COMPOSITE INSULATORS FOR MEDIUM VOLTAGE LINES

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00	17/11/2017	First emission.
01	21/02/2018	Editorial corrections. Missed codes.
02	23/04/2019	New codes Brazil and Colombia. EDSP convergence. Recodification Chile and Perú. Tracking Perú. Creepage distance reference. Check lists.

INDEX

1 SCOPE

The aim of this document is to provide technical requirements for the supply of MV composite insulators to be used in the MV lines of the distribution networks of Enel Group Distribution Companies, listed below:

- Enel Distribución Colombia — Colombia
- Enel Distribución Peru — Perú
- Edesur — Argentina
- E-distributie Banat — Romania
- E-distributie Dobrogea — Romania
- E-distributie Muntenia — Romania
- E-distribuzione — Italy
- Endesa Distribución Eléctrica — Spain
- Enel Distribución Chile — Chile
- Enel Distribuição Ceará — Brazil
- Enel Distribuição Rio — Brazil
- Enel Distribuição Goiás — Brazil
- Enel Distribuição São Paulo — Brazil

This document specifies the characteristics and tests that must be accomplished by the composite insulators used in the medium voltage distribution network.
Additional prescriptions or integration of the main common part are reported in Local Sections with the same corresponding clause or sub-clause number.
The local standards replaced by this standard appear in the local section.

2 REFERENCE LAWS AND STANDARDS

The list of reference laws and standards are mentioned below in this document.

2.1 Laws

Brazil

- NR-10 - Segurança em Instalações e Serviços em Eletricidade

Chile

- NSEG5. E.n.71 Reglamento de Instalaciones Eléctricas de Corrientes Fuertes.

Colombia

- RETIE, Reglamento Técnico de Instalaciones Eléctricas.

Peru

- Código Nacional de Electricidad – Suministro 2011.

Romania

- NTE 001/03/00 – Normativ privind alegerea izolației, coordonarea izolației și protecția instalațiilor electroenergetice împotriva supratensiunilor
- NTE 003/04/00 – Normativ pentru construcția liniilor electrice aeriene de energie electrică cu tensiuni peste 1000 V

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.
- R.D. 223/2008, de 15 de febrero, por el que se aprueban el Reglamento sobre condiciones técnicas y garantías de seguridad en líneas eléctricas de alta tensión y sus instrucciones técnicas complementarias ITC-LAT 01 a 09.

2.2 Standards

The following standards are needful for the application of this Global Standard.

- CIGRE 33-204. Considerations on the design of composite suspension insulators based on experience from natural ageing testing and electric field calculations.
- IEC 60071-1. Insulation co-ordination - Part 1: Definitions, principles and rules.
- IEC 60071-2. Insulation co-ordination - Part 2: Application guide.
- IEC 60383-1. Insulators for overhead lines with a nominal voltage above 1000 V - Part 1: Ceramic or glass insulator units for a.c. systems - Definitions, test methods and acceptance criteria. (Zinc Coating Test).
- IEC 60383-2. Insulators for overhead lines with a nominal voltage above 1000 V - Part 2: Insulator strings and insulator sets for a.c. systems – Def, test methods and acceptance criteria.
- IEC 60587. Electrical insulating materials used under severe ambient conditions - Test methods for evaluating resistance to tracking and erosion.
- IEC 60695-11-10. Fire hazard testing - Part 11-10: Test flames - 50 W horizontal and vertical flame test methods.
- IEC 60815-1. Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 1: Definitions, information and general principles.
- IEC 60815-3. Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Part 3: Polymer insulators for a.c. systems.

- IEC 61109. Insulators for overhead lines - Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria.
- IEC 61621. Dry, solid insulating materials - Resistance test to high-voltage, low-current arc discharges.
- IEC 61466 -1. Composite string insulator units for overhead lines with a nominal voltage greater than 1000 V - Part 1: Standard strength classes and end fittings.
- IEC 61466 -2. Composite string insulator units for overhead lines with a nominal voltage greater than 1000 V - Part 2: Dimensional and electrical characteristics.
- IEC 61952. Insulators for overhead lines - Composite line post insulators for A.C. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria
- IEC 62631. Dielectric and resistive properties of solid insulating materials.
- IEC TS 62073. Technical Specification: Guidance on the measurement of wettability of insulator surfaces.
- IEC 62217. Polymeric HV insulators for indoor and outdoor use - General definitions, test methods and acceptance criteria.
- ISO 1461. Hot dip galvanized coatings on fabricated iron and steel articles -- Specifications and test methods.
- ISO 34-1. Rubber, vulcanized or thermoplastic -- Determination of tear strength -- Part 1: Trouser, angle and crescent test pieces.
- ISO 37. Rubber, vulcanised or thermoplastic. Determination of tensile stress-strain properties
- ISO 868. Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)
- ISO 1183-1. Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pyknometer method and titration method
- IEC/TR 62662 Guidance for production, testing and diagnostics of polymer insulators with respect to brittle fracture of core materials (and its Spanish transposition to UNE-CLC/TR62662 IN)

2.3 Local standards

See local section

3 SERVICE CONDITIONS

The service conditions to be considered for the material included in this standard are:

- Maximum Ambient Air Temperature: + 50 ºC.
- Minimum Ambient Air Temperature: - 40 ºC.
- Maximum relative humidity: 95%. For higher values see IEC 60071-1 and IEC 60071-2.
- Maximum altitude above mean sea level: 1.000 m (*). For higher values see IEC 60071-1 and IEC 60071-2

- Maximum solar radiation: 1.000 W/m^2

Note: Insulation capacity depends on these service conditions, it can be considered the selection of a Um value equal to or higher than the expected level for the nominal voltage when the equipment has to be installed at an altitude higher than 1.000 m in order to compensate the decrease of withstand voltage of the external insulation.

3.1 Specific service conditions for Colombia

The reference altitude is 2.700 m.

4 DEFINITIONS

4.1 Insulator

Device designed to support and insulate a conductive element.

4.2 Composite insulator

Insulator made of at least two insulating parts, namely a core and a housing equipped with end fittings.
Composite insulators, for example, can consist either of individual sheds mounted on the core, with or without an intermediate sheath, or alternatively, of a housing directly moulded or cast in one or several pieces onto the core.

4.3 String insulator unit

Insulator of which the end fittings are suitable for flexible attachment to other similar string insulator units or to connecting accessories.

4.4 Line post insulator

Rigid insulator intended to be subjected to cantilever, tensile and compressive loads, constructed with one or more insulating materials and assembled on a metal base that is intended to be mounted rigidly on a supporting structure.

4.5 Creepage distance

Shortest distance through the insulator surface between conductive parts of both sides of the insulator which support the service voltage.

4.6 Arcing distance

Shortest distance in the air between conductive parts of both sides of the insulator which support the service voltage.

5 TECHNICAL REQUIREMENTS

5.1 Mechanical Load

5.1.1 String insulators: Specific Mechanical Load (SML)

Three levels of specific mechanical load are specified:

Specific Mechanical Load, SML (kN)		
44,5	70	100

Table 1

5.1.2 Line Post insulator

Four levels of specific cantilever load are specified:

Cantilever Load, SCL (kN)			
6	10	12,5	13

Table 2

5.2 Electrical requirements

5.2.1 Standardized insulation levels

The standardized insulation levels are specified according to IEC 60071-1:

Material maximum voltage, U_m (kV)	Power frequency withstand voltage (kV)	Lighting impulse withstand voltage (kV)
24	50	125
36	70	170

Table 3

For countries of South America, it could be used higher electrical requirements due to their specific conditions (see Annex A):

Material maximum voltage (U_m)	Power frequency withstand voltage	Lighting impulse withstand voltage
kV	kV	kV
24	100	190
36	130-145	250-280

Table 4

5.2.2 Creepage distance and arcing distance

The minimum creepage distance of an insulator depends on its maximum material voltage and the pollution level. Standard IEC 60071-2 refers to IEC 60815 series to get a value for this minimum creepage distance.

On the other hand, the minimum arcing distance is related to the lighting impulse withstand voltage.
Standard IEC 61466-2 shows a table relating the insulation level and the minimum arcing distance for standardized composite string insulators:

Material maximum voltage U_m (kV)	Lighting impulse withstand voltage (kV)	Minimum arcing distance (mm)
24	*125*	*210*
	145	*240*
36	*170*	*285*

Table 5

As a rule, the application of IEC 60071 (parts I and II) based upon the real voltage and the real service conditions will give the definition of the needed insulator.

5.3 Other dimensions

5.3.1 Total length

The total length is defined considering the minimum distance phase-ground from the supports.

5.3.1.1 *Line post insulators*

The minimum total length phase-ground shall be higher than 300 mm.

5.3.2 String insulators: Maximum diameter

According to IEC 61466, the maximum diameter from the isolating zone of the string insulators is 200 mm.

5.4 Special characteristics for covered conductors

The line post insulators to be used in the covered conductor distribution networks shall accomplish specific dimensions in order to fit to the actual structures. For this reason it shall be accepted in some countries line post insulators designed for 15 kV as maximum material voltage and with length less than 300mm. See annex 13.2.

6 DESIGNATION

6.1 String insulators

The string insulators are designated as follows (see IEC 61466-1 and 2):

- Letters CS
- Specific Mechanic Load in kN
- Two letters representing both end fittings, first one for the insulator upper side.
- Two numbers separated by a slash, the first one represents the lighting impulse withstand voltage in kV and the second one the minimum creepage distance in mm
- A dash followed by the total length in mm (this last information doesn't appear in the IEC 61466)

6.2 Line post insulators

Line post insulators are designated as follows:

- Letters CLP
- Specific Cantilever Load in kN followed by dash.
- Two numbers separated by a slash, the first one represents the lighting impulse withstand voltage in kV and the second one the minimum creepage distance in mm

6.3 Designation Example

CS 70 EB 125/600-455

Composite string insulator, Specific mechanic load equal to 70 kN, with an eye for the support-side and a ball for the conductor side, lighting impulse withstand voltage equal to125 kV and minimum creepage distance of 600 mm. Total length equal to 455 mm.

7 CONSTRUCTION CHARACTERISTICS

7.1 Construction

There are three important parts in an insulator:

- Dielectric Insulator Core
- Hydrophobic insulation housing
- Fittings

The insulator shall be designed and assembled to ensure that no moisture, water or external substances reach the core.

7.1.1 Dielectric Insulator Core

It transmits the mechanical stresses produced by conductors to the support and provides the necessary electrical insulation.

7.1.1.1 *Material*

Epoxy resin resistant to hydrolisys reinforced with glass fiber resistant to corrosion in order to prevent the risk of brittle fractures.

7.1.2 Hydrophobic insulation housing

The hydrophobic insulation housing (sheath and sheds) protects the core from external agents providing sealing and preventing the formation of a continuous film of water. The hydrophobic insulation housing minimum thickness is 3mm. The housing provides the necessary creepage distance in order to get the required insulation of the core surface.

In order to facilitate the integration with the environment the colour of the silicone-rubber shall be gray. Other different colour shall be approved by Enel.

7.1.2.1 *Material*

Sheath and sheds shall be silicone-rubber (VMQ - Vinyl-Methyl-Polysiloxane, with filler additives) free of EPDM or other organic rubbers.

7.1.2.1.1 Silicone rubbers

Silicone-rubbers recommended in this standard are:

- **HTV (High Temperature Vulcanized – solid silicone rubber):** This type of silicone rubber is solid and vulcanizes at a high temperature (near 200ºC).
- **LSR (Liquid Silicone Rubber):** Two components of liquid silicone rubber are mixed to vulcanize at a temperature between 100 and 200ºC.

Two fabrication processes are allowed for both silicone rubbers considered in the standard, molding process or by assembling modules.

The characteristics of the silicone rubbers are described in the table below:

Mechanic characteristics	Standard		Minimum value HTV	Minimum value LSR
Density	ISO 1183-1	g/cm³	1,1	0,9
Hardness	ISO 868	Shore A	60	40
Breaking stress	ISO 37	N/mm²	3,5	4,5
Breaking elongations	ISO 37	%	200	350
Tear strength	ISO 34-1	N/mm²	12	17

Table 6

At every existing interface from the composite insulator, the adhesion strength of the interface (interface resistance) shall be higher than the tear strength of the silicone.

Silicone-rubbers of insulators shall have a resistance to tracking and electric erosion with a classification of Class 1A 4,5 according to IEC 60587 and shall resist the effects of corona discharges and ozone (except for Peru, where it shall be considered a resistance to tracking and electric erosion class 2A 6). It shall withstand a low-current arc discharge for more than 300 seconds under the conditions indicated in standard IEC 61621 and its volume resistivity shall be over 10^{10} Ω·m according to IEC 62631.

The silicone-rubber must be type V0 according to the IEC 60695-11-10.

Additionally the silicone rubber shall have highly hydrophobic features and shall be classified type WC1 as specified in IEC TS 62073.

7.1.3 Fittings

The fittings transmit the mechanical stress from the ends of the core to the support and to the conductor.

There is a triple junction point located where the core meets the metal coupling and the silicone-rubber coating ends (connection zone). Usually, the electrical field strength is concentrated in this point, so the fabrication process shall be careful in this point. The connection zone must be water and air sealed to ensure the total enclosure of the insulator.

The end fittings shall be directly attached to the core by radial or circumferential compression process for a better load distribution.

7.1.3.1 *Material*

Hot dip galvanized forged steel:
High pollution:

- Minimum for individual sample: 500g/m², equivalent to 70μm

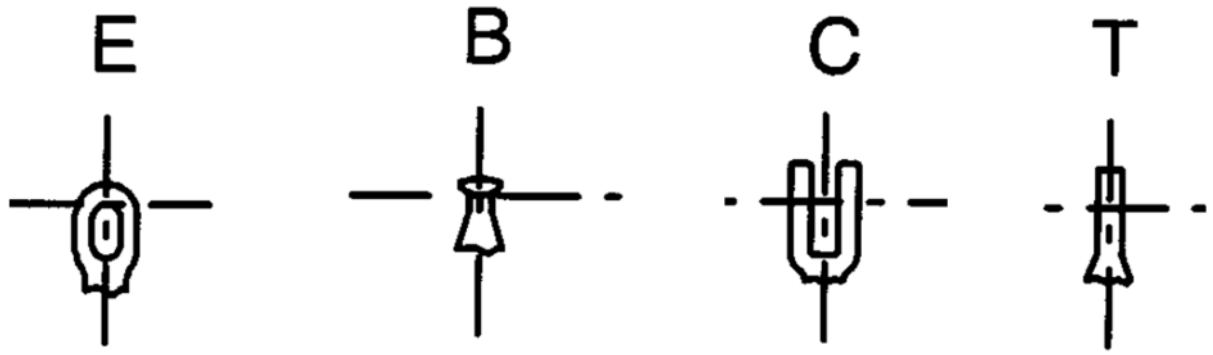
- Minimum for the average of the whole sample: 600 g/m², equivalent to 85μm

Very high pollution:

- Minimum for individual sample: 720g/m², equivalent to 100μm
- Minimum for the average of the whole sample: 865 g/m², equivalent to 120μm

7.1.3.2 *Type of end fitting for string insulators*

Standard IEC 61466 presents different types of end fittings. The ones selected for this standard are:



E: eye B: ball C: clevis eye T: tongue

Image 1

The end fittings must be only assembled by the insulator manufacturer, during the manufacturing process.

7.1.3.3 *Type of end fitting for line post insulators*

See local section for details.

7.2 Quality issues

The technical conformity of a particular design of composite insulator strings shall be determined by accomplishing design tests, type tests, sample tests and routine test related in this document, but, additionally, it is recommended that manufacturers take into account the conclusions given in the document CIGRÉ 33-204. This document include some recommendations related to parting lines when removing the insulator from the mould, distance between last shed and end fitting or the connection zone between core, end fitting and housing.

On the other hand, IEC TS 60815-3 contains gives specific guidelines and principles of the behaviour of an insulator in certain pollution environment. This guideline would be recommended in this type of situations.

Finally, IEC/TR 62662 is a technical report which gives guidance for production, testing and diagnostics of polymer insulators with respect to brittle fracture of core materials.

8 MARKING

Each insulator shall be clearly and indelibly marked as specified in IEC 62217, indicating:

- The name or trademark of the manufacturer.
- The year of manufacture.
- The specified mechanical load (SML) / Maximum Design Cantilever Load (MDCL) – kN.
- Manufacturer reference for the insulator.
- Material maximum voltage

9 TESTING

The composite insulators must be according the standards IEC 62217 (for all types of polymeric insulators), IEC 61109 (only for string composite insulators) and IEC 61952 (only for line post composite insulators).

Tests are divided into four groups:

- Design tests
- Type tests
- Sample tests
- Routine tests

Design and Type tests are performed once, during the TCA process. Sample and Routine tests shall be carried out on every singular purchased lot, as an acceptance tests.

9.1.1 Design Tests

These tests are intended to verify the suitability of the designs, materials and methods of manufacture (technology).

When happens any change in the design, these test must be repeated. IEC 62217 gives the general recommendation for the criteria and IEC 61109 and 61952 the concrete rules.

The design of a composite insulator is defined by:

- Core and housing materials and their manufacturing method.
- When needed, end fitting material, design and method of attachment (excluding the other fittings of the string).
- Thickness of the core housing.

- Core diameter.

Tests			Generic	String insulators	Line post insulators
Tests on interfaces and connections of end fittings	Pre-stressing		IEC 62217, 9.2.5	Consult particularities in IEC 61109	Consult particularities in IEC 61952
	Water immersion pre-estressing		IEC 62217, 9.2.6		
	Verification tests	Visual test	IEC 62217, 9.2.7		
		Steep front impulse voltage test	IEC 62217, 9.2.7		
		Dry power frequency voltage test	IEC 62217, 9.2.7		
Tests on sheds and housing material	Hardness test		IEC 62217, 9.3.1		
	Accelerated weathering test		IEC 62217, 9.3.2		
	Tracking and erosion test		IEC 62217, 9.3.3		
	Flammability test		IEC 62217, 9.3.4		
Tests on the core material	Porosity test (dye penetration test)		IEC 62217, 9.4.1		
	Water diffusion test		IEC 62217, 9.4.2		
Assembled core load-time test	Determination of the average failing load of the core of the assembled insulator				
	Control of the slope of the strength-time curve of the insulator				

Table 7

Additional tests on the housing material in order to obtain certain mechanical and electrical properties:

	Test	Standard
Mechanical characteristics	Density	ISO 1183-1
	Hardness	ISO 868
	Breaking stress	ISO 37
	Breaking elongation	ISO 37
	Tear strength	ISO 34-1
Electrical characteristics	Tracking and erosion	IEC 60587
	Low current arc discharge	IEC 61621
Fire properties	Test flame	IEC 60695-11-10

Table 8

9.1.1.1 *Test on resistance of core against stress corrosion*

This test will be performed at ambient temperature to confirm the mechanical resistance against corrosion stress of the core. It is done according to the indications of the IEC Project 36-6-2 of WG 36-07 through the Spanish transposition of the IEC/TR 62662 (UNE-CLC/TR62662 IN).

Test specimen

It will be used an insulator from the production line or a specimen with length between end fittings of at least 10 times the core diameter. The end fittings shall be identical to those used in the production.

The test is executed in the bare part of the rod, so the housing must be removed in the middle part of the insulator in a minimum length of 150 mm. The visible core surface has to be smoothed by means of a fine abrasive cloth (grain size 180). Remaining parts of the housing have to be completely removed. An acid container made of polyethylene shall be arranged surrounding the visible core surface in such a way that the liquid can simply be poured into the container and no acid comes into contact with the end fittings. The size of the acid container shall be adapted in such a way that the core is surrounded by a liquid thickness not less than 1 cm and a liquid level of not less than 4 cm. The container shall be covered to prevent liquid evaporations greater than 5% of its volume during the test period.

Performance of the test

The insulator must be subjected to a tensile load applied between the metal parts along the test. The tensile load must be increased rapidly but regular, from zero up to 70% of the specified mechanical load (SML) and then must be maintained at this value for 96 h. Immediately after applying the load, a nitric acid of 1N concentration must be poured into the acid container (i.e. 1 N = 63,01 g HNO_3 per litre of solution). The acid must not come into contact with the end fittings.

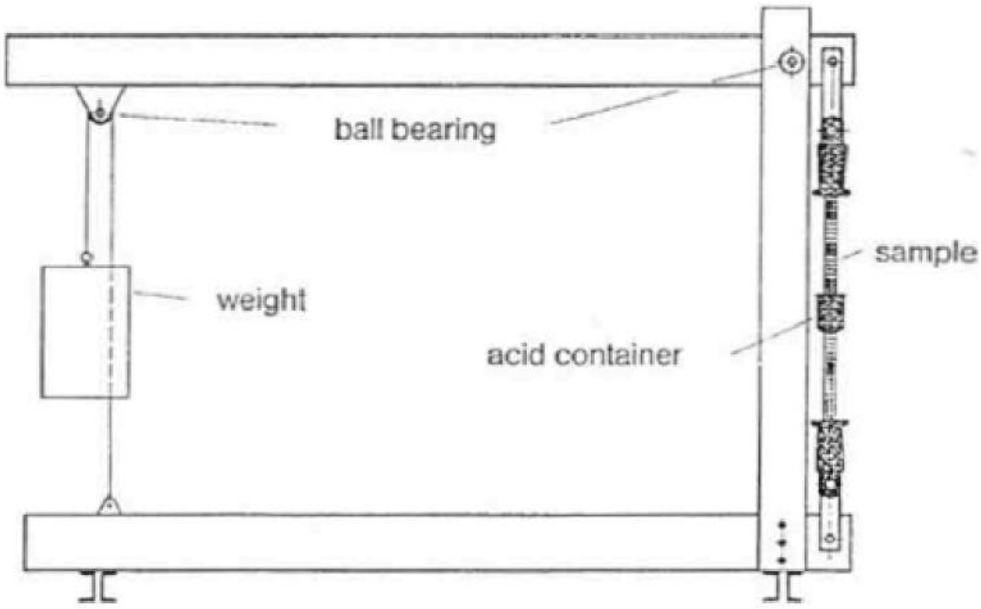


Image 2

Test evaluation

The test is passed if no fracture of the core occurs during the 96 h. test (no failures occur, and macroscopic inspection reveals no damage or change in the composite after the exposure).

9.1.2 Type tests

An insulator is defined electrically by the arcing length, creepage distance and the housing profile (inclination, diameter and spacing of sheds). On the other hand, the main mechanical characteristic is the SML o SCL for a specific insulator (depending on core diameter, method of attachment and coupling design).

Type tests shall be applied to polymeric insulators belonging to an already qualified design class. The type tests shall be repeated only when the type of the polymeric insulator is changed. The parameters defining a type of polymeric insulator and the applicable type tests are given in the relevant product standard.

According to specific standards IEC 61109 and 61952, type tests are:

Tests string insulator		Standard
Mechanical characteristics	Damage limit proof test and test of the tightness of the interface between end fittings and insulator housing	IEC 61109 11.2
Electrical characteristics	Dry lighting impulse withstand voltage test	IEC 61109 11.1
	Wet power frequency test	IEC 61109 11.1

Table 9

Test line post insulator		Standard
Mechanical characteristics	Cantilever failing load test	IEC 61952 11.2
Electrical characteristics	Dry lighting impulse withstand voltage test	IEC 61952 11.1
	Wet power frequency test	IEC 61952 11.1

Table 10

9.1.3 Sample tests

Sample tests are intended to verify other characteristics of a composite insulator, including those which depend on the quality of the manufacturing process and the materials used. Sample test must be done as a part of the acceptance tests.

The tests will be done to sample groups E1 and E2. The material will be selected at random.

	Sample size	
N (lot size)	E1	E2
N≤300	3	2
300<N≤2000	4	3
2000<N≤5000	8	4
5000<N≤10000	12	6

Table 11

For lot sizes bigger than 10.000 insulators, the lot will be divided into an optimum number of lots comprising between 2.000 and 10.000 insulators. The results of the tests shall be evaluated separately for each lot.

Test String insulators	Sample	Standard
Verification of dimensions	E1+E2	IEC 61109, 12.2
Verification of the end fittings	E2	IEC 61109, 12.3
Verifications of tightness of the interface between end fittings and insulator housing	E2	IEC 61109, 12.4
Verifications of the specified mechanical load, SML	E1	IEC 61109, 12.4
Galvanizing test	E2	IEC 61109, 12.5

Table 12

Test Line post insulators	Sample	Standard
Verification of dimensions	E1+E2	IEC 61952, 12.2
Galvanizing test	E1+E2	IEC 61952, 12.3
Verifications of cantilever load test	E1	IEC 61952, 12.4

Table 13

9.1.4 Routine tests

The aim of these tests is to eliminate composite insulators with manufacturing defects. They shall be made on every composite insulator offered for acceptance.

Test string insulators	Standard
Mechanical routine test	IEC 61109, 13.1
Visual examination	IEC 61109, 13.2

Table 14

Test line post insulators	Standard
Tensile load test	IEC 61952, 13.1
Visual examination	IEC 61952, 13.2

Table 15

10 TECHNICAL CONFORMITY ASSESSMENT

Technical Conformity is issued by Enel Group and must be supported by accomplishing all of the Design, Type and Sample tests on every type of insulator to be accredited. Design and Type tests are performed once, during the TCA process.

10.1 Local Certifications

For Colombia, RETIE certification shall be also provided according to local regulation (see 2.1).

11 GUARANTEE

Requirement of warranty will be indicated in the request for bids, indicating periods and standards.

12 CONDITIONS OF SUPPLY

Manufacturers of insulators shall provide appropriate instructions, documents showing sample and routine tests and information covering general conditions during transport, storage and installation of the insulators. These instructions must include recommendations for handling, cleaning or maintenance. The documents must be in the local language of the destiny country.

The line post insulators will be supplied with all the necessary elements for its correct fixation to the pole (flat washer, optional flat square washer, spring washer, nut and optional lock nut, as described on local sections).

Insulators of the same batch must be packed in wood crates or hard cardboard boxes. Every box shall be marked with a code selected by the manufacturer for the purpose of identifying the fabrication lot, the type of insulator (insulators marking, as described in this document) and the quantity. These marks must be indelible and resistant to weathering under severe weather conditions during transport and storage.

They shall be securely packaged to prevent insulators to touch each other and to avoid any damage to sheds during storing, loading and transportation. Specific supports shall be needed to immobilize the insulators.

The insulators shall be packed in lots of 3, and each box shall contain a maximum of 60 insulators. They all shall be of the same type.

The consistency of the boxes shall permit a three-ply storage/transportation and they shall be prepared for handling by forklift trucks and by boom cranes. They also must be treated to prevent degradation over time.

Package dimension shall be in compliance with the standard EN 13698-1 for loading palettes 80x120 cm.

13 ANNEX A- LIST OF COMPONENTS

13.1 List of components, String insulators

Material maximum voltage	Pollution Level	Global code	Designation	Argentine	Brazil	Chile	Colombia	Italy	Perú	Romania	Spain
$U_m \leq 24$ kV	Strong	GSCC010/01	CS 45 CE 190/560-430		6772263 321293	300130	T300024				
		GSCC010/02	CS 70 EB 125/600-455								300092
		GSCC010/03	CS 70 TT 125/570-455					301873		301873	
	Very strong	GSCC010/04	CS 45 CE 190/744-430						300517		
		GSCC010/05	CS 70 EB 125/835-400								530699
		GSCC010/06	CS 100 EB 125/835-455								300031
		GSCC010/07	CS 70 TT 125/900-455					301874		301874	
Um ≤ 36 kV	Strong	GSCC010/08	CS 45 CE 250/740-525		6794539 321292	300221					
		GSCC010/09	CS 45 CE 280/900-590				6790080				
		GSCC010/10	CS 70 EB 170/900-555								300032
	Very strong	GSCC010/11	CS 70 EB 170/1250-1150								300020
		GSCC010/12	CS 100 EB 170/1250-555		T300031						300033

13.1.1 String insulators, main characteristics

Global code	Country code	Designation	Material maximum voltage (U_m)	Power frequency withstand voltage	Lighting impulse withstand voltage	Minimum creepage distance	Minimum arcing distance	Total length	Specific Mechanical Load (SML)	End fitting pole side	End fitting conductor side	Pollution level	International Standard	Alternative Standard for testing	Notes
			kV	kV	kV	mm	mm		kN						
GSCC010/01	300130 6772263 T300024 321293	CS 45 CE 190/560-430	24	100	190	560		430 ± 25	44,5	Clevis	Eye	Strong	IEC 62217 IEC 61109	ANSI C29.13	DS-28, see local section for end fitting
GSCC010/02	300092	CS 70 EB 125/600-455	24	50	125	600	270	455 ± 10	70	Eye (24)	Ball (16)	Strong	IEC 62217 IEC 61109	-	See local section for end fitting
GSCC010/03	301873	CS 70 TT 125/570-455	24	50	125	570		415 ± 10		Tongue	Tongue	Strong	IEC 62217 IEC 61109	-	See local section for end fitting
GSCC010/04	300517	CS 45 CE 190/744-430	24	100	190	744		430 ± 25	44,5	Clevis	Eye	Very Strong	IEC 62217 IEC 61108	ANSI C29.13	See local section for end fitting
GSCC010/05	530699	CS 70 EB 125/835-400	24	50	125	835	350	400 ± 10	70	Eye (24)	Ball (16)	Very Strong	IEC 62217 IEC 61109	-	Birdlife protection, see local section
GSCC010/06	300031	CS 100 EB 125/835-455	24	50	125	835	350	455 ± 10	100	Eye (24)	Ball (16)	Very Strong	IEC 62217 IEC 61109	-	See local section for end fitting
GSCC010/07	301874	CS 70 TT 125/900-455	24	50	125	900		415 ± 10		Tongue	Tongue	Very Strong	IEC 62217 IEC 61109	-	See local section for end fitting
GSCC010/08	6794539 300221 321292	CS 45 CE 250/740-525	36	130	250	740		525 ± 60	44,5	Clevis	Eye	Strong	IEC 62217 IEC 61109	ANSI C29.13	DS-35, see local section for end fitting
GSCC010/09	6790080	CS 45 CE 280/900-590	36	145	280	900		590 ± 50	44,5	Clevis	Eye	Very Strong	IEC 62217 IEC 61109	ANSI C29.13	DS-46, see local section for end fitting
GSCC010/10	300032	CS 70 EB 170/900-555	36	70	170	900	350	555 ± 10	70	Eye (24)	Ball (16)	Strong	IEC 62217 IEC 61109	-	See local section for end fitting
GSCC010/11	300020	CS 70 EB 170/1250-1150	36	70	170	1250	1000	1150 ± 10	70	Eye (24)	Ball (16)	Very Strong	IEC 62217 IEC 61109	-	Birdlife protection, see local section
GSCC010/12	300033 T300031	CS 100 EB 170/1250-555	36	70	170	1250	450	555 ± 10	100	Eye (24)	Ball (16)	Very Strong	IEC 62217 IEC 61109	-	See local section for end fitting

13.2 List of components, Line post insulators

Material maximum voltage	Pollution Level	Global code	Designation	Argentine	Brazil	Chile	Colombia	Italy	Perú	Romania	Spain
Um ≤ 15 kV	Light	GSCC010/24	CLP 10-110/300		321323						
Um ≤ 24 kV	Light	GSCC010/13	CLP 13-125/350								
	Medium	GSCC010/14	CLP 13-150/550			300161	T300023 T300074				
		GSCC010/15	CLP 13-160/560		6785764 6771058 321297						
	Strong	GSCC010/16	CLP 10-170/720					301875 301876		300001 630271	
	Very Strong	GSCC010/17	CLP 13-190/744						300516		
Um ≤ 36 kV	Light	GSCC010/18	CLP 13-200/530				T300022 T300073				
	Medium	GSCC010/19	CLP 6-170/760								300043
		GSCC010/20	CLP 13-200/700			300220					
		GSCC010/21	CLP 13-200/740								
	Strong	GSCC010/22	CLP 13-200/900		4545811 321296						
	Very Strong	GSCC010/23	CLP 13-200/1116		T300030						

13.2.1 Line post insulators, main characteristics

Global code	Country code	Designation	Material maximum voltage (U_m)	Power frequency withstand voltage	Lighting impulse withstand voltage	Minimum creepage distance	Minimum arcing distance	Cantilever Load	Pollution level	International Standard	Notes
			kV	kV	kV	mm	mm	kN			
GSCC010/24	321323	CLP 10-110/300	15	40	110	300	205	10	Light	IEC 62217 IEC 61952	Special spefication with U_m 15 kV for covered conductor (Brazil)
GSCC010/13		CLP 13-125/350	24	55	125	350	165	13	Light	IEC 62217 IEC 61952	Substitute for HDPE pin insulator
GSCC010/14	T300023(1) 300161 T300074(2)	CLP 13-150/550	24	60	150	550	230	13	Medium	IEC 62217 IEC 61952	Substitute for HDPE pin insulator. (1) Wooden crossarm (2) Metal crossarm
GSCC010/15	6785764 321297	CLP 13-160/560	24	70	160	560	241	12,5	Medium	IEC 62217 IEC 61952	
	6771058	CLP 13-160/560	24	70	160	560	241	12,5	Medium	IEC 62217 IEC 61952	Protected Creepage distance
GSCC010/16	301875 300001	CLP 10-170/720	24	70	170	720		10	Strong	IEC 62217 IEC 61952	For Cu conductor
	301876 630271	CLP 10-170/720	24	70	170	720		10	Strong	IEC 62217 IEC 61952	For Aldrey conductor
GSCC010/17	300516	CLP 13-190/744	24	100	190	744		12,5	Very strong	IEC 62217 IEC 61952	Consider ceramic head
GSCC010/18	T300022(1) T300073(2)	CLP 13-200/530	36	70	200	530	260	13	Light	IEC 62217 IEC 61952	Substitute for HDPE pin insulator. (1) Wooden crossarm (2) Metal crossarm
GSCC010/19	300043	CLP 6-170/760	36	70	170	760	280	6	Medium	IEC 62217 IEC 61952	Substitute for ARVI 42
GSCC010/20	300220	CLP 13-200/700	36	80	200	700	260	13	Medium	IEC 62217 IEC 61952	Substitute for HDPE pin insulator
GSCC010/21		CLP 13-200/740	36	95	200	740	311	12,5	Medium	IEC 62217 IEC 61952	
		CLP 13-200/740	36	95	200	740	311	12,5	Medium	IEC 62217 IEC 61952	Protected Creepage distance
GSCC010/22	4545811 321296	CLP 13-200/900	36	95	200	900	311	12,5	Strong	IEC 62217 IEC 61952	
GSCC010/23	T300030	CLP 13-200/1116	36	95	200	1116	311	12,5	Very strong	IEC 62217 IEC 61952	Protected Creepage distance

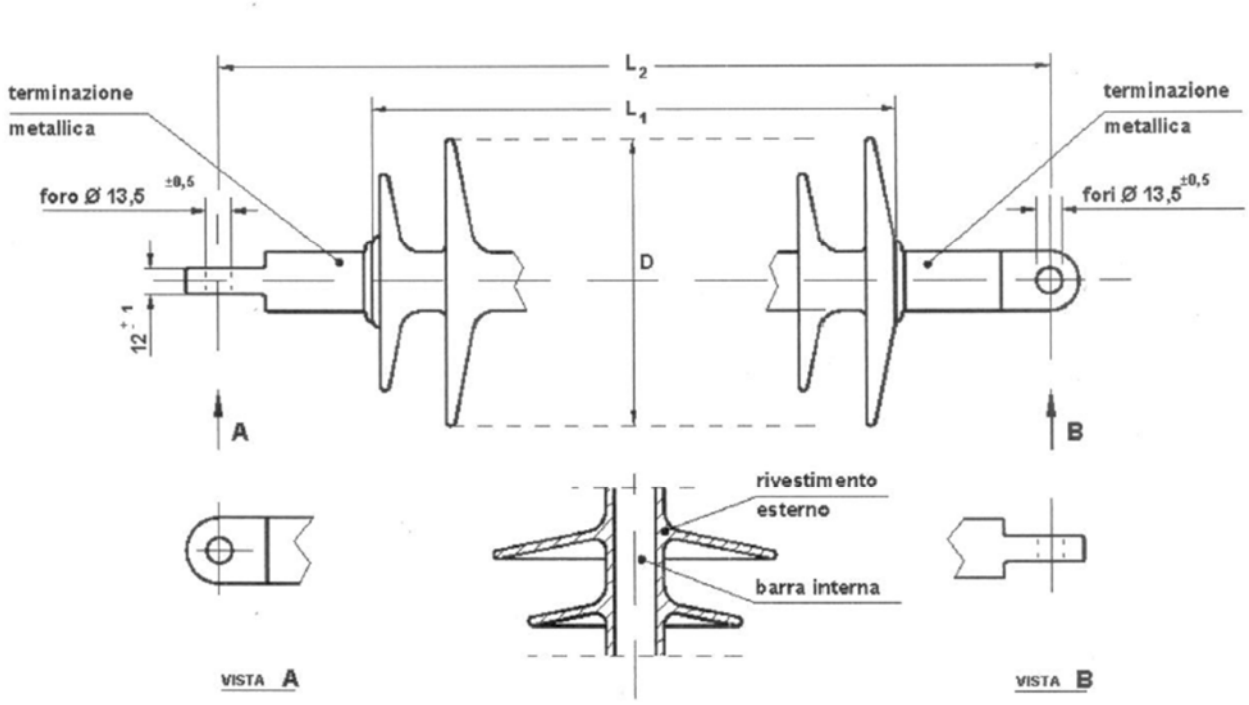
14 ANNEX B- LOCAL SECTIONS

14.1 E-DISTRIBUZIONE-ITALIA, E-DISTRIBUȚIE BANAT, E-DISTRIBUȚIE DOBROGEA, E-DISTRIBUȚIE MUNTENIA

14.1.1 Replaced Local standards:

- String insulators: DJ 511 and DJ 511 RO
- Line post insulators: DJ 502 and DJ502/2 RO

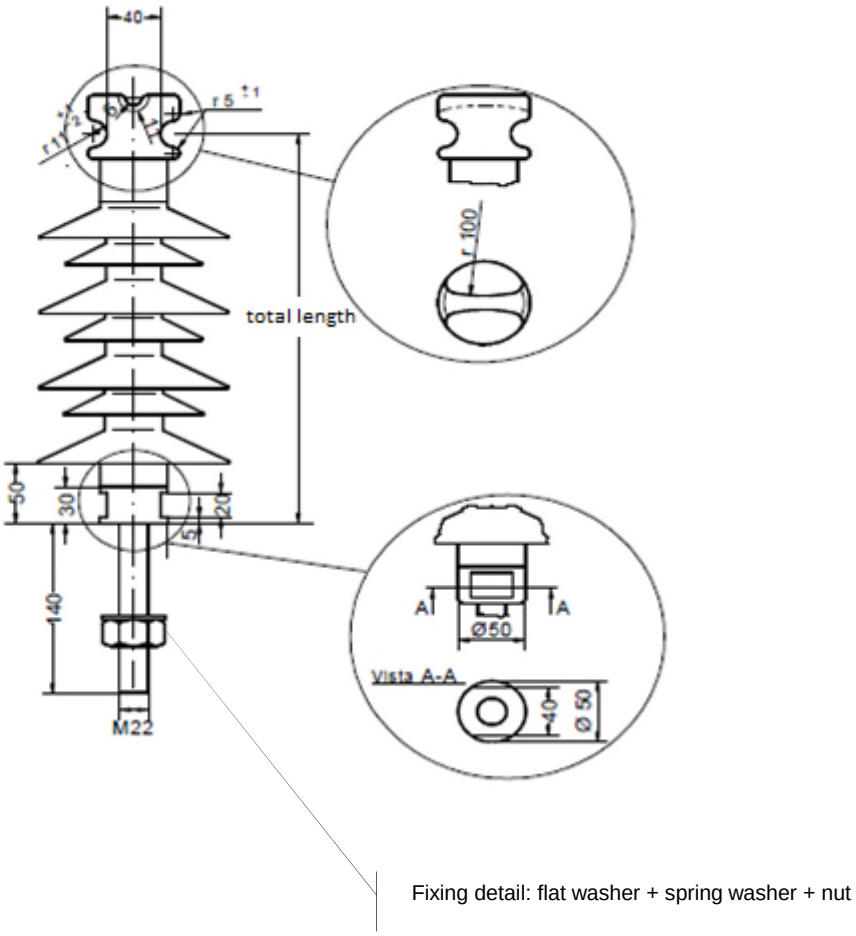
14.1.2 Detail for end fittings from string insulators:



Nominal dimensions (mm)	Country code	
	301873	301874
L1	215	215
L2	415	415
D maximum	200	200

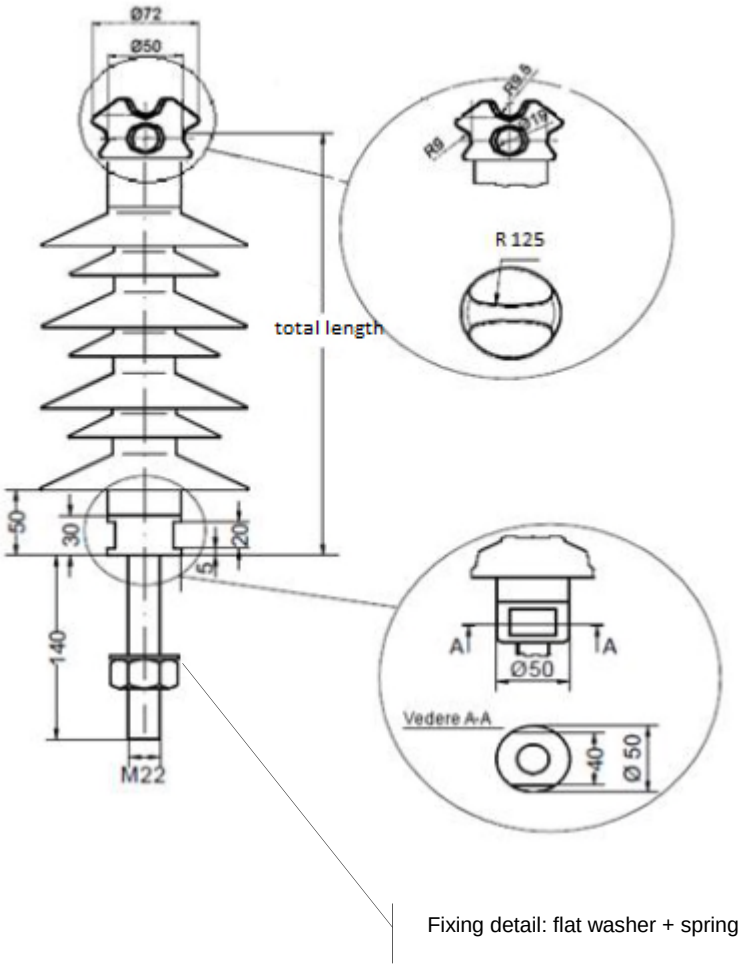
14.1.3 Detail for line post insulators GSCC010/16

14.1.3.1 *Codes 301875 and 301876:*



Maximum nominal diameter, 170 mm
Total length, 320 mm [-0,+30], according to 5.3.1.1

14.1.3.2 *Codes 630270 and 630271*



Maximum nominal diameter, 170 mm
Total length, 320 mm [-0,+30], according to 5.3.1.1

14.2 Supply

Package dimension shall be in compliance with the standard GUI 101 - CARATTERISTICHE GENERALI E PRESCRIZIONI DI IMPIEGO DEL PALLET IN LEGNO DA UTILIZZARE PER L'IMBALLO DI TRASPORTO

14.3 ENDESA DISTRIBUCIÓN ELÉCTRICA- SPAIN

14.3.1 Related Local standards:

- String insulators: AND012
- Line post insulator: 6704113/300043

14.3.2 Marking

It must be included de level of pollution:

- A, Strong pollution level
- MA, Very Strong pollution level

14.3.3 Detail for end fittings from string insulators:

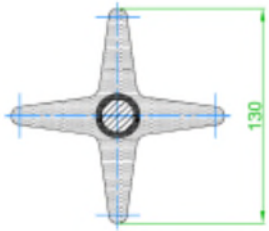
End fittings type ball shall be according to IEC 60120.

14.3.4 Additional comment for GSCC010/05 (country code 530699)

This code is designed to be used in suspensions on vault-type support structures located in areas of bird protection when the distance between the top of the pole and the central conductor makes it necessary.

14.3.5 Additional design requirements for GSCC010/11 (country code 300020)

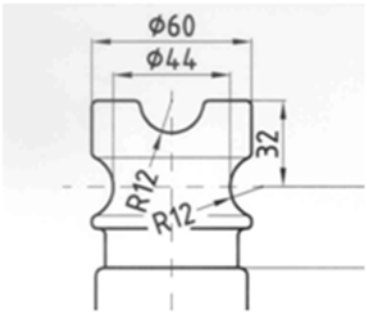
This code shall have a minimum of 5 sheds distributed homogeneously along the whole length.
It shall also include elements avoiding the birds to remain, distributed along the insulator. Each section of 50 mm shall include a shed or an “anti bird” element at least.
This “anti bird” element will have the form of a four-pointed star with a blunt end, inscribed in a circle with a diameter of approximately 130mm and centered on the axis of the insulator. The “anti-bird” elements will be obtained from the same molding process of the sheds of the insulator and from the same material. See an example in the next image:



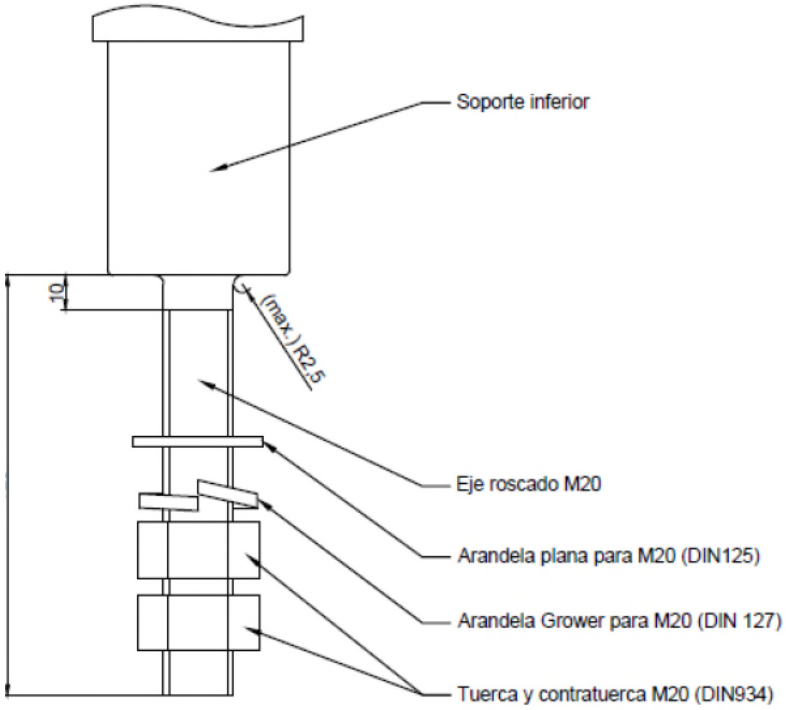
This insulator shall have a maximum creepage line of 1350 mm and an insulated length of 1000 mm.

14.3.6 Details code GSCC010/19, country code 300043

14.3.6.1 *Head and support details*

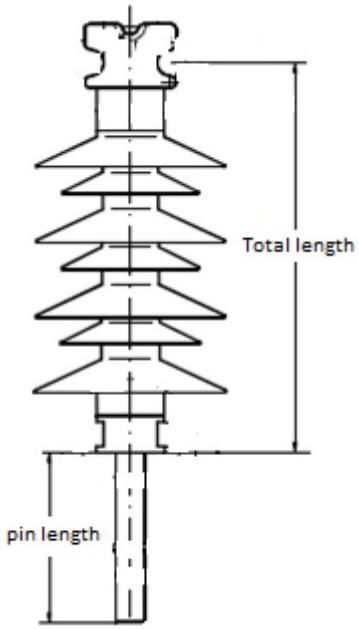


Insulator Head



Insulator Support, Support with threaded shaft in a single body of hot-galvanized forged steel.

14.3.6.2 *Dimensions*



Total length: 420 ± 10% mm (*according to 5.3.1.1)*
Pin length: minimum 120 mm, maximum 140 mm

14.3.6.3 *Conditions of supply*

The insulators will be supplied with all the necessary elements for its correct fixation according to figure from clause 14.2.6.1. Manufacturers shall provide appropriate instructions, written in Spanish, which will specify the torque to be applied on nut and lock nut.

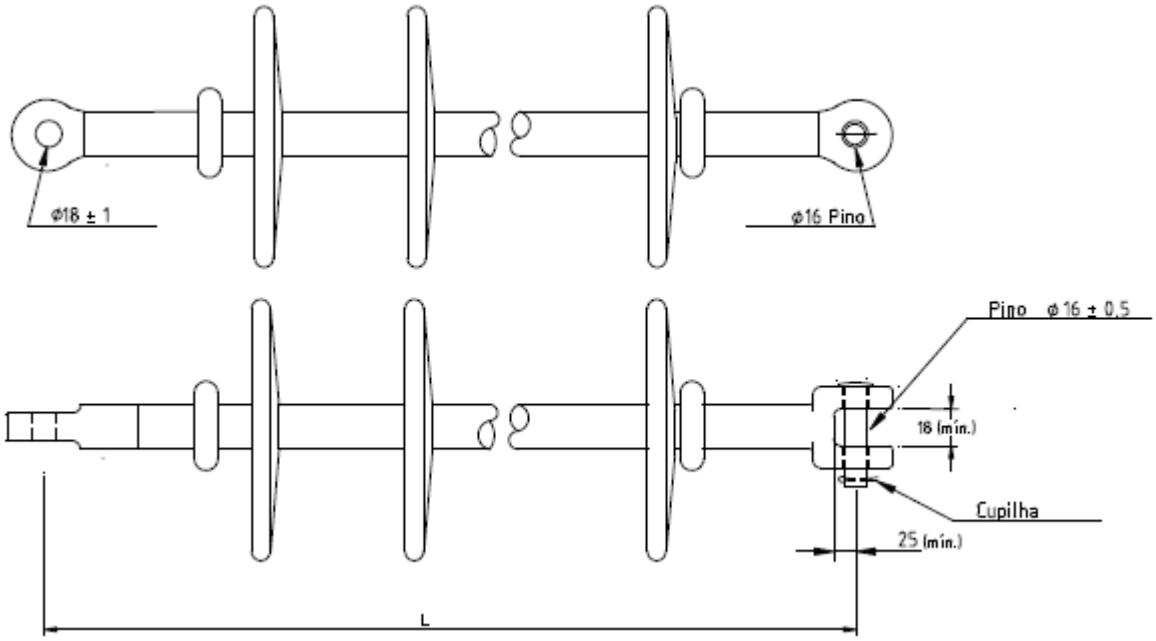
14.4 ENEL DISTRIBUCION COLOMBIA, ENEL DISTRIBUCION PERÚ, ENEL DISTRIBUCION CHILE, ENEL DISTRIBUCAO RIO, ENEL DISTRIBUCAO CEARÁ, ENEL DISTRIBUCAO GOIAS, ENEL DISTRIBUIÇÃO SÃO PAULO.

14.4.1 Related Local standards:

- E-MT-011
- NTU AES-002
- NTU AES-006
- Standard drawings MP-06-22 and MP-06-23

14.4.2 String insulator details

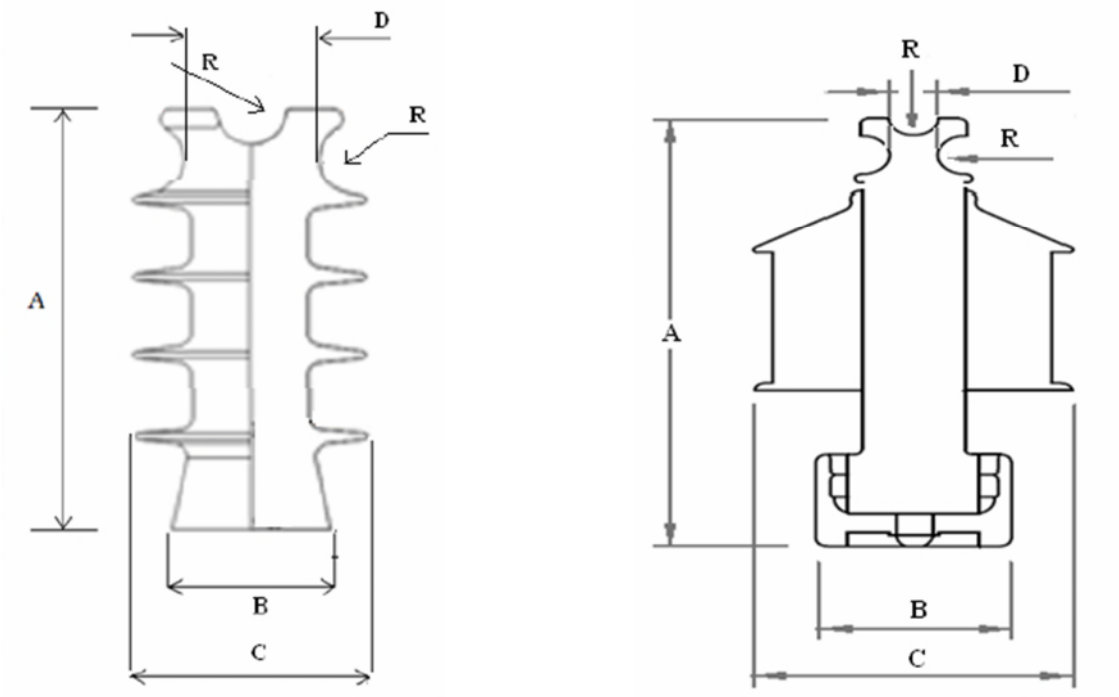
Most codes:



14.4.2.1 *Exceptions:*

Code T300031, eye fitting (24) for pole side and ball fitting (16) for conductor side. Ball fitting according to IEC 60120.

14.4.3 Line post insulator details



Main dimensions A, B, C, D and R shall be given by the supplier.

Thread metric	M20 x 2,5
Bolt, depth	25

14.4.3.1 *Head material*

It could also be considered ceramic for the head material.
In this case, there will be considered additional design, type and sample tests: Thermal shock test and Porosity test, as described in ANSI C29.7.

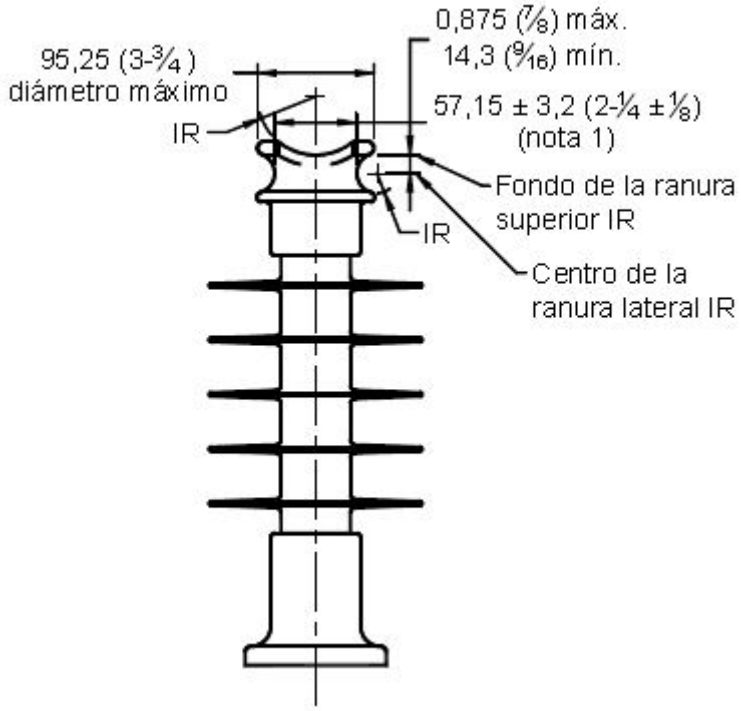
14.4.3.2 *Line post insulator with protected creepage distance*

This type of insulator shall have two parts, a core and a polymeric shell. The core shall be made of glass fiber or ceramic material. In case of ceramic core, there will be considered additional design, type and sample tests: Thermal shock test and Porosity test, as described in ANSI C29.7
These insulators are designed for conductor size up to 240 mm².

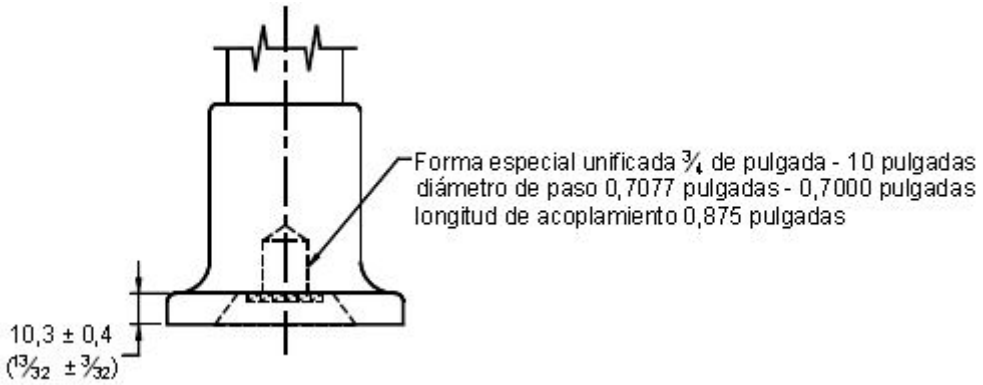
14.4.3.3 *ENEL DISTRIBUCION COLOMBIA*

14.4.3.3.1 Insulator

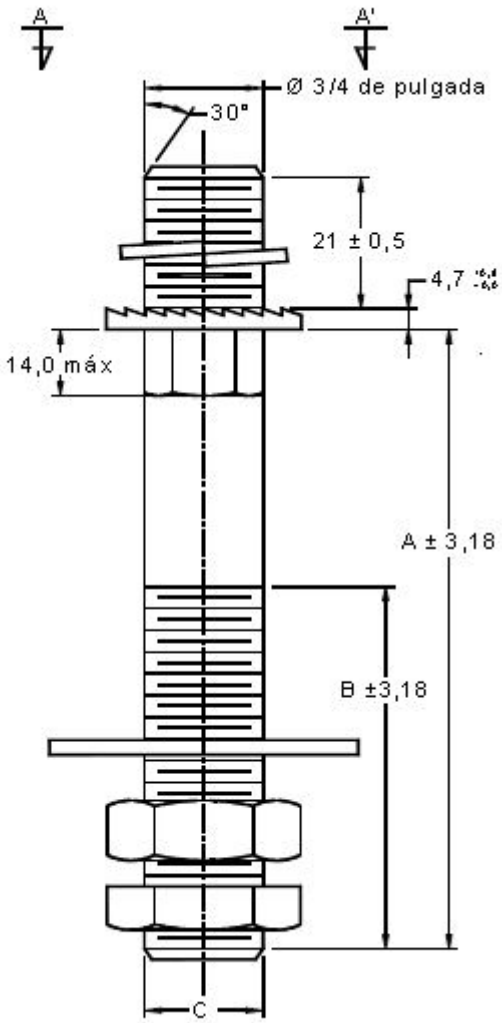
Line post insulator



Detail from the basis of the insulator



14.4.3.3.2 Pin for wooden crossarm (dimensions and additional details)



Dimensions (mm)	
A	180
B	100
C	19(¾")

Country Codes: T300022 and T300023
Fixing accessories:

- Pressure washer, flat square washer, nut and locknut.

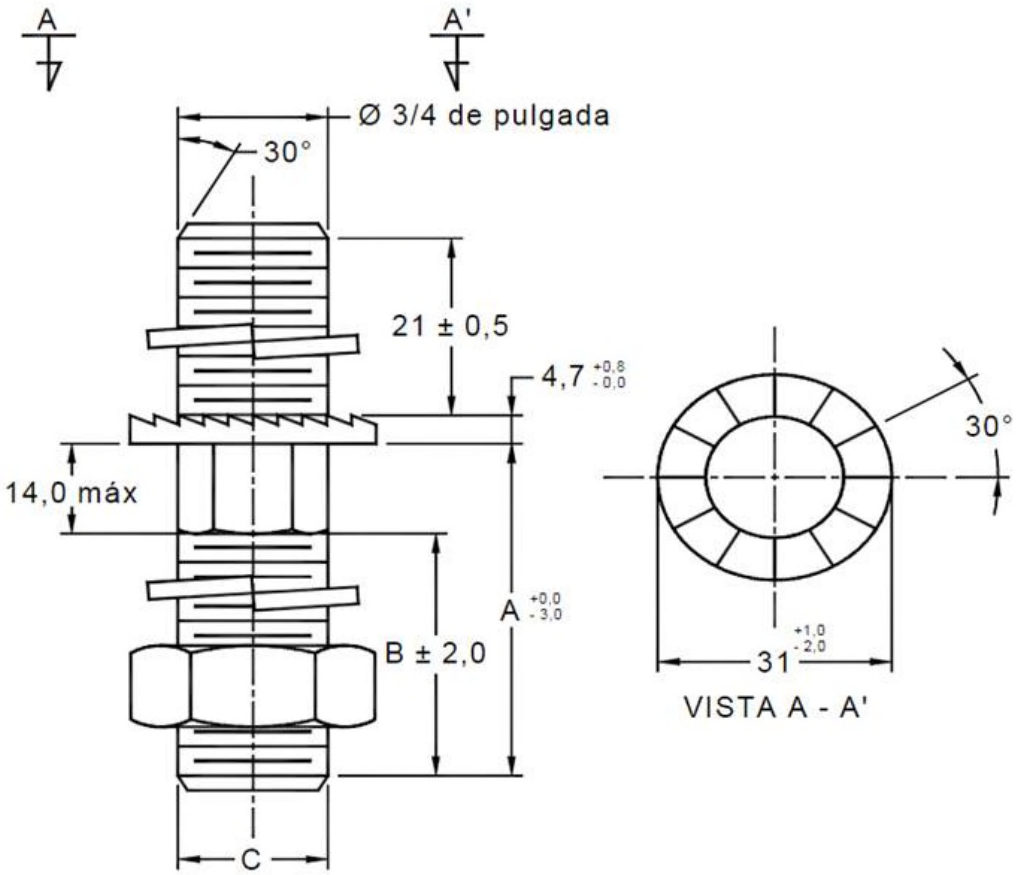
Material:

- Pin, nut and washer: carbon steel forged and galvanized to fire.

Mechanical resistance to bending:

- Pin must withstand, minimum load of 12.5 KN

14.4.3.3.3 Pin for metal crossarm (dimensions and additional details)



Dimensions (mm)	
A	50
B	38
C	19(¾")

Country Codes: T300073 and T300074
Fixing accessories:

- Two pressure washers and hexagonal nut.

Material:

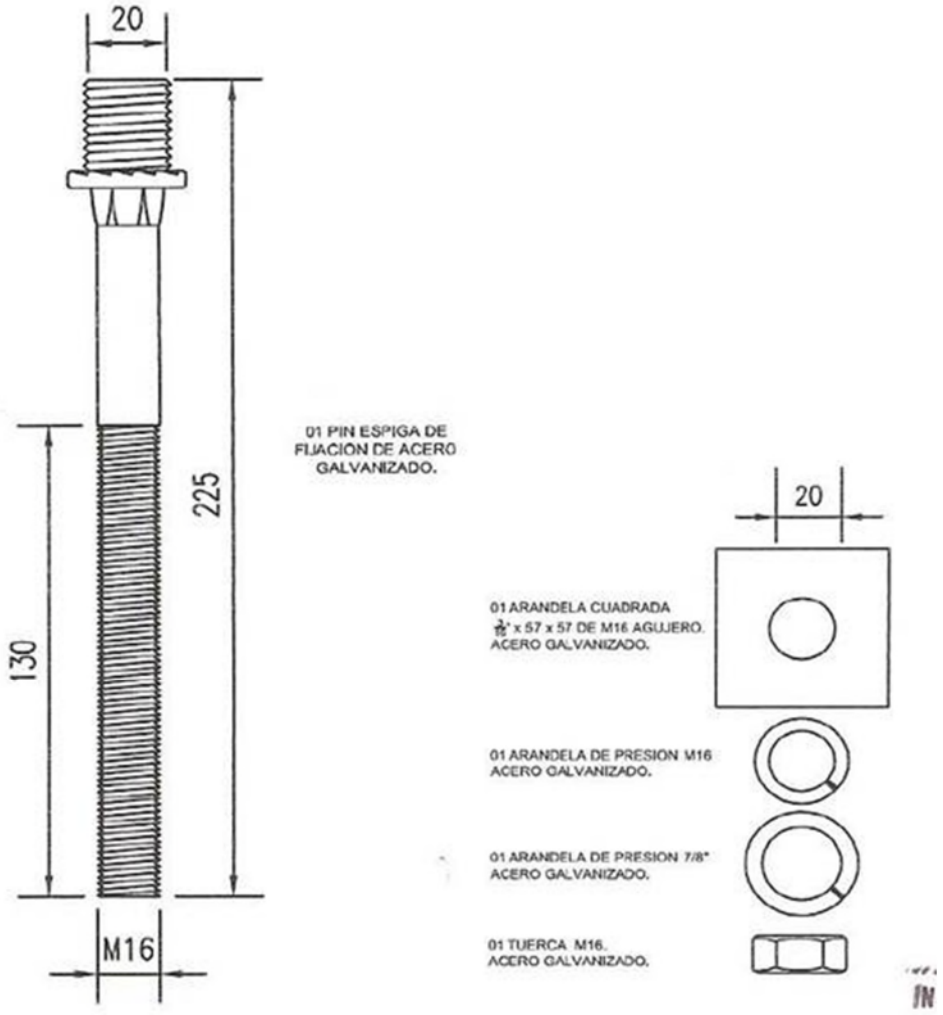
- Pin, nut and washer: carbon steel forged and galvanized to fire.

Mechanical resistance to bending:

- Pin must withstand, minimum load of 12.5 KN

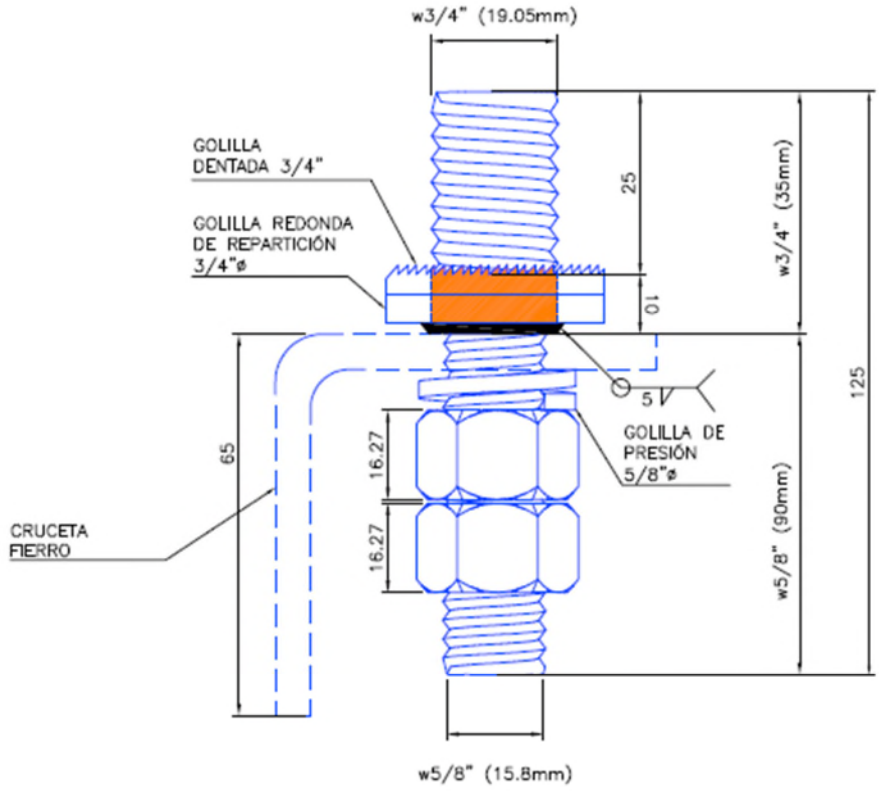
14.4.3.4 *ENEL DISTRIBUCION PERÚ*

Pin (dimensions and additional details)



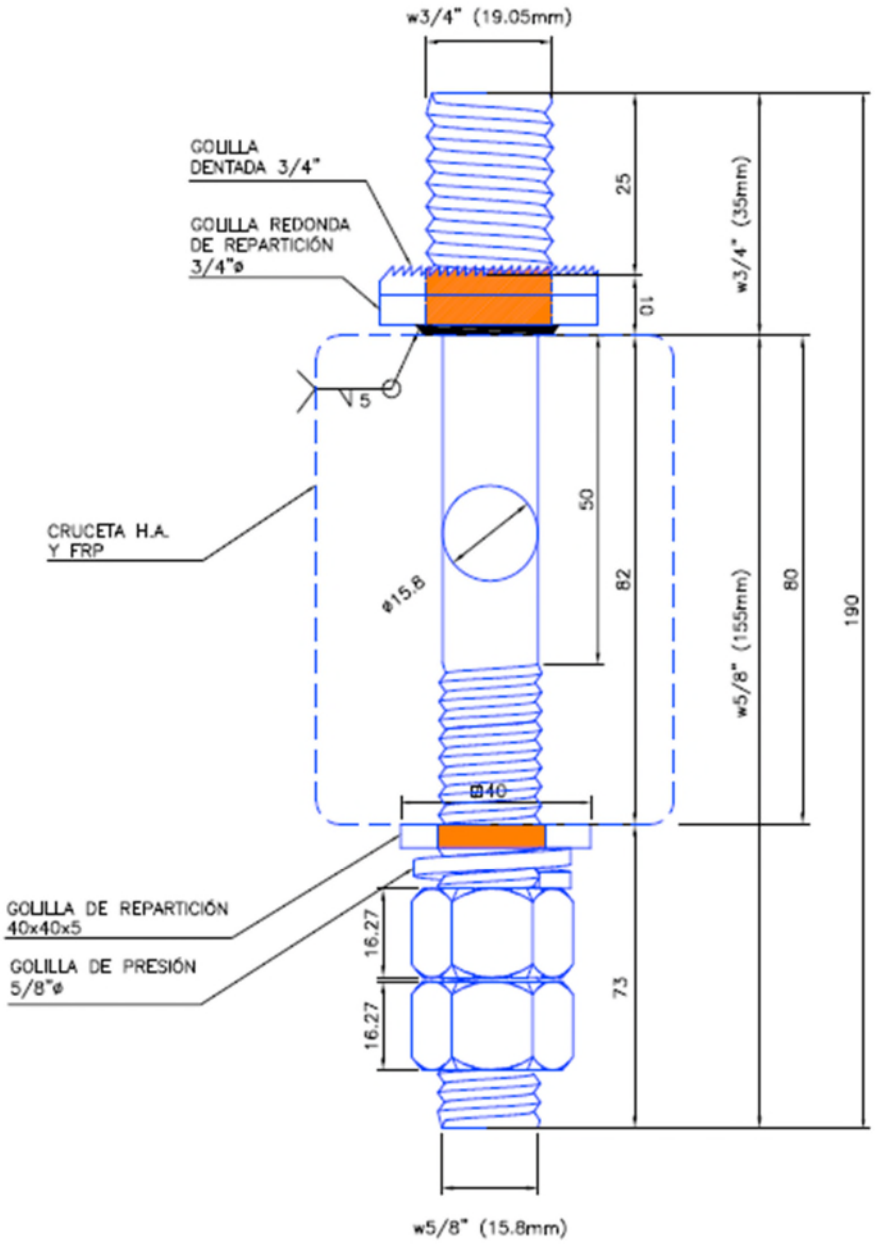
14.4.3.5 *ENEL DISTRIBUCION CHILE*

Pin (dimensions and additional details



PERNO PARA CRUCETA FIERRO

*)



PARA CRUCETA FRP Y H.A.

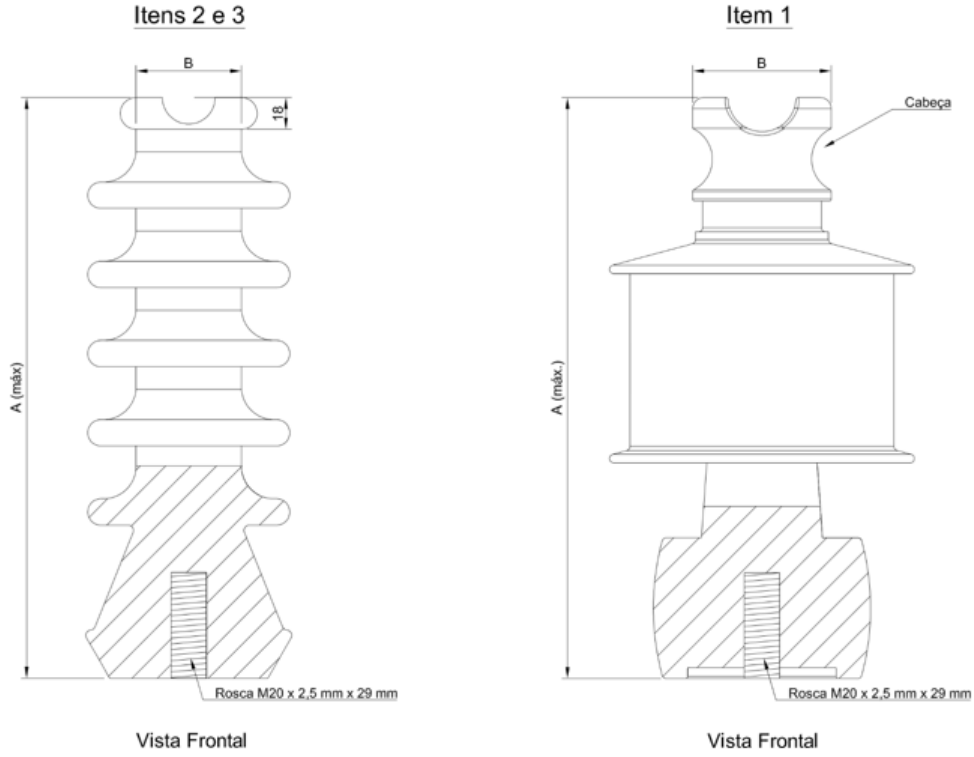
14.4.3.6 *ENEL DISTRIBUIÇAO RIO, ENEL DISTRIBUIÇAO CEARÁ, ENEL DISTRIBUIÇAO GOIAS, ENEL DISTRIBUIÇÃO SÃO PAULO*

14.4.3.6.1 Fittings

Due to the application in areas with severe salt pollution the string insulators and line post insulator with protected creepage line must have AISI 304 stainless steel or aluminum alloy fittings.

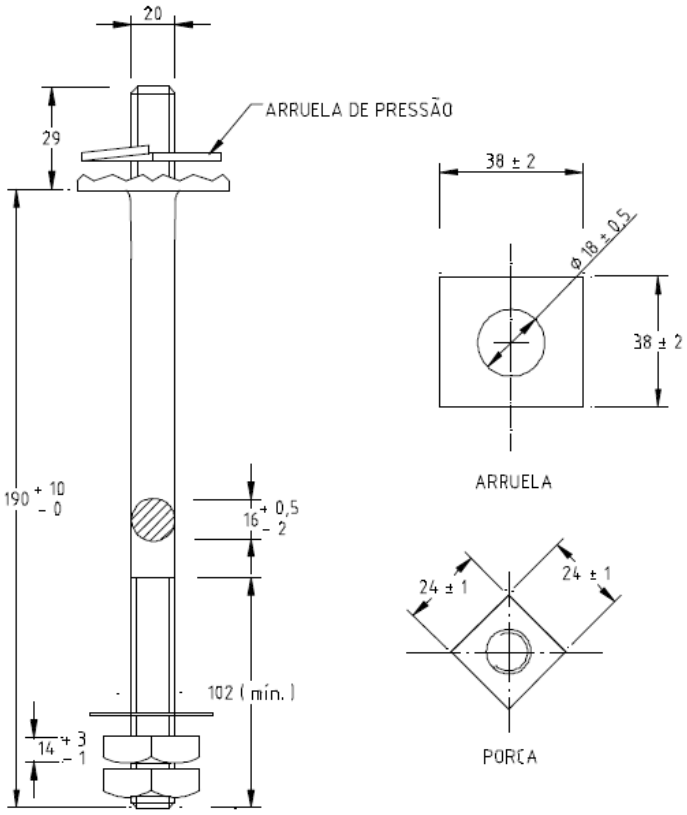
14.4.3.6.2 Line post insulator (dimensions and additional details)

Line post insulator *Line post insulator with protected creepage distance*



Country code	Bolt depth (mm)	Thread metric	A maximum (mm)	B nominal (mm)	Material type
6771058	29	M20 x 2,5	330	60	Polymeric, protected creepage line
6785764			345	60	Polymeric
321297 321323			345	60	Polymeric
4545811 321296 T300030			381	73	Polymeric

14.4.3.6.3 Pin for codes 6771058, 6785764, 4545811, T300030 (dimensions and additional details)



Material

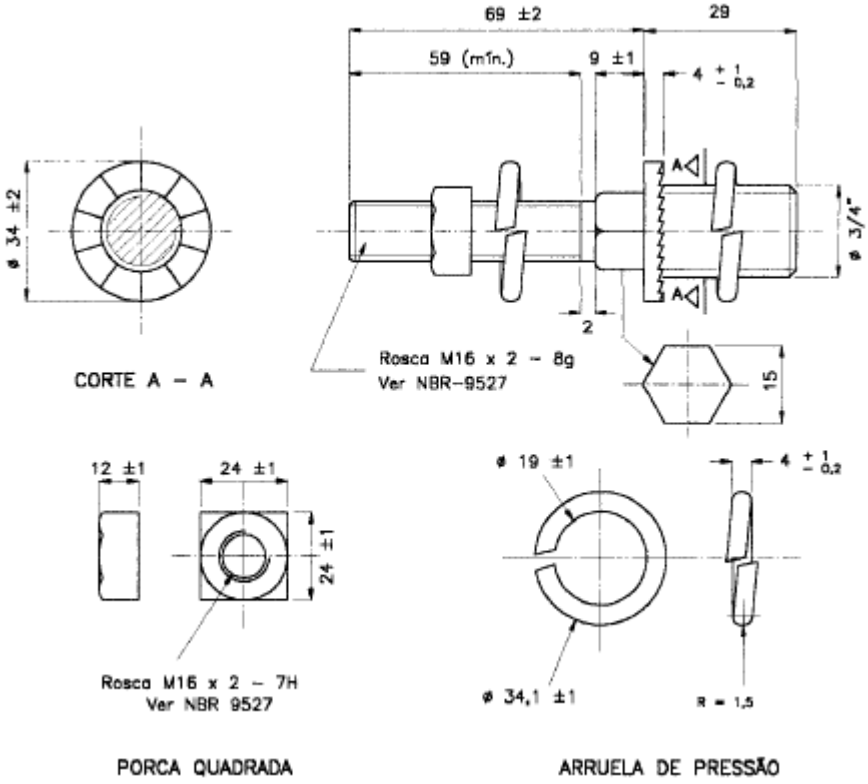
- Pin, nut and washer: carbon steel forged and galvanized to fire.
- Head of the pin: lead head.

Constructive characteristics

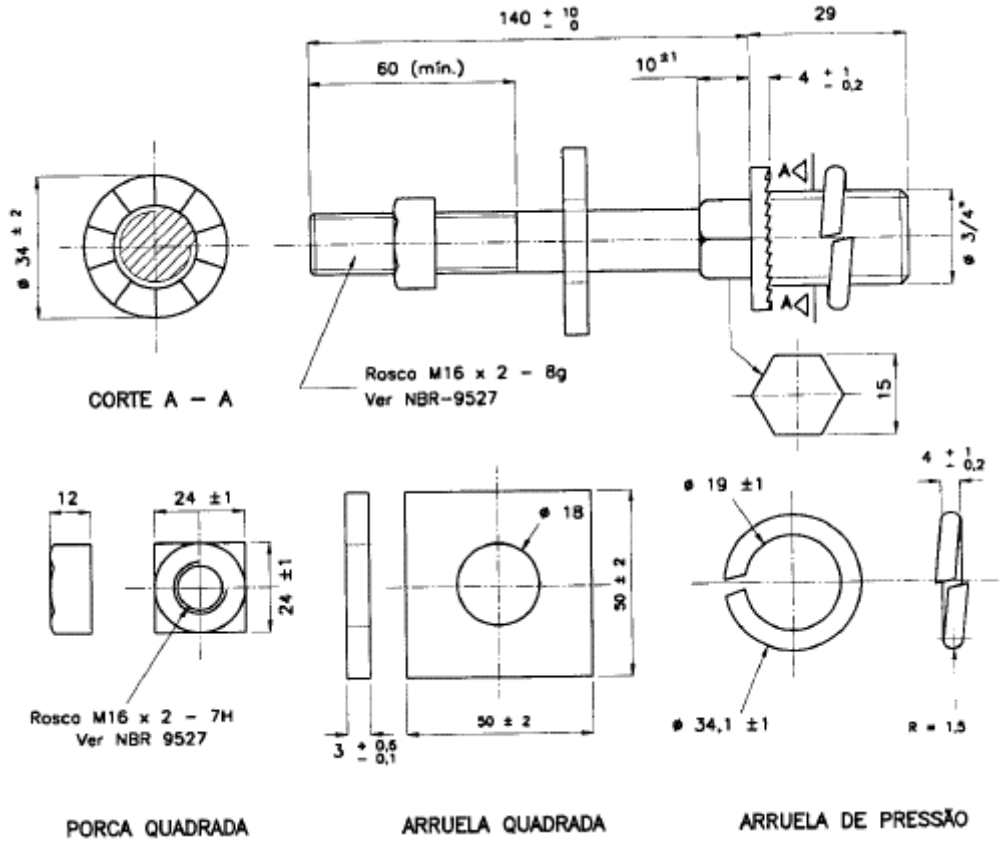
- The pin should withstand the following mechanical stresses:
  - Strain (F) of 200 daN (min.) with maximum shaft of 29 mm and maximum residual shaft of 15 mm.
  - Strain (F1) or C compression of 300 daN (min) without permanent deformation.
- The pin should be supplied assembled with nut and washer as shown above
- The piece should have a smooth and even finish and should be free of sharp corners and burrs.

14.4.3.6.4 Pin for codes 321323, 321296 and 321297(dimensions and additional details)

A- Compact grid



B- Not compact grid



Material

- Pin, nut and washer: carbon steel forged and galvanized to fire.
- Head of the pin: lead head.

Constructive characteristics

- The pin should withstand the following mechanical stresses:
  - Strain (F) of 200 daN (min.) with maximum shaft of 29 mm and maximum residual shaft of 15 mm.
  - Strain (F1) or C compression of 300 daN (min) without permanent deformation.
- The pin should be supplied assembled with nut and washer as shown above
- The piece should have a smooth and even finish and should be free of sharp corners and burrs.

15 ANNEX C - TECHNICAL CHECK LIST

15.1 String insulators

Item	Description	Unit	Value	Deviation GSCC010
1	**GENERAL INFORMATION**			
1.1	Supplier	-		
1.2	Factory	-		
1.3	Location of factory	-		
2	**MAIN FEATURES**			
2.1	Distribution Company and Country	-		
2.2	Country Code	-		
2.3	GS Type Code	-	GSCC010/xx	
2.4	Designation	-		
2.5	Supplier reference	-		
2.6	Drawing	-		
2.7	Maximum system voltage Um	[kV]		
2.8	Dry lightning impulse withstand voltage	[kV]		
2.9	Wet power frequency withstand voltage	[kV]		
2.10	Specified mechanical load (SML)	[kN]		
2.11	Routine test load (RTL)	[kN]		
2.12	Pollution level (IEC 6815-1)	-		
2.13	Creepage distance	[mm]		
2.14	Arcing distance	[mm]		
2.15	Section length	[mm]		
2.16	Weight	[kg]		
2.17	Marking	-		
3	**FITTINGS**			
3.1	Material	-		
3.2	Type of assembling	-		
3.3	Type of fitting tower side	-		
3.4	Size of fitting tower side	-		
3.5	Type of fitting conductor side	-		
3.6	Size of fitting conductor side	-		
3.7	Hot dip galvanized	[g/m^2]		
4	**CORE *informative***			
4.1	Material	-		
4.2	Nominal diameter (without housing)	[mm]		

4.3	Length of rod	[mm]		
4.4	Glass transition temperature	[ºC]		
4.5	Volume resistivity	[Ω · m]		
5	**HOUSING**			
5.1	Material	-		
5.2	Tear strength	[N/mm]		
5.3	Resistance to tracking class	-		
5.4	Fire resistance class type	-		
5.5	LOI	[%]		
5.6	Hydrophobic classification type	-		
5.7	Volume resistivity	[Ω · m]		
5.8	Minimum thicknes of housing over the core	[mm]		
5.9	Color	-		
6	**SHEDS PROFILE *informative***			
6.1	Material	-		
6.2	Manufacturing process	-		
6.3	Number of sheds (large-small)	-		
6.4	Diameter of shed (large-small)	[mm]		
6.5	Shed to shed spacing	[mm]		
6.6	Shed overhang (large-small)	[mm]		
6.7	Minimun distance between sheds	[mm]		
6.8	Shed angle (large-small)	[º]		
6.9	Thickness at base (large-small)	[mm]		
6.10	Thickness at tip (large-small)	[mm]		
7	**PACKING**			
7.1	Material of crates	-		
7.2	Insulators per crate	[Units]		
7.3	Ready for handling by forklift and boom crane	-		
8	**NOTES**			

15.2 Line post insulators

Item	Description	Unit	Value	Deviation GSCC010
1	**GENERAL INFORMATION**			
1.1	Supplier	-		
1.2	Factory	-		
1.3	Location of factory	-		
2	**MAIN FEATURES**			
2.1	Distribution Company and Country	-		
2.2	Country Code	-		
2.3	GS Type Code	-	GSCC010/xx	
2.4	Designation	-		
2.5	Supplier reference	-		
2.6	Drawing	-		
2.7	Maximum system voltage Um	[kV]		
2.8	Dry lightning impulse withstand voltage	[kV]		
2.9	Wet power frequency withstand voltage	[kV]		
2.10	Specific Cantilever Load	[kN]		
2.11	Routine Tensile load test	[kN]		
2.12	Pollution level (IEC 6815-1)	-		
2.13	Creepage distance	[mm]		
2.14	Arcing distance	[mm]		
2.15	Section length	[mm]		
2.16	Weight	[kg]		
2.17	Marking	-		
3	**FITTINGS**			
3.1	Material	-		
3.2	Type of assembling	-		
3.3	Length pin	mm		
3.4	Pin diameter	M		
3.5	Diameter insulator head	mm		
3.6	Diameter holes insulator head	mm		
3.7	Hot dip galvanized	[g/m^2]		
4	**CORE *informative***			
4.1	Material	-		
4.2	Nominal diameter (without housing)	[mm]		
4.3	Length of rod	[mm]		
4.4	Glass transition temperature	[ºC]		

4.5	Volume resistivity	[Ω · m]		
5	**HOUSING**			
5.1	Material	-		
5.2	Tear strength	[N/mm]		
5.3	Resistance to tracking class	-		
5.4	Fire resistance class type	-		
5.5	LOI	[%]		
5.6	Hydrophobic classification type	-		
5.7	Volume resistivity	[Ω · m]		
5.8	Minimum thicknes of housing over the core	[mm]		
5.9	Color	-		
6	**SHEDS PROFILE *informative***			
6.1	Material	-		
6.2	Manufacturing process	-		
6.3	Number of sheds (large-small)	-		
6.4	Diameter of shed (large-small)	[mm]		
6.5	Shed to shed spacing	[mm]		
6.6	Shed overhang (large-small)	[mm]		
6.7	Minimun distance between sheds	[mm]		
6.8	Shed angle (large-small)	[º]		
6.9	Thickness at base (large-small)	[mm]		
6.10	Thickness at tip (large-small)	[mm]		
7	**PACKING**			
7.1	Material of crates	-		
7.2	Insulators per crate	[Units]		
7.3	Ready for handling by forklift and boom crane	-		
8	**NOTES**			

Note: For ENEL DISTRIBUCAO RIO, ENEL DISTRIBUCAO CEARÁ, ENEL DISTRIBUCAO GOIAS ENEL DISTRIBUCAO SAO PAULO, ENEL DISTRIBUCION COLOMBIA, ENEL DISTRIBUCION PERÚ, ENEL DISTRIBUCION CHILE this table shall include additional rows to inform about main dimensions A, B, C, D and R

16 ANNEX D - STANDARDIZED DESIGNATION TO CREATE NEW CODES

In order to create new codes for insulators included in this standard, the designation shall be:

- TYPE OF INSULATOR (STRING, LINE POST)
- INS
- Material maximum voltage with units (kV)
- Designation according to Section 6

Example for GSCC010/02, country code 300092: STRING INS 24KV CS 70 EB 125/600-455