to be used for manufacturing foot (tubes) are of S355JR UNI EN 10025 quality.
- The materials to be used for manufacturing of gusset plates are of S275JR UNI EN 10025 quality.
- Welding will be done with electrodes E52 quality class 3 according to UNI 5132-74 or with automatic/semi-automatic qualified procedure.
- Manufacturing tolerances on dimensions of semi-finished products (diameter of tubes and similar) according to UNI EN 10216 -2005.
- Manufacturing tolerances on overall dimensions: ± 2mm
- Manufacturing tolerances on interaxle spacing and drilling pitches, and in general on geometric dimensions of all coupling elements with other components: ± 1mm
- Machining tolerances on planarity: ± 1/100
- Machining tolerances on holes: ± 1mm
- Hot dip galvanization according to EN ISO 1461

7.5.5.5. Secondary Terminals Box

It shall be located in an easy position to allow connections and have the following features:

- be equipped with a front door and fully sealable (the various fastening systems such as hinges, screws, etc., shall not be accessible from the outside, or alternatively be sealable).
- be equipped with a fitting as indicated in the FIG.1 and FIG.2 (“*particolare M”)*, or alternatively with a 27 mm hole (suitable for fastening G1 pipe threaded with a ring nut), however positioned at the bottom part.
- have a protection degree not lower than IP 44 (IEC 60529).

- be equipped with a ground collector connected directly to VT's earthing point.
- be fitted with an aeration system to prevent condensation and corrosion. Openings shall be fitted with anti-insect screens.
- have, inside, indelibly reported, the connection diagrams of the sections, primary and secondary windings.

7.5.5.6. Liquid Level Gauge

The device for checking the liquid level shall indicate whether the liquid level is within the operating range, during operation and must be clearly readable from ground.

7.5.5.7. Overpressure Relief Device

The mechanical protective action can be performed by liquid expansion conservator. The conservator shall be watertight to the external environment and designed to exclude condensation and stagnation of water, to prevent damages at low temperatures.

7.5.5.8. Liquid Sampling Device

7.5.5.9. Lifting Lugs

Placed to facilitate lifting of VT.

7.5.5.10. Rating Plate

In accordance with IEC 61869-1 & IEC 61869-3. Rating plate shall be supplied in Italian language and all information shall be marked in an indelible manner. Material shall be aluminum.

7.5.5.11. Terminal Marking

All terminals shall be permanently marked according to IEC 61689-2.

7.5.5.12. Capacitive Tap

7.5.5.13. Ferroresonance Prevention

7.6 TESTING

7.6.1. Type Tests

In addition to the tests detailed in the document GSCT0014 VTs Common Part, the electrical-environmental accelerated ageing test for the bushings shall be performed for 5000h (see par. 7.5.2)

7.6.2. Routine/Acceptance Tests

7.6.3. Special Tests

7.6.4. Sample Tests

7.7 CONDITIONS OF SUPPLY

7.7.1. Warranty

7.7.2. Reception Control

7.7.3. Technical Information Required

7.7.4. Packaging and Transport

After the inspection, a copy of the packing list must be issued for checking and approval by the purchaser, before dispatching.

7.7.5. Installation, Operation, Maintenance and Disassembling

Manual for installation, operation, maintenance and disassembling shall be provided in Italian.

7.7.6. Technical Conformity Assessment (TCA)

CONTENTS

ANNEX LOCAL SECTION PERÙ (PE)

7.1 DOCUMENT/SECTION SCOPE

The scope of this Local Section is to integrate the Common Part to provide the technical standard requirements for the voltage transformers (VTs) of Infrastructure and Networks of Enel Distribución Perú S.A.A.

7.2 LIST OF COMPONENTS

See ANNEX A.

7.3 SERVICE CONDITIONS

The equipment of this specification will be designed for an installation at a maximum height above sea level of 1000 m and severe environmental pollution and a marine environment.

7.4 TECHNICAL CHARACTERISTICS

For definitions IEC 61869-1, IEC 61869-3 apply.

7.4.1. Type of Voltage Transformers

See Datasheets.

7.4.2. Number of Cores and Windings

Voltage transformers will be single primary winding, and up to two secondary windings

See Datasheets.

7.4.3. Rated Insulation Levels

See Datasheets.

7.4.4. Rated Output

See Datasheets.

7.4.5. Rated Accuracy Class VT

Winding accuracy may be specified in three ways, according to the performance:

Class 0,5: For windings intended for measurement for system operation.

Class 0.2: For windings intended for measurement for billing.

Class 3P: For windings intended for protection.

The accuracy shall be specified according to IEC61869-3, whereby the supplier shall ensure the voltage error and angular displacement limits at nominal frequency between 80% and 120% of the nominal voltage.

The manufacturer shall ensure the required accuracy class in all processing ratios.

For more details see Datasheets.

7.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

7.4.7. Rated Secondary Voltage U_{sr}

The secondary voltage shall be 110 V.

See Datasheets.

7.4.8. Rated Voltage Factor F_v

See Datasheets.

7.4.9. Rated Thermal Limiting Output

Thermal power of the voltage transformers shall be 1500 (VA) for both protection and measurement cores.

For more details see Datasheets.

7.4.10. Static Withstand Load (F_R)

See Datasheets.

7.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

7.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3.

7.4.13. Seismic Qualification

Seismic conditions with a horizontal acceleration of 0.5 g.

7.4.14. Short Circuit Withstand Capability and Secondary Current

7.5 CONSTRUCTION CHARACTERISTICS

7.5.1. Internal Insulation

The internal insulating of HV voltage transformers shall be oil, ester and paper for transformers for outdoor installation and epoxy resin for transformers for indoor installation. Other types of insulation will be submitted to the approval of ENEL.

Equipment insulated in oil or ester shall be provided with a fluid expansion chamber with a metal bellows, in order to absorb thermal contractions and expansions of the fluid. The oil used shall be naphthenic-based, without inhibitors or additives, free of PCBs and shall meet the requirements of the IEC 60296 Standard.

The ester used shall meet the requirements of the IEC 62770 Standard.

7.5.2. External Insulation

The external insulation of the VTs shall be porcelain or silicone rubber for external installation and epoxy resin or silicone rubber for internal installation. Other types of insulation will be submitted to ENEL's approval. The creepage distance of the insulators shall be in accordance with the level of pollution requested by ENEL.

The active part of the voltage transformers shall be located in the metallic bodies (upper or lower, as appropriate). Designs with the active part located inside the porcelain will not be accepted.

7.5.3. Overall Dimensions and Layout

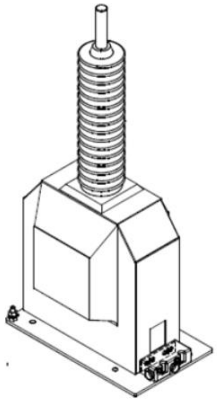


Figure 1PE (Outdoor application) *Figure 2PE (Indoor application)*

VTs for outdoor installation shall be inductive type and exceptionally capacitive type. All VTs for indoor installation shall be only inductive type.

7.5.4. Metal Surface Treatment

Painting and galvanization shall be suitable for the environmental conditions indicated in clause 7.3, *Table 3CP* (Common Part).

The thicknesses of the galvanized parts shall comply with Annex B for the different thicknesses of sheets and environmental conditions. The non-energized metallic surfaces of the voltage transformers shall be made of steel hot-dip galvanized and/or painted or aluminum, as indicated in Annex B. The painting and galvanization processes described in this specification shall not be applied to the composite material insulators of voltage transformers.

7.5.5. Accessories

7.5.5.1. Primary outer Terminals

The primary terminals of the VTs for outdoor installation shall be made of silver aluminum. The terminal shall be plate type (NEMA 4N).

The distances between terminal holes shall be 44,5 mm x 44,5 mm according to NEMA 4N.

In case of voltage transformers for indoor installation, the terminals shall be flat, silver-plated copper material; a specific distance between terminal holes is not required. Terminals shall have clearly distinguishable polarity markings.

7.5.5.2. Secondary Terminals

In case of VTs for outdoor use, the secondary terminals shall be made of phosphor bronze, and they shall be wired to terminal blocks located inside a box. This box shall be suitable for outdoor use, with an IP55 degree of protection and will allow external cable connections from below.

In case of indoor installation transformers, the secondary terminal box will allow external cable connections laterally. Secondary terminals shall have clearly distinguishable terminal and polarity markings.

The manufacturer shall include appropriate sectionable terminals in the terminal box where the cables of the measured and protected cores voltage signals will be connected, which shall contain thermomagnetic switches with an auxiliary contact only for outdoor measuring transformers.

7.5.5.3. Grounding Terminals

The manufacturer shall supply terminals to connect the VTs to the ground system of the substation. The connections to the ground mesh shall be plate type with a section of 3 x 40 mm.

7.5.5.4. VT Support Base

7.5.5.5. Secondary Terminals Box

An MCB thermomagnetic switch with auxiliary contact for signaling will be installed in the LV junction box of the outdoor type of instrument transformers; the secondary voltage output of the instrument transformer will be connected to the MCB.

7.5.5.6. Liquid Level Gauge

This element shall have a maximum and minimum level indication and be easy to read for an operator standing on the floor through a UV-resistant visor.

7.5.5.7. Overpressure Relief Device

7.5.5.8. Liquid Sampling Device

Voltage transformers shall have a device to be able to take samples of the liquid, which shall be adequately ensured, preserving the tightness of the equipment. Its location should be in the base below that team.

7.5.5.9. Lifting Lugs

7.5.5.10. Rating Plate

A stainless steel or aluminum rating plate in Spanish language, shall be included. This rating plate shall comply with what is indicated in the IEC 61869 Standards, a plate with the winding connection diagram shall also be included.

The rating plate with indelible indication shall have at least the following characteristics (located on the LV side of the tank):

- *Nombre del fabricante y marca por la cual pueda ser identificado.*
- *Año de fabricación, número de serie y tipo de designación.*
- *Frecuencia Nominal.*
- *Tensión más alta del equipo.*
- *Nivel de aislamiento nominal.*
- *Potencia nominal continua.*
- *Tensiones.*
- *Corrientes.*
- *Temperatura ambiente considerada para el diseño.*
- *Peso (kg), marca y tipo de aceite.*
- *Peso de la parte activa (kg).*
- *Peso total (kg).*
- *Normas de fabricación*

The rating plate shall support the service conditions indicated in the document GSCT0014 Common Section and will have the name of ENEL printed on it.

7.5.5.11. Terminal Marking

In accordance with IEC 61869-3.

7.5.5.12. Capacitive Tap

7.5.5.13. Ferroresonance Prevention

7.6 TESTING

7.6.1. Type Tests

According to clause 7.6.1 Common Part.

7.6.2. Routine/Acceptance Tests

According to clause 7.6.2 Common Part.

In addiction the following tests shall be performed:

- Measure of the paint thickness and adherence, ASTM 3359 (for tank and rating plate, if applicable).
- Insulating oil or ester test, according to IEC 60296 or IEC 62770.

7.6.3. Special Tests

According to clause 7.6.3 Common Part.

In addiction the following tests shall be performed:

- Test for vegetable oil, according to Mexican Standard NMX-J-628-ANCE.
- Mechanical bending tests on fixing support.

7.6.4. Sample Tests

According to clause 7.6.4 Common Part

7.7 CONDITIONS OF SUPPLY

7.7.1. Warranty

7.7.2. Reception Control

7.7.3. Technical Information Required

7.7.4. Packaging and Transport

It is essential that the transport, storage and installation of voltage transformers, as well as their operation and maintenance in service, be carried out in accordance with the instructions given by the manufacturer. Consequently, the manufacturer shall provide timely instructions for the transportation, storage, installation, operation and maintenance of voltage transformers.

The supplier will carry out the appropriate packaging of the voltage transformers to ensure their protection during transport by sea, land or air. In the packaging, padding material will be used to ensure good protection in the event that the boxes containing the materials are hit or damaged during loading and unloading maneuvers.

To protect materials from moisture, airtight covers or bags containing hygroscopic material shall be used.

Each drawer shall have the following information printed on it:

- Type of material and quantity
- Net and gross weight
- Date

The supplier will be responsible for transporting the transformers to ENEL's warehouses, unless otherwise indicated in the purchase order.

For each type of voltage transformer, the installation instructions provided by the manufacturer shall include at least the items listed below:

- Information required for safe unpacking and lifting
- Diagram of assembly and marking of the parts
- Instructions for the assembly of voltage transformers, auxiliary and operating devices
- Instructions for connecting conductors, auxiliary circuits, liquid systems, connections to earth and the manufacturer's recommendation for the type of cable to be connected to the secondary terminals

Provide instructions for inspection and testing to be performed after the voltage transformer has been installed and all connections have been completed

7.7.5. Installation, Operation, Maintenance and Disassembling

Manual for installation, operation, maintenance, and disassembling shall be provided in Spanish.

7.7.6. Technical Conformity Assessment (TCA)

CONTENTS

ANNEX LOCAL SECTION SPAIN (SP)

7.1 DOCUMENT/SECTION SCOPE

The scope of this Local Section is to integrate the Common Part to provide the technical standard requirements for the voltage transformers (VTs) of e-distribución.

7.2 LIST OF COMPONENTS

See ANNEX A.

7.3 SERVICE CONDITIONS

7.4 TECHNICAL CHARACTERISTICS

For definitions IEC 61869-1, IEC 61869-3 apply.

7.4.1. Type of Voltage Transformers

See Datasheets.

7.4.2. Number of Cores and Windings

Voltage transformers will be single primary winding, and up to two secondary windings.

See Datasheets.

7.4.3. Rated Insulation Levels

See Datasheets.

7.4.4. Rated Output

See Datasheets.

7.4.5. Rated Accuracy Class VT

See Datasheets.

7.4.6. Rated Primary Voltage U_{pr}

See Datasheets.

7.4.7. Rated Secondary Voltage U_{sr}

See Datasheets.

7.4.8. Rated Voltage Factor F_v

See Datasheets.

7.4.9. Rated Thermal Limiting Output

7.4.10. Static Withstand Load (F_R)

See Datasheets.

7.4.11. Installation

The type of installation can be indoor or outdoor.

See Datasheets.

7.4.12. Temperature Rise

See IEC-61698-1 and IEC-61698-3.

7.4.13. Seismic Qualification

7.4.14. Short Circuit Withstand Capability and Secondary Current

According to IEC 61869-5. Moreover, the VT design or an additional safety device shall avoid explosive rupture of the transformer's tank, in case of prolonged short circuit conditions or other internal malfunction.

Short circuit current in the secondary winding when this is short-circuited shall be less than or equal to 150A.

7.5 CONSTRUCTION CHARACTERISTICS

7.5.1. Internal Insulation

7.5.2. External Insulation

Insulators shall be made exclusively of light grey inorganic composite material, with HTV (Hight Temperature Vulcanization) or LSR (Liquid Silicone Rubber) silicone rubber, without EPDM or other organic rubber, in accordance with IEC 61462 for mechanical testing and IEC 61109 for dielectric testing and electrical-environmental accelerated ageing test.

For current transformers for indoor application external insulation shall be fireproof synthetic resin, M1 class (UNE 23727). When subjected to an ignition source the performance shall correspond to an equivalent FV1 (UNE 53315) category, according to UNE-EN 60085 and UNE-EN 60505.

7.5.3. Overall Dimensions and Layout

Dimensions according to below drawings. Only interchangeable dimensions are shown in the below pictures, and they are both mandatory, without prejudging the actual shape of VTs.

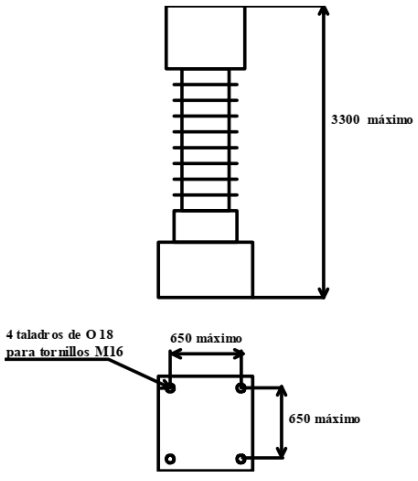


Figure 1SP (220kV Outdoor)

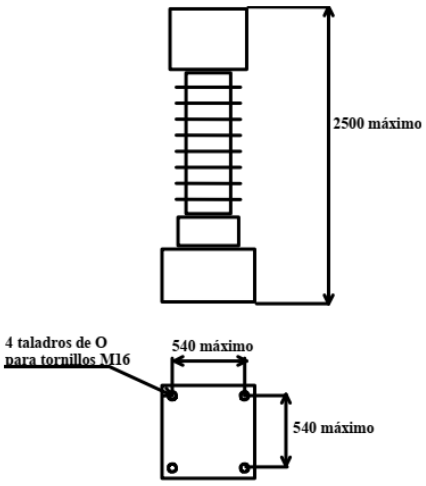


Figure 2SP (110-132kV Outdoor)

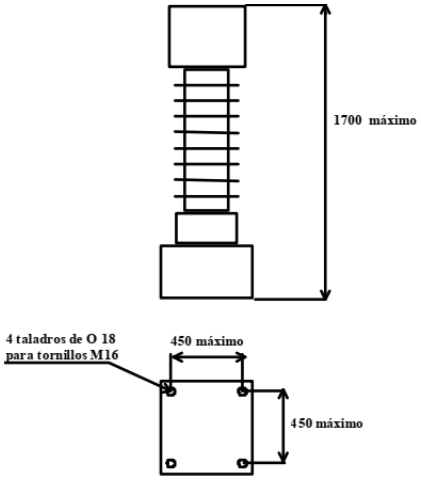


Figure 3SP (66-55kV Outdoor)

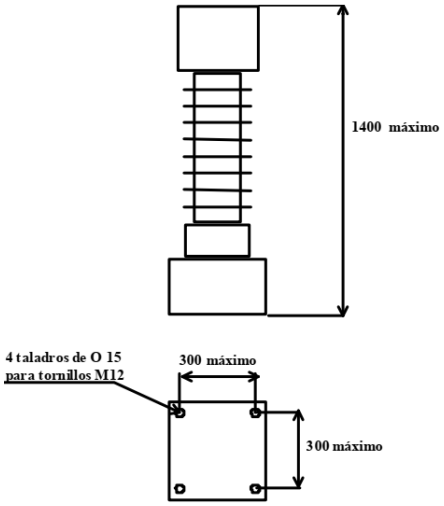


Figure 4SP (45 kV Outdoor)

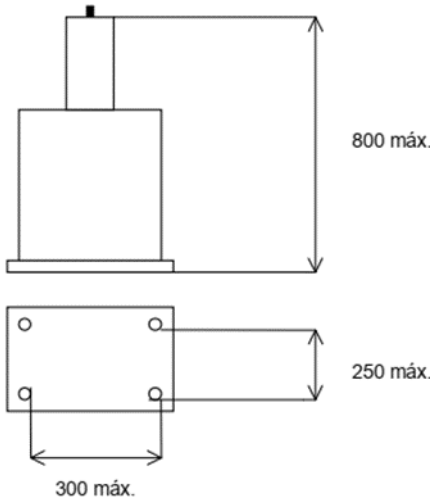


Figure 5SP (45 kV Indoor)

7.5.4. Metal Surface Treatment

7.5.5. Accessories

7.5.5.1. Primary outer Terminals

Material can be aluminum, tinned or silvered copper. The outer terminal shall be cylindrical type.

7.5.5.2. Secondary Terminals

Secondary terminals shall be suitable for connecting cable lugs preferably M8, or screw clamps DIN type, suitable to connect a 6 mm^2 copper conductor, with its clamping terminal

7.5.5.3. Grounding Terminals

For transformer grounding a 14 mm hole shall be provided in a suitable position to allow easy connection, equipped with a stainless steel M12 bolt included in the supply and identified in a permanent manner.

7.5.5.4. VT Support Base

7.5.5.5. Secondary Terminals Box

Secondary winding terminals shall be M8 ring-tongue type (with bolt and nuts) or screw clamp terminals mounted on a symmetric screw clamps DIN rail terminal block suitable for copper cable of 6 mm^2.

Secondary terminals shall be placed inside a suitable metal terminals box, which shall have three exit holes (diameter Pg 16) on the bottom part, one of them blinded by a

plug and the other two equipped with a cable gland (AISI 316), which can be interchanged for both purposes.

It shall be equipped with vents protected against the entry of insects and be fitted with an aeration system to prevent condensation and corrosion. Openings shall be fitted with anti-insect screens.

The terminal box shall be connected to the grounded terminal without interfering with the secondary terminals connections.

There will be no internal provision for earthing the terminals which shall be grounded externally.

There shall be an M8 earthing terminal inside the box or a terminal with the same characteristics as the rest of the terminal block and with standardized colour for grounding of the cable screens to be connected to the secondary terminals. The box shall be suitable to ground all the cable screens.

7.5.5.6. Liquid Level Gauge

The device for checking the liquid level shall indicate whether the liquid level is within the operating range, during operation and must be clearly readable from ground.

7.5.5.7. Overpressure Relief Device

The mechanical protective action can be performed by liquid expansion conservator.
VT shall be designed in such a way that if an internal failure occurs in the main insulation, any overpressure originating in the internal part can be only released upwards, avoiding the breakage and projection of the porcelain.

7.5.5.8. Liquid Sampling Device

VT shall be equipped with a liquid sampling device plug-in type or similar.

7.5.5.9. Lifting Lugs

Placed to facilitate lifting of CV.

7.5.5.10. Rating Plate

A stainless steel or aluminum rating plate in Spanish language, shall be included. This rating plate shall comply with what is indicated in the IEC 61869 Standards, a plate with the winding connection diagram shall also be included.
The rating plate with indelible indication shall have at least the following characteristics:

- *Tipo, número de serie y año de fabricación*
- *Relaciones de transformación y bornes secundarios correspondientes*

- *Frecuencia asignada*
- *Potencias y clases de precisión*
- *Tensión más elevada para el material*
- *Nivel de aislamiento*
- *Factor de tensión*
- *Potencia límite de calentamiento*
- *Referencia Norma IEC*

7.5.5.11. Terminal Marking

All terminals shall be marked as indicated in the following drawings:

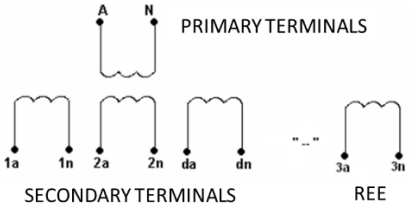


Figure 6SP (outdoor)

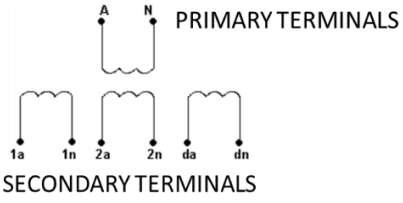


figure 7SP (indoor)

Note: the following tables show a comparison between new and old terminal marking.

New Terminal Markings	Old Terminal Markings
A	P1
N	P2
1a	1S1
1n	1S2
2a	2S1
2n	2S2
3a	-
3n	-
da	-
dn	-

Table 1SP (outdoor applications)

New Terminal Markings	Old Terminal Markings
A	P1
N	P2
1a	1S1
1n	1S2
2a	2S1
2n	2S2
da	-
dn	-

Table 2SP (indoor applications)

7.5.5.12. Capacitive Tap

7.5.5.13. Ferroresonance Prevention

7.6 TESTING

7.6.1. Type Tests

According to clause 7.6.1 Common Part.

Moreover, the Mechanical tests according to par. 7.4.5 IEC 61869 shall be performed.

For indoor applications only the following tests shall be performed:

TYPE TESTS	Subclause IEC 61869-1 IEC 61869-3
Temperature rise test	7.2.2
Impulse voltage withstand test on primary terminals	7.2.3
Test for accuracy	7.2.6
Verification test of the degree of protection of the enclosures	7.2.7
Short-circuit withstand capability test	7.2.301
Mechanical tests	7.4.5

7.6.2. Routine/Acceptance Tests

According to clause 7.6.2 Common Part.

Moreover, the following tests shall be performed:

- Measurement of capacitance and dielectric dissipation factor
- Measurement of short circuit current

For indoor applications only the following tests shall be performed:

ROUTINE TESTS	Subclause IEC 61869-1 IEC 61869-3
Power-frequency voltage withstand tests on primary terminals	7.3.1
Partial discharge measurement	7.3.2
Power-frequency voltage withstand tests between sections	7.3.3
Power-frequency voltage withstand test on secondary terminals	7.3.4
Test for accuracy	7.3.5
Verification of markings	7.3.6
Measurement of short circuit current	
Visual and Dimensional checks (including VT base support where requested)	-
Painting check	-

7.6.3. Special Tests

According to clause 7.6.3 Common Part.

For indoor applications only the following tests shall be performed:

- Chopped impulse voltage withstand test on primary terminals.

7.6.4. Sample Tests

According to clause 7.6.4 Common Part

7.7 CONDITIONS OF SUPPLY

7.7.1. Warranty

7.7.2. Reception Control

7.7.3. Technical Information Required

7.7.4. Packaging and Transport

7.7.5. Installation, Operation, Maintenance and Disassembling

Manual for installation, operation, maintenance, and disassembling shall be provided in Spanish.

7.7.6. Technical Conformity Assessment (TCA)