

	GLOBAL STANDARD	Page 47 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

INDEX – LOCAL SECTION LATAM


1	SCOPE	49
2	LIST OF COMPONENTS	49
3	REFERENCE LAWS AND STANDARDS	49
3.1	LAWS	49
3.2	INTERNATIONAL STANDARDS	49
3.3	LOCAL STANDARDS	49
3.4	OTHER RELEVANT DOCUMENTS	49
3.5	REPLACED STANDARDS	49
4	SERVICE CONDITIONS	50
5	RATINGS	50
5.1	TYPES OF TRANSFORMERS	50
5.2	NUMBER OF WINDINGS	50
5.3	NUMBER OF PHASES	50
5.4	COOLING SYSTEM	50
5.5	RATED POWER	50
5.6	RATED VOLTAGE	50
5.7	RATED FREQUENCY	50
5.8	VOLTAGE REGULATION	50
5.9	WINDINGS CONNECTIONS	50
5.10	INSTALLATION	50
5.11	HV AND MV NEUTRAL	50
5.12	OVER-LOAD CAPABILITY	50
5.13	BUSHINGS	50
5.14	INSULATION LEVELS	51
5.15	LOSSES AND SHORT CIRCUIT IMPEDANCES	51
5.16	OVER-EXCITATION CONDITIONS	51
5.17	NO-LOAD CURRENT	51
5.18	OVER-TEMPERATURE OF THE CORE	51
5.19	CAPABILITY TO WITHSTAND SHORT-CIRCUIT	51
5.20	SOUND POWER LEVELS	51
5.21	OVERALL DIMENSIONS	51
5.22	RATING PLATES	51
5.23	TOLERANCES	51
6	DESIGN REQUIREMENTS	52
6.1	CORE AND FRAME	52
6.2	WINDINGS	52
6.3	HV AND MV NEUTRAL	52
6.4	TANK	52
6.5	INSULATING LIQUID AND MATERIAL	53
6.6	MV WIDINGS CONNECTIONS CHANGE	53
6.7	COOLING SYSTEM	53
6.8	ACCESSORIES AND AUXILIARIES	54
6.8.1	Valves	54
6.8.2	Current transformers (CT's)	55

 	GLOBAL STANDARD	Page 48 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

6.8.3	Anchoring	56
6.8.4	Oil preservation system.....	56
6.8.5	No- Load Tap Changer (DETC).	56
6.8.6	Protections	57
6.8.7	Instruments.....	57
6.8.8	surge arresters support	58
6.9	MARSHALLING BOX.....	58
6.10	PROTECTIVE PAINTING.....	60
7	MAIN COMPONENTS	61
8.	TESTS.....	64
8.1	LIST AND CLASSIFICATION OF TESTS	64
8.1.1	Routine tests	64
8.1.2	Additional routine tests for transformers with $U_m \geq 72,5$ KV	64
8.1.3	Type tests.....	64
8.1.4	Special tests	64
8.1.5	General statements for the tests	64
8.1.5.1	Short circuit test criteria.....	64
9	SUPPLY REQUIREMENTS.....	65
9.1	TRANSPORT.....	65
9.2	COMMISSIONING.....	65
9.3	DOCUMENTATION.....	65
9.4	GUARANTY.....	65
9.4.1	DEFECTIVENESS	66
9.4.2	PROTECTIVE COATING	66
9.4.3	TRANSFORMERS IN OPERATION	66
10	EXCEPTIONS	66
11	FIGURES AND TABLES	66
11.1	OVERALL DIMENSIONS.....	67
11.2	BASE ANCHORING.....	68
11.3	CURRENT TRANSFORMERS IN BUSHINGS.....	70
11.4	PRINCIPAL ACCESSORIES LOCATION	72
11.5	BUSHINGS.....	73

ANNEXES

B)	DATA SHEETS OF TRANSFORMER REQUIREMENTS.....	75
-----------	---	-----------

	GLOBAL STANDARD	Page 49 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

1 SCOPE

The scope of this document is to provide technical requirements for the supply of the power transformers to be used in the distribution networks of Latam.

The present document completes the Global Standard GST002.

2 LIST OF COMPONENTS

See Common List.

3 REFERENCE LAWS AND STANDARDS

3.1 LAWS

Brasil

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

3.2 INTERNATIONAL STANDARDS

- IEC – 61869-1 General requirements for instrument transformers
- IEC – 61869-2 Additional requirements for current transformers
- IEC – 60450 Measurement of the average viscometric degree of polymerization of new and aged cellulosic electrically insulating materials
- IEC 60068-3-3 Environmental testing Parte 3: Guidance - Seismic test methods for equipments.



3.3 LOCAL STANDARDS

- Chilectra.
 - ETGI-1020 - ESPECIFICACIONES TÉCNICAS GENERALES - REQUISITOS DE DISEÑO SÍSMICO PARA EQUIPO ELECTRICO.
- Edelnor
 - E – SE – 010: “Acción sísmica en equipos eléctricos y mecánicos”

3.4 OTHER RELEVANT DOCUMENTS

3.5 REPLACED STANDARDS

E – SE – 001

 	GLOBAL STANDARD	Page 50 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

4 SERVICE CONDITIONS

Specific service conditions

- a) Altitude.
Colombia (Codensa). The reference altitude is 2.600 m.
- b) Seismic qualification level
 - Chilectra : ETGI-1020
 - Codensa
 - Seismic horizontal acceleration :0,3 g.
 - Seismic vertical acceleration:0,25 g
 - Edelnor : AG5- IEC 60068-3-3 or E-SE-010

5 RATINGS

5.1 TYPES OF TRANSFORMERS

See Data sheet

5.2 NUMBER OF WINDINGS

See Datsheet

5.3 NUMBER OF PHASES

See Data Sheet

5.4 COOLING SYSTEM

See Data Sheet

5.5 RATED POWER

See Data Sheet

5.6 RATED VOLTAGE

See Data Sheet

5.7 RATED FREQUENCY

See Data Sheet

5.8 VOLTAGE REGULATION

See Data Sheet

5.9 WINDINGS CONNECTIONS

See Data Sheet

5.10 INSTALLATION

See Data Sheet



5.11 HV AND MV NEUTRAL

The MV neutral connection shall be adapt for the connection of the neutral point with resistance or earthing reactor or direct grounded.

5.12 OVER-LOAD CAPABILITY

5.13 BUSHINGS

Copyright 2013. All rights reserved.

 	GLOBAL STANDARD	Page 51 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

The type of bushings are chosen accordingly to the transformer rated power, the rated voltage, the overload capability and the interfaces with terminals to overhead conductors in the substation.

The type and quantity of bushings to be used for the HV and MV terminals (three or four, one of which for the neutral) will be indicated in Data sheet

The Bushing shall be adequate for pollution level of each company.

In the case porcelain bushing shall be brown

The bushings must be sized so as to allow the installation of current transformers (CT's) in each of them. The Supplier shall provide to distribution company the design drawing bushings to check the space for the CT's.

5.14 INSULATION LEVELS

See Data Sheet

The minimum distances between energized parts and earth, as well as the separations between phases must be determined by the insulations levels (see recommendations IEC 60071). These minimum distances in the air must be provided for the Supplier.

5.15 LOSSES AND SHORT CIRCUIT IMPEDANCES

The prescribes values for the losses and the short circuit impedances are given in the data sheet.

The impedance values of the transformer shall refer to the temperature of 75 C (IEC) and to the base power indicated respectively. The loss values shall refer to the same temperature as the impedance values (75°C)

5.16 OVER-EXCITATION CONDITIONS

5.17 NO-LOAD CURRENT

5.18 OVER-TEMPERATURE OF THE CORE

5.19 CAPABILITY TO WITHSTAND SHORT-CIRCUIT

5.20 SOUND POWER LEVELS

See Data sheet

5.21 OVERALL DIMENSIONS


The dimensions and the position of the main accessories, are shown in the figures listed and reported in 11.1 and 11.4 of this document.

5.22 RATING PLATES

The nameplate language shall be in Spanish for Codensa, Chilectra, Edelnor and Edesur and Portuguese for Ampla and Coelce. The name plate shall be submitted to the Distribution Company approval .

The accesories included in the transformer: Insulators (Bushings), OLTC, current transformers (including the destined to measuring temperature and voltage regulation), must have their nameplates in compliance with the corresponding standards, located in places that are easy to read by an operator.

5.23 TOLERANCES

	GLOBAL STANDARD	Page 52 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

6 DESIGN REQUIREMENTS

The transformers must be designed so as to be suitable to operate in parallel with other transformers of similar characteristics.

In the case of transformers with a delta tertiary compensator, the use of special reactors to limit the short circuit current is not acceptable.

The Supplier must inform about the inclusion of non-linear resistors or other accessory included in its design, which influence certain behaviors of the transformer, so this information must be made known to the Distribution Company.

All materials, components, and equipment incorporated into the transformers must be new and of the best quality, to ensure that the complete equipment complies with the continuous operation requirements during its entire useful life. The company could reject the elements or components that not comply with the requirements of this specification.

The Distribution Company reserves the right to realize programmed and unscheduled inspections, during the manufacturing process to verify the quality and characteristics of the materials, the manufacturing methods and request the quality certificates of the magnetic steel, the conductors, papers, oils, etc.

The transformer must resist the thermal and mechanical effects of the symmetric short circuit current.

Likewise, it must be capable of resisting all the impacts during its transport and assembly.

The fully assembled transformer must comply with the requirements specified for seismic action for the companies required.

6.1 CORE AND FRAME

6.2 WINDINGS

6.3 HV AND MV NEUTRAL

6.4 TANK



The cover shall not be welded to the main tank. In the design of the cover, the Supplier shall take special care in preventing the accumulation of rainwater.

The transformer shall include adequate hatches, for possible internal inspections (Manhole and Handhole accesses), with the minimum dimensions indicated. These hatches should be located in places easily accessible (not behind the radiator).

Minimum dimensions for Manholes and Handholes.

		Handholes	Manholes
Round	Diameter	229	381
Rectangular	Length	368	406
	Width	114	254

The transformer must be designed so that the core-coil assembly cannot move inside the tank.

 	GLOBAL STANDARD	Page 53 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

All procedures related to the welding, including the repairs of the latter, shall follow the instructions indicated in the Standard ASME “Boiler and Pressure Vessel Code”, section IX, or equivalent. The final finishing of the welding will be a smooth surface with a good appearance.

All gaskets must be new, made of synthetic material, compatible with the use of mineral oils, resistant to the effects of moisture and solar rays. The Supplier must supply a complete set of all of the gaskets necessary for the assembly of the transformer. The Distribution Company reserves the right to verify the quality of the gaskets used.

The tanks must include the elements necessary for lifting, carrying, turning, assembly and application of hydraulic jacks.

Clamps should be provided for grounding the tank, welded to it and located at the level of the base on two opposite sides of the tank. These clamps must be suitable for a copper cable with a 70 – 240 mm² diameter or a 3 x 40 mm² copper bar.

A safety device shall be included on the tank cover, which function is to support two columns to which a lifeline is attached, to be used by personnel in maintenance tasks.

In the case of Edesur, for power transformers with nominal capacity greater or equal to 150 MVA, when expressly requested by the Distribution Company, a “bell-type” tank must be provided.

6.5 INSULATING LIQUID AND MATERIAL

The oil shall be not contain inhibitors or additives (Class U) according to IEC 60296. The Supplier shall indicate the features oil, its typical composition in percentage indicating the amount of aromatic and naphthenic or isoparaffins components.

The supplier shall include a curve transformer oil level (scale 0 to 10) vs temperature(°C). This curve must be recorder in stainless metal and beside to transformer nameplate.

For Brazil, it is possible to offer local dielectric oil (Class I). However, previously shall be approved by the distribution company.

6.6 MV WIDINGS CONNECTIONS CHANGE

The transformer must include a panel (in-tank bar connection), or switch equipment off-load (DETC) that allows making or modifying internal connections in the transformer. See Data sheet

In the case of in-tank-bars, all connections must be realized with a minimum decrease in the oil level.

The mechanical joints must ensure perfect and permanent electrical connections that do not loosen with the vibrations. Special tools should not be necessary to make joints.


6.7 COOLING SYSTEM

The cooling equipment of each transformer shall consist mainly in a group of radiators, and one of two groups of fans normally controlled by a temperature monitor. The number of groups of fans shall depend on the cooling stages specified in Data sheet.

For Brazil (Ampla and Coelce) and Edelnor (Perú) the radiators and fans shall consider a hot dip galvanized as cover layer painting or another scheme previous approved by the distribution company.

Radiators:

The radiators must form a structural assembly with the transformer tank, so they must bear the adequate no-load conditions. Pipes should not be used as structural elements for fastening. The

	GLOBAL STANDARD	Page 54 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

location of the radiators must be in accordance with that requested by each company. The radiators must be dismountable.

The radiators must be sized so that, upon dismounting one of them, the capacity of the cooling system does not affect the transformer's capacity.

The radiators should have bolted flanges at all joints, with throttle valves at the joints with the tank, air purging, drain plugs, and lifting lugs.

Fans:

The fans shall conform one or two independent groups, symmetrical and uniformly distributed, depending on the specific cooling stages.

The fans must have blades made of a single metal piece (not blades bolted). At least must have 3 blades to ensure stability. The fans should have an arrow indicating the direction of the spin and identification of the group to which they belong.

The fan motors shall be three-phase AC power, with the frequency and magnitude indicated:

Rated supply voltage (Vac) Phase-Phase/ Phase-neutral	Coelce (60Hz) – Chilectra and Edesur (50Hz)	380/220
	Edelnor (60Hz)	220
	Ampla (60Hz)	220/127
	Codensa (60 Hz)	208/120

The output cables from each fan motor should be channeled through flexible metal ducts and have watertight plugs, so that they can be removed without cutting off the power, and without compromising personnel safety.

6.8 ACCESSORIES AND AUXILIARIES


6.8.1 VALVES

The piping system for the cooling oil must have ball type valves, in such a way that it be possible to dismantle any element without it being necessary to empty or lower the level of the transformer's oil.

a. **Valves for the main tank.** Each transformer must be supplied with the following valves :

- Drain valve that allows full drainage. (minimum 2"Ø)
- Filtering valve, near the bottom (minimum 2"Ø).
- Sampling valve for the oil at the bottom (maximum ½"Ø).
- Filtering valve near the top of the tank, on the same side as the storage tank, and on the opposite side as the lower filtering valve. (minimum 2"Ø).
- Sampling valve near the top end of the main tank. (maximum ½"Ø).

For filling the transformer, the Supplier shall put, welded inside the tank, a deflector element that prevents the oil from hitting the windings. The design must keep in mind that it is necessary to prevent the accumulation of gases.

	GLOBAL STANDARD	Page 55 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

b. **Valves for the oil conservator.** Each transformer must be supplied with the following valves:

- Drain valves that allow full drainage. (minimum 1½"Ø).
- Valve at the top for oil fill in (minimum 1½"Ø).
- Sampling valve on the bottom. (maximum ½"Ø).
- Shut-off valves on both sides of the Buchholz relay.
- Vacuum valve, located on the upper part of the oil conservator. (2"Ø minimum).
- Pressure equalization valves between the oil conservator and the on-load tap changer, and for the oil conservator system that the Supplier offers.
- Automatic check valve which will be installed in the Buchholz relay piping connecting the main expansion tank (conservator) and the tank. This valve shall be automatically closed and will block the flow of oil when an important loss occurs in the vat. The operating position shall be clearly identified. In case the check valve is not suitable for realizing treatments or filling with oil through it, a special circuit for said purposes should be provided. A plan with details and constructive profiles of said valve must be provided for its approval, where the check mechanism, the constitutive elements, and the materials employed can be seen.

c. **Valves for the radiators.** Each transformer shall be provided with shut-off valves at the inlet and outlet of each radiator in such a way that repairs or changes can be made without affecting the operation of the transformer.

d. **Conditions required for the valves.** The following conditions must be met by the supplied valves:


- All the drain, filtering, and sampling valves must be able to resist, without leaking, the operating pressures with hot oil and the overpressure tests with air and oil.
- All the filtering valves must be suitable to allow coupling with a flange to the oil treatment equipment.
- Shut off valves must have a device that indicates the closed and open positions and allows their blocking in both positions. Each position must be clearly Marked.
- All valves must be connected by means of flanges, joined with bolts and gaskets that allow installing and removing them individually.
- The radiator valves must be the butterfly type with a metal-metal seal. They must not have "O – rings" for closing.
- Oil-proof blind flanges, or their equivalent must be supplied separately, for use at each joint, when the radiator panels are removed.
- The Supplier shall provide a drawing with location and characteristics of the valves offered.
- For Edesur (Argentina). The upper valves must have intakes at the floor level . The valves will be meeting in a "valves box" located on the side of the oil conservator.

6.8.2 CURRENT TRANSFORMERS (CT's)

When applicable, the CT's bushing type must be included, which must comply with the requirements IEC.

The quantity, location, and type of each current transformer included for metering and protection are indicated in 11.3.

The Supplier shall supply the suitable current transformers to be used with the temperature measurement system and the voltage regulator to control the OLTC. The characteristics of these CT's

	GLOBAL STANDARD	Page 56 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

must be informed by the Supplier to the Distribution Company, for its knowledge. The secondary rated current shall be 5 [A] or 1 [A] to confirm.

All secondary CT's terminals must lead to outlet boxes located near the Bushings. These outlet boxes must be hermetic, with protection index IP 54, and be accessible from outside. From these boxes, the Supplier shall wire the CT's secondaries to the transformer's control cabinet.

All the cables ends will have safety terminals. The brand and model of the terminal blocks will be shall be of a well known quality and are subject to the Distribution Company approval.

The polarity of CT's must be subtractive. They must have a minimum thermal factor of 1.2.

The Supplier must provide protocols for the type and routine tests applied to CT's included in the transformer. They must also include the CT's excitation curves.

6.8.3 ANCHORING

For anchoring the transformer to its base, one of the two following alternatives must be considered, as indicated in the point 11. 2:

- a) Skid-type base for direct attachment to the foundation. Chilectra
- b) System with wheels and interlock-brake adequate (seismic forces). Ampla, Coelce, Codensa, Edenor and Edesur.

6.8.4 OIL PRESERVATION SYSTEM

The insulating oil preservation system must be by means of a storage tank. It must include a dehydrating respirator.

A membrane or bag system should be provided to prevent contact of the oil with environmental oxygen.

The storage tank must have an inspection hatch of at least 400 mm diameter, that allows verifying the operation of the level indicator system.


The transformer's storage tank system must have a protection with a double-float Buchholz relay, with two independent contacts for operation. This relay must be earthquake-proof; its installation must be accessible for adjustment and testing tasks; it must be protected so as to prevent its operation due to blows from tools or other external objects. It should be equipped with piping that allows taking gas samples from the relay to an operator standing on the base of the transformer. The relay must be installed with valves on both sides.

The storage tank must be removable and its location must not block the maintenance of other nearby accessories (for example, the OLTC).

For Brazil, oil preservation system must have an membrane/bag rupture relay.

6.8.5 No- Load TAP CHANGER (DETC).

In some cases the power transformer must be provided with a No-Load Tap Changer. This changer must also be installed in the transformer's high voltage winding. The information design shall be sent to distribution company to approval.

	GLOBAL STANDARD	Page 57 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

As part of the transformer, it must support all the electric and mechanical requirements applied to the latter. The DETC information design shall be sent to distribution company to approval.

It must be provided with an external mechanism for manual operation, to operate at a floor level, which must be simultaneous in the three phases, in the case of three-phase transformers.

It must be installed so that its inspection and maintenance may be realized through an adequately-sized hatch, without being necessary to intervene in the transformer's core or coils.

It must be provided with a visible position indicator that permits its safe inspection and operation for personnel.

It must have an interlocking and safety system that prevents the operation of the switch by external personnel.

The Supplier must include a warning sign that its operation must be without voltage.

6.8.6 PROTECTIONS

The transformer must include at least the following protections:

- An anti-seismic Buchholz relay for the transformer's tank oil preservation system. This relay shall be the double-float type, with three independent contacts, one for alarm due to incipient failure and two operation contacts for frank failure. Mercury contacts shall not be accepted.
- An internal overpressure valve of the transformer and a system for an adequate oil expulsion
- A protection relay for the OLTC.
- A pressure relief valve for the OLTC's tank.

These three last protection elements must have three independent contacts, one for alarm and two for operation.

6.8.7 INSTRUMENTS

The transformer must at least include the following instruments:

a) **Oil level indicators for the transformer and the OLTC**, magnetic type, with two independent NO/NC contacts, or with variable resistance. They shall be adjusted in the factory to operate with a minimum level, which must be expressly indicated by the Supplier. The scale of the level indicators must be graduated from "0" to "10" in a range of 240°, indicating minimum, maximum, and normal levels. The indicators must be installed in their respective storage tanks.



These level indicators must be installed at an inclination angle of 45° to facilitate their reading by an operator standing at the foot of the base.

b) **Temperature monitor.**

This instrument, with technology based on microprocessors, must register the instantaneous and maximum oil temperatures and incorporate a simulation circuit to indicate the instantaneous and maximum temperatures of the hottest spot in the transformer's winding (Thermal image).

It must have outlets for remote measurement of oil and windings temperatures. The transformer must include all temperature sensors.

The thermometers placed in the tank must have mechanical protection.

 	GLOBAL STANDARD	Page 58 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

Optionally, the use of optic sensors will be permitted for the direct measurement of the temperature, as an alternative to the traditional thermal image.

The temperature monitoring system shall be a equipment homologated by the distribution companies (Qualitrol, Tree Tech, SEL, Messko-MR ,etc).

A system should be provided that allows conveniently adjusting the elevation of the hottest spot of the winding above the upper oil, obtained from the heating tests of the transformer.

A display should be included with local information on the oil and windings and ambient temperatures.

It should have the capacity to store data, that allows recovering and reading in the visor the maximum values of oil and windings temperatures.

It should have a class of accuracy of 2%, and an adjustable time constant of between 1 and 10 minutes for the windings temperature.

The algorithm to calculate the hottest spot of the winding must be in accordance with the recommendations of the Standard IEC 60076-7.

The location of the monitor must be suitable so that an operator standing in front of the Control Cabinet can read it without difficulty through a window in the cabinet door.

If requested, it should be supplied with a variable resistance output to power the temperature monitor.

The Supplier must include in the process of the monitor, the software, communications cables, and other accessories.

c) Parallelism monitoring device.

This instrument, with microprocessor technology, must collect the respective information for the Companies, this equipment shall be quoted as optional.

6.8.8 SURGE ARRESTERS SUPPORT

If surge arresters (not include in supply) are installed above the transformer, the Supplier must supply removable supports, attached to the transformer tank, so that, when installed, they form a rigid assembly with the tank. These supports must be independent from the radiators.

The Distribution Company will indicate in the data sheet if require the surge arresters support.

The surge arresters shall be supplied by the Distribution Company, who shall inform their brand, type, and characteristics to the transformer Supplier.

This information must be used to realize the seismic analysis of the transformer, when applicable.

When applicable, the height of the supports must be adjusted so as the top end of each surge arresters is next to the associated bushing's terminal, thereby complying with the appropriate electric and safety distances



6.9 MARSHALLING BOX

In the Control Cabinet, the Supplier shall install the necessary equipment and devices for the feeding and control of the different elements indicated for each company.

The Control Cabinet must be suitable for outdoor use, with a degree of protection IP 54.

It shall be installed at an appropriate height above the base level for a standing operator.

Copyright 2013. All rights reserved.

 	GLOBAL STANDARD	Page 59 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

The control circuits and auxiliary equipment must be suitable to be fed from sources of direct or alternating current (DC or AC) provided by the Distribution Company.

Rated supply voltage for control U_a (Vdc)	Ampla, Coelce, Chilectra, Codensa, Edelnor	125
	Edesur	110
Rated supply voltage (Vac) Phase-Phase/ Phase-neutral	Coelce (60Hz) – Chilectra and Edesur (50Hz)	380/220
	Edelnor (60Hz)	220
	Ampla (60Hz)	220/127
	Codensa (60 Hz)	208/120

Both the control circuits, and the power and heating circuits must be protected by thermomagnetic circuit breakers, which, in turn, must have auxiliary alarm contacts.

All the various devices must be wired to terminal strips. When applicable, the Supplier shall realize the wiring in accordance with that indicated in drawings prepared by the Distribution Company.

Once adjudicated the transformer, the distribution company will send to the supplier the drawings and functional requirements of the control circuits. These requirements must be fully compliant in the design of the control circuits

The Control Cabinet must include a lid on the lower part, with bolts, gaskets, and packing nuts, for the inlet and outlet of control and power cables. The cable inlets and outlets may not be on the sides or top of the Control Cabinet.

All the devices must have easy access for their inspection and maintenance.

It must include a lock and a door stop in the open position.

The Control Box inside shall include an electric socket output (Vac).


It must have a shielded heater, controlled by thermostat, to prevent interior moisture condensation. It must also include ventilation louvers with a filter.

It must have interior lighting powered by a door switch.

A device must be provided that allows energizing the heater through the packing, during the equipment's storage period.

The Control Cabinet shall be painted at the same transformer color.

The control drawings will be delivered to the supplier adjudicated. The design of the control circuits shall comply to the information indicated in the control drawings.

	GLOBAL STANDARD	Page 60 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

All devices installed in the Control Cabinet must be conveniently identified by acrylic plates printed indelibly in accordance with the wiring plans. The Control Cabinet itself must also have an identification plate in Spanish or Portuguese, as applicable.

The Control Cabinet shall be installed with dampers or shock absorbers to prevent the transfer of the transformer's vibration to the control elements.

Control Cabinet's wiring and terminal block

The insulation of the control cable must be of nominal voltage 0.6/1 kV, as per IEC 60502.

The control cable used for the wiring of the Control Cabinet must have a 90°C class operating temperature. Also, the cable flexibility shall be class 5 as per IEC 60228.

If possible, the different circuits should be differentiated by colors.

The wiring cables of the Control Cabinet must be provided with conveniently identified clampable terminals. The terminals must be the pointed type, with insulating collar.

All the conductors must reach terminal strips or blocks and have indelible markings that indicate: Place of origin / destination. Only one conductor per terminal strip will be accepted.

The terminal blocks shall be the stackable type, suitable for their identification with correlative numbers.

The terminal blocks for current circuits must be sectionable and include bridges that allow short-circuiting them. They must also include type eye terminal.

The Supplier must provide at least 20% of extra terminal blocks, of each type, for the Distribution Company's use.

The channeling inside the cabinets must be implemented preferably using plastic conduit pipes. The conductors shall be grouped and attached with non-metallic fasteners, suitable for protecting its insulation and to support the weight of the cables.


All the external wiring to the control cabinet must be protected against mechanical damage by means of rigid or flexible metal pipes (not accept amendments on the wires). The Cable junction boxes easily accessible

6.10 PROTECTIVE PAINTING

Painting cycles for pollution level "High, Very high or Extra Very high", can be proposed by the transformer supplier and approved by Distribution Company.

The paint color is indicated in the Data sheet.

For Brazil, shall be required painting for "extra very heavy" pollution and the cover layer thickness shall be ≥ 100 [μm] and then the total thickness ≥ 240 [μm]

	GLOBAL STANDARD	Page 61 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

7 MAIN COMPONENTS

7.1 BUSHINGS GENERAL REQUIREMENTS

The Bushings to allow connecting to aerial conductors. The Bushings must comply with IEC – 60137.

The design of the Bushings must ensure that they can be assembled from outside of the transformer, without raising the tank cover.

The Bushings must be of adequate size so as to allow installing the current transformers in each one of them. The Supplier must present to the Distribution Company the design, to verify the space destined to the current transformers

The external terminals must be made of silver coated copper.

7.1.1 HV BUSHINGS

7.1.1.1 RATINGS

According to the transformer ratings. Data sheets

7.1.1.2 DESIGN REQUIREMENTS

Must be the capacitor type, hermetically sealed, and will have their own independent oil.

The connection from base to the terminal of the Bushings must be continuous. Joints will not be accepted.

They must have an oil level indicator. A person standing at floor level must be able to see the level of oil in the insulator easily.

The Bushings must be provided with a capacitor tap suitable for measurement purposes.

The bases of the bushings must have a plate identifying, indicating each one of the phases.

- Edesur and Edelnor: HV side: 1U-1V-1W-1N
- Ampla –Coelce: : HV side: H1-H2-H3
- Chilectra and Codensa: HV side: H1-H2-H3-N

7.1.1.3 OVERALL DIMENSIONS

The overall dimensions of the bushings shall be in compliance with the relevant standard, if any.

7.1.1.4 TESTS


For the definitions, the prescriptions and the tests procedure IEC 60137 applies, unless otherwise specified.

7.1.2 MV BUSHINGS

7.1.2.1 RATINGS

According to the transformer ratings.

7.1.2.2 DESIGN REQUIREMENTS

	GLOBAL STANDARD	Page 62 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

The Medium Voltage Bushings must be the solid type of one single piece of porcelain preferably brown in color or of polymeric material in a grey color.

The bases of the bushings must have a plate identifying, indicating each one of the phases.

- Edesur and Edelnor: MV side:1u-1v-1w-1n
- Ampla –Coelce- Chilectra and Codensa MV side: X1-X2-X3-X0

In case of Edesur, the transformer 80 MVA shall be required two(2) bushings per phase, to conform two(2) outputs MV three-phase (See 11. 5). The bushings will be adequate for power of 40MVA.

7.1.2.3 OVERALL DIMENSIONS

The overall dimensions of the bushings shall be in compliance with the relevant standard, if any.

7.1.2.4 TESTS

The tests, with regard to the definition, the prescriptions and the test procedure, shall be in compliance with IEC 60137, unless otherwise specified.

7.2 ON LOAD TAP CHANGER (OLTC)

The scope of the present chapter is to define the technical-functional parameters, the design requirements and the tests definitions of the on-load tap changers to be used for the voltage regulation.

7.2.1 RATINGS

Unless otherwise specified, IEC 60214-1 applies.

The on-load tap changer shall be vacuum type.

The on-load tap changers,with the change-over selector either fine-coarse type or reversing type.

7.2.2 DESIGN REQUIREMENTS

The OLTC (on-load tap changer) shall be vacuumm technoly


The OLTC (on-load tap changer) and its accessories must be the brand: Maschinenfabrik Reinhausen (MR) or ABB.

The automatic control equipment must be in accordance with the brand chosen for the OLTC. Other brands of automatic control equipment may possibly be accepted, but are subject to the Distribution Company's approval.

The OLTC and its automatic control equipment, must comply with the Standard IEC 60214-1: "On-load tap changers".

The OLTC's motorized mechanism shall be fed with alternating current (AC) from the Control Cabinet, and must have independent thermo-magnetic protection with auxiliary alarm contact.

Likewise, when requested, the Supplier must provide a device for parallel operation.

	GLOBAL STANDARD	Page 63 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

The OLTC must have a lever to operate it manually. When this lever is placed in its operating position there must be a contact that blocks its electrical operation (automatic and manual).

The OLTC must have a local mechanical position indicator which must be visible from the place of operation.

The OLTC must have a mechanical operations counter with at least six(06) digits.

The OLTC must have electric contacts with limit switch and suitable stops that prevent and block the operation beyond its extreme positions.

The OLTC's Control Cabinet must comply with the same construction requirements as the transformer's Control Cabinet.

The OLTC must be easy to maintain. It is not acceptable that other accessories have to be disassembled (for example, the oil storage tank), to be able to realize maintenance to the OLTC selectors.

The Supplier of the transformer must obtain, from the Supplier of the OLTC, the guarantee of good operation of the OLTC for a period equal to or longer than the transformer's guarantee and the detailed maintenance guidelines recommended for the equipment.

The Supplier must provide to the Distribution Company the study realized to adapt the design of the transformer, to the Type of OLTC chosen. In particular it must make known the position of the OLTC in the windings, its location in the center or at the end of the coils, and the use of polarization resistors or any other element of protection against surges, such as voltage arresters.

The Distribution Company may require a a current-compensated voltage regulator relay, for the automatic control of the OLTC. For remote indication of tap positions, the following must be supplied

- One binary-coded decimal (BCD) signal device.
- One potentiometric signal device.
- One 4 – 20 mA or +/- 10 mA signal device

7.2.2.1 PAINTING


SEE 6.12

7.2.2.2 MAINTENANCE

7.2.2.3 FUNCTIONAL REQUIREMENTS

7.2.3 TESTS

According to IEC 60214-1.

	GLOBAL STANDARD	Page 64 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

8. TESTS

Final reception acceptance tests.

The final reception tests at factory of each transformer shall consist in all routine tests

All the tests mentioned are mandatory, unless indicated otherwise and must be included in the price of the transformer.

Further, the Supplier shall quote the following type and special tests. These tests could be made, on each delivery to one unit of same type transformer (not prototype).

- Temperature-rise type test (IEC 60076-2).
- Measurement of zero-sequence impedance(s) on three-phase transformers.
- Measurement of degree of paper polymerization (IEC 60450)

Eventually, Distribution Company could to quote another special or type test.

The Distribution Company may request the verification of the instruments and other equipment that is used in the reception tests, in the presence of its agents. The Supplier must have the certificates of calibration of all the measurement instruments and present them to the inspector when requested.

The sequence of acceptance testing shall be approved previously by the distribution company. For this purpose, the tests schedule shall be sent by the supplier to the distribution company at least two month prior to the tests at the factory by approval

8.1 LIST AND CLASSIFICATION OF TESTS

8.1.1 ROUTINE TESTS

8.1.2 ADDITIONAL ROUTINE TESTS FOR TRANSFORMERS WITH $U_m \geq 72,5$ KV

8.1.3 TYPE TESTS



8.1.4 SPECIAL TESTS

8.1.5 GENERAL STATEMENTS FOR THE TESTS

8.1.5.1 SHORT CIRCUIT TEST CRITERIA

In Latam, also is possible to demonstrate the ability to short circuit according Annex A IEC 60076-5 (Theoretical evaluation).

Anyway if expressly required by distribution company may be requested, the performing or repetition of the short circuit test according to the contract conditions.

 	GLOBAL STANDARD	Page 65 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

9 SUPPLY REQUIREMENTS

9.1 TRANSPORT

Each transformer and its accessories shall be packed in proper conditions for overland and sea transport, specially preparing the packaging to prevent damage from shock, corrosion, moisture absorption, and theft.

The HV Bushings, radiators, and other dismountable elements must be packed separately from the main body of the transformer, and the contents of each package and its weight must be indicated in detail.

The packing of the delicate accessories must be specially prepared for transport and rough handling and must have clear indications in regard to the fragility of its content.

The marshalling box and other control box, will be mounted in the transformer

Once the transformer is disassembled, each one of the accessories must be identified with the transformer's series N°, for the purpose of facilitating the subsequent assembly work.

Each one of the packages must include facilities for lifting it by straps.

All of the packages must have the necessary identification details and clear and indelible markings for its transport and handling.

Each transformer must be dispatched for transport in vertical position, full of nitrogen gas at a pressure indicated by the Supplier at 25° C or with oil. The alternative (gas or oil) will be agreed between Distribution Company and Supplier. The Supplier must install in the transformers an automatic device that allows controlling and maintaining the gas pressure constant during transport.

It must also install an interconnection between the transformer tank and the OLTC tank, to keep the internal pressures equalized during transport.

All elements that may allow gas to escape must be blocked to prevent removals or deliberate openings. The packaging of the tank must have clearly indicated access to control the gas pressure at the port of arrival.

If in the arrival port or on the installation site, it is detected that the gas pressure is insufficient and moisture has entered the equipment, the Supplier must pay the costs involved in the drying process to which it must be submitted.

The transformer must be transported with a three-way impact recorder attached to the tank and adequately protected, which will subsequently be returned to the Supplier.

9.2 COMMISSIONING

The site tests on each transformer should be carried out, independently of the tests done in the factory, with the objective of demonstrating the compliance with the specifications once the transformer is fully assembled and prior to its energizing.



The Supplier should consider installation supervision of each supplied transformer.

9.3 DOCUMENTATION

The final information "as-built" in digital and paper files. Databook must be inside cabinet block in 03 copies

9.4 GUARANTY

Copyright 2013. All rights reserved.

 	GLOBAL STANDARD	Page 66 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014


9.4.1 DEFECTIVENESS

9.4.2 PROTECTIVE COATING

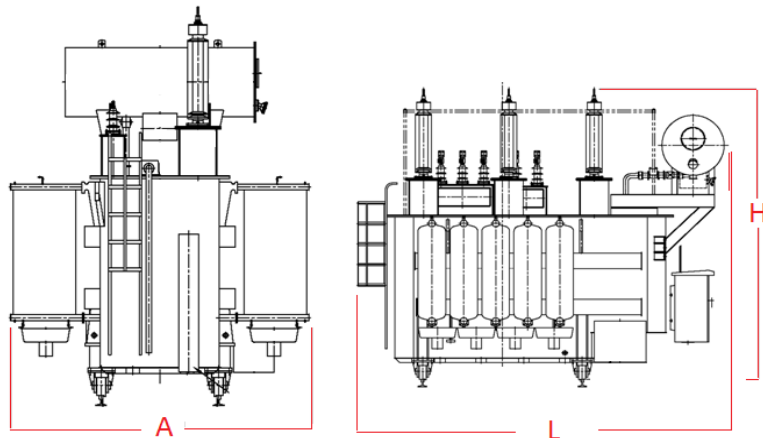
9.4.3 TRANSFORMERS IN OPERATION

10 EXCEPTIONS

11 FIGURES AND TABLES



	GLOBAL STANDARD	Page 67 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

11.1 OVERALL DIMENSIONS



(*) Only reference figure

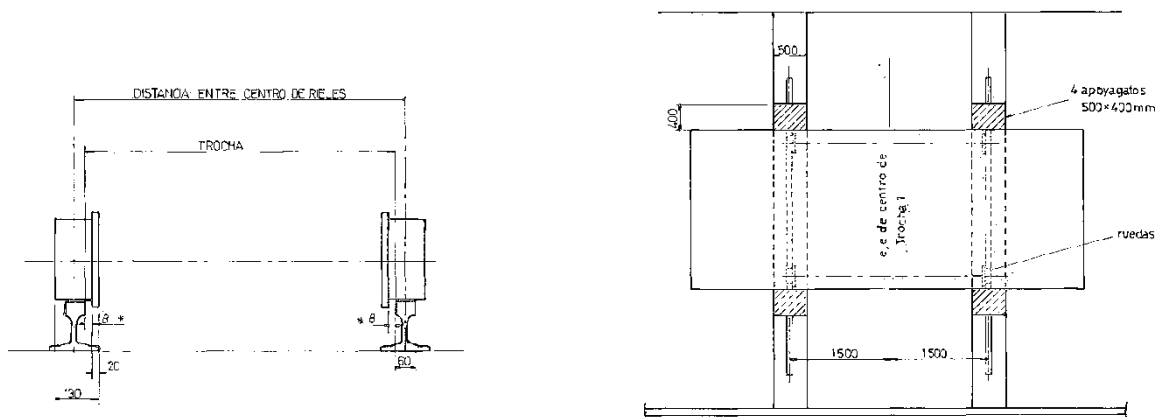
Company	HV- Power	Transformer Type : GST002 /...	L [mm]	A [mm]	H[mm]
Chilectra	110kV - 50 MVA	801-802-803-804-805-806-807	< 7100	<5200	<6000
	220kV- 133MVA	809-810	< 8000	<7000	<7000
	220kV- 50 MVA	807-808	< 7500	<5600	<7000
Coelce	7,5 – 15 -33,3 MVA	601-602-603	< 5500	<4800	<4900
Ampla	33,5 MVA	901	< 6250	< 4550	< 5445
	15 MVA	902	< 5700	< 3650	< 5250
	25 MVA	905	< 5350	< 3700	< 4730
	12,5 MVA	906	< 4130	< 3620	< 4310
	41,6 MVA	903	< 5950	< 4410	< 5810
	20 MVA	904	< 5650	< 4500	< 5350
	15 MVA	907	< 4380	< 3340	< 4300
	83 MVA	909	< 7085	<4850	<5960
Codensa	7,5 MVA	908	< 3350	< 2600	< 3390
	40 MVA	701-702	< 6395	< 3894	< 6105
	56 MVA	703	<10614	< 6732	< 10614
	40 MVA	704	< 10514	< 6682	< 9983
	500 kV 150 MVA	705	< 7460	< 7800	< 10975
	230 kV 100 MVA	706	< 7483	< 6157	< 8492
Edelnor	230 kV 56 MVA	707	< 6896	< 5666	< 8112
	200kV - 180 MVA	501	< 7700	< 6700	< 7000
	200/√3kV- 60 MVA	502	< 5490	< 4300	< 7400
	58kV - 40 MVA	503-507	< 4600	< 4000	< 4500
	25 MVA	504-505-506	< 4900	< 4000	< 4500

 	<p style="text-align: center;">GLOBAL STANDARD</p> <hr/> <p style="text-align: center;">POWER TRANSFORMERS</p> <p style="text-align: center;">LOCAL SECTION LATAM</p>	<p>Page 69 of 182</p> <hr/> <p style="text-align: center;">GST002 Rev. 01 15/01/2014</p>
---	---	---

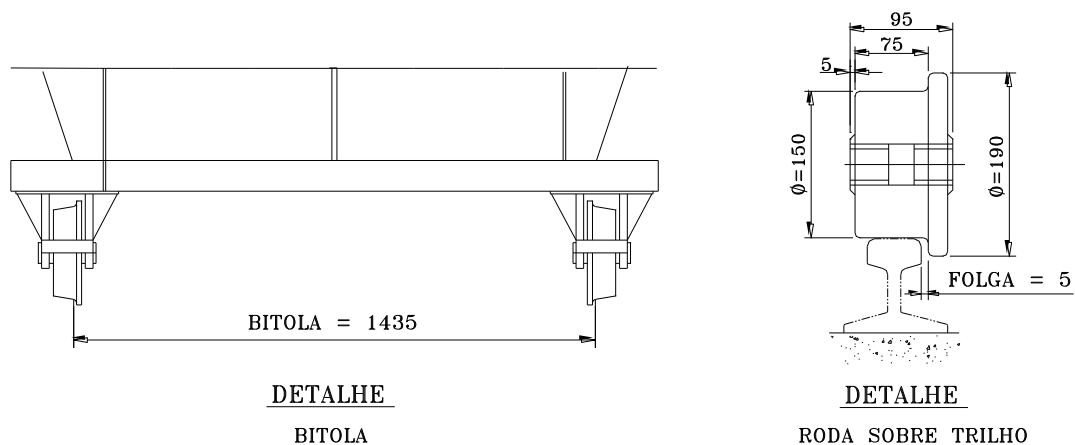
d) Edesur : Wheel with brake



Distance between wheels: 3.000 mm in parallel axis
1.736 mm on the same axis

Track Gauge: 2.490 mm in parallel axis
1.676 mm on the same axis





e) Ampla & Coelce: Wheel with brake




 	GLOBAL STANDARD		Page 70 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM		GST002 Rev. 01 15/01/2014

11.3 CURRENT TRANSFORMERS IN BUSHINGS.

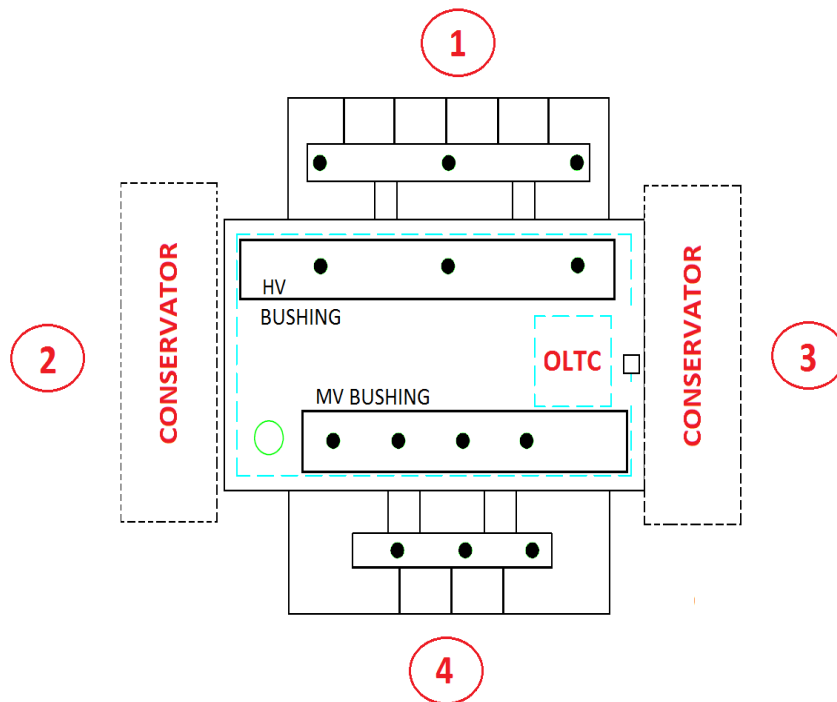
Company	GST Type	Relation	Quanty	Location	Class	Aplication
Ampla	901-2-3-4-8-9	1600/800/400 – 5	3	HV	50VA, 10P20	Protective
	905-6-7	1400/700/350-5				
	901	2400/1200/600-5	3	MV		
	902-6-8-9	1400/700/350-5				
	903-4-7	1600/800/400-5				
	905	1800/900/450-5	3	MV2		
	909	1600/800/400-5				
	901	2400/1200/600-5	1	Neutral		
	902-6-8	1400/700/350-5				
	903-4-7-9	1600/800/400-5				
905	1800/900/450-5					
909	1600/800/400-5	1	Neutral 2			
Chilectra	801-2-4-5	600/400/200 – 5	3	HV	30VA - 5P20	Protective
		3000/2000/1000 - 5	3	MV	45VA - 0,2FS5	Metering
		1200/1000/800 - 5	1	Neutral	30VA - 5P20	Protective
	803-6	600/400/200 – 5	3	HV	30VA - 5P20	Protective
		1600/1400/1200 - 5	3	MV	45VA - 0,2FS5	Metering
		1200/1000/800 - 5	1	Neutral	30VA - 5P20	Protective
	807-808	300/200/100 – 5	3	HV	30VA - 5P20	Protective
		1600/1400/1200 - 5	3	MV	45VA - 0,2FS5	Metering
		1200/1000/800 - 5	1	Neutral	30VA - 5P20	Protective
	809	1600/1200/1000 - 1	2	HV	30 VA 5P20	Protective
			2	HV	45VA - 0,2FS5	Metering
		3000/2500/2000/1500- 1	2	MV	30 VA 5P20	Protective
			1	MV	45VA - 0,2FS5	Metering
	810	1600/1200/1000 – 1	2	HV	30 VA 5P20	Protective
			2	HV	45VA - 0,2FS5	Metering
		3000/2500/2000/1500- 1	2	MV	30 VA 5P20	Protective
			1	MV	45VA - 0,2FS5	Metering
Coelce		601	800/600/400/200-5	3	HV	100VA, 10P20
	3			MV		
	1			MV-Neutral		
	602	1200/800/600/400-5	3	HV		
			3	MV		
			1	MV-Neutral		
	603	2000/1600/1200/800-5	3	HV		
			3	MV		
1			MV-Neutral			
Edesur	401	200-1	9	HV	20VA 5P40	Protective
			3		10 VA, 0,5 FS 5	Metering
	402	400-1	9	HV	20VA 5P40	Protective
			3		10 VA, 0,5 FS 5	Metering
Codensa	705	600/1	1	HV	5 VA - 5P20	Protective
		600/1	1	HV	10 VA - 0,2S	Metering
		2500/1	1	MV	5 VA - 5P20	Protective
		600/1	2	MV2	5 VA - 5P30	Protective
		600/1	1	Neutral	5 VA - 5P30	Protective
	706	1000/1	1	HV	20 VA - 5P20	Protective
		1000/1	1	HV	10 VA - 0,2S	Metering
		In= 1920 RCT= 1600/1	2	MV	20 VA - 5P20	Protective
		1200/1	2	MV2	20 VA - 5P20	Protective
		1000/1	1	Neutral	20 VA - 5P20	Protective

 	GLOBAL STANDARD	Page 71 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

	707	800/1	2	HV	20 VA - 5P20	Protective
		800/1	1	HV	10 VA - 0,2S	Metering
		1200/1	2	MV	20 VA - 5P20	Protective
		1200/1	2	MV2	20 VA - 5P20	Protective
		800/1	1	Neutral	20 VA - 5P20	Protective
Edelnor		Not applie	-			


	GLOBAL STANDARD	Page 72 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

11.4 PRINCIPAL ACCESSORIES LOCATION



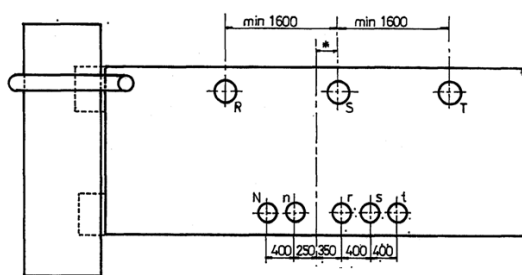
The next **Table** show the principal accessories mandatory location according to the zone or side indicated in the figure previous

	Ampla	Coelce	Codensa	Chilectra	Edelnor	Edesur
Oil Conservator	-	-	Side 2	Side 3	-	Side 2
OLTC	-				-	Side 2
OLTC cabinet	-	-	Side 2	-	-	-
Radiators	-	-	-	Just Side 1	-	-
Control Boxes	-	-	Side 2	Side 4	-	-

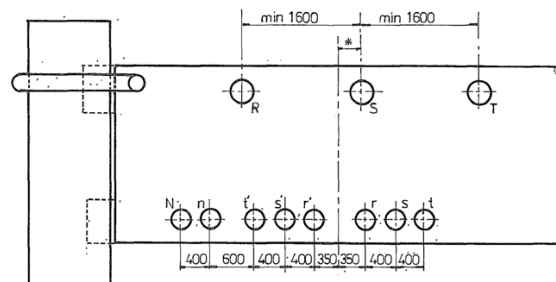
	GLOBAL STANDARD	Page 73 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

11.5 BUSHINGS



a) Edesur. Bushings HV/MV - Double output MV



Transformador de 40 MVA



Transformador de 80 MVA

 	GLOBAL STANDARD	Page 74 of 182
	POWER TRANSFORMERS LOCAL SECTION LATAM	GST002 Rev. 01 15/01/2014

ANNEX B - DATA SHEET FORM

See file attached