CONCRETE POLES FOR DISTRIBUTION NETWORKS

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Revision	Date	List of modifications
00	30/03/2015	First emission
01	03/05/2016	Correction of Table 6,Table 18 and update of the Common List
02	10/07/2018	Local Section Latam general update
03	10/08/2018	Correction of Table 3a and Common list for Brazil
04	21/09/2018	Additional requirements for Enel Distribución Colombia

INDICE

1 SCOPE

The standard specifications establishes characteristics about concrete poles that will be used on electric distribution overhead lines up to 33 kV in the Enel Group Distribution Companies, listed below:

• Enel Distribuição Rio (EDR)	Brasil	LATAM
• Enel Distribuição Ceará (EDC)	Brasil	
• Enel Distribuição Goiás (EDG)	Brasil	
• Enel Distribución Chile (CH)	Chile	
• Enel Distribución Colombia (CD)	Colombia	
• Enel Distribución Perú (EN)	Perú	
• Edesur (ES)	Argentina	
• Endesa Distribución Eléctrica (EE)	Spain	EUROPE
• Enel Distributie Banat (ER)	Romania	
• Enel Distributie Dobrogea (ER)	Romania	
• Enel Distributie Muntenia (ER)	Romania	
• E-Distribuzione (ED)	Italy	

This document is composed of one Common Main Section, and three Local Sections.

Additional requirements are added to the common main section by the corresponding clause or sub-clause numbers that is found in the Local sections, which provide additional information about poles of each country in question.

2 DEFINITIONS

Pole

Slender vertical structure rigidly fixed at the base.

Normal Pole

Pole that resists nominal stress "E_n" at a distance "d" below from the top.

Butt

Lower end of pole.

Top

Upper end of pole.

Nominal Distance (L)

Distance from butt up to top of the pole.

Concrete

Cement mixture, aggregates (sand, gravel) and water.

Metal Reinforcement Steel – Rebar

Steel bar or mesh of steel wires used as a stress device in reinforced concrete, to strengthen and hold the concrete in stress.

Embedment Length or Embedment distance (h_e)

Segment length of the pole buried firmly in the earth or concrete base.

Main Direction or Cross Direction

Perpendicular direction to the axis pole at which point maximum stress resistance is present.

Secondary Direction or Longitudinal

Normal direction to the axis pole and perpendicular to the main direction.

Nominal Stress or Admissible Load (E_n)

It is the stress by which the pole is designated and represents the free stress in the main direction at a distance "d" below from the top of the pole.

Tensile Test (T_1)

It is the term used in ENEL for the maximum stress in the primary direction that causes breaking, required by the pole.

Secondary Stress (E_s)

The stress level that a pole can resist in the secondary direction (perpendicular at the primary direction) applied at a distance “d” below from the top.

Breaking Strength or Tensile Strength (E_r)

It is one that, apply according to normal poles and reinforced poles, perpendicular to the axis pole and on the plane of bending, causes a breaking stress.

Torsional Stress (E_t)

Horizontal stress available at the top of the pole, located at d = 0.25m below the top and at a distance dh = 1.5m from center thereof which tends to make it rotate around its axis.

Safety factor (CS)

Is the relationship between the breaking load per the permissible specified load.

Sag

Measuring displacement of a point located in the plane of application of the stresses, caused by the action of them.

Crack

Fissure on the pole surface in which separating edges can be distinguished with the naked eye.

Capillary cracks

Fissure on the pole surface in which cannot see the edges with the naked eye.

Application Plane of Real Stresses

Transverse plane located at a distance “d” below the top.

Application Plane of Virtual Stresses

Transverse plane located at a distance “dv” above the top.

Conicity

Is the relationship between the differences of the diameters of the bases divided by the height of the pole.

3 LIST OF COMPONENTS

The list of components with the main requirements, which is an integral part of the document, is reported in: "Pole Project, Common List" appendix attached.

4 REFERENCE LAWS AND STANDARDS

Here below is reported the list of reference laws and standards mentioned in this document.

4.1 International standards

See Local Section.

4.2 Local Standards

See Local Section.

4.3 List of replaced Local Standards

See Local Sections.

5 SERVICE CONDITIONS

5.1 Environmental Conditions

In general, poles for distribution networks should be supplied to operate satisfactorily in outdoor environments under the conditions presented in Table 1.

Table 1: Environmental characteristics

Characteristics	ENEL DISTRIBUIÇÃO RIO / GOIÁS	ENEL DISTRIBUIÇÃO CEARÁ	ENEL DISTRIBUCIÓN COLOMBIA	ENEL DISTRIBUCIÓN CHILE	ENEL DISTRIBUCIÓN PERÚ	EDESUR	ENEL Distributie	E-Distribuzione	ENDESA
Altitude (m)	< 1.000	< 1.000	2.700	< 1.000	< 1.000	< 1.000	-	-	-
Relative moisture (IEC – 60721-2-1)	100%	95%	90%	100%	100%	100%	-	-	-
Pollution level (IEC 60815)	High (III)	Very High (IV)	Medium (II)	Medium (II)	Very High (IV)	Medium (II)	Medium (II)	Medium (II)	Medium (II)
Seismic activity	No	No	Yes(1)	Yes(1)	Yes(1)	No	Yes(1)	Yes(1)	No

(1) For seismic requirements see Local Sections.

6 CLASSIFICATION

The classifications of concrete poles are shown in Table 2.

Table 2: Types of concrete poles

Type	Model	Description
HV	**Reinforced vibrated concrete**	Reinforced vibrated concrete pole whose geometric shape is that of a truncated pyramid of rectangular outside beam.
HC	**Centrifuged reinforced concrete**	Centrifuged reinforced concrete pole whose geometric shape is that of a truncated circular ring section beam.
HCV	**Reinforced vibrated concrete**	Reinforced vibrated concrete pole whose geometric shape is that of a truncated circular ring section beam

The typical configuration of the pole type HV is shown in Figure 1, the main parts are: Top section or Cogolla and butt section, nominal stress and secondary stress, total length, solid section length and embedment length.

Reinforced vibrated concrete has the geometric form of a frustum beam of rectangular solid outer section in the first few meters from the top and with shaped "I" section reinforced with ribs on the other length.

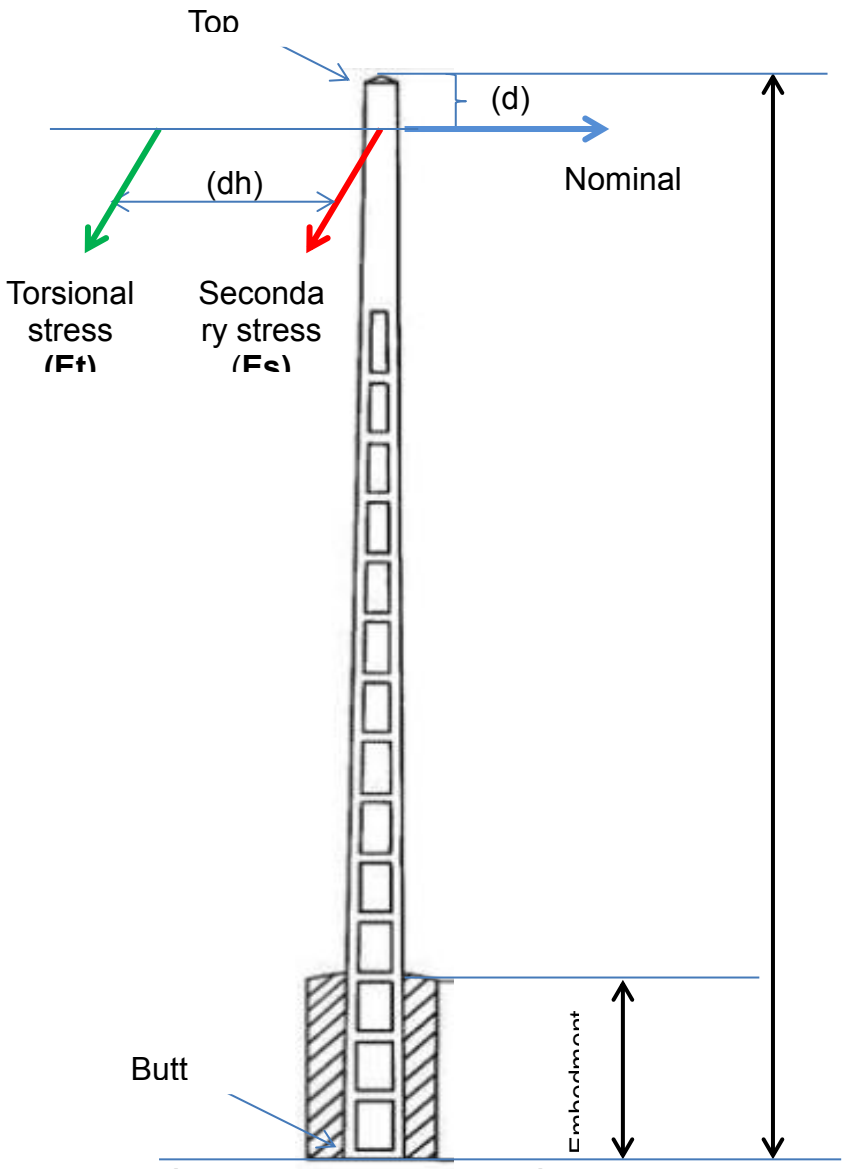

Figure 1: Scheme concrete pole type HV

Concrete poles type HV is used by ENDESA, ENEL DISTRIBUIÇÃO RIO, ENEL DISTRIBUIÇÃO CEARÁ, ENEL DISTRIBUIÇÃO GOIÁS and ENEL DISTRIBUCIÓN CHILE are defined by the characteristic features: Nominal length, Nominal stress and secondary stress. See details in the corresponding Local Section.

The typical configuration of the pole type HC is shown in Figure 2, whose main part are: Top diameter and butt diameter, nominal stress, total length and embedment length, see characteristic definitions in

paragraph 2. The pole has the geometric shape of a truncated circular cross-section beam, hollow along nominal length.

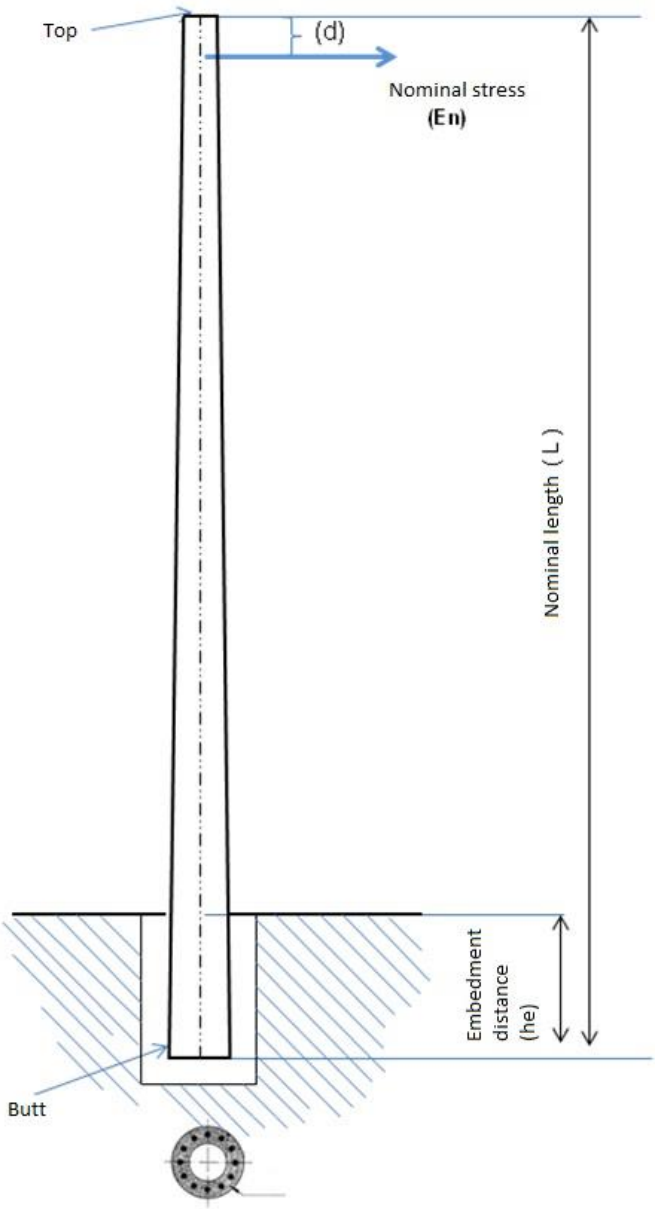

Figure 2: Scheme concrete pole type HC

Concrete poles type HC are used by ENEL, ENEL DISTRIBUCIÓN COLOMBIA, ENEL DISTRIBUCIÓN PERU, and EDESUR are defined by the following features: Nominal length, Nominal stress.

Concrete poles type HCV are used in ENEL DISTRIBUIÇÃO GOIÁS and ENEL DISTRIBUCIÓN COLOMBIA. The typical configuration of the pole type HCV is shown in Figure 3, whose main part are: Top diameter and butt diameter, nominal stress, total length and embedment length, see characteristic definitions in paragraph 2.

The pole has the geometric shape of a truncated circular cross-section beam, hollow along nominal length and closed on the top.

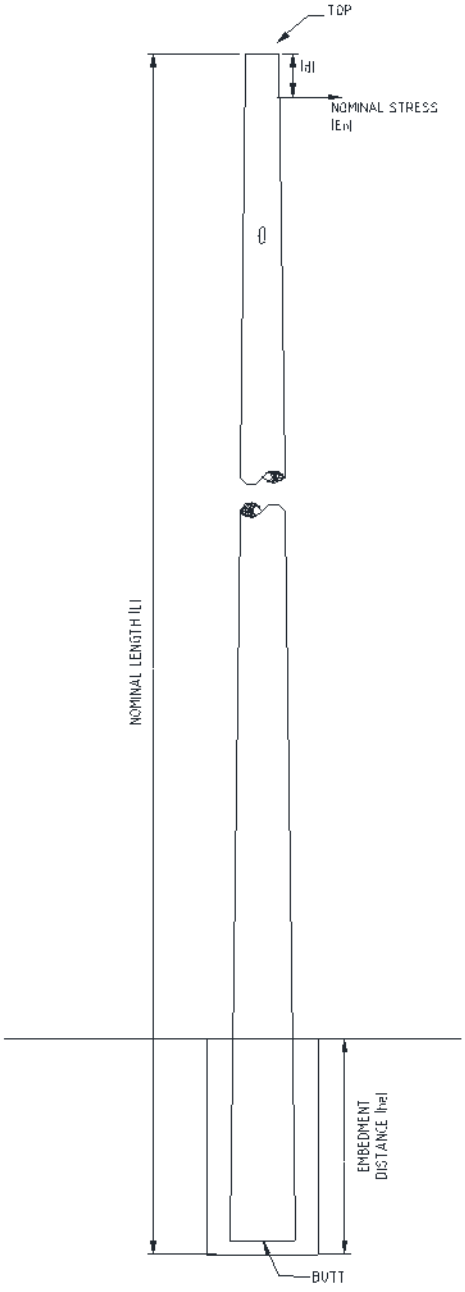

Figure 3: Scheme concrete pole type HCV

7 DESIGN AND MANUFACTURE

7.1 Manufacturing materials

The materials used for manufacturing poles, shall be tested in accordance with corresponding Local Standards. See Local section.

7.2 Dimensions

See Local Section.

7.3 Finished pole

The poles shall provide sufficiently smooth outer surfaces, no sharp edges, no cracks or fractures (except small capillary cracks, not longitudinally oriented, inherent in the material) without visible rebar.

7.4 Holes

Holes for fittings and cables shall be cylindrical and shall comply the following requirements:

a) The holes for fixing fittings should have an axis perpendicular to the pole axis and be centered on opposite sides.

b) The holes shall not provide obstructions and shall not expose any part of the rebar.

c) The location of the holes and their tolerances are specified in the Local Section.

7.5 Tolerance

See Local Section.

7.6 Embedment length

See Local Section.

7.7 Elasticity

See Local Section.

7.7.1 Sag

See Local Section.

7.7.2 Residual Sag

See Local Section.

7.7.3 Cracks

See Local Section.

7.8 Nominal Stress

For further details see 7.2 Local Section.

7.9 Safety factor

See local Section.

7.10 Grounding or Earthing system

See Local Section.

7.11 Marking and designation of pole

See Local Section.

7.12 Safety line.

See Local Section.

7.13 Lifetime

See Local Section.

8 TEST

8.1 Qualification test

Prior to conducting the tests the manufacturer shall provide the information requested in paragraph 11.

8.2 Type test

Tests carried out before marketing a type of pole, in order to prove that their service features correspond to the intended applications.

8.2.1 Sampling plan (type)

Shall be carried out in a limited sample for each type of pole to be utilized.

8.2.2 List of type tests

For further details of the procedure and requirements see Local Section.

8.3 Reception test

Tests performed by the provider during delivery.

8.3.1 Sampling plan (reception)

See Local Section.

8.3.2 List of reception tests

For further details of the procedure and requirements see Local Section.

8.4 Other tests

See Local Section.

9 CONFORMITY ASSESSMENT

9.1 Conditions of supplier

The manufacturer shall provide personnel and equipment necessary to carry out type tests and receiving described herein. Or in failing to hire the service, to a laboratory previously accepted by the customer and assume the cost. The product must comply with the requirements of GSCG002 regarding the Technical Conformity Assessment.

The equipment should be properly calibrated by a laboratory certified or approved by the client. The manufacturer shall possess daily calibration certificates (to turn over) at the time of inspection.

9.2 Acceptance and rejection

All poles rejected during receiving tests that are within accepted lots, will be replaced by the manufacturer with new units in perfect condition without charge to the Customer.

Acceptance of a lot by the customer does not relieve the manufacturer of liability to provide poles with the requirements of this specification or invalidate claims that the customer makes about the quality of the material used and the manufacturing of the pole.

10 GUARANTEE

The manufacturer will guarantee that the poles supplied meet all requirements of this Specification. The poles will be warranted against manufacturing defects for a period of 5 years in addition to meeting the requirements listed in this specification.

11 TECHNICAL INFORMATION FROM THE MANUFACTURER

11.1 General

All documents related to the proposal, such as drawings, technical descriptions, specifications, shall use the measurement units of the metric system.

11.2 Information for the proposed

Each bidder shall submit with its bid the information requested in this specification and any other information necessary to enable the distributor to select the poles to acquire.

11.3 Design drawing

See Local Section.

A. LOCAL SECTION – LATAM: ENEL DISTRIBUIÇÃO RIO (BRAZIL), ENEL DISTRIBUIÇÃO CEARÁ (BRAZIL), ENEL DISTRIBUIÇÃO GOIÁS (BRASIL), ENEL DISTRIBUCIÓN CHILE (CHILE), ENEL DISTRIBUCIÓN COLOMBIA (COLOMBIA), ENEL DISTRIBUCIÓN PERÚ (PERÙ), EDESUR (ARGENTINA).

ITEM	TITLE	DESCRIPTION
4.2	Local standards	ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS • **NBR 5732:1991 :** Cimento Portland comum. • **NBR 5733:1991 :** Cimento Portland de alta resistência inicial • **NBR 5737:1991 :** Cimento Portland resistentes a sulfatos • **NBR 5738:1994 :** Concreto - Procedimento para moldagem e cura de corpos-de-prova. • **NBR 5739:1991 :** Concreto - Ensaios de compressão de corpos-de-prova cilíndricos • **NBR 6118:2007 :** Projeto de estruturas de concreto - Procedimento. • **NBR 6210 :** Corrosão atmosférica – Materiais metálicos – Preparo, limpeza e determinação da taxa de corrosão de corpos-de-prova em ensaios de corrosão. • **NBR 7211 :** Agregado para Concreto – Especificação**.** • • **NBR 7480:2007 :** Aço destinado a armaduras para estruturas de concreto armado - Especificação • **NBR 7482:2008 :** Fios de aço para estruturas de concreto protendido - Especificação • **NBR 7483:2008 :** Cordoalhas de aço para estruturas de concreto protendido – Especificação • **NBR 8451-1 :** Postes de concreto armado e protendido para redes de distribuição e de transmissão de energia elétrica – Parte 1: Requisitos; • **NBR 8451-2 :** Postes de concreto armado e protendido para redes de distribuição e de transmissão de energia elétrica – Parte 2: Padronização de postes para redes de distribuição de energia elétrica; • **NBR 8451-3 :** Postes de concreto armado e protendido para redes de distribuição e de transmissão de energia elétrica – Parte 3: Ensaios mecânicos, cobrimento da armadura e inspeção geral.

		• **NBR 8451-4 :** Postes de concreto armado e protendido para redes de distribuição e de transmissão de energia elétrica – Parte 4: Determinação da absorção de água. • **NBR 8451-5 :** Postes de concreto armado e protendido para redes de distribuição e de transmissão de energia elétrica – Parte 5: Postes de concreto para entrada de serviço até 1kV. • **NBR 8451-6 :** Postes de concreto armado e protendido para redes de distribuição e de transmissão de energia elétrica – Parte 6: Postes de concreto armado e protendido para linhas de transmissão e subestações de energia elétrica – Requisitos, padronização e ensaios • **NBR 12654:2000:** Controle tecnológico de materiais componentes do concreto - Procedimento • **NBR 12655:2006:** Concreto de cimento Portland - Preparo, controle e recebimento – Procedimento • **NBR 14643 :** Corrosão Atmosférica – Classificação da corrosividade de atmosferas. • **NBR 7680 :** Extração, preparo e ensaios de testemunhos de concreto. • **NBR 11768 :** Aditivos químicos para concreto de cimento Portland – Requisitos.
		<u>ENEL DISTRIBUCION CHILE</u> • **NCh148:1968 :** Cemento - Terminología, clasificación y especificaciones generales. • **NCh163:1979 :** Áridos para morteros y hormigones - Requisitos generales • **NCh204:2006 :** Acero - Barras laminadas en caliente para hormigón armado hormigón • **NCh205:1968 :** Acero - Barras reviradas para hormigón armado • **NCh170:1985 :** Hormigón - Requisitos generales • **NCh1498:1982 :** Hormigón – Agua de amasado – Requisitos • **NSEG 5.E.n.71 :** Reglamento de instalaciones eléctricas de corrientes fuertes. • **DMAD-0182 / SDO-8156:** Poste de Hormigón Armado de 8,7m • **DMAD-0180 / SDO-8158:** Poste de Hormigón Armado de 11,5m • **DMAD-0184 / CHI-25930:** Poste de Hormigón Armado de 13,5m • **DMAD-0183 / SDO-11411:** Poste de Hormigón Armado de 15,0m • **PDAR-3011:** Procedimiento de ensayos de recepción a postes en fábrica **CMD-14161:** Cancha para ensayes

		ENEL DISTRIBUCIÓN COLOMBIA • **NTC 30** : Cemento portland. Clasificación y nomenclatura. • **NTC 121** : Ingeniería civil y arquitectura. cemento portland. Especificaciones físicas y mecánicas. • **NTC 321** : Ingeniería civil y arquitectura. Cemento portland. Especificaciones • **NTC 174** : Concretos. Especificaciones de los agregados para concreto. • **NTC 2** : Ensayo de tracción para productos de acero • **NTC 116** : Alambre duro de acero para refuerzo de concreto. • **NTC 159** : Alambres de acero sin recubrimiento liberados de esfuerzo para concreto pretensado. • **NTC 161** : Barras lisas de acero al carbono para hormigón armado. • **NTC 248** : Barras y rollos corrugados de acero al carbono para hormigón armado • **NTC 673** : Ensayo de resistencia a la compresión, de cilindros normales de hormigón. • **NTC 1299** : Aditivos químicos para el hormigón. • **NTC 2010** : Torones de acero de siete alambres sin recubrimiento para concreto pretensado. • **NTC 1329** : Prefabricados en concreto. postes de concreto para líneas de energía eléctrica y telecomunicaciones. • **RETIE** : Reglamento técnico de instalaciones eléctricas. **RETILAP** : Reglamento Tecnico de Illuminacion y Alumbrado Publico

		ENEL DISTRIBUCIÓN PERU • **NTP 334.009 :** CEMENTOS. Cemento Portland. Requisitos. 5a. Ed. • **NTP 334.090 :** CEMENTOS. Cementos Portland adicionados. Requisitos. 5a. ed. • **NTP 334.082 :** CEMENTOS. Cemento Portland. Especificación de la Performance. 3a. ed. • **NTP 400.037 :** AGREGADOS. Agregados para concreto. Requisitos. 4ª Edición • **NTP 400.012 :** AGREGADOS. Análisis granulométrico del agregado fino, grueso y global • **NTP 339.088:** CONCRETO. Agua de mezcla utilizada en la producción de concreto de cemento Portland. Requisitos • **NTP 341.031 :** HORMIGÓN (CONCRETO). Barras de acero al carbono con resaltes y lisas para hormigón (concreto) armado. Especificaciones • **NTP 341.032 :** Tochos, palanquillas, planchones y llantones de acero al carbono para laminar productos de uso estructural. 1ª Edición • **NTP 339.034 :** HORMIGÓN (Concreto). Método de ensayo normalizado para la determinación de la resistencia a la compresión del concreto, en muestras cilíndricas. 3a. ed. • **NTP 339.059 :** CONCRETO. Método de ensayo normalizado para la obtención y ensayo de corazones diamantinos y vigas seccionadas de concreto. 3a ed. • **NTP 339.088 :** HORMIGÓN (CONCRETO). Agua de mezcla utilizada en la producción de concreto de cemento Portland. Requisitos • **NTP 339.027 :** HORMIGON (CONCRETO). Postes de hormigón (concreto) armado para líneas aéreas. 2a. ed. • **NTP 339.187 :** HORMIGÓN (CONCRETO). Método de ensayo normalizado para determinar la densidad, absorción y porcentaje de vacíos en el hormigón (concreto) endurecido

		EDESUR • **IRAM 50000** : Cemento para uso general. Composición, características, evaluación de la conformidad y condiciones de recepción. • **IRAM 50001** : Cemento. Cementos con propiedades especiales. • **IRAM 1512** : Agregado fino para hormigón de cemento. Requisitos. • **IRAM 1531** : Agregado grueso para hormigón de cemento. Requisitos • **IRAM 1627** : Agregados. Granulometría de los agregados para hormigones. • **IRAM 1634** : Hormigón de cemento. Método de ensayo de compresión. • **IRAM 1585** : Elementos estructurales de hormigón. Sistema constructivo de la toma de tierra en elementos de hormigón armado o pretensado para soporte de instalaciones aéreas. • **IRAM 1601** : Agua para morteros y hormigones de cemento. • **IRAM 1605** : Postes de hormigón pretensado, de sección anular y forma troncocónica, para soporte de instalaciones aéreas. • **IRAM 1663** : Hormigón de cemento. Aditivos químicos. • **IRAM 15** : Inspección por atributos. Planes de muestra única, doble o múltiple, con rechazo. • **IRAM 18** : Muestreo al azar. • **IRAM-IAS U500-03** : Cordones de siete alambres de acero para estructuras de hormigón pretensado. • **IRAM-IAS U500-07** : Cordones de dos o tres alambres de acero para estructuras de hormigón pretensado. • **IRAM-IAS U500-26** : Alambres de acero para armadura en estructuras de hormigón. • **IRAM-IAS U500-207** : Barras de acero conformadas de dureza natural soldables, para armadura en estructuras de hormigón. • **IRAM-IAS U500-245** : Alambres de acero conformado para estructuras de hormigón pretensado. • **IRAM-IAS U500-502** : Barras de acero laminadas en caliente, lisas y de sección circular para armadura en estructuras de hormigón. • **IRAM-IAS U500-517** : Alambres para hormigón pretensado. • **IRAM-IAS U500-528:** Barras de acero conformadas de dureza natural, para armadura en estructuras de hormigón. • **IRAM 1666-1** : Hormigón de cemento Portland. Hormigón elaborado. Requisitos, inspección y recepción y métodos de ensayo. • **AEA95201 - Edición 2003:** Asociación Electrotécnica Argentina: Reglamentación de líneas aéreas exteriores de baja tensión. • **AEA95301 - Edición 2007:** Asociación Electrotécnica Argentina: Reglamentación de líneas aéreas exteriores de media y alta tensión. • **CIRSOC 201** : Proyecto, cálculo y ejecución de estructuras de hormigón armado y pretensado. Edición julio1982. Actualización 1984.
4.3	List of replaced Local Standards	• **E-MT-024 :** POSTES DE CONCRETO PARA REDES DE DISTRIBUCION HASTA 23 KV

<table>
<tr><td>5.1</td><td>Environmental Conditions</td><td><u>ENEL DISTRIBUCIÓN PERU / ENEL DISTRIBUCION CHILE</u>

Seismic requirements: for Enel Distribución Peru the technical specification E-SE-010 applies. For Enel Distribución Chile the technical specification ETG-1020 applies.</td></tr>
<tr><td>6</td><td>CLASSIFICATION</td><td>Pre-stressed pole:

<u>ENEL DISTRIBUCIÓN COLOMBIA</u>
It is the pole which steel reinforcement bar has been pre-stressed. This initial pre-stressed steel should not be transferred to the concrete until it no longer has strength of 245 kg/cm² and before tensioning losses occur.

The minimum resistance to compression of concrete shall be 245kg/cm² (3 500 psi) for conventional poles and 350 kg/cm² (5 000 psi) for pre-stressed poles. This resistance shall be verified through laboratory tests on sections taken from different lots according to standard ICONTEC 673.

The minimum strength of steel shall be 4218 kg / cm² (60000psi) and shall not exceed 0.94 at the time of initial pre-tensioning. Steel spirals or rings shall be made of smooth or corrugated rods of 6.4 mm minimum diameter.

<u>EDESUR</u>
At the time of applying the force of pre-compression, compression stresses in the concrete should not exceed 50% of the characteristic strength of concrete at the age.</td></tr>
<tr><td>7.1</td><td>Manufacturing materials</td><td>
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NTC 2010
NTC 248</td><td>NCh204 Of77
NCh205 Of69</td><td>NTP 341.031
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IRAM-IAS U500-026
IRAM-IAS</td></tr>
<tr><td>Concrete</td><td>NBR 5739
NBR 5738
NBR 12654
NBR 12655</td><td>NTC 673
NTC 1299</td><td>NCh170 of 85</td><td>NTP 339.034
NTP 339.059
NTP 339.088
NTP 339.027
NTP 339.187</td><td>IRAM 1666-1</td></tr>
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7.2 Dimensions

ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS :

Table 3a shows the different poles with their main nominal dimensions according to the length and nominal stress. These poles are the HV type.

Length L (m)	Nominal stress "E_n" (daN)	Safety factor	Top measures mm x mm (± 5 mm)	Butt measures mm x mm (± 5 mm)	L_2 (mm) ± 20	L_3 (mm) ± 20	L_4 (mm) +20 - 5	Distribution Company
9	150	2.0	100 x 120	190 x 264	1150	75	1525	EDC
9	200	2.0	100 x 120	190 x 264	1000	75	3025	EDR
9	300	2.0	110 x 140	290 x 392	1150	75	1525	EDC
9	400	2.0	110 x 140	290 x 392	1000	75	3025	EDR
9	600	2.0	110 x 140	290 x 392	1000	75	3025	EDC/EDR
10	300	2.0	110 X 140	310 X 420	1100	975	3025	EDG
10	600	2.0	110 X 140	310 X 420	1100	975	3025	EDG
10.5	150	2.0	100 x 120	205 x 288	1350	1475	3025	EDC
10.5	300	2.0	110 x 140	320 x 434	1350	1475	3025	EDC
10.5	600	2.0	110 x 140	320 x 434	1350	1475	3025	EDC
10.5	1000	2.0	200 x 266	350 x 476	1350	1475	3025	EDC
11	200	2.0	100 x 120	210 x 296	1200	1875	4525	EDR
11	300	2.0	110 X 140	330 X 448	1200	1875	4525	EDG
11	400	2.0	110 x 140	330 x 448	1200	1875	4525	EDR
11	600	2.0	110 x 140	330 x 448	1200	1875	4525	EDR
11	1000	2.0	140 x 182	360 x 490	1200	1875	4525	EDR
11	1500	2.0	170 x 224	390 x 532	1200	1875	4525	EDR
12	300	2.0	110 x 140	350 x 476	1450	2775	4525	EDC/EDG
12	400	2.0	110 x 140	350 x 476	1300	2775	4525	EDR
12	600	2.0	110 x 140	350 x 476	1300	2775	4525	EDC/EDR

12	1000	2.0	200 x 266	380 x 518	1300	2775	4525	EDC
12	1000	2.0	140 X 182	380 X 518	1300	2775	4525	EDR
12	2000	2.0	200 X 266	440 X 602	1300	2775	4525	EDR
13	600	2.0	110 X 140	370 X 504	1400	2775	4525	EDR
13	1000	2.0	140 X 182	400 X 546	1400	2775	4525	EDR
13	2000	2.0	200 X 266	460 X 630	1400	2775	4525	EDR

Table 3a: Nominal dimensions of the pole HV

The geometrical general configuration of the pole type HV is shown in paragraph 11.3 of this appendix, the dimensions of the main sections are detailed.

Table 3b shows the different poles with their main nominal dimensions according to the length and nominal stress. These poles are the HCV type.

LENGHT *L* ± 0,05 (m)	TYPE	NOMINAL STRESS Cn (daN)	NOMINAL FLOUR MOMENT APPLIED ON THE APPLICATION	ADICIONAL STRENGHT ON THE APPLICATION PLAN OF Cn (FA) (5) (daN)	MASS (2) (kg)	DIMENSIONS (mm)				
						A ± 5	B ± 5		F ± 20 (6)	J ± 20 (6)
							(A)	(B)		
9	**C-17**	300	450	149	820	170	350	305	75	1000
	C-19	600	900	298	1.000	190	370	325		
10	**C-23**	1.000	900	592	1.350	230	430	380	975	1100
11	**C-19**	600	900	322	1.260	190	410	355	1875	1200
	C-23	1.000	900	602	1.600	230	450	395		
	C-29	1.500	**(Note 5)** 900	952	2.100	290	510	455		
12	**C-19**	600	**(Note 5)** 900	331	1.440	190	430	370	2775	1300
	C-23	1.000		611	1.770	230	470	410		
	C-29	1.500		960	2.450	290	530	470		
	C-33	2.000		1311	3.000	330	570	510		
13	**C-17**	300	**(Note 5)** 450	165	1.280	170	430	365	2775	1400
	C-19	600	900 **(Note 5)**	330	1.680	190	450	385		
	C-23	1.000		610	1.920	230	490	425		
	C-29	1.500		968	2.700	290	550	485		
	C-33	2.000		1310	3.500	330	590	525		
14	**C-19**	600	**(Note 5)** 900	345	1.900	190	470	400	2775	1500

Table 3b: Nominal dimensions of the pole HCV

1) (A) - Conicity 20 mm / m;

(B) - Conicity 15 mm / m.

2) The masses are approximate for conicity 20 mm / m and have no normative sense, and should not be required to observe them, including inspection.

3) Minimum values for the distance from the application plane Cn at the top of the pole equal to 100 mm.

4) The MA column values were obtained experimentally.

5) The values of FA were calculated by the expression FA = (0,7 ME - MA) / h, where ME is the moment of settling (ME = Cn. Hu).

6) The F and J dimensions refer to the holes for the input and output of the grounding cable, and a built-in duct system can be used.

The geometrical general configuration of the pole type HCV is shown in paragraph 11.3 of this appendix, the dimensions of the main sections are detailed.

ENEL DISTRIBUCION CHILE

Table 4 shows the different poles with their main nominal dimensions according to the length and nominal stress. These poles are the normal type.

Table 4: Nominal dimensions of the pole HV

Length L (m)	Nominal stress "En" (daN)	Secondary stress "Es" (daN)	Safety factor	Top measures mm x mm (± 5 mm)	Butt measures mm x mm (± 5 mm)
8,7	225	60	2	120 x 120	220 x 350
11,5	267	125	2	150 x 150	250 x 430
13,5	660	340	2	165 x 180	300 x 450
15,0	660	240	2	150 x 150	300 x 450

The geometrical general configuration of the pole type HV is shown in paragraph 11.3 of this appendix, the dimensions of the main sections are detailed.

ENEL DISTRIBUCIÓN PERU

Table 5 shows the different poles with their main nominal dimensions according to the length and nominal stress. These poles are the normal type.

The base of the post will be protected with a concrete sealer approved by ENEL, which will be applied from the embedment level (reference): 0.7m above and 0.5m below.

In paragraph 11.3 of this appendix, the dimensions of the main sections are detailed.

Table 5 : Conical frustum Poles ENEL DISTRIBUCIÓN PERÚ

Length L (m)	**Nominal stress "E_n"** (daN)	**Safety factor**	**Top φ ce** (mm)	**Butt φ ce** (mm)	**B** (mm)
7	200	2.00	150	255	0.40
8	200		150	270	0.50
9	200		150	285	0.60

11	200		150	315	0.80
11	400	2.50	180	345	0.80
13	400		180	375	1.00
15	400		210	435	1.20

ENEL DISTRIBUCIÓN COLOMBIA

Table 6 shows the different poles with their main nominal dimensions according to the length and nominal stress. These poles are the pre-stressed type. The pole shall have a conicity between 1.5cm/m and 2.0 cm/m. The pole shall be closed on top.

In paragraph 11.3 of this appendix, the dimensions of the main sections are detailed.

Table 6 : Conical frustum Poles ENEL DISTRIBUCIÓN COLOMBIA

Length "L"	Breaking strength "E_r"		Safety factor	Top Diameter	Butt diameter	Nominal Stress	
(m)	(daN)	(kgf)		(mm)	(mm)	(daN)	(kgf)
10	500	510	2.50	140	290	200	204
10	1030	1050		170	320	412	420
12	500	510		140	320	200	204
12	735	750		140	320	294	300
12	1030	1050		190	370	412	420
12	1324	1350		220	400	530	540
12	1961	2000		260	440	785	800
12	2452	2500		280	460	981	1000
12	2942	3000		300	480	1177	1200
12	3432	3500		320	500	1373	1400
14	735	750		160	370	294	300
14	1030	1050		190	400	412	420
14	1324	1350		200	410	530	540
14	1961	2000		260	470	785	800
14	2452	2500		280	490	981	1000
14	2942	3000		300	510	1177	1200
14	3432	3500		320	530	1373	1400

Poles for Public Lighting ENEL DISTRIBUCIÓN COLOMBIA

Length "L"	Breaking strength "E_r"		Safety factor	Top Diameter	Butt diameter	Nominal Stress
(m)	(daN)	(kgf)		(mm)	(mm)	daN
10	500	510	2.50	170	320	200
12	500	510		140	320	200
14	735	750		140	370	294
16	735	750		180	420	294
18	735	750		200	470	294

EDESUR

Table 7 shows the different poles with their main nominal dimensions according to the length and nominal stress. These poles are the normal type.
In paragraph 11.3 of this appendix, the dimensions of the main sections are detailed.

Table 7 : Conical frustum Poles EDESUR

Length L	Nominal stress "E_n"	Breaking strength "E_r"	Top Diameter	Conicity
(m)	(daN)	(daN)	(mm)	(mm/m)
7.5	400	-	140 - 160	15
7.5	1050	-	200 - 220	
8.5	1050	-	200 - 220	
11	1200	1275	220 - 240	
12	900	-	180 - 200	
12	1200	1275	220 - 240	
12	2400	1275	260 - 280	
13	900	-	180 - 200	
13	1200	1275	220 - 240	
13	1800	1275	240 - 260	
13	2400	1275	260 - 280	
14	1200	1275	220 - 240	
14	1800	1275	240 - 260	
14	2400	1275	260 - 280	
15	1200	1275	220 - 240	

7.4 Holes

ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS

The arrangement of the holes required on each of the faces, as other particulars are shown in Figure 6 These have a diameter of 19 mm (+2 mm / -1 mm)

ENEL DISTRIBUCION CHILE

All the holes have a diameter of 22mm.

ENEL DISTRIBUCIÓN PERU / ENEL DISTRIBUCIÓN COLOMBIA

In the designs diagrams of paragraph 11.3 of this appendix, the details of the holes to consider are shown in Figure 8 and Figure 9 for ENEL DISTRIBUCIÓN PERU, Figure 10 and Figure 11 for ENEL DISTRIBUCIÓN COLOMBIA.

Poles shall have two holes with a minimum diameter of 1 inch, located respectively at a distance of 20 cm over and 50 cm below the embedment line.

EDESUR

The holes are not required.

<table>
<tr>
<td>7.6</td>
<td>Embedment length</td>
<td>
<u>ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS / ENEL DISTRIBUCIÓN COLOMBIA</u>
For the embedment length shall apply the following formula: he = 0.1L + 0.6, where L are meters.
<u>ENEL DISTRIBUCIÓN PERU</u>
For the embedment length shall apply the following formula: he = 0.1L + 0.5, where L are meters.
For the embedment length with foundation shall apply the following formula: he1 = 0.1L, where L are meters.

In addition to this for ENEL DISTRIBUCIÓN COLOMBIA see Table 8 only for poles of street lighting (AP), which shall be in compliance with RETILAP.

Table 8 : Embedment length
<table>
<tr><th>Nominal Length</th><th>Description</th><th>Embedment length</th></tr>
<tr><th>(m)</th><th>-</th><th>(m)</th></tr>
<tr><td>10</td><td>10 x 510 AP</td><td>1.8</td></tr>
<tr><td>12</td><td>12 x 510 AP</td><td>1.8</td></tr>
<tr><td>14</td><td>14 x 750 AP</td><td>2.0</td></tr>
<tr><td>16</td><td>16 x 750 AP</td><td>2.0</td></tr>
<tr><td>18</td><td>18 x 750 AP</td><td>2.0</td></tr>
</table>
<u>ENEL DISTRIBUCION CHILE</u>
The poles of 8.7m, 11.5m, 15.0m and 13.5m are special cases which are not subject to, this rule, so their embedment lengths are 1.4m, 2.0m, 2.5m and 2.5m respectively.
<u>EDESUR</u>
For the embedment length shall apply the following formula: h_e = 0.1L - 0.1, where L are meters.
</td>
</tr>
<tr>
<td>7.7.1</td>
<td>Sag</td>
<td>
<u>ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS</u>
The poles subject to a stress equal to the allowable load (E_n) at a distance of 0.10 m, of size greatest stress and 0.15 m of size least stress from the top, should not submit sags above:

5% of the nominal length, when traction is applied in the direction of least stress.
3.5% of the nominal length, when traction is applied in the direction of greatest stress.

<u>ENEL DISTRIBUCIÓN PERU</u>
The poles subject to a stress equal to the allowable load (En) at a distance of 0.15 m from the top, should not submit sags above:
· 5% of the nominal length, when traction is applied in the direction of least stress.
· 3.5% of the nominal length, when traction is applied in the direction of greatest stress.
</td>
</tr>
</table>

		ENEL DISTRIBUCIÓN CHILE The tests will be developed as indicated in local procedure PDAR-3011, the installation for the development of the tests is specified in CMD-14161 The poles subject to a stress applied horizontally and progressive, at a distance of 0.15 m from the top, should not submit sags above: • 3% of the nominal length, when traction is applied in the direction of least stress. Applying stress equal to Secondary stress (Es) . • 2% of the nominal length, when traction is applied in the direction of greatest stress. Applying stress equal to Nominal stress (En) **ENEL DISTRIBUCIÓN COLOMBIA** The poles subjected to a stress equal to the allowable load (E_n) at a distance of 0.20m from the top, should not submit sags above: • 3.0% of the free length of the pole (L-h_e), **EDESUR** In accordance with IRAM 1605.
7.7.2	Residual Sag	**ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS/ ENEL DISTRIBUCIÓN PERU** Residual sag is the sag that remains after removing the stresses. This sag measured after having applied a stress that is equal to 140% of the allowable load on the application plane of the real stress, shall not exceed: • 0.5% of the nominal length, when traction is applied in the direction of least stress. • 0.35% of the nominal length, when traction is applied in the direction of greatest stress. **ENEL DISTRIBUCIÓN COLOMBIA** The poles subjected to a stress equal to 40% of breaking stress (E_r) at a distance of 0.20m from the top, should not submit sags above: • 3.0% of the nominal length (L) for each type of pole. Finally, when the 40% of the breaking stress (E_r) applied has finished, the pole should not submit sags above: • 5.0% of the maximum sag specified for each type of pole.

Table 9 : Conical frustum Poles ENEL DISTRIBUCIÓN COLOMBIA

Length "L"	Breaking strength "E_r"		Nominal Stress		Sag under load	Permanent Sag
(m)	(daN)	(kgf)	(daN)	(kgf)	(mm)	(mm)
10	500	510	200	204	252	12,6
10	1030	1050	412	420	252	12,6
12	500	510	200	204	306	15,3

		12	735	750	294	300	306	15,3
		12	1030	1050	412	420	306	15,3
		12	1961	2000	785	800	306	15,3
		12	2452	2500	981	1000	306	15,3
		12	2942	3000	1177	1200	306	15,3
		12	3432	3500	1373	1400	306	15,3
		14	735	750	294	300	360	18,0
		14	1030	1050	412	420	360	18,0
		14	1324	1350	530	540	360	18,0
		14	1961	2000	785	800	360	18,0
		14	2452	2500	981	1000	360	18,0
		14	2942	3000	1177	1200	360	18,0
		14	3432	3500	1373	1400	360	18,0

This table does not include poles for street lighting (AP).

EDESUR

In accordance with IRAM 1605.

ENEL DISTRIBUCION CHILE

The tests will be developed as indicated in local procedure PDAR-3011, the installation for the development of the tests is specified in CMD-14161

The poles subjected to a stress equal the breaking stress (Er) at a distance of 0.15m from the top, should not submit sags above, after reducing the load evenly, to return zero, the residual deflection shall not exceed:

· 0.8% of the nominal length, when traction is applied in the direction of least stress. Applying stress equal to Secondary stress (Es) x Safety Factor (CS)

· 0.35% of the nominal length, when traction is applied in the direction of greatest stress. Applying stress equal to Nominal stress (En) x Safety Factor (CS)

7.7.3	Cracks	All the poles subject to a stress equal to nominal stress shall not submit cracks, with the exception of capillary cracks. Cracks that appear while implementing stress related to 140% of the nominal stress, after removing the stress, should be closed or become capillaries.. The tests will be developed as indicated in local procedure PDAR-3011, the installation for the development of the tests is specified in CMD-14161. **ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS** Cracks that appear during 140% of nominal stress (E_n) and the application of bending moments and nominal vertical load will be less than 0.3mm. The residual cracks that appear after residual sag shall close or to be capillary.

7.8	Nominal Stress	**ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS / ENEL DISTRIBUCION CHILE** In accordance with Table 3 **ENEL DISTRIBUCION CHILE** In accordance with Table 4 **ENEL DISTRIBUCIÓN PERU** In accordance with Table 5 **ENEL DISTRIBUCIÓN COLOMBIA** In accordance with Table 6 **EDESUR** In accordance with Table 7
7.9	Safety factor	**ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUCION CHILE / ENEL DISTRIBUCIÓN PERU / ENEL DISTRIBUCIÓN COLOMBIA** This value is obtained by the following formula: $CS = \frac{E_R}{E_n}$ *CS : Safety Factor / E_R : Breaking Strength / E_n : Nominal Stress* Stresses are applied at the plane of real stress, which is located at a distance “d” below of the top of the pole. The requested value for ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ will be 2.00. For ENEL DISTRIBUCIÓN PERÚ this value will be 2.00 and 2.50 for the poles of nominal stress of 200 daN and 400 daN respectively. For ENEL DISTRIBUCIÓN CHILE this value will be 2.00 for all poles, according to Local Standard NSEG. For ENEL DISTRIBUCIÓN COLOMBIA this value will be 2.50 for all poles.
7.10	Grounding or Earthing system	**ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS** The poles used in Medium Voltage Electrical Systems shall have a PVC or Polyethylene pipe for the passing of the grounding conductor, as provided indications on design drawings of paragraph 11.3. Also for ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ the diameter of the PVC or Polyethylene pipe will be 19mm. **ENEL DISTRIBUCION CHILE** The poles used in Medium Voltage Electrical Systems shall have a HDPE PEN 16, diameter 20mm and 2mm thickness pipe for the passage of the grounding conductor, as provided indications on design drawings of paragraph 11.3. **EDESUR** In accordance with IRAM 1605.

		ENEL DISTRIBUCION COLOMBIA Concrete posts must have a plate or other metallic element with a section not less than 78 mm^2, located less than one meter from the burial mark, which serves as an electrical contact between the steel of the pole frame and the external grounding connection.
7.11	Marking and designation of pole	The poles shall submit a recorded identification (labeling) directly on the concrete, legibly and indelibly, located according to design drawings. Shall be considered the following information: Date of manufacture, nominal length, nominal stress, manufacturer´s name, name of the distribution company. Also poles shall submit the following marks: • Signage to 3m, measured from the butt. • Mark of embedment height. • Mark of center gravity. For **ENEL DISTRIBUCIÓN PERU** additionally shall be included: • Diameter of the top. For **ENEL DISTRIBUCIÓN COLOMBIA** additionally shall be included: • Manufacturing date dd-mm-yy. • Weight of pole. • The word “BOG-CUN” and the purchase order. • Value of Breaking Strength For **ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS** additionally shall be included: • Serial number Should be identified with paint on pole butt section at least the information: Length, rated load and date of manufacture. For **ENEL DISTRIBUCION CHILE** additionally shall be included: · Manufacturing date dd-mm-yy. · Weight of pole. · "Identification plate for Poles" with serial number as standard for "Marking Concrete Poles”. · Mark of center gravity . Mark of embedment height.
7.13	Lifetime	The poles manufactured under this specification shall have a minimum life of 35 years from the date of manufacturing, with a failure percentage of 1% for the first 10 years and 1% for each 5 subsequent years, totaling 6% at the end of period.

		N°	TEST	REQUIREMENT	TEST METHOD
8.2.2	List of type tests		Materials Quality		
		A	Concrete additive materials	Values required by standards specified in section 4.2	
		B	Metal reinforcement steel	Values required by standards specified in section 4.2	
			Manufacturing Quality		
		C	Compressive resistance of concrete	Values required by standards specified in section 4.2	
		D	Concrete coating	ENEL DISTRIBUCIÓN COLOMBIA Required thickness : 20 mm ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS Required thickness : 15mm for longitudinal and transversal measurements. 20mm for the top of the pole. ENEL DISTRIBUCION CHILE Required thickness : 20mm ENEL DISTRIBUCIÓN PERU Required thickness : 20mm (En = 200) 25mm (En = 400)	Typically the verification is performed on poles that were tested to break. Found 5 points along the pole exposing the rebar, by some mechanical means, then measured at each point concrete thickness with a gauge accurate to 1mm. This verification may be performed by non-destructive process.
		E	Test water absorption index	a) 6% of the average of the samples b) 7.5% to test pole For ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS: a) ≤ 5.5% of the average of the samples b) ≤ 7.0% to test pole	a) The samples for absorption tests are removed after breaking test. After each broken pole is removed 4 concrete blocks without apparent cracks, whose linear dimensions are four to ten times greater than the maximum diameter of the aggregate used in the production of concrete. b) Samples are marked with the same number or identification mark of the poles that were removed. c) The samples are immersed in water, in a suitable vessel, at ambient temperature, for a minimum 30h, or until constant weight is maintained, that is,

				when 2 (two) successive weighings indicate an increase not higher than 0.1% of its original weight. Once removed from the water, drained for a 1 min and having removed the surface water carefully using a dry cloth, the sample shall be weighed immediately. After weighing, will dry at a temperature between 70 ° C and 80 ° C until 2 (two) successive weighing, with a minimum interval of 2 h, indicate a weight loss of no more than 0.1% of its original weight. d) If the samples shown pieces of rebar, considerations of the results shall be determined and shall reduce its weight. e) The difference in weight of the sample after immersion and after drying, expressed in percentages by weight of the dry sample, shall be the absorption index. f) The absorption index of a pole in percentage is the arithmetic mean of the values obtained with the samples removed from the same pole. For ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ/ENEL DISTRIBUIÇÃO GOIÁS will be according to NBR 8451-4.
			Dimensionales	
	F	Checking dimensions	Design drawings approved	Visual Inspection
	G	Marking	Paragraph 7.11	Visual Inspection
			Mechanics	
	H	Elastic bending test with 100% rated load	a) The pole shall not present cracks, except capillary cracks. b) The sag shall not be higher than indicated in 7.7.1.	a) The pole shall be embedded rigidly at a distance "he", referred in paragraph 7.6. b) At a distance d = 0.1 m from the top, a force shall applied gradually up to a value E_n (nominal stress) and maintain this stress for one minute to allow the accommodation of embedment.

			c) Release the applied load gradually and reapply a stress gradually until to achieve the value "E_n", will maintain this stress for at least 5 minutes.
I	Breaking strength test	a) This value shall be equal or greater than 200% rated load	Proceed similarly to the nominal load test but this time using a higher stress than "E_n" until cause the rupture of the pole.

ENEL DISTRIBUCION CHILE:

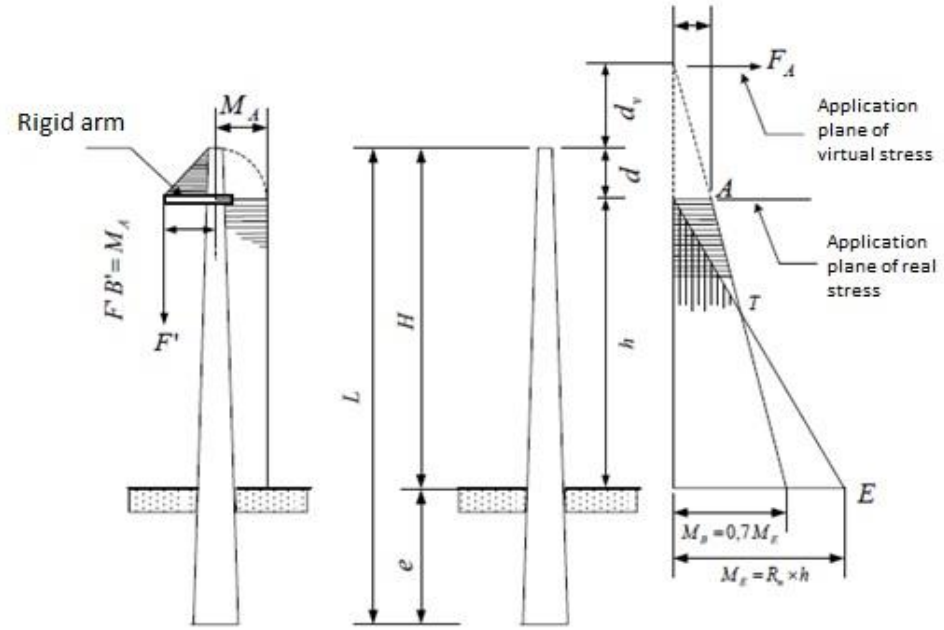


Figure 3: Scheme for testing bending moment

ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS:

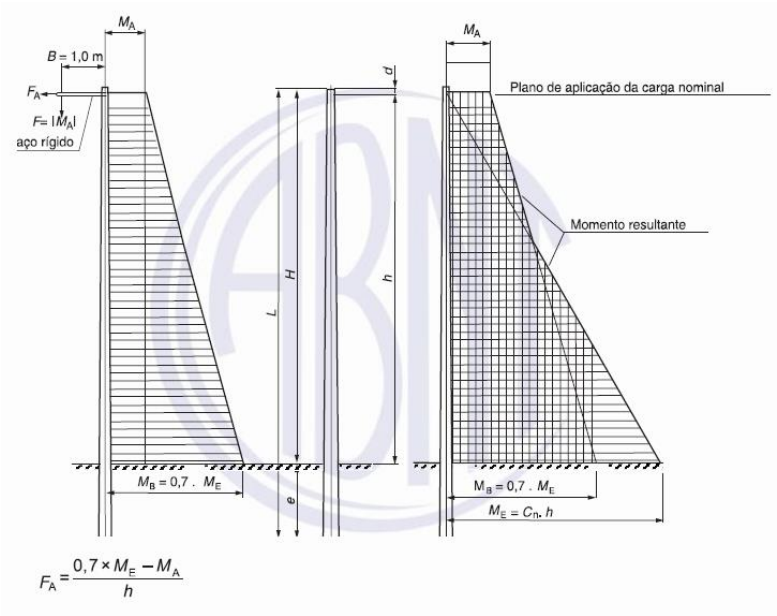


Figure 4: Scheme for testing bending moment

EDESUR

In accordance with IRAM 1605.

8.3.1 Sampling plan (reception)

Table 10: Sample Size, and Acceptance Criteria – Dimensional tests

Distribution Company	Type of Sample	Inspection Level	AQL
ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ/ ENEL DISTRIBUIÇÃO GOIÁS	Double, according to NBR 8451-1 Table 7 and Table 9	I	1.5% 4.0% 10.0%
ENEL DISTRIBUCIÓN COLOMBIA	Single	II	4.0%
ENEL DISTRIBUCIÓN PERU	According to NTP 339.027		
ENEL DISTRIBUCIÓN CHILE	According to PDAR-3011		
EDESUR	Double	S-2 y S-3(Normal)	4.0%
		S-4 (Simplification)	4.0%
		S-3 (Strict)	6.5%

Table 11 :Sample Size, and Acceptance Criteria – Mechanical tests

Distribution Company	Type of Sample	Inspection Level	AQL
ENEL DISTRIBUIÇÃO RIO/ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS	Single, according to NBR 8451-1 Table 8 and Table 10 [1]	S-3	1.5% 4.0%
ENEL DISTRIBUCIÓN COLOMBIA [2]	Single	S-3	4.0%
ENEL DISTRIBUCIÓN PERU	According to NTP 339.027		
ENEL DISTRIBUCIÓN CHILE	According to PDAR-3011		
EDESUR	Double	S-2 y S-3(Normal)	4.0%
		S-4 (Simplification)	4.0%
		S-3 (Strict)	6.5%

[1]: The sample size to perform the breaking strength load test, vertical load, concrete coating, water absorption, and bending moment shall be 1 for each lot of 200 poles.

[2]: for Enel Distribución Colombia the following apply:

Sampling plan. Bending test at working load. Ispection level S3, NCA = 4%

Lot q.ty	Samples	Acceptance	Reject
2 - 8	2	0	1
9 - 15	2	0	1
16 - 25	3	0	1
26 - 50	3	0	1
51 - 90	5	0	1
91 - 150	5	0	1
151 - 280	8	1	2
281 - 500	8	1	2
501 - 1200	13	1	2

Sampling plan. Bending test at nominal load. Ispection level S 1, NCA = 4%

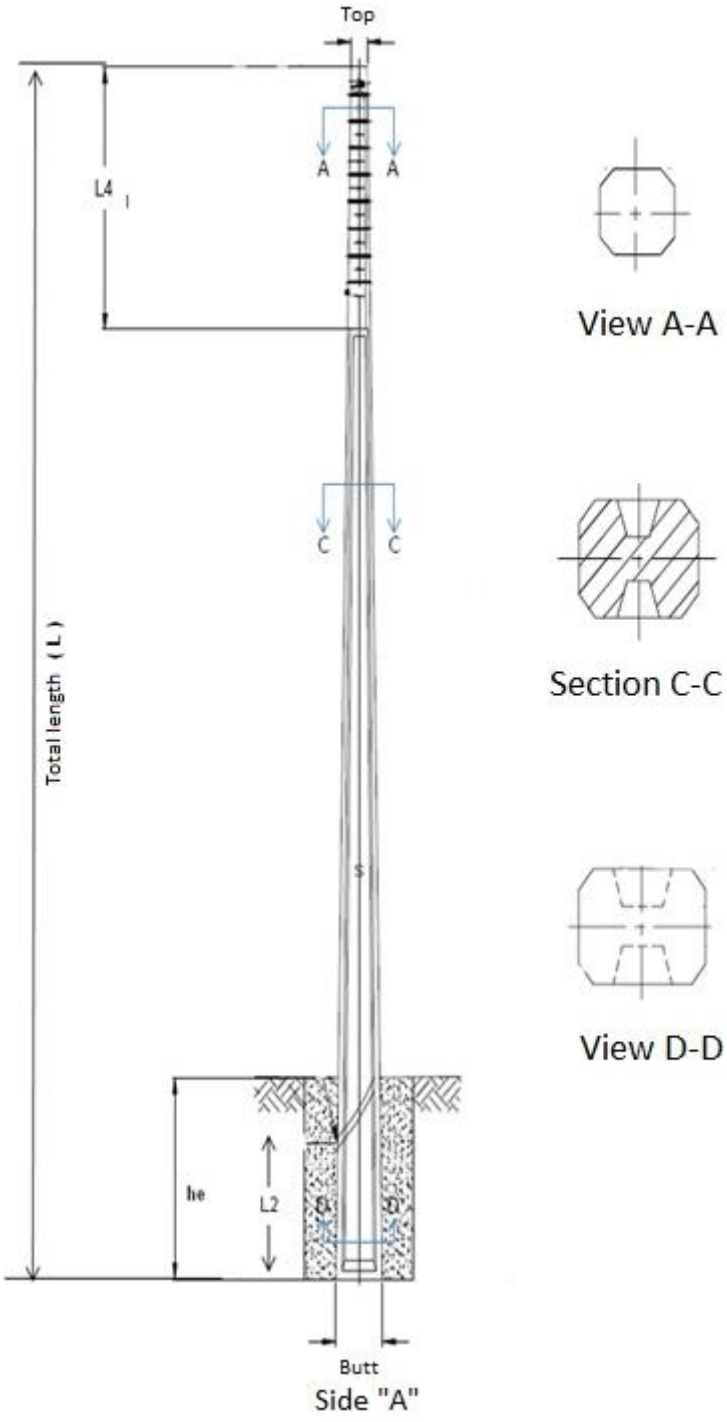
Lot q.ty	Samples	Acceptance	Reject
2 - 8	2	0	1
9 - 15	2	0	1
16 - 25	2	0	1
26 - 50	2	0	1
51 - 90	3	0	1
91 - 150	3	0	1
151 - 280	3	0	1
281 - 500	3	0	1
501 - 1200	5	0	1

Table 12 :Sample Size – Manufacturing Quality Test

Distribution Company	Lot or Batch Size	Sample Size
Enel Distribuição Rio / Enel Distribuição Ceará / Enel Distribuição Goiás	200	2
Enel Distribución Chile	60 - 120	1
	According to PDAR-3011	
Enel Distribución Colombia	50 - 150	3
Enel Distribución Peru	200	1
Edesur	200	1

8.4	Other tests	**ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS** In addition.

N°	TEST	REQUIREMENT	TEST METHOD
1	Mechanics		
1.1	Elastic bending test with 140% rated load	a) The pole shall not present cracks, except capillary cracks. b) The sag shall not be higher than indicated in 7.7.1 and 7.7.2 c) Residual sag is the sag that remains after removing the stresses, indicated in 7.7.2	a) The pole shall be embedded rigidly at a distance "he", referred in paragraph 7.6. b) At a distance according item 7.7.1 from the top, a force shall applied gradually up to a value E_n (nominal stress) and maintain this stress for 3 minutes to allow the accommodation of embedment. c) Apply a stress gradually until to achieve the value $1.4xE_n$, will maintain this stress for at least 3 minutes.
1.2	Bending Moment Test	a) The pole shall not present cracks under specified load.	According to NBR 8451-3

11.3	Design drawing	**ENEL DISTRIBUIÇÃO RIO / ENEL DISTRIBUIÇÃO CEARÁ / ENEL DISTRIBUIÇÃO GOIÁS:**  **Figure 5: General geometry of pole type HV**

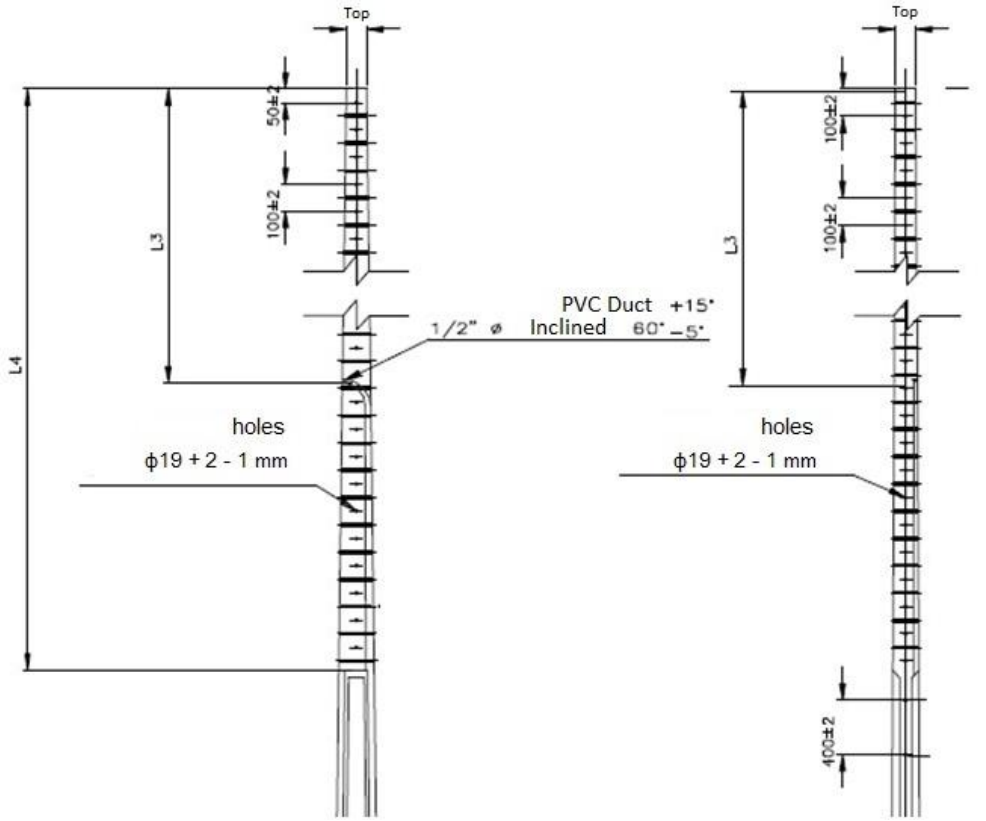


Figure 6: General construction details of pole type HV

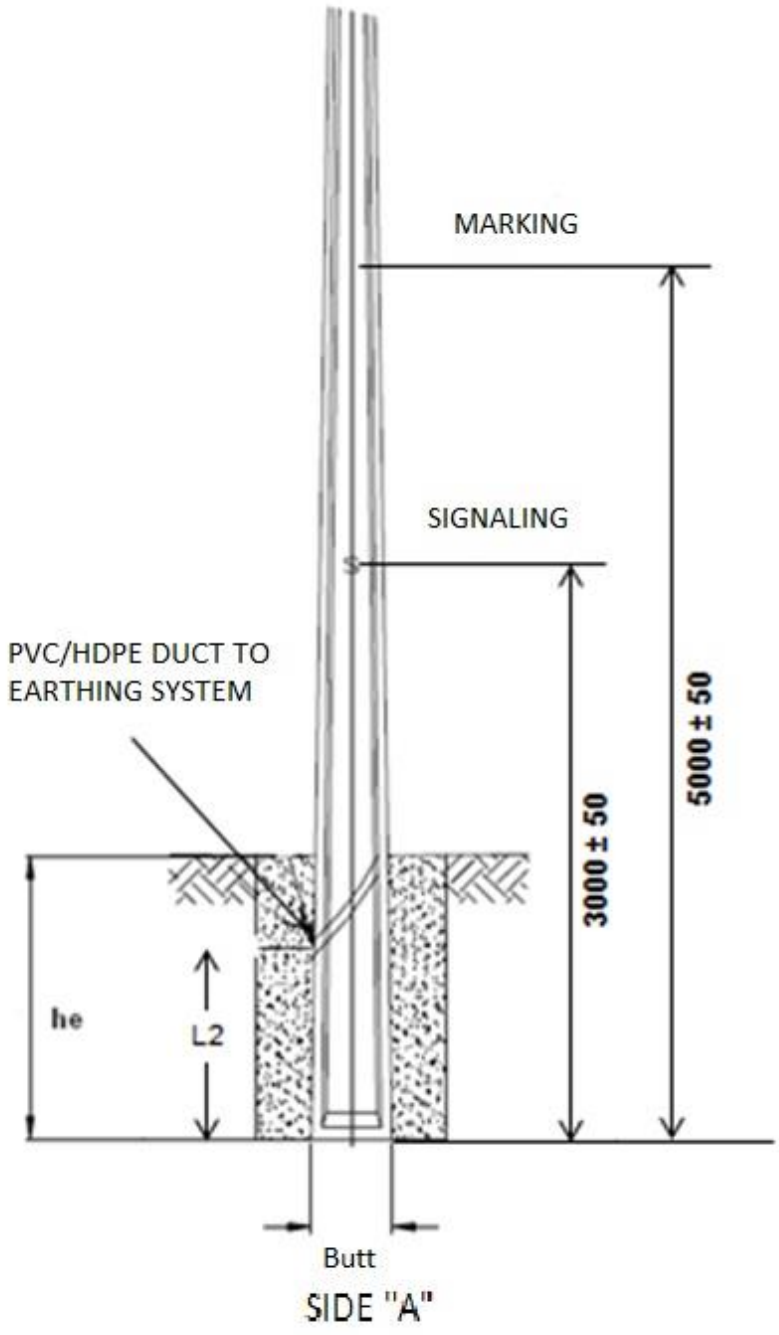


Figure 7: Marking details of pole type HV

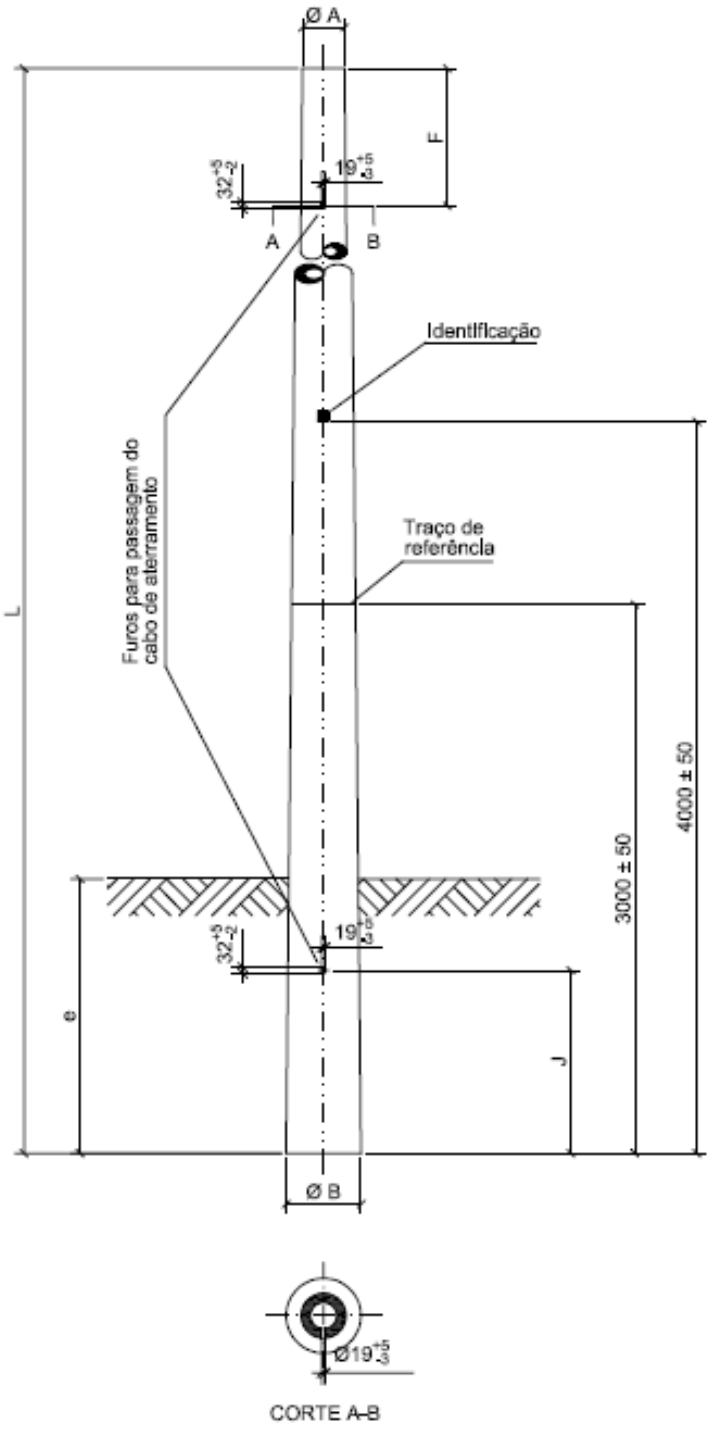
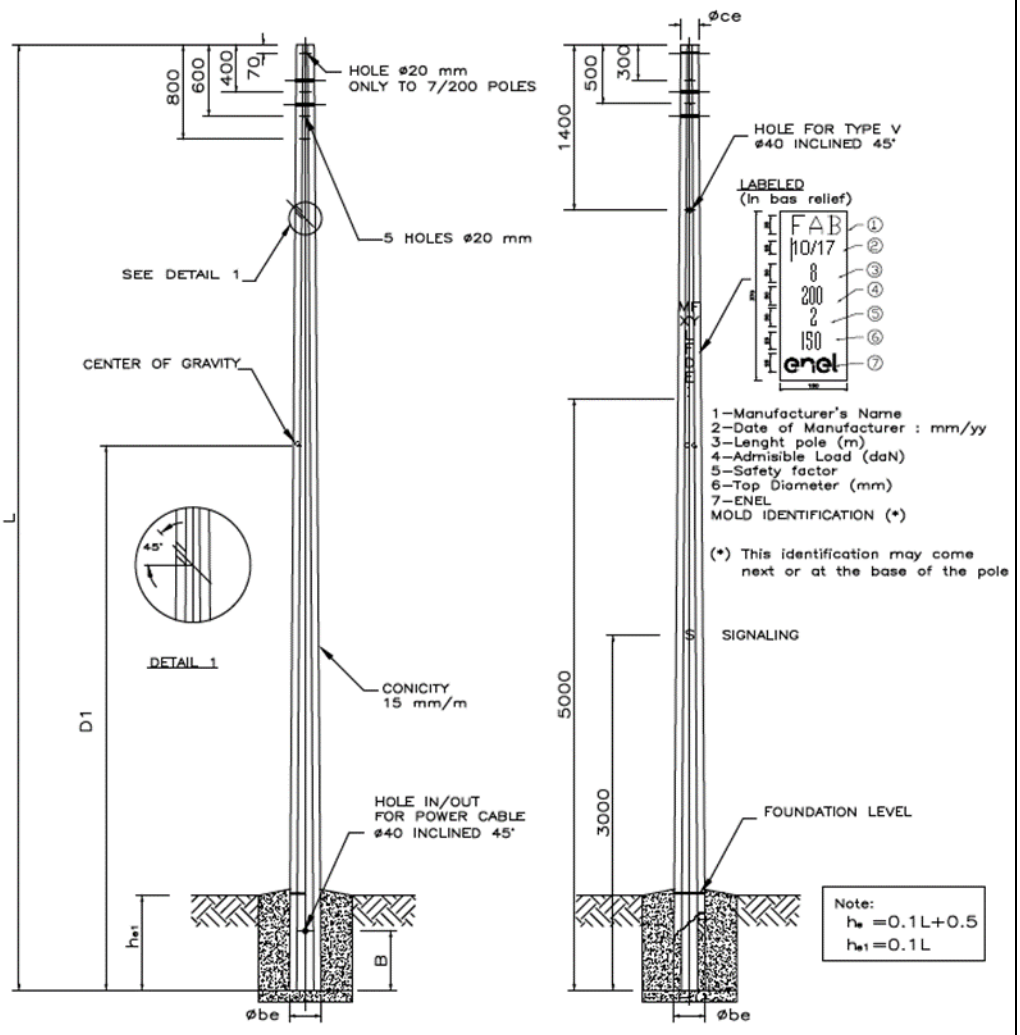


Figure 8: General geometry of pole type HCV

11.3	Design drawing	**ENEL DISTRIBUCIÓN PERU:**  **Figure 8: Centrifuged Concrete Pole – Low Voltage Overhead Lines**

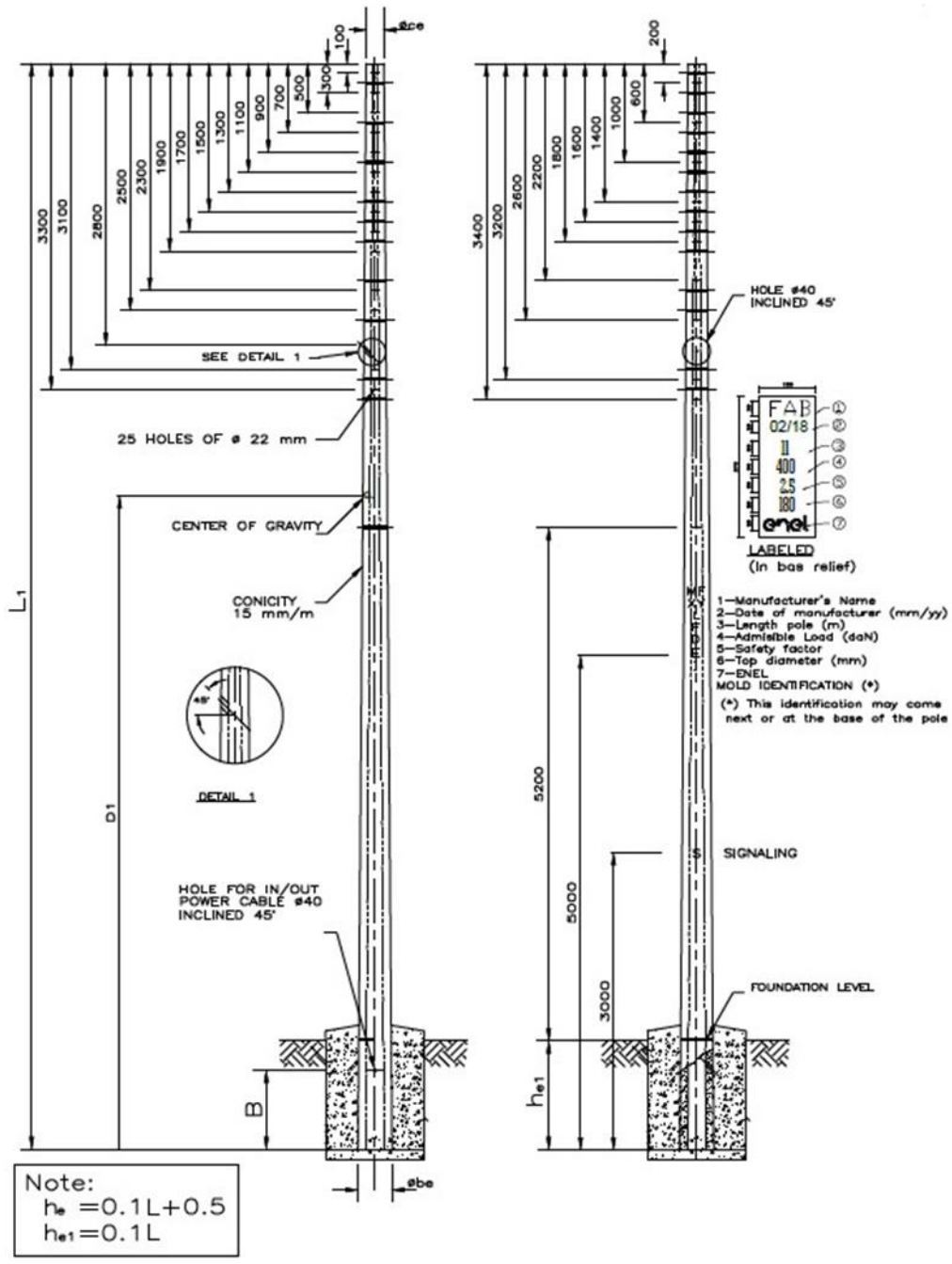


Figure 9: Centrifuged Concrete Pole – Medium Voltage Overhead Lines

11.3	Design drawing	**ENEL DISTRIBUCIÓN COLOMBIA:**

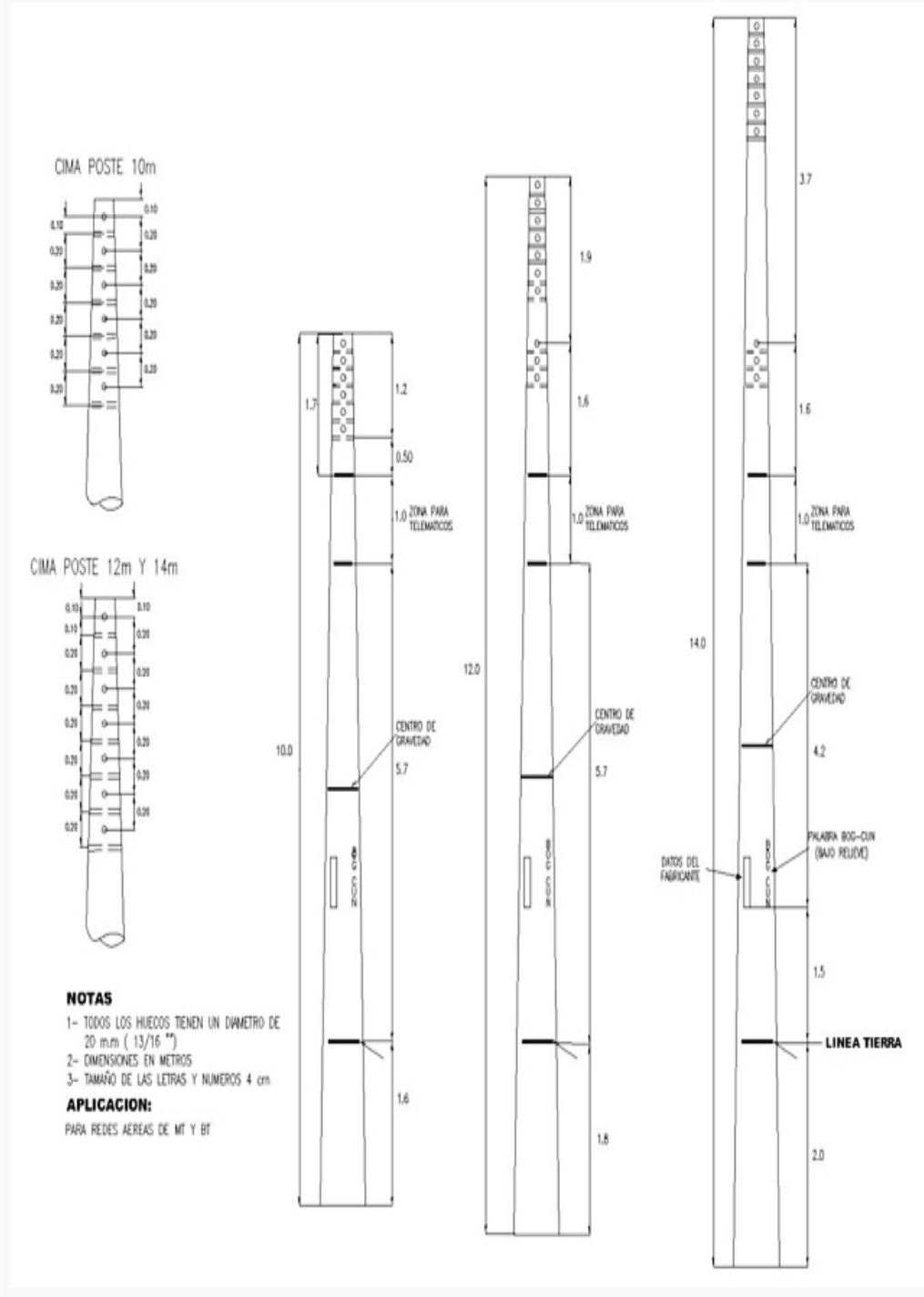


Figure 10: Pre-stressed Conical Frustum Pole – Medium/Low Voltage Overhead Lines

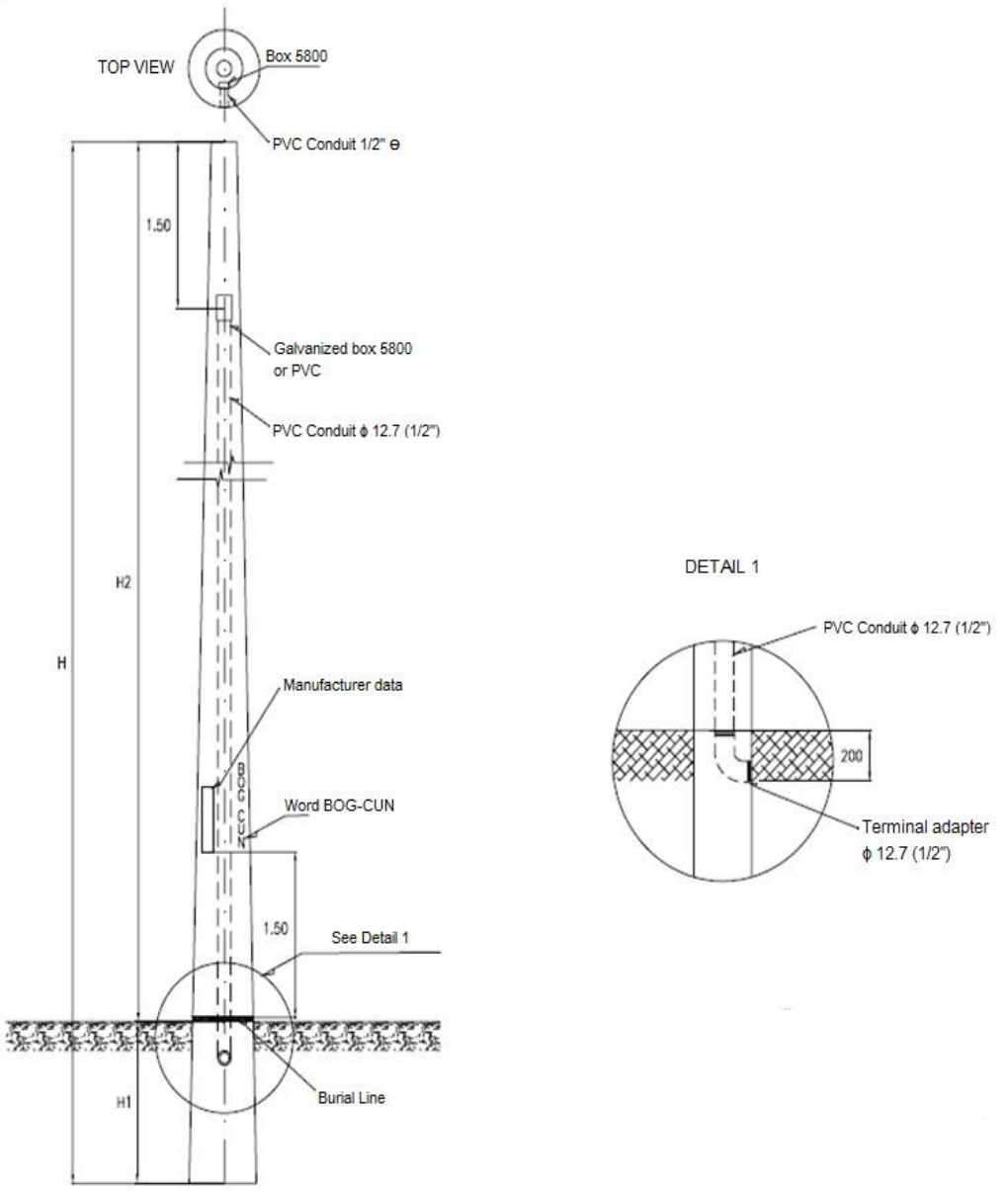
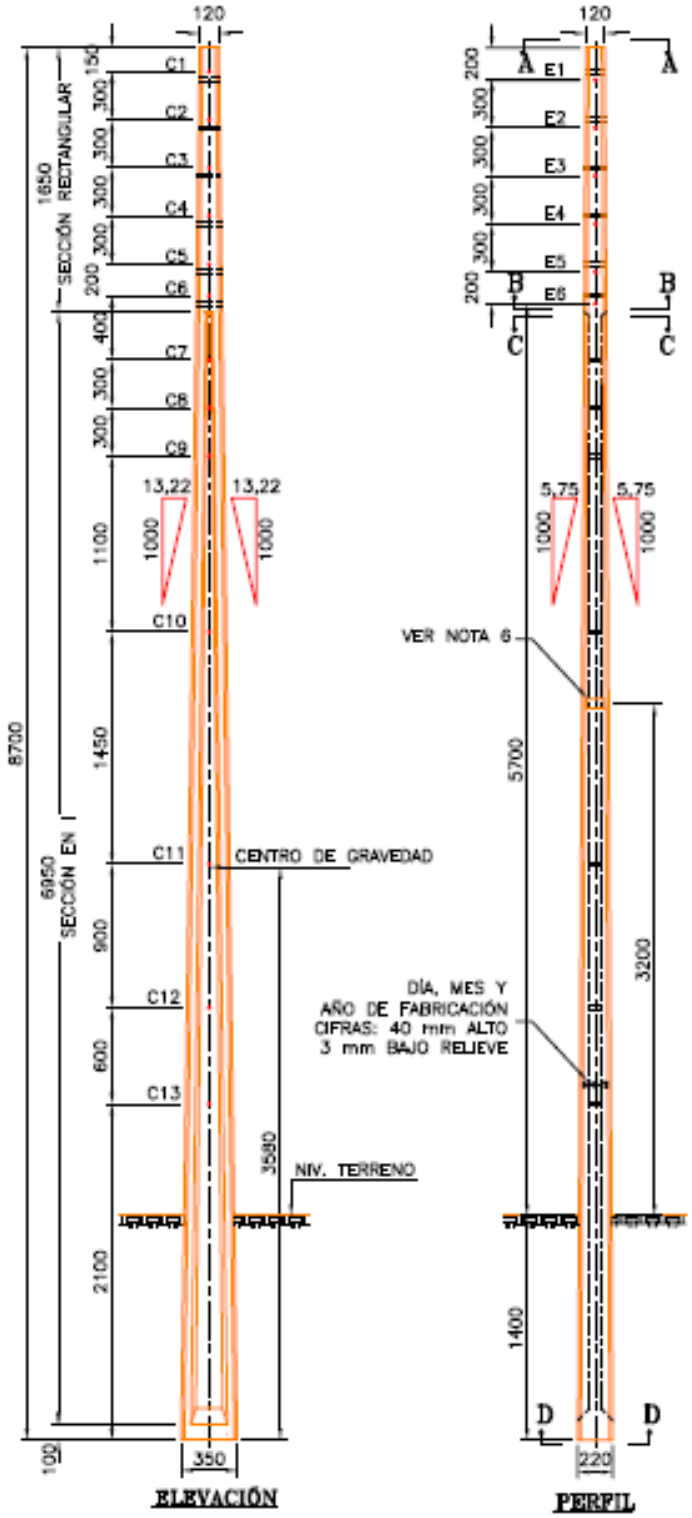


Figure 11: Pre-stressed Conical Frustum Pole – Underground Lines for street lighting (AP)

ENEL DISTRIBUCION CHILE:

Data sheet		
L (m)	Armor details	General layout
8,7	DMAD-0182	SDO-8156
11,5	DMAD-0180	SDO-8158
13,5	DMAD-0184	CHI-25930
15,0	DMAD-0183	SDO-11411


120
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C12
C13
150
300
300
300
300
200
400
300
300
1100
1450
900
600
2100
100
1650
SECCIÓN RECTANGULAR
6950
SECCIÓN EN I
8700
13,22
13,22
1000
1000
CENTRO DE GRAVEDAD
3580
NIV. TERRENO
350
ELEVACIÓN
120
A
A
E1
E2
E3
E4
E5
B
B
E6
C
C
200
300
300
300
300
300
200
5,75
5,75
1000
1000
VER NOTA 6
5700
DÍA, MES Y
AÑO DE FABRICACIÓN
CIFRAS: 40 mm ALTO
3 mm BAJO RELIEVE
3200
1400
D
D
220
PERFIL
POSTE 8.7 m

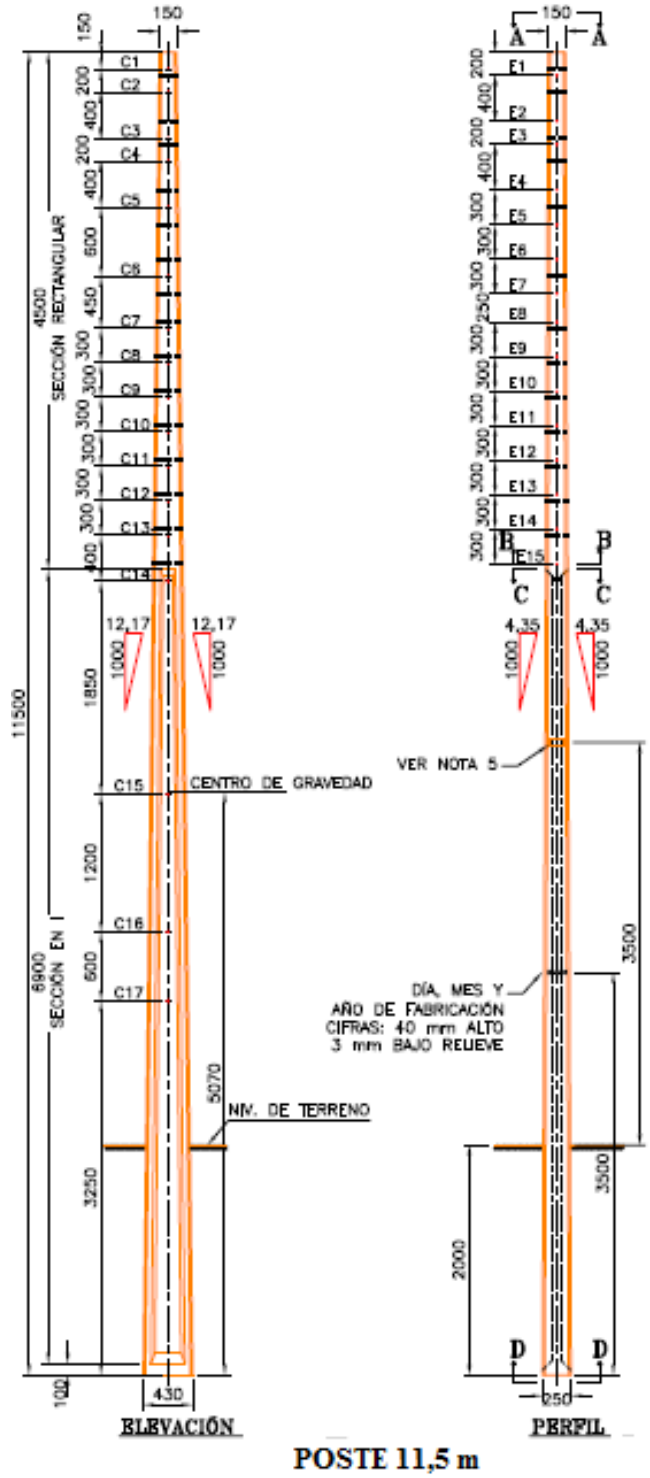
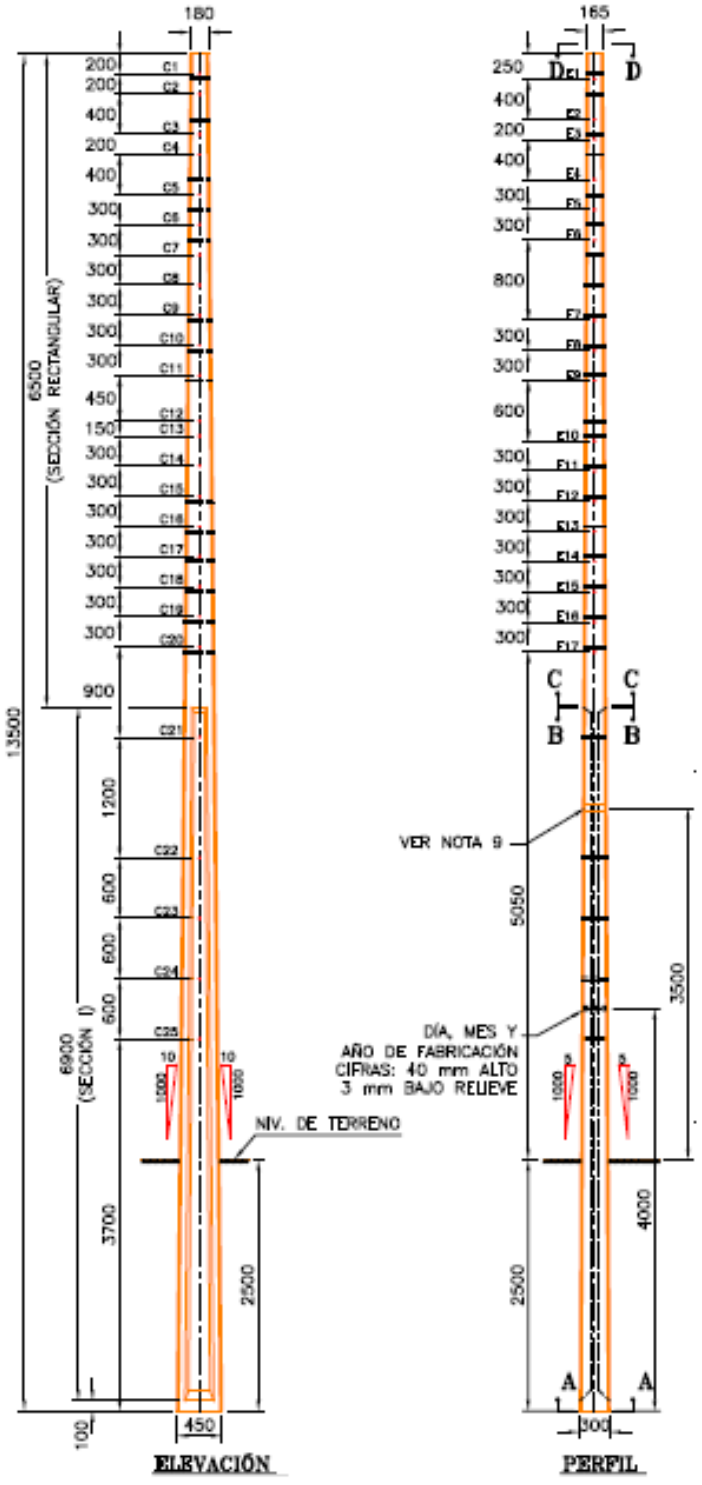


Figure 12: General dimensions for poles type HV – 8.7m and 11.5m


180
200
200
400
200
400
300
300
300
300
300
300
300
450
150
300
300
300
300
300
300
300
900
1200
600
600
600
6900
(SECCIÓN I)
6500
(SECCIÓN RECTANGULAR)
13500
3700
2500
100
450
NIV. DE TERRENO
ELEVACIÓN
165
250
400
200
400
300
300
800
300
300
600
300
300
300
300
300
300
300
C
B
B
C
VER NOTA 9
5050
3500
DÍA, MES Y
AÑO DE FABRICACIÓN
CIFRAS: 40 mm ALTO
3 mm BAJO RELIEVE
4000
2500
A
A
300
PERFIL

POSTE 13,5 m

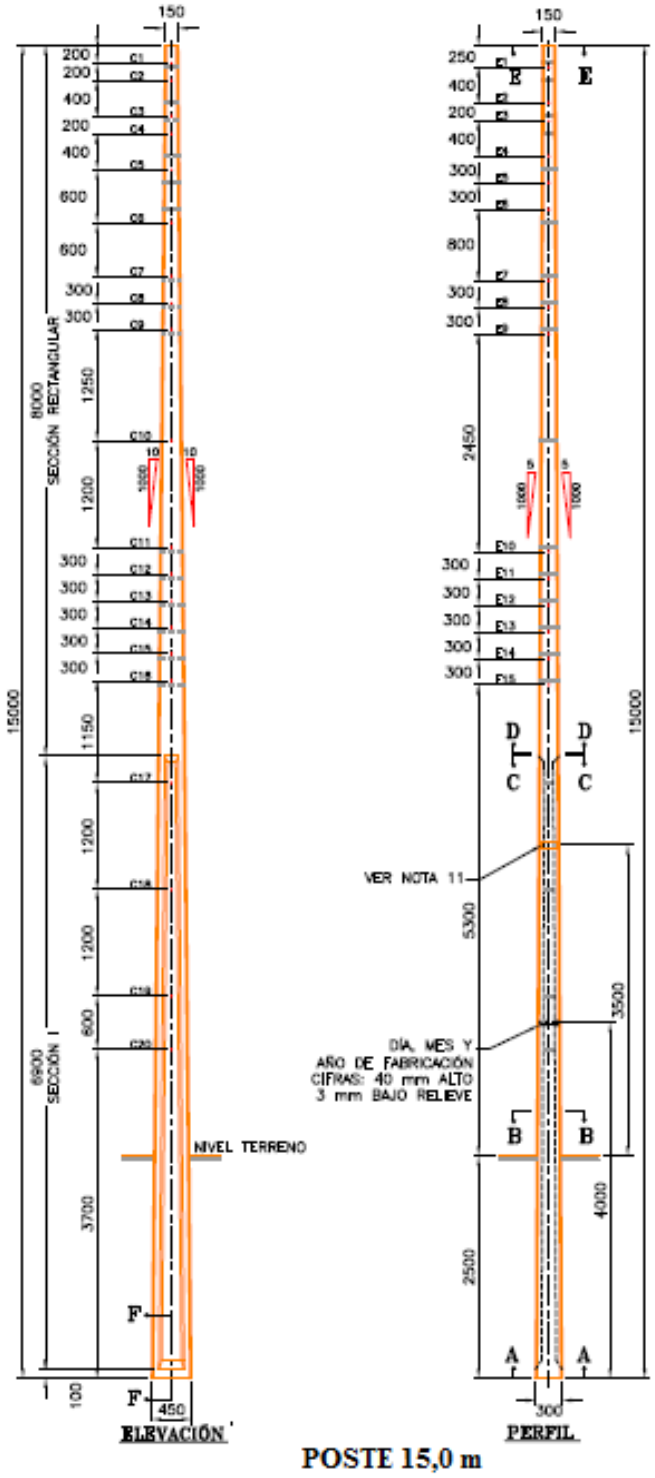


Figure 13: General dimensions for poles type HV – 13.5m and 15m

ENEL DISTRIBUIÇÃO RIO:

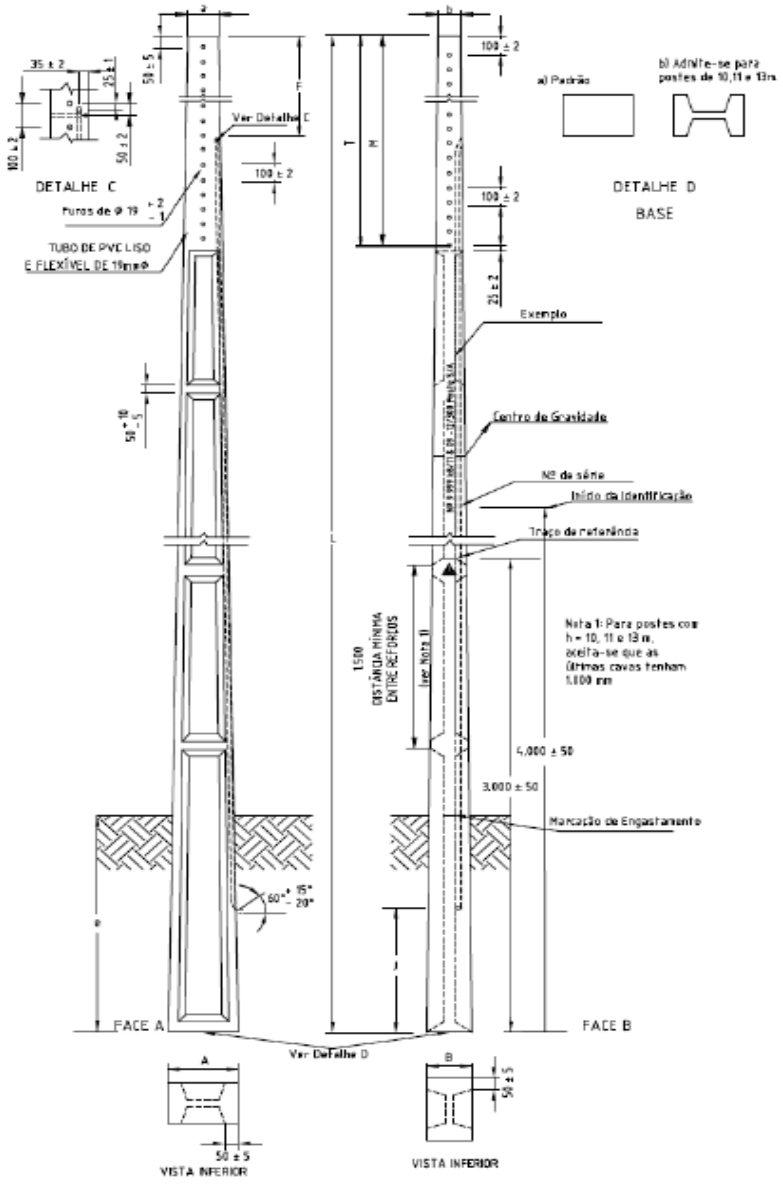


Figure 14: General dimensions for poles HV

B. LOCAL SECTION – ENDESA DISTRIBUCIÓN ELÉCTRICA (SPAIN)

ITEM	TITLE	DESCRIPTION
2	DEFINITIONS	**Reinforced Pole:** A pole designed to withstand the nominal stress "E_n" at a distance "d=0.25m" below the top (Cogolla) or a useful stress "K x E_n" at a distance "h_5" above the top (Cogolla) that represent the position of the resultant of applied stresses. To h_5 = 0,75 m; K = 0,9 For other values of h_5, K = 5,4 / (h_5 + 5,25) HV poles are reinforced **Nominal Stress or admissible load, E_n (complement)** In addition to the general section, this stress will apply at a distance "d=0.25m" below the top (cogolla) and simultaneously with the resulting stress from the pressure of 100 daN / m^2 exerted by the wind in the same direction on the free surface of the pole. **Secondary stress (E_s) (complement)** In addition to the general section, this stress will apply at a distance "d=0.25m" below the top (cogolla) with the same safety factor applied to nominal stress and without wind load consideration. **Global Safety Factor at break** Ratio between the breaking torque and service torque of a determined section.
4.1	International standards	• **EN 197-1** : Cement – Part 1: Composition, specifications and conformity criteria for common cements. • **EN 353-1** : Personal protective equipment against falls from a height – Part 1: Guided type fall arresters including a rigid anchor line. • **EN 353-2** : Personal protective equipment against falls from a height – Part 2: Guided type fall arresters including a flexible anchor line. • **EN 934-2** : Admixtures from a concrete, mortar and grout – Part 2: Concrete admixtures – Definitions, requirements, conformity, marking and labeling. • **EN 1008** : Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete.

		• **EN 10080** : Steel for the reinforcement concrete – Weldable reinforcing steel – General. • **EN 12620** : Aggregates for concrete. • **EN 12843** : Precast concrete products – Mast and poles. • **EN 12878** : Pigments for the colouring of building materials based on cement and/or lime – Specifications and methods of test. • **EN 13369** : Common rules for precast concrete products.
4.2	Local Standards	• **UNE 207016** : Postes de hormigón tipo HV y HVH para líneas eléctricas aéreas. • **UNE 17024** : Tirafondos de cabeza redonda con ranura recta**.** • **Real decreto 223/2008, de 15 de febrero por el que se aprueba 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.** • **DMAD-0182 / SDO-8156** Poste de Hormigón Armado de 8,7m • **DMAD-0180 / SDO-8158** Poste de Hormigón Armado de 11,5m • **DMAD-0184 / CHI-25930** Poste de Hormigón Armado de 13,5m • **DMAD-0183 / SDO-11411** Poste de Hormigón Armado de 15,0m • **PDAR-3011** Procedimiento de ensayos de recepción a postes en fábrica • **CMD-14161** Cancha para ensayes •
4.3	List of replaced Local Standards	• **AND00200** : POSTES DE HORMIGON ARMADO VIBRADO (HV)

7.1 Manufacturing materials

	Tests /Requirements
Cement	CE marking (UNE-EN 197-1) Requirements EHE (Code on Structural Concrete)
Gravel (Aggregates)	CE marking (UNE-EN 12620) Requirements EHE (Code on Structural Concrete)
Water	UNE-EN 1008
Steel	UNE-EN 10080 Requirements EHE (Code on Structural Concrete)
Additives	CE marking (UNE-EN 934-2) Requirements EHE (Code on Structural Concrete)
Pigments	UNE-EN-12878 Requirements EHE (Code on Structural Concrete)
Concrete	UNE-EN 13369 UNE-EN 12843 UNE 207016

7.2 Dimensions

The poles to use shall be of the reinforced type.

Table 13 shows lengths and nominal stress for selected concrete poles:

Table 13: Lengths and Nominal Stresses

Length (m)	Nominal Stress (daN)					
	250	400	630	800	1000	1600
9	X	X	X	X	X	
11	X	X	X	X	X	X
13	X	X	X	X	X	X
15				X	X	

Table 14, shows the nominal and secondary stress with their global safety factor at break and the breaking torque. In Table 15, nominal dimensions of the top for each length and stress level of the poles are established.

Table 14: Stresses and Safety factors

Nominal		Secondary		Breaking torsional stress (daN x m)
E_n (daN)	Safety Factor	E_s (daN)	Safety Factor	
250	2.25	160	2.25	-

			400	2.25	250	2.25	-
			630	2.25	360	2.25	-
			800	2.25	400	2.25	-
			1000	2.25	500	2.25	540
			1600	2.25	600	2.25	540

Table 15 : Nominal dimensions of the Top (Cogolla)

Nominal Stress, E_n (daN)	Measurement of the Top (mm x mm)	Length (m)			
		9	11	13	15
250	110 x 145	X	X	X	
400	140 x 200	X	X	X	
630		X	X	X	
800		X	X	X	X
1000	170 x 255	X	X	X	X
1600			X	X	

The conicity adopted to the wide face should be (21 ± 2) mm/m and to the narrow face (13 ± 2) mm/m.
The general geometry of the pole type HV is shown in section 11.3 of this Appendix where the dimensions of the main sections are detailed.

7.4	Holes	The arrangement of the holes required in each of the faces, as other particulars are shown in Figure 21. These holes will have a diameter of 18 mm (± 0.7 mm).
7.6	Embedment length	The theoretical embedment length will corresponds to the following formula: **he = 0,1 L + 0,5**
7.8	Nominal Stress	They are shown in Table 13.
7.9	Safety factor	Is determined by the global safety factor at break (CS), which must have a minimum value of 2.25. This value is obtained according the loading capacity test defined in paragraph 5.2.2 from standard UNE 207016.
7.10	Grounding or Earthing system	The poles have two identical grounding terminals, on the same narrow face of the pole. In Figure 15 the shape and arrangement of the ground terminals are detailed. The screw with strength class 5.6 and the 50 mm × 50 mm plate, shall be galvanized. The screw shall be provided installed on the pole.

The rebar earthing welding will be at least 30 mm long and continuous in two sections.

The upper terminal will be located at 2.10 m ± 0.05 m from the pole top (cogolla).

The lower terminal will be located at the distance $\mathbf{h_t}$ from the base, as shown in Table 16 for the HV type poles with a tolerance of ± 0.05 m.

Electrical continuity shall exist between the two terminals.

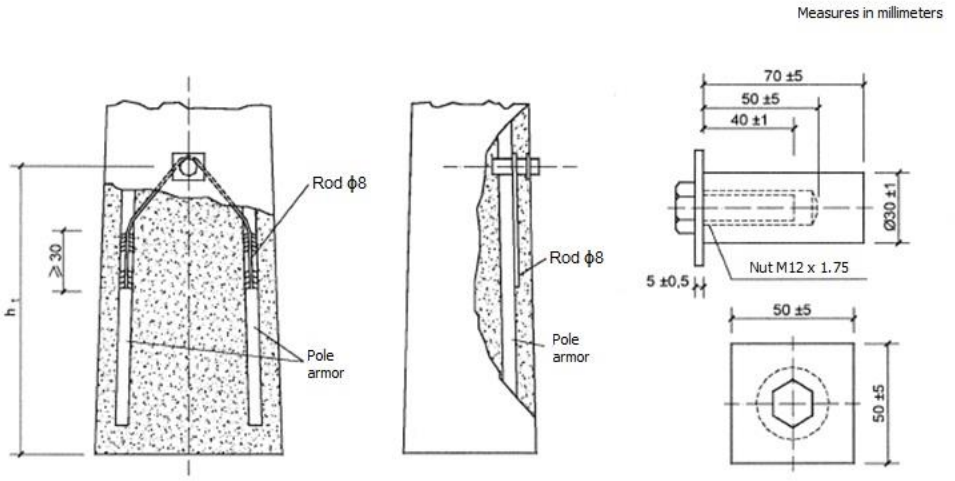


Figure 15: Shape and Arrangement of Grounding Terminals

Table 16 : ht distance, from the lower earthing terminal to the pole bottom

Nominal Stress E_n (daN)	Length (m)			
	9	11	13	15
250	2.00	2.10	2.30	-
400	2.20	2.30	2.50	-
630	2.20	2.30	2.50	-
800	2.20	2.30	2.50	2.60
1000	2.30	2.40	2.50	2.60
1600	-	2.40	2.50	-

7.11	Marking and designation of pole	**Marking** Poles should come equipped with an engraved plate which records, indelibly and easily legible, in addition to what was indicated in paragraph ZA.3.1.1 (simplified label) of UNE-EN 12843 Standard, the content shown in Figure 16. The plate measures and design must be according to Figure 16 and shall have a thickness between 0.6 mm to 0.8 mm, consist of anodized aluminum, and shall be installed at 4 m ± 0.20 m from the pole butt. It shall be fixed in the concrete through curled edges, claws or others providing similar hooking. For easy poles identification, the top (cogolla) shall be painted, as shown in Figure 17 with the color code specified in Table 17.

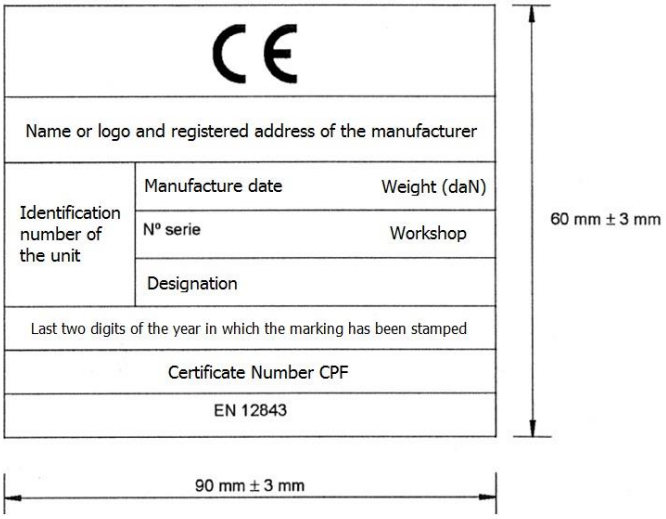


Figure 16: Characteristics plate

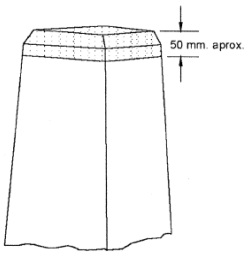


Figure 17: Painted of the top (Cogolla)

Table 17: Identification color for poles type HV

Nominal Stress, E_n (daN)	Identification Colors
250	Black
400	Blue
630	Red
800	Yellow
1000	Green
1600	White

Designation:

The reinforced vibrated concrete poles for overhead power lines are designated by acronyms arranged in the following order and with the following meaning:

- Acronym HV, indicative of the pole type, in this case reinforced vibrated concrete pole.
- Figure, in daN, representing the nominal stress value E_n.
- Acronym R, indicative of the reinforced pole.
- Figure, in meters, representing the pole length.

Example:
HV 1000 R 13
Pole type HV of 1000 daN nominal stress, reinforced, and with a total length of 13 meters.

Electrical hazards signaling:

Electrical hazards signaling shall be made by the electrical hazard sign shown in Figure 18 stamped on the concrete. The mark shall be formed with the same concrete which is an integral part of the pole and shall be made during the same manufacturing process, in order to be integrated as a uniform part of the pole. This mark will be located about 0.20 m below the characteristics plate.

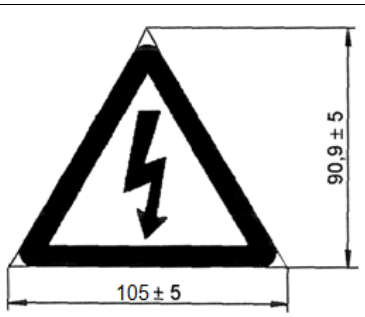


Figure 18: Electrical hazards stamped signaling (measures in mm)

Moreover, in order to foresee the installation of electric hazard signal shown in Figure 19, two plastic anchors shall be placed, embedded in the concrete, suitable for round head lag screws 3x18 according to UNE 17024 standard. These plastic anchors will be arranged on the narrow face axis of the pole, at a distance of 0,5m ± 0,05m above the characteristics plate and with a 154mm ± 2mm spacing between them.

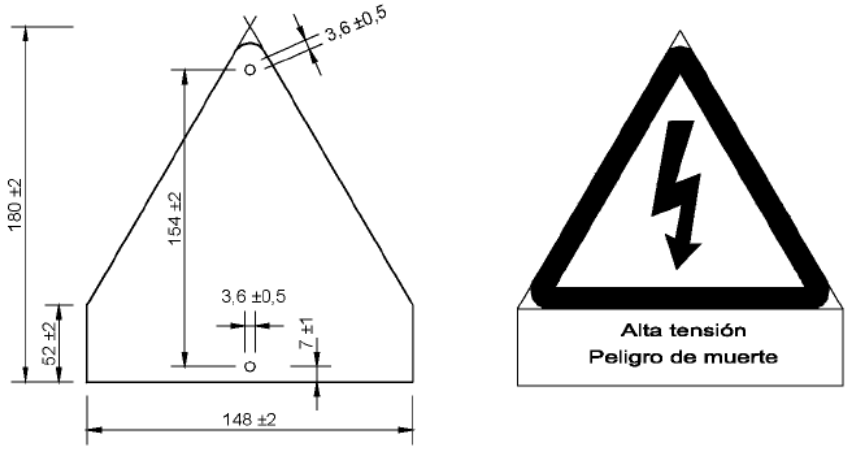


Figure 19: Electric hazard warning plate (measures in mm)

<table>
<tr><td>7.12</td><td>Safety line.</td><td>Concrete poles for overhead power lines should be foreseen and comply with the use of a safety line.
The safety line shall comply with the standard UNE-EN 353.
The poles shall be justified by calculation for a global safety factor at break not less than 1.5 in any of the following suppositions:

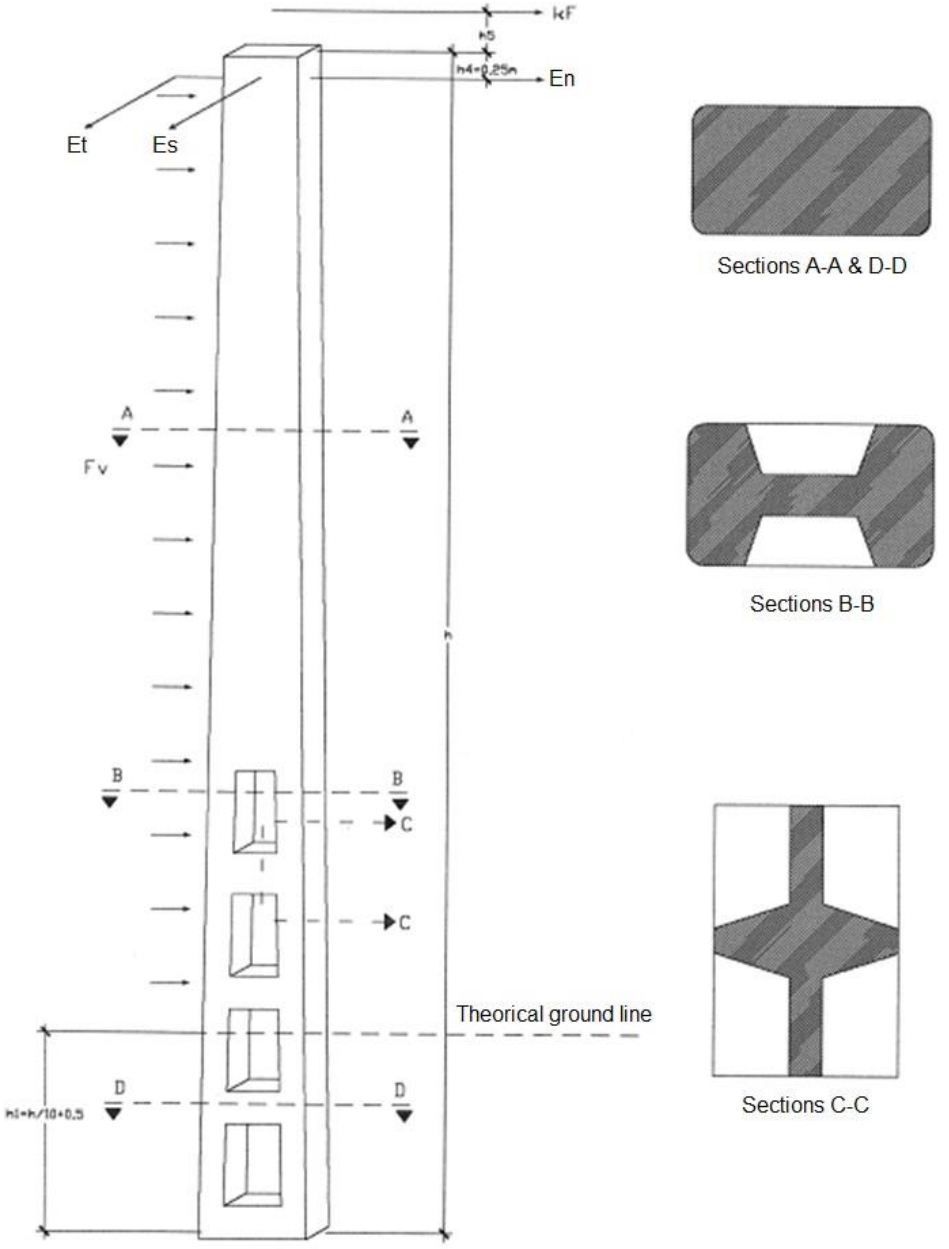
• A vertical stress in safety line anchor point of 600 daN simultaneous with a horizontal stress in the secondary direction equal to E_S (defined in Table 14)
• A vertical stress in safety line anchor point of 600 daN simultaneous with a horizontal stress in the main direction equal to E_n (defined in Table 14).

The upper safety line anchor point shall not be located closer than 170 mm from the pole top (Cogolla).
The safety line anchor device will have a design such that the maximum spacing between the application point of falling force and the face of pole on which it is held, shall be 100 mm.</td></tr>
<tr><td>8.2.1</td><td>Sampling plan (type)</td><td>Tests are performed on randomly selected lots that shall include a pole of each type and samples of materials used.</td></tr>
<tr><td>8.2.2</td><td>List of type tests</td><td>
<table>
<tr><th></th><th>TEST</th><th>REQUIREMENT</th><th>TEST METHOD</th></tr>
<tr><td></td><td colspan="3">Materials Quality</td></tr>
<tr><td>A</td><td>Concrete constituent materials</td><td>UNE-EN 13369, paragraph 4.1.2
Requirement EHE</td><td>Documentary, compliance requirements by the supplier</td></tr>
<tr><td>B</td><td>Metal reinforcement steel</td><td>UNE-EN 13369, paragraph 4.1.3
Requirement EHE</td><td>Supplier specifications</td></tr>
<tr><td></td><td colspan="3">Manufacturing Quality</td></tr>
<tr><td>C</td><td>Concrete compressive strength</td><td>UNE-EN 12843, paragraph 4.2
UNE 207016, paragraph 4.1</td><td>According to UNE-EN 13369, paragraph 5.1.1</td></tr>
<tr><td>D</td><td>Concrete Coating</td><td>UNE 207016, paragraph 4.2.3</td><td>Measurement according to UNE-EN 12843, paragraph 5.4</td></tr>
<tr><td></td><td colspan="3">Dimensional</td></tr>
<tr><td>F</td><td>Dimensional checking</td><td>UNE-EN 12843, paragraph 4.3.1
UNE 207016, paragraph 4.2.1</td><td>Measurement according to UNE 207016, paragraph 5.1</td></tr>
<tr><td>G</td><td>Marking</td><td>UNE-EN 12843, paragraph 7
UNE 207016, paragraph 7</td><td>Visual</td></tr>
<tr><td></td><td colspan="3">Mechanics</td></tr>
<tr><td>H</td><td>Elastic bending test</td><td>UNE 207016, paragraph 5.2.1.3</td><td>According to UNE-EN 12843, paragraph 5.5.2.2

According to UNE 207016, paragraph 5.2.1.2</td></tr>
<tr><td>I</td><td>Breaking strength test (Loading capacity test)</td><td>UNE 207016, paragraph 5.2.2.1</td><td>According to UNE-EN 12843, paragraph 5.5.3
According to UNE 207016, paragraph 5.2.2</td></tr>
</table>
</td></tr>
</table>

		J	Torsional test	UNE 207016, paragraph 5.2.3.3	According to UNE-EN 12843, paragraph 5.5.4 According to UNE 207016, paragraph 5.2.3
		K	Checking secondary stress	UNE 207016, paragraph 5.2.4.1	According to UNE 207016, paragraph 5.2.4
			Others		
		L	Grounding or Earthing Terminals	UNE-EN 12843, paragraph 4.3.9 UNE 207016, paragraph 4.2.4	Visual
				Electrical continuity between upper and lower terminals	Verification
8.3.1	Sampling plan (reception)	The manufacturer must have the testing and measurement equipment as set out in UNE207016 section 6.2.1 - Table 11. Sampling plan: On the 4% of the lot, with a minimum of two poles, the following tests will be performed: • Dimensional checking. • Marking. • Nondestructive elastic bending test. • Verification of earthing terminals continuity. On the 1% of the lot the following tests will be performed: • Breaking strength test (loading capacity test). • Checking secondary stress. • Torsional Test For orders under 50 poles, these tests will be carried out gathering different orders so that one pole will be tested for every 50 units. Only one of the three tests will be done, alternatively. These orders can be separated in time. For orders between 50 and 100 poles only one of the three tests will be done, up to 200 poles two tests will be done and for orders more than 200 poles the three tests will be done, alternatively. • Concrete Coating. This test will be always done when breaking strength test, secondary stress test or torsional test is carried out. If a defect is detected during receiving, two additional tests will be carried out and, if a defect in the new samples is detected, the batch shall be rejected. If the two additional tests were favorable, the lot			

		shall be accepted replacing the deficient pole. If the number of defects found is two or more, the lot shall be rejected. The manufacturer must have the records corresponding to materials inspection as stated in UNE 207016, section 6.2.1 - Table 12.
8.3.2	List of reception tests	The test to be performed, according to the sampling plan described in 8.3.1 are: • Checking dimensions. • Marking. • Nondestructive elastic bending test • Verification of earthing terminals continuity. • Breaking strength test (loading capacity test). • Checking secondary stress. • Torsional test • Concrete Coating. The test method and requirement are the same as detailed in section 8.2.2 (Type Tests)

11.3	Design drawing	 **Figure 20: Overall geometrical configuration of pole type HV**

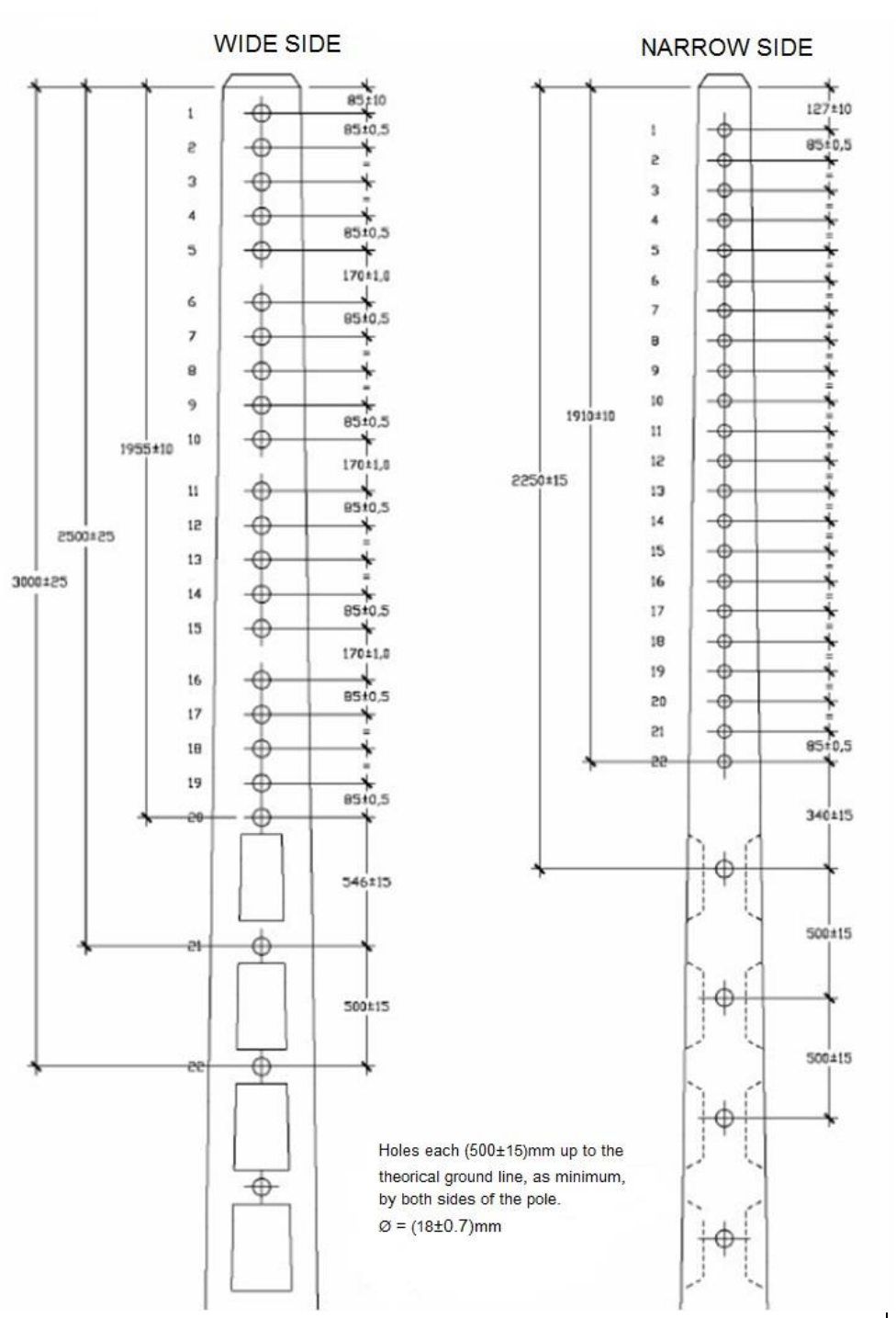
11.3	Design drawing	

Figure 21: General construction details of pole type HV

C. LOCAL SECTION – E-DISTRIBUZIONE (ITALY), ENEL DISTRIBUTIE: BANAT, DOBROGEA, MUNTENIA (ROMANIA).

ITEM	TITLE	DESCRIPTION
4.2	Local Standards	• **D.M. 3-06-68** • **EN 197-1 : 2011; EN 1992-1-1 : 2004; EN 206-1 : 2003** • **UNI EN ISO 6892 : 2009 – EN ISO 6892 : 2009** • **UNI EN 10080 : 2005 – EN 10080 : 2005** • **UNI EN 12350-1 : 2009 – EN 12350** • **UNI EN 12390-1 : 2012 – EN 12390-1 : 2012** • **UNI EN 12390-2 : 2009 – EN 12390-2 : 2009** • **UNI EN 12390-3 : 2009 – EN 12390-3 : 2009** • **CEI 7.6 – EN ISO 1461 : 2009** • **D.M. 14-1 : 2008** • **UNI EN 12843 : 2005 – EN 12843 : 2004** • **EN 197-1 : 2011** • **EN 206-1 : 2013**
4.3	List of replaced Local Standards	• DS 3000 – DS 3000 RO only for the centrifuged reinforced concrete poles without metal extensions • DS 3800 – DS 3800 RO only for the centrifuged reinforced concrete poles without metal extensions • DS 3801 – DS 3801 RO only for the centrifuged reinforced concrete poles without metal extensions • DS 3005 – DS 3005 RO only for the centrifuged reinforced concrete poles used as support for MV/LV transformer

7.1	Manufacturing materials	

	Tests /Requirements
Cement	**D.M. 3-06-68– EN 197-1:2011** **EN 206-1:2013** **EN 1992-1-1:2004**
Steel	**UNI 556 – EN ISO 6892:2009** **UNI EN 10080: 2005 – EN 10080:2005** **CEI 7.6 – EN ISO 1461:2009**
Concrete	**UNI EN 12350-1 : 2009 – EN 12350-1:2009** **UNI EN 12390-1 : 2012 – EN 12390-1: 2012** **UNI EN 12390-2 : 2009 – EN 12390-2:2009** **UNI EN 12390-3 : 2009 – EN 12390-3:2009** **D.M. 14-1:2008** **UNI EN 12843:2005 – EN 12843:2004**

7.2 Dimensions

In Table 18 shows the different poles with the main nominal dimensions according to their length and nominal stress.

Table 18 : Lengths and Nominal Stress

Type	Length (m)	d (mm)	D (mm)	Theorical mass (Kg)	Scheme	Tensile Test "T" at a distance "h" from application (measured from the top of the pole)			
						"T_1" (daN)	h_1 (m)	"T_2" (daN)	h_2 (m)
A	10	120	270	620	1	412	0.1	--	--
B	10	140	290	720	1	550	0.1	--	--
	12	140	320	1000	1	550	0.1	227	9
C	10 [1]	180	330	950	1	824	0.1	--	--
	12	180	360	1270	2	824	0.1	265	9
D	10	200	350	1120	1	1091	0.1	--	--
	12	200	380	1460	2	1099	0.1	--	--
	14	200	410	1910	2	1099	0.1	220	10.8
E	10	240	390	1450	1	1638	0.1	--	--
	12	240	420	1900	2	1648	0.1	--	--
	14	240	450	2400	2	1648	0.1	402	10.8
F	10	270	420	1700	1	2188	0.1	--	--
	12	270	450	2250	2	2198	0.1	--	--
	14	270	480	2800	2	2198	0.1	263	10.8
	10	310	460	2100	2	3286	0.1	--	--

G	10 [2]	310	460	2100	2	3286	0.1	--	--
	12	310	490	2700	2	3296	0.1	--	--
	14	310	520	3400	2	3296	0.1	485	10.8
H	12	320	500	3600	2	6280	0.1	--	--

[1] This pole could also be used as support for MV disconnectors therefore, in order to perform earthing resistance tests and measurement, an earthing circuit to be connected with the MV disconnector chassis must be embedded in the pole and the relevant earthing contact must be available at a height of 2,5 meters to the ground.

[2] This pole is used as support for MV/LV transformer (see local standard DS3005 ed. 1 del 12/1999) therefore, in order to perform earthing resistance tests and measurement, an earthing circuit to be connected with the transformer tank must be embedded in the pole and the relevant earthing contact must be available at a height of 2,5 meters to the ground.

The general geometry of the pole type HC is shown in section 11.3 of this Appendix, the dimensions of the main sections are detailed.
In Figure 24 shown the general geometrical configuration of this type of pole.
Low Voltage poles have simplest features and obey the scheme 1 of Figure 25.
Poles to be used in MV/LV power lines obey the scheme 2 in Figure 25 and include additional features to system grounding.

In Table 18, the nominal measurements of the top and base diameter are established, theoretical mass, corresponding to the poles according to their length and nominal stress.

7.4	Holes	The arrangement of the holes required on each of the faces, as other particulars are shown in Figure 25, these holes shall have a diameter of 22 mm.
7.6	Embedment length	The following formula shall be applied for embedment length: $h_e = 0{,}1\ L$ Where L is the nominal length of the pole. For poles type F and G, minimum embedment length shall be 1.20 m.
7.8	Nominal Stress	It is determined by the tensile test or breaking strength ER, which is to be the result of the combination of two stresses T_1 and T_2 applied on two specific points of the pole at a distance 0.1 and h_2 from the top of the pole, tabulated in Table 18, as shown in Figure 22.

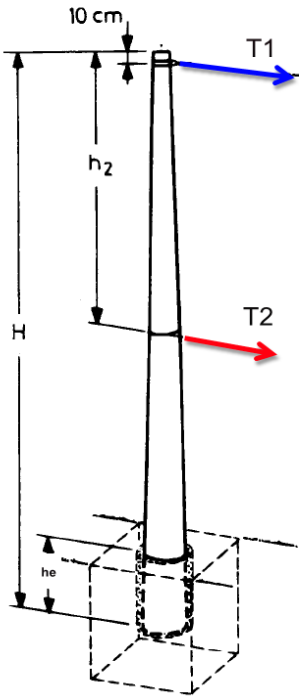


Figure 22: Upright scheme to stress applications T_1 and T_2

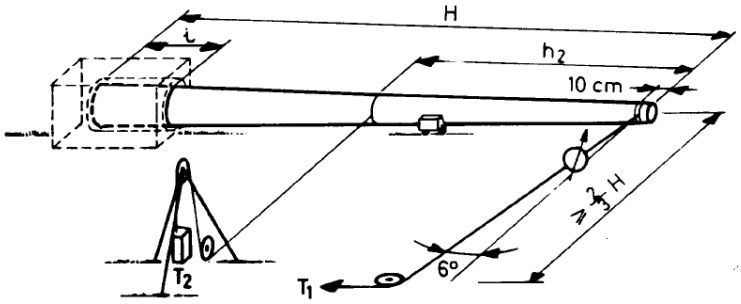


Figure 23: Horizontal scheme of stress applications T1 and T2

Nominal stress is considered 40% from Tensile Test or Breaking Strength, value that be determined by safety factor. They are shown in Table 18.

7.9	Safety factor	Safety factor (CS), once calculated shall result in a minimum value of **2.5**. This value is obtained by the following formulation: $CS = \frac{F_R}{F}$ *CS : Safety factor at break* *F_R : Tensile test or Break strength*

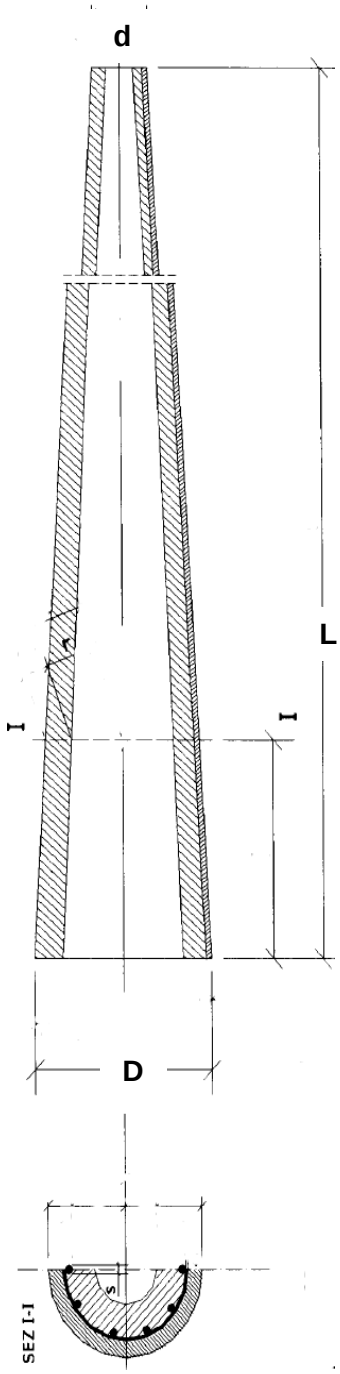
		F : Nominal Stress
7.10	Grounding or Earthing system	It shall consist for two elements that are: • **Cap (Fondello con bussola**) of hot dipped galvanized steel, which is welded to the rebar ring from the top of the pole. The Cap hole shall not be eccentric, respect to the diameter from the top of the pole. The inner of cap shall be free at least 70 mm to let appropriate adjustment of the bolt. The depth of the cap shall be covered by a plastic cover. The pole arrangement shown in Figure 25 and Figure 26, detail "B". • **Lower hole to insert grounding system**, composed of a steel insert as a blind hole on the edge of the outer surface located at the height of the pole embedment section. This insert is welded to the base ring. The location details are shown in Figure 25 and Figure 26 Detail "C".
7.11	Marking and designation of pole	**<u>Marking</u>** The pole shall carry at 3m to the butt a stainless steel metal plate, solidly anchored to the concrete pole. Registration shall be in high or bas relief so that it can be readable the following information: • Builder Acronym • Acronym of the pole (height, type, diameter) • Year of manufacture This model can see in Figure 26 detail "A" **<u>Designation</u>** Centrifuged concrete poles for overhead power lines will be designated by groups of acronyms, arranged in the following order with the following meaning. • Acronyms **PALO CAC**, indicative of the type of pole, in this case Centrifuged Concrete Pole. • Acronyms that represents, in meters, the length of the pole. • Acronym that represents the type of the pole. The values range from A-H and L. • Acronyms that represents, in centimeters, the top's diameter of the pole. Example: **PALO CAC – 10 / B / 14**: Pole type CAC 10 m length, type "B" and 14 cm diameter from the top of the pole.

8.2.1	Sampling plan (type)	The number of poles required, shall be the necessary to performs all the tests required in paragraph 8.2.2

8.2.2 List of type tests

	TEST	REQUIREMENT	TEST METHOD
	Materials Quality		
A	Visual inspection	Checking erroneous characteristics on pole	Visual inspection.
B	Checking dimensions	Check if tolerances are no exceed	Direct verification by means tools of the pole dimensions.
C	Mass checking	Checking values in Table 18	Consists at controlling the mass of each pole according to the reference value.
D	Grounding or Earthing system verification		Consist of two tests : a) Mechanical strength test of the lower insert, willing for grounding. Screw the normalized ground terminal in the hole provided and check if no occur faults in the immediate vicinity, then tighten with a dynamometric wrench a torque of 10 kg-m. b) Checking on the electrical continuity of the connection between the top cap and the lower insert. It is performed applying a voltage between the cap and the insert to permit the current flow of not less than 20 A, so that the ratio between the applied voltage, expressed in volts, and the effective current, in amperes, is not greater than 0.05 ohms.
E	Mechanic Resistance of bussola	a) The test is considered valid if it can achieve the required stress without the presence of lesions in the pole and bussola.	a) It shall apply gradually an equivalent stress equal to 1/3 of the tensile test "T_1" (indicated in Table 18 for each type of pole) on a bolt of appropriate test, up to 800 kg. At half of this value fine cracks can appear, that are no longer visible when removing the load.
F	Elastic Bending Test (with 40% Tensile Test)	a) In the maximum stress only shall occur capillary cracks, which disappear from view by removing the load.	a) It applies on the pole a stress T_1 and T_2 (in accordance with arrangement of Figure 22) divided by 2.5, for the time necessary to measure the displacement of the top section and the following sections, taken from 2 m to 2 m with respect to the initial position of the pole. b) It shall be verified that during the implementation of stresses, the pole will act with a smooth curve without sharp points.
F	Breaking Strength Test	a) Effective Breaking Strength is the recorded maximum reading just before the pole fracture.	a) Provide the pole according to the scheme shown in Figure 22 or that shown in Figure 23. b) The interlocking or embedment length, shall be continuous, it enough to ensure that every stress shows no buckling.

					c) The values of T_1, T_2, h_1, h_2 are characteristic to each tested pole and are tabulated in Table 18. The test considers the moment diagram of the effect arising due to the conductors and wind pressure. d) The T_2 stress shall be maintained constant during the test. Being T1 a variable stress, whose value shall gradually increase until achieve a value T_1. e) Successively will increase the stress on the top to achieve effective break of the pole. f) The dynamometer used shall have accuracy not less than 3% of the T_1 stress and the drive mechanism shall allow, a gradual stress increase, at 20% of the T_1 stress.
		G	Metal reinforcement steel	According to UNI 556 EN ISO 6892 : 2009 According to UNI 6407 EN 12390-3 : 2009	According to UNI 556 EN ISO 6892 : 2009
		H	Welding Method	According to UNI 556 EN ISO 6892 : 2009	According to UNI 556 EN ISO 6892 : 2009
		I	Compressive resistance of concrete	According to UNI 6130-72 EN 12390-1 : 2012	According to UNI 6126-72 EN 12350-1 : 2009
		I	Tensile Test for Rebar	According to UNI 556 EN ISO 6892 : 2009	According to UNI 556 EN ISO 6892 : 2009
8.3.1	Sampling plan (reception)	Simple sampling type, acceptance level II and AQL of 2.5%			
8.3.2	List of reception tests	The tests to be performed, according to the sampling plan described in 8.3.1 are: • Visual inspection. • Checking dimensions. • Mass verification • Grounding System check • Compressive resistance of concrete • Tensile Test for Metallic Reinforcement Steel The test method and requirement are the same as detailed in section 8.2.2 (Type Tests)			

11.3	Design drawing	 **Figure 24: Overall geometrical configuration of pole type HC**

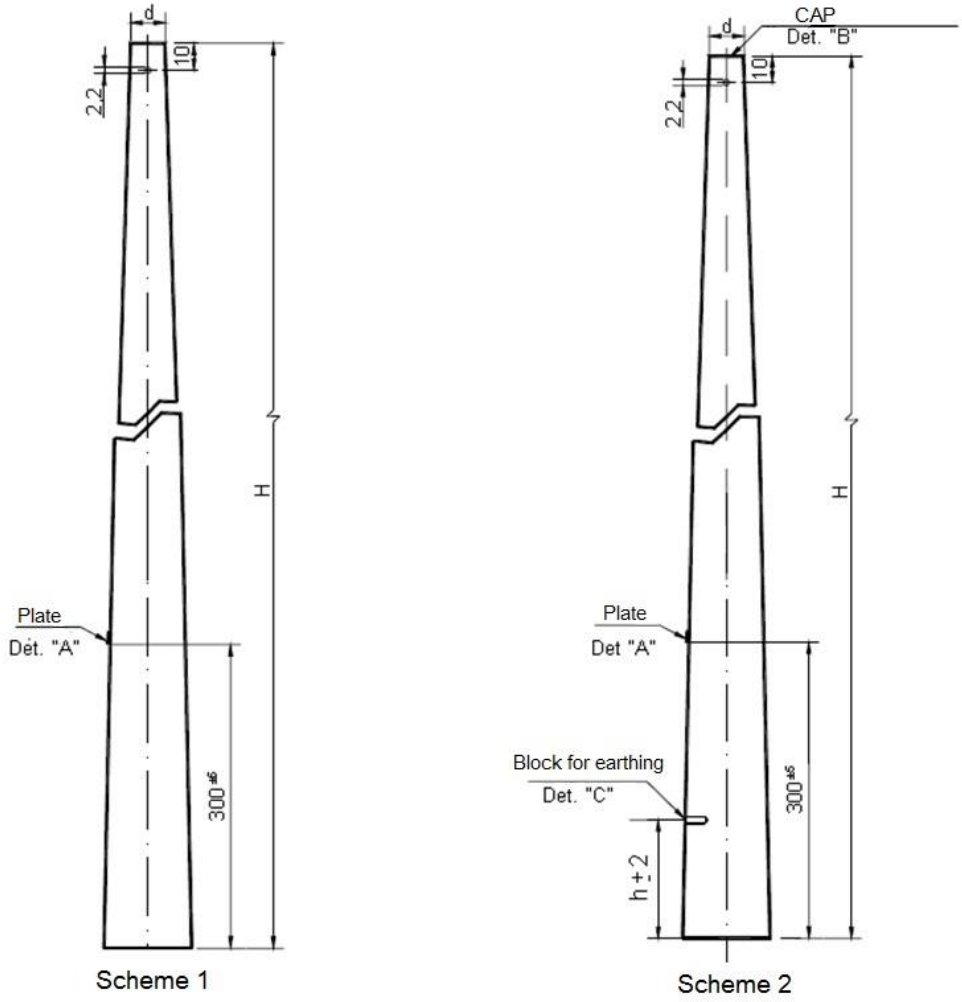
11.3	Design drawing	

Figure 25: Poles LV/MV schemes

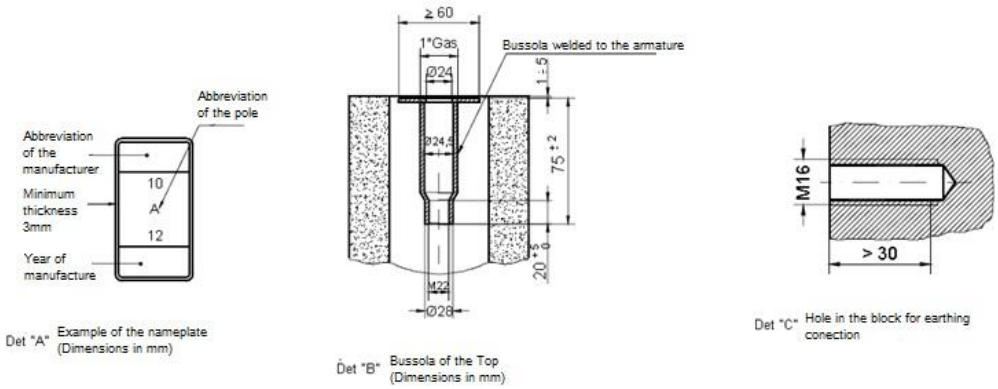


Figure 26: General construction details of pole type HC

COMMON LIST OF MAIN REQUIREMENTS

CONCRETE POLES FOR DISTRIBUTION NETWORKS REFERENCE LIST is attached in the following.

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
1	GSS002/01	EE-Spain	6700355	MV / LV	HV	9	-	HV 250 R 9	110 x 145	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	250	2,25	-	-	-	-	160	2,25	-	-
2	GSS002/02	EE-Spain	6700356	MV / LV	HV	9	-	HV 400 R 9	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	400	2,25	-	-	-	-	250	2,25	-	-
3	GSS002/03	EE-Spain	6700357	MV / LV	HV	9	-	HV 630 R 9	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	630	2,25	-	-	-	-	360	2,25	-	-
4	GSS002/04	EE-Spain	6700358	MV / LV	HV	9	-	HV 800 R 9	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	800	2,25	-	-	-	-	400	2,25	-	-
5	GSS002/05	EE-Spain	6700359	MV / LV	HV	9	-	HV 1000 R 9	170 x 255	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	1000	2,25	-	-	-	-	500	2,25	-	540
6	GSS002/06	EE-Spain	6700670	MV / LV	HV	11	-	HV 250 R 11	110 x 145	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	250	2,25	-	-	-	-	160	2,25	-	-
7	GSS002/07	EE-Spain	6700360	MV / LV	HV	11	-	HV 400 R 11	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	400	2,25	-	-	-	-	250	2,25	-	-
8	GSS002/08	EE-Spain	6700361	MV / LV	HV	11	-	HV 630 R 11	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	630	2,25	-	-	-	-	360	2,25	-	-
9	GSS002/09	EE-Spain	6700362	MV / LV	HV	11	-	HV 800 R 11	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm,	-	800	2,25	-	-	-	-	400	2,25	-	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
																strips: 15mm											
10	GSS002/10	EE-Spain	6700363	MV / LV	HV	11	-	HV 1000 R 11	170 x 255	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	1000	2,25	-	-	-	-	500	2,25	-	540
11	GSS002/11	EE-Spain	6700370	MV / LV	HV	11	-	HV 1600 R 11	170 x 255	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	1600	2,25	-	-	-	-	600	2,25	-	540
12	GSS002/12	EE-Spain	6700671	MV / LV	HV	13	-	HV 250 R 13	110 x 145	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	250	2,25	-	-	-	-	160	2,25	-	-
13	GSS002/13	EE-Spain	6700371	MV / LV	HV	13	-	HV 400 R 13	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	400	2,25	-	-	-	-	250	2,25	-	-
14	GSS002/14	EE-Spain	6700372	MV / LV	HV	13	-	HV 630 R 13	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	630	2,25	-	-	-	-	360	2,25	-	-
15	GSS002/15	EE-Spain	6700373	MV / LV	HV	13	-	HV 800 R 13	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	800	2,25	-	-	-	-	400	2,25	-	-
16	GSS002/16	EE-Spain	6700374	MV / LV	HV	13	-	HV 1000 R 13	170 x 255	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	1000	2,25	-	-	-	-	500	2,25	-	540
17	GSS002/17	EE-Spain	6700375	MV / LV	HV	13	-	HV 1600 R 13	170 x 255	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	1600	2,25	-	-	-	-	600	2,25	-	540

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
18	GSS002/18	EE-Spain	6701501	MV / LV	HV	15	-	HV 800 R 15	140 x 200	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	800	2,25	-	-	-	-	400	2,25	-	-
19	GSS002/19	EE-Spain	6701502	MV / LV	HV	15	-	HV 1000 R 15	170 x 255	-	-	-	-	13 ± 2	21 ± 2	Steel bars: 20mm, strips: 15mm	-	1000	2,25	-	-	-	-	500	2,25	-	540
20	GSS002/20	ED-Italy	230212	LV	HC	10	A	10 / A / 12	-	-	120	270	15	-	-	≥15	620	-	-	412	-	-	2,5	-	-	-	-
21	GSS002/21	ED-Italy	230222	LV	HC	10	B	10 / B / 14	-	-	140	290	15	-	-	≥15	720	-	-	550	-	-	2,5	-	-	-	-
22	GSS002/22	ED-Italy	230232	MV/LV	HC	10	C	10 / C / 18	-	-	180	330	15	-	-	≥15	950	-	-	824	-	-	2,5	-	-	-	-
23	GSS002/23	ED-Italy	230242	LV	HC	10	D	10 / D / 20	-	-	200	350	15	-	-	≥15	1120	-	-	1091	-	-	2,5	-	-	-	-
24	GSS002/24	ED-Italy	230252	LV	HC	10	E	10 / E / 24	-	-	240	390	15	-	-	≥15	1450	-	-	1638	-	-	2,5	-	-	-	-
25	GSS002/25	ED-Italy	230262	LV	HC	10	F	10 / F / 27	-	-	270	420	15	-	-	≥15	1700	-	-	2188	-	-	2,5	-	-	-	-
26	GSS002/26	ED-Italy	230272	LV	HC	10	G	10 / G / 31	-	-	310	460	15	-	-	≥15	2100	-	-	3286	-	-	2,5	-	-	-	-
27	GSS002/27	ED-Italy	230224	LV	HC	12	B	12 / B / 14	-	-	140	320	15	-	-	≥15	1000	-	-	550	227	9	2,5	-	-	-	-
28	GSS002/28	ED-Italy	230234	MV / LV	HC	12	C	12 / C / 18	-	-	180	360	15	-	-	≥15	1270	-	-	824	265	9	2,5	-	-	-	-
29	GSS002/29	ED-Italy	230244	MV / LV	HC	12	D	12 / D / 20	-	-	200	380	15	-	-	≥15	1460	-	-	1099	-	-	2,5	-	-	-	-
30	GSS002/30	ED-Italy	230254	MV / LV	HC	12	E	12 / E / 24	-	-	240	420	15	-	-	≥15	1900	-	-	1648	-	-	2,5	-	-	-	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
31	GSS002/31	ED-Italy	230264	MV / LV	HC	12	F	12 / F / 27	-	-	270	450	15	-	-	≥15	2250	-	-	2198	-	-	2,5	-	-	-	-
32	GSS002/32	ED-Italy	230274	MV / LV	HC	12	G	12 / G / 31	-	-	310	490	15	-	-	≥15	2700	-	-	3296	-	-	2,5	-	-	-	-
33	GSS002/33	ED-Italy	230276	MV / LV	HC	12	H	12 / H / 32	-	-	320	500	15	-	-	≥15	3600	-	-	6280	-	-	2,5	-	-	-	-
34	GSS002/34	ED-Italy	230245	MV / LV	HC	14	D	14 / D / 20	-	-	200	410	15	-	-	≥15	1910	-	-	1099	220	10,8	2,5	-	-	-	-
35	GSS002/35	ED-Italy	230255	MV / LV	HC	14	E	14 / E / 24	-	-	240	450	15	-	-	≥15	2400	-	-	1648	402	10,8	2,5	-	-	-	-
36	GSS002/36	ED-Italy	230265	MV / LV	HC	14	F	14 / F / 27	-	-	270	480	15	-	-	≥15	2800	-	-	2198	263	10,8	2,5	-	-	-	-
37	GSS002/37	ED-Italy	230275	MV / LV	HC	14	G	14 / G / 31	-	-	310	520	15	-	-	≥15	3400	-	-	3296	485	10,8	2,5	-	-	-	-
38	GSS002/38	ED-Italy	228010	MV	HC	10	G	10 / G / 31	-	-	310	460	15	-	-	≥15	2100	-	-	3286	-	-	2,5	-	-	-	-
39	GSS002/39	CD-Colombia	6762449	MV / LV	HC/HCV	10	-	10 x 510	-	-	140	290	15	-	-	20	-	200	2,5	-	-	-	-	-	-	500	-
40	GSS002/40	CD-Colombia	6762457	LV	HC/HCV	10	-	10 x 510 AP	-	-	170	320	15	-	-	20	-	200	2,5	-	-	-	-	-	-	500	-
41	GSS002/41	CD-Colombia	6762450	MV / LV	HC/HCV	10	-	10 x 1050	-	-	170	320	15	-	-	20	-	412	2,5	-	-	-	-	-	-	1030	-
42	GSS002/42	CD-Colombia	6762451	MV / LV	HC/HCV	12	-	12 x 510	-	-	140	320	15	-	-	20	-	200	2,5	-	-	-	-	-	-	500	-
43	GSS002/43	CD-Colombia	6762448	LV	HC/HCV	12	-	12 x 510 AP	-	-	140	320	15	-	-	20	-	200	2,5	-	-	-	-	-	-	500	-
44	GSS002/44	CD-Colombia	6762452	MV / LV	HC/HCV	12	-	12 x 750	-	-	140	320	15	-	-	20	-	294	2,5	-	-	-	-	-	-	735	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
45	GSS002/45	CD-Colombia	6762467	MV / LV	HC/HCV	12	-	12 x 1050	-	-	190	370	15	-	-	20	-	412	2,5	-	-	-	-	-	-	1030	-
46	GSS002/46	CD-Colombia	6762453	MV / LV	HC/HCV	14	-	14 x 750	-	-	160	370	15	-	-	20	-	294	2,5	-	-	-	-	-	-	735	-
47	GSS002/47	CD-Colombia	6762454	LV	HC/HCV	14	-	14 x 750 AP	-	-	140	370	15	-	-	20	-	294	2,5	-	-	-	-	-	-	735	-
48	GSS002/48	CD-Colombia	6762458	MV / LV	HC/HCV	14	-	14 x 1050	-	-	190	400	15	-	-	20	-	412	2,5	-	-	-	-	-	-	1030	-
49	GSS002/49	CD-Colombia	6762464	MV / LV	HC/HCV	14	-	14 x 1350	-	-	200	410	15	-	-	20	-	530	2,5	-	-	-	-	-	-	1324	-
50	GSS002/50	CD-Colombia	6810480	LV	HC/HCV	16	-	16 X 750 AP	-	-	180	420	15	-	-	20	-	294	2,5	-	-	-	-	-	-	735	-
51	GSS002/51	CD-Colombia	6810481	LV	HC/HCV	18	-	18 X 750 AP	-	-	200	470	15	-	-	20	-	294	2,5	-	-	-	-	-	-	735	-
52	GSS002/52	ES-Peru	6785151	LV	HC	7	-	7 / 200 / 2,0 / 150 / 255	-	-	150	255	15	-	-	20	-	200	2,0	-	-	-	-	-	-	-	-
53	GSS002/53	ES-Peru	6785152	LV	HC	8	-	8 / 200 / 2,0 / 150 / 270	-	-	150	270	15	-	-	20	-	200	2,0	-	-	-	-	-	-	-	-
54	GSS002/54	ES-Peru	6785153	LV	HC	9	-	9 / 200 / 2,0 / 150 / 285	-	-	150	285	15	-	-	20	-	200	2,0	-	-	-	-	-	-	-	-
55	GSS002/55	ES-Peru	6756424	LV	HC	11	-	11 / 200 / 2 / 150 / 315	-	-	150	315	15	-	-	20	-	200	2,0	-	-	-	-	-	-	-	-
56	GSS002/56	ES-Peru	6756411	MV / LV	HC	11	-	11 / 400 / 2,5 / 180 / 345	-	-	180	345	15	-	-	25	-	400	2,5	-	-	-	-	-	-	-	-
57	GSS002/57	ES-Peru	6756425	MV / LV	HC	13	-	13 / 400 / 2,5 / 180 / 375	-	-	180	375	15	-	-	25	-	400	2,5	-	-	-	-	-	-	-	-
58	GSS002/58	ES-Peru	6756426	MV / LV	HC	15	-	15 / 400 / 2,5 / 210 / 435	-	-	210	435	15	-	-	25	-	400	2,5	-	-	-	-	-	-	-	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
59	GSS002/59	CE-Brasil	6770683	LV	HV	9	D	9m/150daN	100 x 120	190 x 264	-	-	-	10	16	15	470	150	2	-	-	-	-	75	2	300/150	-
60	GSS002/60	CE-Brasil	6770686	LV	HV	9	B	9m/300daN	110 x 140	290 x 392	-	-	-	20	28	15	750	300	2	-	-	-	-	150	2	600/300	-
61	GSS002/61	CE-Brasil	6770796	MV	HV	10,5	D	10,5m/150daN	100 x 120	205 x 288	-	-	-	10	16	15	600	150	2	-	-	-	-	75	2	300/150	-
62	GSS002/62	CE-Brasil	6770797	MV	HV	10,5	B	10,5m/300daN	110 x 140	320 x 434	-	-	-	20	28	15	980	300	2	-	-	-	-	150	2	600/300	-
63	GSS002/63	CE-Brasil	6770798	MV	HV	10,5	B	10,5m/600daN	110 x 140	320 x 434	-	-	-	20	28	15	980	600	2	-	-	-	-	300	2	1200/600	-
64	GSS002/64	CE-Brasil	6770799	MV	HV	10,5	B-1,5	10,5m/1000daN	200 x 266	350 x 476	-	-	-	20	28	15	1300	1000	2	-	-	-	-	500	2	2000/1000	-
65	GSS002/65	CE-Brasil	6770694	MV	HV	12	B	12m/300daN	110 x 140	350 x 476	-	-	-	20	28	15	1210	300	2	-	-	-	-	150	2	600/300	-
66	GSS002/66	CE-Brasil	6770703	MV	HV	9	B	9m/600daN	110 x 140	290 x 392	-	-	-	20	28	15	750	600	2	-	-	-	-	300	2	1200/600	-
67	GSS002/67	CE-Brasil	6770699	MV	HV	12	B	12m/600daN	110 x 140	350 x 476	-	-	-	20	28	15	1210	600	2	-	-	-	-	300	2	1200/600	-
68	GSS002/68	CE-Brasil	6770709	MV	HV	12	B-1,5	12m/1000/daN	200 x 266	380 x 518	-	-	-	20	28	15	1900	1000	2	-	-	-	-	500	2	2000/1000	-
69	GSS002/69	RJ-Brasil	6771952	LV	HV	9	D	9m/200daN	100 x 120	190 x 264	-	-	-	16	20	15	470	200	2	-	-	-	-	100	2	400/200	
70	GSS002/70	RJ-Brasil	6771953	LV	HV	9	B	9m/400daN	110 x 140	290 x 392	-	-	-	20	28	15	750	400	2	-	-	-	-	200	2	800/400	
71	GSS002/71	RJ-Brasil	6771954	MV	HV	11	D	11m/200daN	100 x 120	210 x 296	-	-	-	16	20	15	680	200	2	-	-	-	-	100	2	400/200	
72	GSS002/72	RJ-Brasil	6771955	MV	HV	11	B	11m/400daN	110 x 140	330 x 448	-	-	-	20	28	15	1050	400	2	-	-	-	-	200	2	800/400	

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
73	GSS002/73	RJ-Brasil	6799790	MV	HV	11	B	11m/600daN	110 x 140	330 x 448	-	-	-	20	28	15	1050	600	2	-	-	-	-	300	2	1200/600	
74	GSS002/74	RJ-Brasil	6771957	MV	HV	12	B	12m/400daN	110 x 140	350 x 476	-	-	-	20	28	15	1.210	400	2	-	-	-	-	200	2	800/400	
75	GSS002/75	RJ-Brasil	6771958	MV	HV	12	B	12m/600daN	110 x 140	350 x 476	-	-	-	20	28	15	1210	600	2	-	-	-	-	300	2	1200/600	
76	GSS002/76	CH-Chile	6751776	LV	HV	8,7	-	-	120 x 120	220 x 350	-	-	-	-	-	20	625	225	2	-	-	-	-	60	2,00	-	-
77	GSS002/77	CH-Chile	6751778	MV	HV	11,5	-	-	150 x 150	250 x 430	-	-	-	-	-	20	1.100	267	2	-	-	-	-	125	2,00	-	-
78	GSS002/78	CH-Chile	4612613	MV	HV	13,5	-	-	165 x 180	300 x 450	-	-	-	-	-	20	1880	660	2	-	-	-	-	340	2,00	-	-
79	GSS002/79	CH-Chile	6751779	MV	HV	15	-	-	150 x 150	300 x 450	-	-	-	-	-	20	2000	650	2	-	-	-	-	240	2	-	-
80	GSS002/80	ES-Argentina	0118-0059	LV	HC	7,5	-	7.50m, 300daN	-	-	120 to140	-	15	-	-	≥15	-	300	-	According to tests	-	-	-	-	-	-	-
81	GSS002/81	ES-Argentina	0118-0031	LV	HC	7,5	-	7.50m, 1050daN	-	-	200 to 220	-	15	-	-	≥15	-	1050	-	According to tests	-	-	-	-	-	-	-
82	GSS002/82	ES-Argentina	0118-0033	LV	HC	8,5	-	8.50m, 1050daN	-	-	200 to 220	-	15	-	-	≥15	-	1050	-	According to tests	-	-	-	-	-	-	-
83	GSS002/83	ES-Argentina	0118-0046	MV	HC	11	-	11m, 1200daN	-	-	220 to 240	-	15	-	-	≥15	-	1200	-	According to tests	-	-	-	-	-	1275	-
84	GSS002/84	ES-Argentina	0118-0035	MV	HC	12	-	12m, 900daN	-	-	180 to 200	-	15	-	-	≥15	-	900	-	According to tests	-	-	-	-	-	-	-
85	GSS002/85	ES-Argentina	0118-0030	MV	HC	12	-	12m, 1200daN	-	-	220 to 240	-	15	-	-	≥15	-	1200	-	According to tests	-	-	-	-	-	1275	-
86	GSS002/86	ES-Argentina	0118-0038	MV	HC	12	-	12m, 2400daN	-	-	260 to 280	-	15	-	-	≥15	-	2400	-	According to tests	-	-	-	-	-	1275	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
87	GSS002/87	ES-Argentina	0118-0051	MV	HC	13	-	13 m, 900daN	-	-	180 to 200	-	15	-	-	≥15	-	900	-	According to tests	-	-	-	-	-	-	-
88	GSS002/88	ES-Argentina	0118-0032	MV	HC	13	-	13m, 1200daN	-	-	220 to 240	-	15	-	-	≥15	-	1200	-	According to tests	-	-	-	-	-	1275	-
89	GSS002/89	ES-Argentina	0118-0037	MV	HC	13	-	13m, 1800daN	-	-	240 to 260	-	15	-	-	≥15	-	1800	-	According to tests	-	-	-	-	-	1275	-
90	GSS002/90	ES-Argentina	0118-0052	MV	HC	13	-	13m, 2400daN	-	-	260 to 280	-	15	-	-	≥15	-	2400	-	According to tests	-	-	-	-	-	1275	-
91	GSS002/91	ES-Argentina	0118-0034	MV	HC	14	-	14m, 1200daN	-	-	220 to 240	-	15	-	-	≥15	-	1200	-	According to tests	-	-	-	-	-	1275	-
92	GSS002/92	ES-Argentina	0118-0048	MV	HC	14	-	14m, 1800daN	-	-	240 to 260	-	15	-	-	≥15	-	1800	-	According to tests	-	-	-	-	-	1275	-
93	GSS002/93	ES-Argentina	0118-0062	MV	HC	14	-	14m, 2400daN	-	-	260 to 280	-	15	-	-	≥15	-	2400	-	According to tests	-	-	-	-	-	1275	-
94	GSS002/94	ES-Argentina	0118-0053	MV	HC	15	-	15m, 1200daN	-	-	220 to 240	-	15	-	-	≥15	-	1200	-	According to tests	-	-	-	-	-	1275	-
95	GSS002/95	ED-Romania	230212	LV	HC	10	A	10 / A / 12	-	-	120	270	15	-	-	≥15	620	-	-	412	-	-	2,5	-	-	-	-
96	GSS002/96	ED-Romania	230222	LV	HC	10	B	10 / B / 14	-	-	140	290	15	-	-	≥15	720	-	-	550	-	-	2,5	-	-	-	-
97	GSS002/97	ED-Romania	230232	MV/LV	HC	10	C	10 / C / 18	-	-	180	330	15	-	-	≥15	950	-	-	824	-	-	2,5	-	-	-	-
98	GSS002/98	ED-Romania	230242	LV	HC	10	D	10 / D / 20	-	-	200	350	15	-	-	≥15	1120	-	-	1091	-	-	2,5	-	-	-	-
99	GSS002/99	ED-Romania	230252	LV	HC	10	E	10 / E / 24	-	-	240	390	15	-	-	≥15	1450	-	-	1638	-	-	2,5	-	-	-	-
100	GSS002/100	ED-Romania	230262	LV	HC	10	F	10 / F / 27	-	-	270	420	15	-	-	≥15	1700	-	-	2188	-	-	2,5	-	-	-	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
101	GSS002/101	ED-Romania	230272	LV	HC	10	G	10 / G / 31	-	-	310	460	15	-	-	≥15	2100	-	-	3286	-	-	2,5	-	-	-	-
102	GSS002/102	ED-Romania	230224	LV	HC	12	B	12 / B / 14	-	-	140	320	15	-	-	≥15	1000	-	-	550	227	9	2,5	-	-	-	-
103	GSS002/103	ED-Romania	230234	MV / LV	HC	12	C	12 / C / 18	-	-	180	360	15	-	-	≥15	1270	-	-	824	265	9	2,5	-	-	-	-
104	GSS002/104	ED-Romania	230244	MV / LV	HC	12	D	12 / D / 20	-	-	200	380	15	-	-	≥15	1460	-	-	1099	-	-	2,5	-	-	-	-
105	GSS002/105	ED-Romania	230254	MV / LV	HC	12	E	12 / E / 24	-	-	240	420	15	-	-	≥15	1900	-	-	1648	-	-	2,5	-	-	-	-
106	GSS002/106	ED-Romania	230264	MV / LV	HC	12	F	12 / F / 27	-	-	270	450	15	-	-	≥15	2250	-	-	2198	-	-	2,5	-	-	-	-
107	GSS002/107	ED-Romania	230274	MV / LV	HC	12	G	12 / G / 31	-	-	310	490	15	-	-	≥15	2700	-	-	3296	-	-	2,5	-	-	-	-
108	GSS002/108	ED-Romania	230276	MV / LV	HC	12	H	12 / H / 32	-	-	320	500	15	-	-	≥15	3600	-	-	6280	-	-	2,5	-	-	-	-
109	GSS002/109	ED-Romania	230245	MV / LV	HC	14	D	14 / D / 20	-	-	200	410	15	-	-	≥15	1910	-	-	1099	220	10,8	2,5	-	-	-	-
110	GSS002/110	ED-Romania	230255	MV / LV	HC	14	E	14 / E / 24	-	-	240	450	15	-	-	≥15	2400	-	-	1648	402	10,8	2,5	-	-	-	-
111	GSS002/111	ED-Romania	230265	MV / LV	HC	14	F	14 / F / 27	-	-	270	480	15	-	-	≥15	2800	-	-	2198	263	10,8	2,5	-	-	-	-
112	GSS002/112	ED-Romania	230275	MV / LV	HC	14	G	14 / G / 31	-	-	310	520	15	-	-	≥15	3400	-	-	3296	485	10,8	2,5	-	-	-	-
113	GSS002/113	ED-Romania	228010	MV	HC	10	G	10 / G / 31	-	-	310	460	15	-	-	≥15	2100	-	-	3286	-	-	2,5	-	-	-	-
114	GSS002/114	RJ-Brasil	4664001	LV	HV	9	B	9m/600daN	110 x 140	290 x 392	-	-	-	20	28	15	750	600	2	-	-	-	-	300	2	1200/600	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
115	GSS002/115	RJ-Brasil	4664002	MV	HV	11	B-1,5	11/1000daN	140 x 182	360 x 490	-	-	-	20	28	15	1330	1000	2	-	-	-	-	500	2	2000/1000	-
116	GSS002/116	RJ-Brasil	4664003	MV	HV	11	B-3,0	11/1500daN	170 x 224	390 x 532	-	-	-	20	28	15	1953	1500	2	-	-	-	-	750	2	3000/1500	-
117	GSS002/117	RJ-Brasil	4664004	MV	HV	12	B-1,5	12/1000daN	140 x 182	380 x 518	-	-	-	20	28	15	1520	1000	2	-	-	-	-	500	2	2000/1000	-
118	GSS002/118	RJ-Brasil	4664005	MV	HV	12	B-4,5	12/2000daN	200 x 266	440 x 602	-	-	-	20	28	15	2000	2000	2	-	-	-	-	1000	2	4000/2000	-
119	GSS002/119	RJ-Brasil	6803414	MV	HV	13	B	13/600daN	110 x 140	370 x 504	-	-	-	20	28	15	1400	600	2	-	-	-	-	300	2	1200/600	-
120	GSS002/120	RJ-Brasil	4664006	MV	HV	13	B-1,5	13/1000daN	140 x 182	400 x 546	-	-	-	20	28	15	2030	1000	2	-	-	-	-	500	2	2000/1000	-
121	GSS002/121	RJ-Brasil	4664007	MV	HV	13	B-4,5	13/2000daN	200 x 266	460 x 630	-	-	-	20	28	15	3090	2000	2	-	-	-	-	1000	2	4000/2000	-
122	GSS002/124	GO - Brazil	4284	MV	HV	10	B	10/300 daN	110 x 140	310 x 420	-	-	-	20	28	≥15	900	300	2	-	-	-	-	150	2	600/300	-
125	GSS002/125	GO - Brazil	14812	MV	HV	10	B	10/600 daN	110 x 140	310 x 420	-	-	-	20	28	≥15	900	600	2	-	-	-	-	300	2	1200/600	-
126	GSS002/126	GO - Brazil	519	MV	HV	11	B	11/300 daN	110 x 140	330 x 448	-	-	-	20	28	≥15	1050	300	2	-	-	-	-	150	2	600/300	-
127	GSS002/127	GO - Brazil	4288	MV	HV	12	B	12/300 daN	110 x 140	350 x 476	-	-	-	20	28	≥15	1210	300	2	-	-	-	-	150	2	600/300	-
128	GSS002/128	GO - Brazil	14805	LV	HCV	9	C-17	9/300 daN	-	-	170	350	20	-	-	≥15	820	300	2	-	-	-	-	-	-	600	-
129	GSS002/129	GO - Brazil	18727	LV	HCV	9	C-19	9/600 daN	-	-	190	370	20	-	-	≥15	1000	600	2	-	-	-	-	-	-	1200	-
130	GSS002/130	GO - Brazil	14811	MV	HCV	10	C-23	10/1000 daN	-	-	230	430	20	-	-	≥15	1350	1000	2	-	-	-	-	-	-	2000	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
131	GSS002/131	GO - Brazil	496	MV	HCV	11	C-19	11/600 daN	-	-	190	410	20	-	-	≥15	1260	600	2	-	-	-	-	-	-	1200	-
132	GSS002/132	GO - Brazil	4279	MV	HCV	11	C-23	11/1000 daN	-	-	230	450	20	-	-	≥15	1600	1000	2	-	-	-	-	-	-	2000	-
133	GSS002/133	GO - Brazil	41030	MV	HCV	11	C-29	11/1500 daN	-	-	290	510	20	-	-	≥15	2100	1500	2	-	-	-	-	-	-	3000	-
134	GSS002/134	GO - Brazil	500	MV	HCV	12	C-19	12/600 daN	-	-	190	430	20	-	-	≥15	1440	600	2	-	-	-	-	-	-	1200	-
135	GSS002/135	GO - Brazil	502	MV	HCV	12	C-23	12/1000 daN	-	-	230	470	20	-	-	≥15	1770	1000	2	-	-	-	-	-	-	2000	-
136	GSS002/136	GO - Brazil	5901	MV	HCV	12	C-29	12/1500 daN	-	-	290	530	20	-	-	≥15	2450	1500	2	-	-	-	-	-	-	3000	-
137	GSS002/137	GO - Brazil	3097	MV	HCV	12	C-33	12/2000 daN		-	330	570	20	-	-	≥15	3000	2000	2	-	-	-	-	-	-	4000	-
138	GSS002/138	GO - Brazil	18728	MV	HCV	13	C-17	13/300 daN	-	-	170	430	20	-	-	≥15	1280	300	2	-	-	-	-	-	-	600	-
139	GSS002/139	GO - Brazil	4282	MV	HCV	13	C-19	13/600 daN	-	-	190	450	20	-	-	≥15	1680	600	2	-	-	-	-	-	-	1200	-
140	GSS002/140	GO - Brazil	504	MV	HCV	13	C-23	13/1000 daN	-	-	230	490	20	-	-	≥15	1920	1000	2	-	-	-	-	-	-	2000	-
141	GSS002/141	GO - Brazil	21016	MV	HCV	13	C-29	13/1500 daN	-	-	290	550	20	-	-	≥15	2700	1500	2	-	-	-	-	-	-	3000	-
142	GSS002/142	GO - Brazil	38243	MV	HCV	13	C-33	13/2000 daN	-	-	330	590	20	-	-	≥15	3500	2000	2	-	-	-	-	-	-	4000	-
143	GSS002/143	GO - Brazil	2815	MV	HCV	14	C-19	14/600 daN	-	-	190	470	20	-	-	≥15	1900	600	2	-	-	-	-	-	-	1200	-
144	GSS002/144	CD-Colombia	6762470	MV	HC/HCV	12	-	12 X 2000			260	440	15			20	-	785	2,5							1961	-

Item	GS Type Code	Distribution Company and Country	Country Code	Distribution Network	Code Type of Pole	Nominal Length (m)	Type	Description	Top Area (mm x mm)	Butt Area (mm x mm)	Top Diameter (mm)	Butt Diameter (mm)	Conicity for Circular poles section (mm/m)	Primary Conicity for rectangular poles section (narrow face) (mm/m)	Secondary Conicity for rectangular poles section (wide face) (mm/m)	Coating (mm)	Mass (Kg)	Nominal Stress		Tensile Test				Secondary Stress		Breaking Strength (daN x m)	Torsional Stress (daN x m)
																		Admissible Load (daN)	Safety Factor	T1 (daN)	T2 (daN)	h2 (m)	Safety Factor	Stress (daN)	Safety Factor		
145	GSS002/145	CD-Colombia	6764017	MV	HC/HCV	12	-	12 X 2500			280	460	15			20	-	981	2,5							2452	-
146	GSS002/146	CD-Colombia	6762455	MV	HC/HCV	12	-	12 X 3000			300	480	15			20	-	1177	2,5							2942	-
147	GSS002/147	CD-Colombia	6763233	MV	HC/HCV	12	-	12 X 3500			320	500	15			20	-	1373	2,5							3432	-
148	GSS002/148	CD-Colombia	6764099	MV	HC/HCV	14	-	14 X 2000			260	470	15			20	-	785	2,5							1961	-
149	GSS002/149	CD-Colombia	6796158	MV	HC/HCV	14	-	14 X 2500			280	490	15			20	-	981	2,5							2452	-
150	GSS002/150	CD-Colombia	6764021	MV	HC/HCV	14	-	14 X 3000			300	510	15			20	-	1177	2,5							2942	-
151	GSS002/151	CD-Colombia	6764022	MV	HC/HCV	14	-	14 X 3500			320	530	15			20	-	1373	2,5							3432	-
152	GSS002/152	CD-Colombia	6769870	MV	HC/HCV	12	-	12 X 1350			220	400	15			20	-	530	2,5							1324	-