

**Subject:** GSCH013 High voltage cable terminations for GIS**Application Areas**Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Enel Grids***CONTENTS**

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THE HEAD OF GLOBAL NETWORK COMPONENTS  
**Fabrizio GASBARRI**

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**1. DOCUMENT AIMS AND APPLICATION AREA**

The aim of this document is to provide technical requirements for the supply of high voltage terminations for GIS, to be used on transmission lines of the Enel Group Companies listed below:

Country	Distribution Company
Argentina	Edesur
Brasil	Enel Distribuição Rio Enel Distribuição Ceará Enel Distribuição Goiás Enel Distribuição São Paulo
Chile	Enel Distribución Chile
Colombia	Codensa
España	e-distribución redes digitales
Italia	e-distribuzione
Perú	Enel Distribución Perú
Romania	Enel Distributie Banat Enel Distributie Dobrogea Enel Distributie Muntenia

**Table 1 - Distribution Companies**

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

**1.1 RELATED DOCUMENTS TO BE IMPLEMENTED AT COUNTRY LEVEL**

This document does not require implementation of further documents.

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

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**2. DOCUMENT VERSION MANAGEMENT**

Version	Date	Main changes description
1	07/12/2022	Issuing of "GSCH013 High voltage cable termination for GIS" material specification

**3. UNITS IN CHARGE OF THE DOCUMENT**

Responsible for drawing up the document:

- Enel Grids: Engineering and Construction / Components and Devices Design / Network Components unit.

Responsible for authorizing the document:

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

**4. REFERENCES**

- Code of Ethics of Enel Group;
- Enel Human Right Policy;
- The Enel Group Zero Tolerance of Corruption (ZTC) Plan;
- Organization and management model as per Legislative Decree No. 231/2001;
- Enel Global Compliance Program (EGCP);
- Integrated Policy of Quality, Health and Safety, Environment, anti-Bribery and Information security;
- ISO 9001:2015 - Quality Management System - Requirements;
- ISO 14001:2015 - Environmental Management System - Requirements and user guide;
- ISO 45001:2018 - Occupational Health and Safety Management System - Requirements and user guide;
- ISO 37001:2016 - Anti-bribery Management System - Requirements with guidance for use;
- ISO 27001:2017 - Information Security Management System – Requirements;
- Guideline GRI-GRI-GUI-E&C-0011 "Design and Construction HV lines Guidelines" -ex GUI-E&C-ND-2022-0107-ex PL 332 ;
- Global Standard GSCH010:" Underground High Voltage Cables".
- Global Standard GSCH006:" Shielded single or double busbar equipment with sulphur hexafluoride insulation (SF6) of 72.5-145-170-245 kV";

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- IEC 60840:2020 “Power cables with extruded insulation and their accessories for rated voltages above 30kV (Um=36kV) up to 150kV (Um=170kV) - Test method and requirements”
- IEC 62067:2022 “Power cables with extruded insulation and their accessories for rated voltages above 150 kV (Um=170 kV) up to 500 kV (Um=550 kV) - Test methods and requirements”
- IEC 60228 “Conductor of insulated cable”
- IEC 60230 “Impulse tests on cables and their accessories”
- IEC 62271-203 High-voltage switchgear and controlgear – Part 203: AC gas-insulated metal-enclosed switchgear for rated voltages above 52 kV
- IEC 62271-209 High-voltage switchgear and controlgear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and extruded insulation cables – Fluid-filled and dry-type cable-terminations

**5. ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY**

Value Chain/Process Area: Engineering & Construction

Macro Process: Devices and Components Development

Process: Standard Catalog Management

**6. DEFINITIONS AND ACRONYMS**

Acronym and Key words	Description
<b>Gas Insulated Substation (GIS)</b>	A compact, multi-component switchgear assembly, enclosed in grounded metallic housings in which the primary insulating medium is gas, typically SF6, and which normally includes buses, switches, circuit breakers, and other associated equipment.
<b>Technical Conformity Assessment (TCA)</b>	A “conformity assessment” <sup>a</sup> with respect to “specified requirements” <sup>b</sup> consists in functional, dimensional, constructional and test characteristics required for a product (or a series of products) and quoted in technical specifications and quality requirements issued by Enel Group distribution companies. This also

<sup>a</sup> Definition 2.1 of ISO/IEC 17000

<sup>b</sup> Definition 3.1 of ISO/IEC 17000

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	includes the verification of conformity with respect to local applicable regulation and laws and possession of relevant requested certifications
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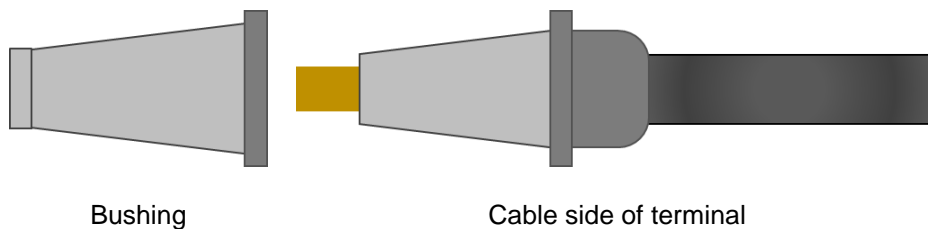
**7. DESCRIPTION**

This standard specifies the electrical and mechanical characteristics and test requirements that must be accomplished by the GIS terminations used with voltage cables included in Global Standard GSCH010, with rated voltage above 52 kV and in detail for  $U_m$  equals to 72,5 kV, 145 kV, 170 kV and 245 kV.

This standard replaces all the local standards used up to now by all the Distribution Companies, as long as local regulation allows it.

**7.1 LIST OF COMPONENTS**

This standard includes dry-type cable terminations for single-core cables with aluminum or copper conductor, XLPE insulation and metallic screen.



**Figure 1 Scheme of a plug-in type terminal.**

The list of terminals with the main requirements, which is an integral part of the present document, is reported in the GS Type Code Lists on Annex B, and their relationship with country codes is reported on the Common List on Annex C. In **Table 2** the list of terminals is shown.

GSCH013 Type Code	$U_m$ [kV]	Conductor section [mm <sup>2</sup> ]	Screen type
GSCH013/001	245	2500	Tube
GSCH013/051	245	2500	Wires
GSCH013/002	245	2000	Tube
GSCH013/031	245	2000	Wires
GSCH013/003	245	1600	Tube
GSCH013/043	245	1600	Wires

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<b>GSCH013 Type Code</b>	<b>U<sub>m</sub> [kV]</b>	<b>Conductor section [mm<sup>2</sup>]</b>	<b>Screen type</b>
GSCH013/030	245	1200	Wires
GSCH013/004	245	1000	Tube
GSCH013/005	245	800	Tube
GSCH013/006	170	1600	Tube
GSCH013/016	170	1600	Wires
GSCH013/007	170	1000	Tube
GSCH013/017	170	1000	Wires
GSCH013/008	170	630	Tube
GSCH013/018	170	630	Wires
GSCH013/041	145	2500	Wires
GSCH013/046	145	2000	Tube
GSCH013/034	145	2000	Wires
GSCH013/047	145	1600	Tube
GSCH013/033	145	1600	Wires
GSCH013/009	145	1200	Tube
GSCH013/019	145	1200	Wires
GSCH013/048	145	1000	Tube
GSCH013/037	145	1000	Wires
GSCH013/010	145	800	Tube
GSCH013/036	145	800	Wires
GSCH013/011	145	630	Tube
GSCH013/021	145	630	Wires
GSCH013/045	145	500	Wires
GSCH013/035	145	400	Wires
GSCH013/029	72,5	2000	Wires
GSCH013/027	72,5	1200	Wires
GSCH013/012	72,5	1000	Tube
GSCH013/023	72,5	1000	Wires
GSCH013/024	72,5	800	Wires
GSCH013/013	72,5	630	Tube
GSCH013/028	72,5	630	Wires
GSCH013/042	72,5	500	Wires

**Table 2 – List of GSCH013 Type Codes for GIS terminals**

**7.2 DESIGN AND MANUFACTURE**

Design of terminations shall assure the integrity of the connection assembly between cable and GIS, both electrical and mechanically, being in compliance with IEC 62271-209.

Terminations must be designed to connect cables included in ENEL's Global Standard GSCH010: "Underground High Voltage Cables" into switchgears included in ENEL's Global Standard GSCH006: "Shielded single or double busbar equipment with sulphur hexafluoride insulation (SF6) of 72,5–145–170-245 kV".

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The GIS termination must allow the use of copper or aluminum conductors indistinctly.

They will be of the dry type, not requiring any fluid to provided insulation or pressure. So, a termination will comprise an elastomeric electrical stress control component in contact with a separating insulating barrier between the cable insulation and the gas insulation of the GIS.

Additionally, it must be possible to engage/disengaged the cable/stress cone assembly into the insulator assembly previously installed into the GIS enclosure (plug-in type terminations). So, the terminal is formed by two sides, the side to be assembled to the GIS, also called bushing or female side, and the side to be assembled to the cable, also called male side. The bushing will be usually pre-assembled and tested at the GIS factory instead of on site.

For system cables with  $U_m$  lower or equal to 170 kV, arrangements with terminations for three phases in one enclosure are allowed. In any other cases, cable terminations in a single-phase enclosure are used.

**7.2.1. General Ratings**

General ratings for GIS equipment are those indicated on ENEL's Global Standard GSCH006:"Shielded single or double busbar equipment with sulphur hexafluoride insulation (SF6) of 72,5–145–170-245 kV".

For cable systems, the rated voltages are those included in **Table 3**.

Highest voltage for equipment $U_m$ [kV]	Value of $U_0$ for determination of test voltages [kV]	Lightning impulse voltage test [kV]
72,5	36	325
145	76	650
170	87	750
245	127	1.050

**Table 3 Test voltages**

The minimum values of the rated short time withstand currents that must be withstood by terminations during 1 s. are 40 kA. Although, for termination with  $U_m$  greater than 145 kV, values of 50 kA or 63 kA could be specified for short time withstand currents on specific orders for special cases.

$U_m$ [kV]	$I$ (1s) [kA]
<b>72,5</b>	40
<b>145</b>	
<b>170</b>	
<b>245</b>	

**Table 4 Short time withstand currents**

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Termination could be used indistinctly on systems with a rated frequency of 50 Hz or 60 Hz.

**7.2.2.Dimensions**

General dimensions of termination are those indicated on Fig. 5 “Dry-type cable connection assembly- Assembly dimensions” from IEC 62271-209:2022.

Moreover, to guarantee compatibility between terminations and cables from GSCH010, there would be the following additional requirements:

- For every cross section of the cable, the minimum diameter range of conductors that must be compatible with the termination are those indicated in **Table 5**.
- For every rated voltage and cross section of the cable, the minimum diameter over insulation range of cables that must be compatible with the termination are those included in **Table 5**.

U <sub>m</sub> [kV]	Conductor diameter [mm]		Cable diameter over insulation [mm.]							
	All		72,5		145		170		245	
Cross section [mm <sup>2</sup> ]	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
<b>400</b>	22,6	24,6	-	-	57,6	61,5	-	-	-	-
<b>500</b>	25,3	27,6	46,3	48,6	60,3	64,2	-	-	-	-
<b>630</b>	28,7	32,5	49,7	53,5	64,0	67,5	67,7	71,5	-	-
<b>800</b>	33,6	36,0	54,6	57	68,6	71	-	-	78,6	83
<b>1000</b>	37,9	40,0	58,9	61	72,9	75	74,9	77	82,9	85
<b>1200</b>	41,7	45,1	62,7	66,1	76,7	80,1	-	-	86,7	90,1
<b>1600</b>	47,7	50,4	-	-	82,7	86,4	82,7	86,4	92,7	95,4
<b>2000</b>	52,5	56,7	73,5	77,7	87,5	91,7	-	-	97,5	101,7
<b>2500</b>	60,2	63,5	-	-	95,2	98,5	-	-	105,2	108,5

**Table 5 Compatible conductor diameter and cable diameter over insulation.**

Nevertheless, other diameters than those indicated herein could be specified on specific orders for special cases.

**7.2.3.Capacitive voltage tap**

The bushing will include a capacitive voltage cap to allow voltage measurements.



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If required, the terminal will include a fiber optics splice box to allow the use of distributed temperature sensing (DTS) systems.

The splice box must ensure reliable operation and resistance against direct exposure to solar radiation, precipitation, and polluted environment.

The splice box shall manage at least two steel pipes included on the cable wires screen with a minimum of 2 fiber optics each. So, the minimum capacity of that box shall be 4 splices.

**7.3 TERMINAL DESIGNATION**

Designation of the terminal is formed by the following terms:

- "ENEL GSCH013"
- the code "GT" indicating GIS terminal.
- voltage level  $U_m$  and "kV",
- section of the conductor (expressed in  $mm^2$ ),
- "+" and a character representing the type of cable screen (H: for wires screen, T: for welded aluminum tube),
- FO (optional) in case there is integrated a fiber optics splice box.

Designation example for joint GSCH013/001 is:

*ENEL GSCH013 – GT - 245 kV - 2.500 mm<sup>2</sup> + T*

**7.4 CONDITIONS OF SUPPLY**

There shall be provided a complete set of assembly instructions together with drawings of the terminal.

The instructions should include lists of all the components of the terminal including consumable materials, the specified assembly tools and the health and safety precautions.

For every step of the assembly instructions there must be available a video where it is shown that assemble step. Those videos could be storage on-line on the website of the supplier and referenced by a QR Code.

All documentation has to be provided in English and in the language of the country destiny of the supply.

Terminals shall be securely packaged to prevent any damage during loading, transport, storage and installation.

The packaged shall be suitable for sea transportation.

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On the packing of the terminals there must be marked the following information:

- a) GS Type Code and reference of this standard.
- b) Rated voltages  $U_0$  ( $U_m$ ).
- c) Manufacturer or brand.
- d) Order number or purchase order.
- e) Year and month of manufacture.
- f) Weights, tare and net.

In case of need, it is possible to supply only the bushing or only the cable side of the terminal. That would be indicated in the specific order.

Equally, it is possible to supply accessories for the terminals, like mechanical protection covers or special tools, in specific orders.

## 7.5 TESTS

These tests shall be accomplished according to the requirements of this standard and those of TCA procedures.

### 7.5.1. Test classification

#### i) Acceptance tests

Acceptance tests shall be carried out in the supplier's facilities and include:

- Visual examination. Checking the absence of defects, the appropriate packaging and the conformity with technical specification, list of components, instructions and documentation included in Technical Conformity Assessment Dossier stated in Enel Standard GSCG002.
- Routine tests in paragraph 7.5.2

If a terminal fails any of the sample tests, two further terminals of the same type shall be subjected to the same tests. If both additional terminals pass the tests, the other units shall be regarded as having complied. If either fails, this type of terminal shall be regarded as having failed to comply.

#### ii) Routine tests

Routine tests shall be performed at 100% of the main insulation of delivered terminals to demonstrate product integrity, according to IEC62271-209 paragraph 8.1.

#### iii) Type tests

Type tests shall be performed before supplying a type of terminal covered by this standard in order to demonstrate satisfactory performance characteristics to meet the intended application.

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Electrical type test shall be performed using the single-phase cable connection enclosure from the switchgear. The terminal shall be tested, assembled on the cable in the manner specified by the manufacturer's instructions, with the grade and quantity of materials supplied, including lubricants, if any. When type tests have been successfully performed on one or more terminals covered herein with one cable of specific cross-section, and of the same rated voltage and construction characteristics, the type approval could be accepted as valid for other accessories as long as all the following conditions are met:

- The rated voltage does not exceed that of the tested accessory.
- The cable with another conductor cross-section is within the range of type approval of the tested cable.
- Terminals have the same or similar construction as that of the tested terminal.
- The calculated nominal electrical stresses within the main insulation parts of the terminal and at the cable and terminal interfaces do not exceed those of the tested terminal.
- The same type of gas or gas mixture and pressure is used in the cable connection enclosure of a gas immersed termination.
- The termination has the same separating insulating barrier, stress cone assembly and cable as are used in the type test.

Terminals shall undergo type tests after having passed all the acceptance tests gathered in routine tests lists.

**iv) Prequalification tests**

Prequalification tests shall be performed before supplying a type of terminal covered by this standard in order to demonstrate satisfactory long term performance of the complete cable system.

The prequalification test shall be performed on cable systems where the calculated nominal electrical stresses at the conductor screen will be higher than 8,0 kV/mm and/or at the insulation screen higher than 4,0 kV/mm. The prequalification test shall be performed except if cable systems with the same construction and accessories of the same family have been prequalified for a higher rated voltage.

Prequalification test must be performed on a cable system, using a cable of a large conductor cross-section in order to cover thermos-mechanical aspects. General conditions for these tests and their extension are those indicated in IEC 62067 clause 13 for cable systems with  $U_0 \geq 127$  kV and IEC 60840 clause 13 for cable systems with  $U_0 \leq 127$  kV.

**7.5.2. Routine Tests List****i) Partial discharge test**

Requirements: No detectable discharge exceeding sensitivity of 5 pC or better at  $1.5 U_0$

Test method: IEC 60840 clause 9.2

**ii) Voltage routine test**

Requirements: No breakdown of the insulation shall occur.

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Test method: IEC 60840 clause 9.3

Test voltage:  $2.5 U_0$

Duration: 30 min

**iii) Pressure test**

Requirements: The insulator shall not show any signs of overstress or leakage.

Test method: IEC 62271-209 clause 8.2

Test pressure: 2 times design pressure

Duration: 1 min

**iv) Visual inspection**

Requirements: No detectable signs of significant defects.

Test method: IEC 62271-209 clause 8.3

**7.5.3.Type Tests List**

Prior to electrical type test of terminals, the insulation thickness of the cable used shall be measured and the test voltage values adjusted, if necessary, as stated in IEC 60840 paragraph 12.4.1

**i) Partial discharge test at ambient temperature**

Requirements: No detectable discharge exceeding sensitivity of 5 pC or better at  $1.5 U_0$

Test method: IEC 60840 clause 12.4.4

**ii) Heating cycle voltage test**

Requirements: A U-bend in the cable is not required

Test method:

IEC 62067 clause 12.4.6 for terminals with  $U_0=127$  kV

IEC 60840 clause 12.4.6 for terminals with  $U_0<127$  kV

**iii) Partial discharge test at ambient and high temperature**

This test shall be carried out after the final cycle of test in **ii)** or, alternatively, after the test in **iv)**

Requirements: No detectable discharge exceeding sensitivity of 5 pC or better at  $1.5 U_0$

Test method: IEC 60840 clause 12.4.4

**iv) Lightning impulse voltage test followed by a power frequency voltage test**

Requirements: No breakdown of the insulation or flashover shall occur

Test method:

IEC 62067 clause 12.4.7 for terminals with  $U_0=127$  kV

IEC 60840 clause 12.4.7 for terminals with  $U_0<127$  kV

Impulse lightning voltage value:

325 kV for terminals with  $U_{max} = 72.5$  kV.

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650 kV for terminals with  $U_{max} = 145$  kV.

750 kV for terminals with  $U_{max} = 170$  kV.

1.050 kV for terminals with  $U_{max} = 245$  kV.

Power frequency voltage value:

90 kV for terminals with  $U_{max} = 72.5$  kV.

190 kV for terminals with  $U_{max} = 145$  kV.

218 kV for terminals with  $U_{max} = 170$  kV.

254 kV for terminals with  $U_{max} = 245$  kV.

**v) Partial discharge test at ambient and high temperature**

If not previously carried out after the final cycle of heating cycle voltage test in point **iii)**

Requirements: No detectable discharge exceeding sensitivity of 5 pC or better at  $1.5 U_0$

Test method: IEC 60840 clause 12.4.4

**vi) Additional electrical type tests on the insulator to be installed by switchgear manufactures (plug in cable termination)**

Requirements and test method: IEC 62271-209 clause 7.2.4.

Rated voltage for equipment $U_m$ [kV]	Power frequency voltage tests $U_d$ [kV]		Lightning impulse voltage test [kV] Phase to earth
	Phase to earth withstand voltage test (1 min.)	Test voltage for PD measurement (> 1 min)	
72,5	140	87	260
145	275	174	520
170	325	204	600
245	460	294	840

**vii) Pressure test**

Requirements: The insulator shall not show any signs of overstress or leakage.

Test method: IEC 62271-209 clause 7.3

Test pressure: 3 times design pressure

Duration: 1 min

**viii) Leak rate on the insulator**

Requirements and test method: IEC 62271-209 clause 7.4

**7.5.4. Prequalification Test list**

**i) Heating cycle voltage test**

Requirements: No breakdown shall occur.

Test voltage:  $1,7 U_0$

Cycles:  $\geq 180$

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Test method:

IEC 62067 clause 13.2.4 for cable systems with  $U_0=127$  kVIEC 60840 clause 13.2.4 for cables systems with  $U_0<127$  kV**ii) Lightning impulse voltage test**

Requirements: withstand 10 positive and 10 negative voltage impulses without failure

Test voltage:

325 kV for cables systems with  $U_{max} = 72.5$  kV.650 kV for cables systems with  $U_{max} = 145$  kV.750 kV for cables systems with  $U_{max} = 170$  kV.1.050 kV for cables systems with  $U_{max} = 245$  kV.

Test method:

IEC 62067 clause 13.2.5 for cables systems with  $U_0=127$  kVIEC 60840 clause 13.2.5 for cables systems with  $U_0<127$  kV**iii) Examination of the cable system after completion of the tests above**

Requirements: No signs of deterioration

Test method: IEC 60840 clause 13.2.6

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**8. ANNEX**

**ANNEX A – TECHNICAL CHECK LIST**

The following chart indicates the minimum technical information that suppliers shall provide in technical offer during tenders and as part of the TCA Type A documentation:

Item	Description	Unit	Required values	Offered values
<b>1</b>	<b>GENERAL INFORMATION</b>			
1.1	Supplier Name	-		
1.2	Supplier CUI			
1.3	Factory	-		
1.4	Location of factory	-		
<b>2</b>	<b>MAIN FEATURES</b>			
2.1	ENEL Distribution Company and Country of supply	-		
2.2	Country Code	-		
2.3	GS Type Code	-		
2.4	Enel designation	-		
2.5	Highest voltage for equipment $U_m$	[kV]		
2.6	$U_0$ for determination of test voltages	[kV]		
2.7	Power frequency withstand voltage (15 min)	[kV]		
2.8	Lighting impulse voltage test	[kV]		
2.9	Rated withstand current in steady state condition	[A]		
2.10	Maximum short circuit withstand current (0,5 s)	[kA]		
2.11	Plug-in dry type termination	[Yes/No]		
2.12	Supplier product designation	-		
<b>3</b>	<b>BUSHING</b>			
3.1	Supplier Reference	-		
3.2	Insulation Material	-		
3.3	Field control method	-		
3.4	Production method			
3.5	Dimensions according to Fig. 5 from IEC62217-209:2022	[Yes/No]		
3.6	d1	[mm]		
3.7	d3	[mm]		
3.8	d4	[mm]		
3.9	d9	[mm]		
3.10	d10	[mm]		

**Subject:** GSCH013 High voltage cable terminations for GIS

**Application Areas**

Perimeter: *Global*  
 Staff Function: -  
 Service Function: -  
 Business Line: *Enel Grids*

Item	Description	Unit	Required values	Offered values
3.11	l4	[mm]		
3.12	l10	[mm]		
3.13	s3	[mm]		
3.14	s4	[mm]		
<b>4</b>	<b>CABLE SIDE</b>			
4.1	Supplier Reference	-		
4.2	Insulation Material	-		
4.3	Field control method	-		
4.4	Production method	-		
4.5	Contact system. Assembly technique	-		
4.6	Material of admissible conductor	Al/Cu		
4.7	Nominal cross-section of admissible conductor	[mm <sup>2</sup> ]		
4.8	Minimum diameter of conductor	[mm]		
4.9	Maximum diameter of conductor	[mm]		
4.10	Minimum diameter of cable core (over insulation)	[mm]		
4.11	Maximum diameter of cable core (over insulation)	[mm]		
4.12	Maximum withstand electrical stress	[kV/mm]		
4.13	Cable Screen type	[mm]		
4.14	Maximum cross-section of cable screen	[mm <sup>2</sup> ]		
4.15	Length outside GIS side	[mm]		
<b>5</b>	<b>ADDITIONAL FEATURES</b>			
5.1	Maximum overall cable diameter	[mm]		
5.2	Maximum inclination installed	[°]		
5.3	Weight of GIS side	[kg]		
5.4	Weight of cable side	[kg]		
5.5	Maximum storage time	[months]		
5.6	Estimated time of installation (GIS side)	[h]		
5.7	Estimated time of installation (cable side)	[h]		
5.8	Expected service life after installation	[years]		
5.9	Integrated FO box in terminal	[Yes/No]		
5.10	Capacity voltage cap included	[Yes/No]		
<b>6</b>	<b>TCA INFORMATION</b>			
6.1	TCA Available	[Yes/No]	Informative	
6.2	TCA Code	-	Informative	
<b>7</b>	<b>OBSERVATION</b>			





INTERNAL

**Material specification code:** GRI-GRI-MAT-E&C-0017

Version no. 1 dated 07/12/2022

**Subject:** GSCH013 High voltage cable terminations for GIS

**Application Areas**

Perimeter: *Global*

Staff Function: -

Service Function: -

Business Line: *Enel Grids*

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Item	Description	Unit	Required values	Offered values
7.1	Any exception to what is required on GSCH013	-		
7.2	Additional comments	-		

**Subject:** GSCH013 High voltage cable terminations for GIS

**Application Areas**

Perimeter: *Global*  
 Staff Function: -  
 Service Function: -  
 Business Line: *Enel Grids*

**ANNEX B – GLOBAL TYPE CODES FOR GIS TERMINALS**

GS Type Code	Designation	Um [kV]	Conductor Section [mm <sup>2</sup> ]	Screen Type
GSCH013/001	GT-245 kV 2500 mm <sup>2</sup> -T	245	2500	T
GSCH013/002	GT-245 kV 2000 mm <sup>2</sup> -T	245	2000	T
GSCH013/003	GT-245 kV 1600 mm <sup>2</sup> -T	245	1600	T
GSCH013/004	GT-245 kV 1000 mm <sup>2</sup> -T	245	1000	T
GSCH013/005	GT-245 kV 800 mm <sup>2</sup> -T	245	800	T
GSCH013/006	GT-170 kV 1600 mm <sup>2</sup> -T	170	1600	T
GSCH013/007	GT-170 kV 1000 mm <sup>2</sup> -T	170	1000	T
GSCH013/008	GT-170 kV 630 mm <sup>2</sup> -T	170	630	T
GSCH013/009	GT-145 kV 1200 mm <sup>2</sup> -T	145	1200	T
GSCH013/010	GT-145 kV 800 mm <sup>2</sup> -T	145	800	T
GSCH013/011	GT-145 kV 630 mm <sup>2</sup> -T	145	630	T
GSCH013/012	GT-72,5 kV 1000 mm <sup>2</sup> -T	72,5	1000	T
GSCH013/013	GT-72,5 kV 630 mm <sup>2</sup> -T	72,5	630	T
GSCH013/016	GT-170 kV 1600 mm <sup>2</sup> -H	170	1600	H
GSCH013/017	GT-170 kV 1000 mm <sup>2</sup> -H	170	1000	H
GSCH013/018	GT-170 kV 630 mm <sup>2</sup> -H	170	630	H
GSCH013/019	GT-145 kV 1200 mm <sup>2</sup> -H	145	1200	H
GSCH013/021	GT-145 kV 630 mm <sup>2</sup> -H	145	630	H
GSCH013/023	GT-72,5 kV 1000 mm <sup>2</sup> -H	72,5	1000	H
GSCH013/024	GT-72,5 kV 800 mm <sup>2</sup> -H	72,5	800	H
GSCH013/027	GT-72,5 kV 1200 mm <sup>2</sup> -H	72,5	1200	H
GSCH013/028	GT-72,5 kV 630 mm <sup>2</sup> -H	72,5	630	H
GSCH013/029	GT-72,5 kV 2000 mm <sup>2</sup> -H	72,5	2000	H
GSCH013/030	GT-245 kV 1200 mm <sup>2</sup> -H	245	1200	H
GSCH013/031	GT-245 kV 2000 mm <sup>2</sup> -H	245	2000	H
GSCH013/033	GT-145 kV 1600 mm <sup>2</sup> -H	145	1600	H
GSCH013/034	GT-145 kV 2000 mm <sup>2</sup> -H	145	2000	H
GSCH013/035	GT-145 kV 400 mm <sup>2</sup> -H	145	400	H
GSCH013/036	GT-145 kV 800 mm <sup>2</sup> -H	145	800	H
GSCH013/037	GT-145 kV 1000 mm <sup>2</sup> -H	145	1000	H
GSCH013/041	GT-145 kV 2500 mm <sup>2</sup> -H	145	2500	H
GSCH013/042	GT-72,5 kV 500 mm <sup>2</sup> -H	72,5	500	H
GSCH013/043	GT-245 kV 1600 mm <sup>2</sup> -H	245	1600	H
GSCH013/045	GT-145 kV 500 mm <sup>2</sup> -H	145	500	H
GSCH013/046	GT-145 kV 2000 mm <sup>2</sup> -T	145	2000	T
GSCH013/047	GT-145 kV 1600 mm <sup>2</sup> -T	145	1600	T
GSCH013/048	GT-145 kV 1000 mm <sup>2</sup> -T	145	1000	T
GSCH013/051	GT-245 kV 2500 mm <sup>2</sup> -H	245	2500	H

**Subject: GSCH013 High voltage cable terminations for GIS****Application Areas**

Perimeter: *Global*  
 Staff Function: -  
 Service Function: -  
 Business Line: *Enel Grids*

**ANNEX C – COMMON LIST**

COMMON LIST					07/12/2022
GS Type Code	Designation	Distribution Company and Country	Country Code	TAM Description	
GSCH013/009	GT-145 kV 1200 mm <sup>2</sup> -T	Edesur Argentina	0113-0241	TERMINAL GIS P/CABLE AT 145KV 1200MM2-T	
GSCH013/021	GT-145 kV 630 mm <sup>2</sup> -H	Edesur Argentina	0113-0242	TERMINAL GIS P/CABLE AT 145KV 630MM2-H	
GSCH013/019	GT-145 kV 1200 mm <sup>2</sup> -H	Edesur Argentina	0113-0243	TERMINAL GIS P/CABLE AT 145KV 1200MM2-H	
GSCH013/051	GT-245 kV 2500 mm <sup>2</sup> -H	Edesur Argentina	0113-0244	TERMINAL GIS P/CABLE AT 245KV 2500MM2-H	
GSCH013/001	GT-245 kV 2500 mm <sup>2</sup> -T	Edesur Argentina	0113-0245	TERMINAL GIS P/CABLE AT 245KV 2500MM2-T	
GSCH013/033	GT-145 kV 1600 mm <sup>2</sup> -H	Enel Distributie Romania	270048	Conector GIS conform GSCH013/033, 145kV, sectiune 1600mm <sup>2</sup> , cu ecran fire cupru	
GSCH013/037	GT-145 kV 1000 mm <sup>2</sup> -H	Enel Distributie Romania	270049	Conector GIS conform GSCH013/037, 145kV, sectiune 1000mm <sup>2</sup> , cu ecran fire cupru	
GSCH013/011	GT-145 kV 630 mm <sup>2</sup> -T	Enel Distributie Romania	270050	Conector GIS conform GSCH013/011, 145kV, sectiune 630mm <sup>2</sup> , cu ecran tub de aluminiu	
GSCH013/047	GT-145 kV 1600 mm <sup>2</sup> -T	Enel Distributie Romania	270051	Conector GIS conform GSCH013/047, 145kV, sectiune 1600mm <sup>2</sup> , cu ecran tub de aluminiu	
GSCH013/048	GT-145 kV 1000 mm <sup>2</sup> -T	Enel Distributie Romania	270052	Conector GIS conform GSCH013/048, 145kV, sectiune 1000mm <sup>2</sup> , cu ecran tub de aluminiu	
GSCH013/009	GT-145 kV 1200 mm <sup>2</sup> -T	e-distribución España	270353	Conector GIS según norma GSCH013, para tensión de 145kV, sección 1200mm <sup>2</sup> , con pantalla en tubo de aluminio	
GSCH013/023	GT-72,5 kV 1000 mm <sup>2</sup> -H	e-distribución España	270358	Conector GIS según norma GSCH013, para tensión de 72,5kV, sección 1000mm <sup>2</sup> , con pantalla de hilos de cobre	
GSCH013/021	GT-145 kV 630 mm <sup>2</sup> -H	e-distribución España	270359	Conector GIS según norma GSCH013, para tensión de 145kV, sección 630mm <sup>2</sup> , con pantalla de hilos de cobre	
GSCH013/019	GT-145 kV 1200 mm <sup>2</sup> -H	e-distribución España	270362	Conector GIS según norma GSCH013, para tensión de 145kV, sección 1200mm <sup>2</sup> , con pantalla de hilos de cobre	
GSCH013/013	GT-72,5 kV 630 mm <sup>2</sup> -T	e-distribución España	270363	Conector GIS según norma GSCH013, para tensión de 72,5kV, sección 630mm <sup>2</sup> , con pantalla en tubo de aluminio	
GSCH013/012	GT-72,5 kV 1000 mm <sup>2</sup> -T	e-distribución España	270364	Conector GIS según norma GSCH013, para tensión de 72,5kV, sección 1000mm <sup>2</sup> , con pantalla en tubo de aluminio	
GSCH013/011	GT-145 kV 630 mm <sup>2</sup> -T	e-distribución España	270365	Conector GIS según norma GSCH013, para tensión de 145kV, sección 630mm <sup>2</sup> , con pantalla en tubo de aluminio	
GSCH013/019	GT-145 kV 1200 mm <sup>2</sup> -H	Enel Distribuição Brasil	270404	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 1200 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/019	
GSCH013/028	GT-72,5 kV 630 mm <sup>2</sup> -H	Enel Distribuição Brasil	270405	TERMINAL INTERNO PARA CABO ISOLADO -72,5 kV 630 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/028	
GSCH013/013	GT-72,5 kV 630 mm <sup>2</sup> -T	Enel Distribuição Brasil	270406	TERMINAL INTERNO PARA CABO ISOLADO -72,5 kV 630 mm <sup>2</sup> -T, UTILIZAÇÃO EM GIS ,GSCH013/013	
GSCH013/023	GT-72,5 kV 1000 mm <sup>2</sup> -H	Enel Distribuição Brasil	270407	TERMINAL INTERNO PARA CABO ISOLADO -72,5 kV 1000 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/023	
GSCH013/012	GT-72,5 kV 1000 mm <sup>2</sup> -T	Enel Distribuição Brasil	270408	TERMINAL INTERNO PARA CABO ISOLADO -72,5 kV 1000 mm <sup>2</sup> -T, UTILIZAÇÃO EM GIS ,GSCH013/012	

**Subject: GSCH013 High voltage cable terminations for GIS**

**Application Areas**

Perimeter: *Global*  
 Staff Function: -  
 Service Function: -  
 Business Line: *Enel Grids*

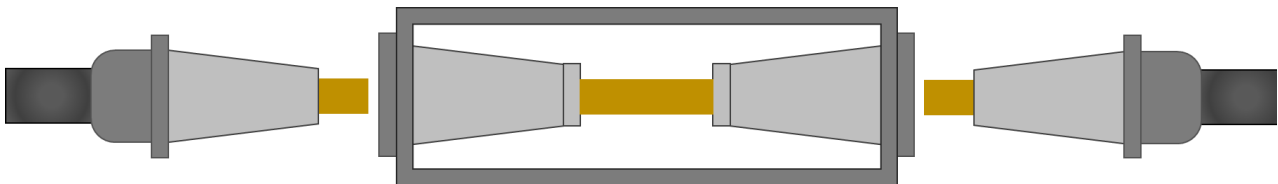
COMMON LIST				07/12/2022
GS Type Code	Designation	Distribution Company and Country	Country Code	TAM Description
GSCH013/010	GT-145 kV 800 mm <sup>2</sup> -T	Enel Distribuição Brasil	270409	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 800 mm <sup>2</sup> -T, UTILIZAÇÃO EM GIS ,GSCH013/010
GSCH013/037	GT-145 kV 1000 mm <sup>2</sup> -H	Enel Distribuição Brasil	270410	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 1000 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/037
GSCH013/036	GT-145 kV 800 mm <sup>2</sup> -H	Enel Distribuição Brasil	270411	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 800 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/036
GSCH013/011	GT-145 kV 630 mm <sup>2</sup> -T	Enel Distribuição Brasil	270412	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 630 mm <sup>2</sup> -T, UTILIZAÇÃO EM GIS ,GSCH013/011
GSCH013/035	GT-145 kV 400 mm <sup>2</sup> -H	Enel Distribuição Brasil	270413	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 400 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/035
GSCH013/009	GT-145 kV 1200 mm <sup>2</sup> -T	Enel Distribuição Brasil	270414	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 1200 mm <sup>2</sup> -T, UTILIZAÇÃO EM GIS ,GSCH013/009
GSCH013/021	GT-145 kV 630 mm <sup>2</sup> -H	Enel Distribuição Brasil	270415	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 630 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/021
GSCH013/045	GT-145 kV 500 mm <sup>2</sup> -H	Enel Distribuição Brasil	270416	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 500 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/045
GSCH013/033	GT-145 kV 1600 mm <sup>2</sup> -H	Enel Distribuição Brasil	270417	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 1600 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/033
GSCH013/034	GT-145 kV 2000 mm <sup>2</sup> -H	Enel Distribuição Brasil	270418	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 2000 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/034
GSCH013/041	GT-145 kV 2500 mm <sup>2</sup> -H	Enel Distribuição Brasil	270420	TERMINAL INTERNO PARA CABO ISOLADO -145 kV 2500 mm <sup>2</sup> -H, UTILIZAÇÃO EM GIS ,GSCH013/041
GSCH013/042	GT-72,5 kV 500 mm <sup>2</sup> -H	Enel Disbribución Perú	270422	Terminal GIS-Cable CU 500mm <sup>2</sup> (72.5kV)
GSCH013/027	GT-72,5 kV 1200 mm <sup>2</sup> -H	Enel Disbribución Perú	270423	Terminal GIS-Cable CU 1200mm <sup>2</sup> (72.5kV)
GSCH013/028	GT-72,5 kV 630 mm <sup>2</sup> -H	Enel Disbribución Perú	270424	Terminal GIS-Cable CU 630mm <sup>2</sup> (72.5kV)
GSCH013/029	GT-72,5 kV 2000 mm <sup>2</sup> -H	Enel Disbribución Perú	270425	Terminal GIS-Cable CU 2000mm <sup>2</sup> (72.5kV)
GSCH013/024	GT-72,5 kV 800 mm <sup>2</sup> -H	Enel Disbribución Perú	270426	Terminal GIS-Cable AL 800mm <sup>2</sup> (72.5kV)
GSCH013/029	GT-72,5 kV 2000 mm <sup>2</sup> -H	Enel Disbribución Perú	270427	Terminal GIS-Cable AL 2000mm <sup>2</sup> (72.5kV)
GSCH013/030	GT-245 kV 1200 mm <sup>2</sup> -H	Enel Disbribución Perú	270428	Terminal GIS-Cable CU 1200mm <sup>2</sup> (245kV)
GSCH013/043	GT-245 kV 1600 mm <sup>2</sup> -H	Enel Disbribución Perú	270429	Terminal GIS-Cable CU 1600mm <sup>2</sup> (245kV)
GSCH013/031	GT-245 kV 2000 mm <sup>2</sup> -H	Enel Disbribución Perú	270430	Terminal GIS-Cable CU 2000mm <sup>2</sup> (245kV)
GSCH013/005	GT-245 kV 800 mm <sup>2</sup> -T	Enel Disbribución Perú	270431	Terminal GIS-Cable AL 800mm <sup>2</sup> (245kV)
GSCH013/002	GT-245 kV 2000 mm <sup>2</sup> -T	Enel Disbribución Perú	270432	Terminal GIS-Cable AL 2000mm <sup>2</sup> (245kV)

**Application Areas**

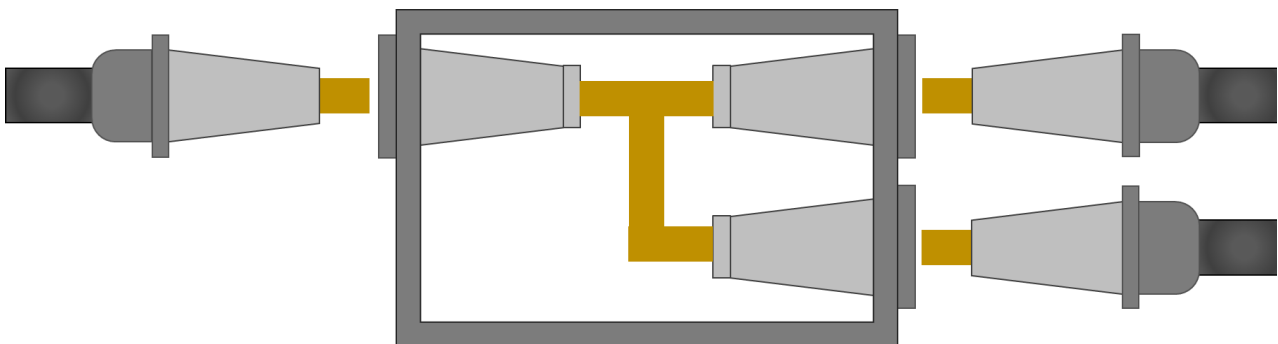
Perimeter: *Global*  
 Staff Function: -  
 Service Function: -  
 Business Line: *Enel Grids*

**ANNEX D – CABLE JOINTS**

GIS terminal could be used to form different types of joints by mean of a GIS enclosure that provide the connection for all of them. The system uses a pressurized vessel ready to connect two or more cable terminals to a connecting rod on the inside. So, it is possible to form a joint or the branching of one or more cables. As an example, in **Figure 2** it is shown a scheme for a joint formed by a vessel and two terminal and in **Figure 3** a scheme for a T-joint formed by a vessel and 3 terminals.



**Figure 2 Scheme of a joint.**



**Figure 3 Scheme of a T-joint.**

The enclosure contains separating insulation barrier, and it is filled with an insulation material, usually pressurized SF6 or any other gas. It will be protected against corrosion and will fulfill the requirements of IP67 class protection according to IEC 60529.

If one connection point remains unused, it must be sealed with an appropriate plug. And, in any case, the enclosure may contain the effects of thermal or electrical failure of any of the elements housed in it.

The technical characteristics of these systems will be defined on every order, according to IEC 62271-203 and IEC60840 or IEC62067.