"I.G." TRANSFORMERS

Instruction Manual for Low Voltage Connection of Single Phase and Three Phase Transformers of the Submersible Type

Cía. Manufacturera de Artefactos Eléctricos, S. A. de C. V.

Instruction Manual: I.G.: **INST.ID.SUM.03**

Contents

1 Objective

The objective is to disseminate the instructions and requirements for the installation of **I.G. transformers** of the submersible type with the low voltage connection.

The **I.G. Submersible** transformers are of the deadfront type, and they are therefore designed for installation in vaults that may occasionally undergo flooding, as stipulated in Section 3 of the **NMX-J-287-ANCE** standard. That is, they may at times be submerged in water, but not in a permanent manner. Therefore, the vault must have a drainage system that will make it possible to drain the water in not more than 24 hours.

2 The installation site

For these units, vaults made of prefabricated concrete are used, standardized in accordance with the **CFE - BMT – EOCEMAH** standard. These vaults can be of various sizes, but they must be of a size that will allow the installation of a submersible transformer, leaving a free horizontal space sufficient to work in of 90 cm, in addition to the space occupied by the cables anchored to the walls.

It is recommended that the following articles of the **NOM-001-SEDE-2005** standard be consulted:

a. **450.-** Transformers and Vaults, Sections 110-17, Safeguarding of live parts; and 110-34, working and construction space

b. **500.-** Dangerous Areas

c.

d. **923.-** Underground Lines, Section 923-17, Dimensions

> **NOTE:** The dimensions of the vaults and the spaces for the transformer are designed to optimize the cooling of the transformer, facilitate its installation and its eventual maintenance.

3 Maintenance Recommendations

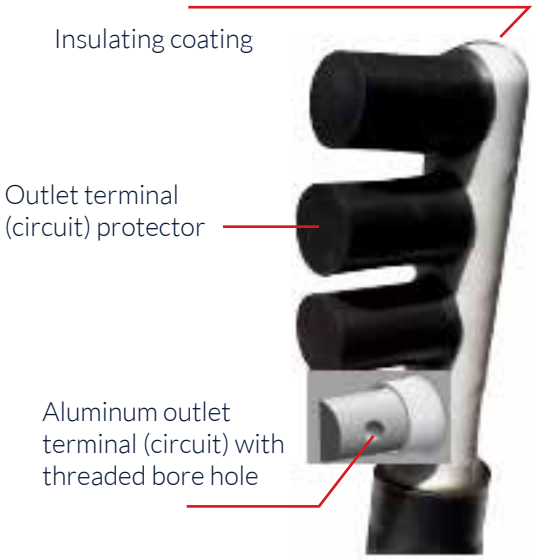
1. Clean the installation site, removing garbage that could obstruct its drainage.
2. Avoid the formation of water puddles.
3. Ensure that the low voltage connectors and cables are watertight to prevent the entrance of moisture into them. The connection terminals not used should also be fully watertight.

4 Instructions for the connection of the cables to the secondary winding connector

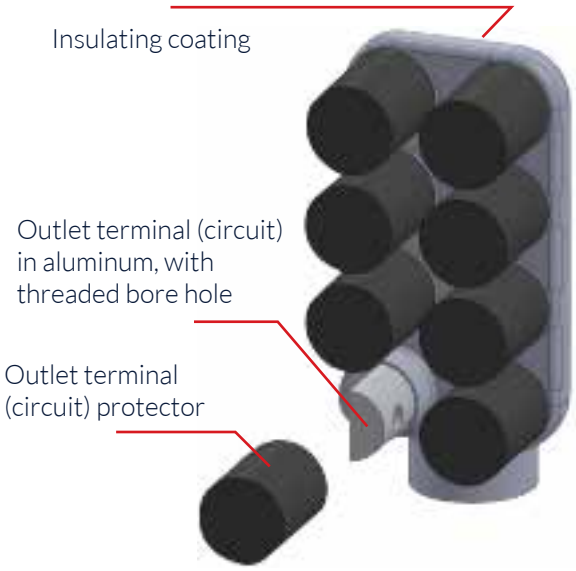
The connectors supplied in the transformer are of aluminum with an insulating coating, and they have a detachable shield made of insulating material on each outlet terminal (circuit). The insulating materials meet the outdoor electrical and resistance requirements necessary for the adequate operation of the apparatus.

1 Identification of the parts of a connector. There are differences in the outlet terminals (circuits) of the **CTMIG1401** and the **TMIG2401** models, and there are therefore differences in the sizes of the connectors and the screws for their connection, but the procedure described here is applicable to both connectors.

Single Phase Connector with 4 outlets or circuits, Model CTMIG1401



Three phase connector with 8 outlets or circuits, Model CTMIG2401



4 Instructions for the connection of the cables to the secondary winding connector

2 Following below are the tools necessary to carry out the connection:

- **a.** Socket wrench
- **b.** Extension for the socket wrench
- **c.** 9/16" and 3/4" sockets for 3/8" and 1/2" hexagonal screws
- **d.** Steel wire brush
- **e.** Fine sandpaper
- **f.** Measuring tape
- **g.** Wire stripping tool
- **h.** Circumferential crimper
- **i.** Dies for the crimper (in accordance with the compression connector)
- **j.** Thermal glove
- **k.** Hot air gun with deflecting shield
- **l.** Cleaning material that will not shed fibers

3 The necessary material to realize the connection at an outlet terminal (circuit). The following figures and tables show the materials and their requirements. All the materials listed are commercial, and there are several brands that can be used.

Material for the connection at an outlet terminal of the CTMIG1401connector

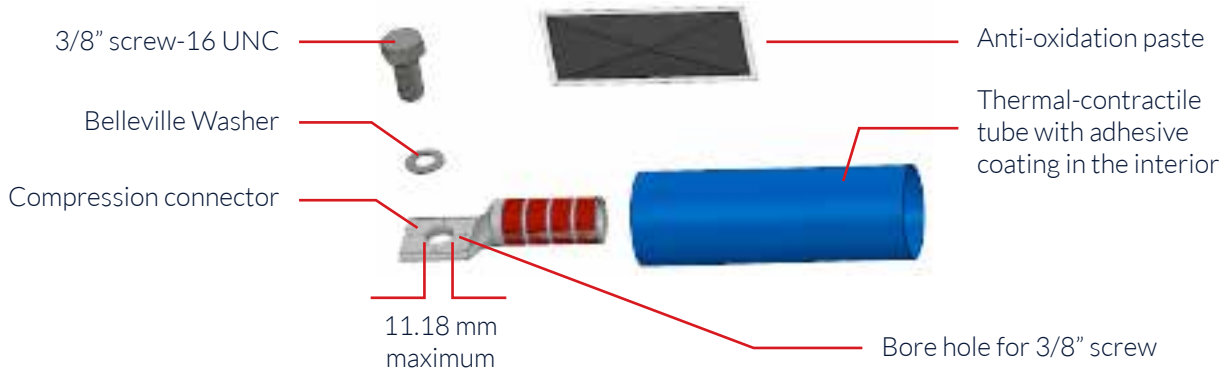


Table for the CTMIG1401 connector
(For the single phase submersible transformers)

Conductor			Connector (Tinned)		Stainless steel screws AISI 316			Thermal-contractile tube (With adhesive coating)			Antioxidant
Material	Gauge	Length of insulation to be removed	Material	Color code	Hexagonal screw	Length of the screw	Belleville Washer	Ø Expanded (Maximum)	Ø Contracted (Minimum)	Length (Minimum)	
Aluminum/ Copper	4 AWG	22.2 mm	Aluminum	Green	3/8"- 16 UNC	3/4 inch	Elastic type (Similar to DIN 2093 Series B) of 3/8", flattening load: 1418 Newtons maximum	34 mm	8 mm	4½" (114 mm)	Anti-oxidation paste, with zinc particles in suspension (Must be compatible with the conductor's insulation)
Aluminum/ Copper	2 AWG	28.6 mm	Aluminum	Rose		3/4 inch		34 mm	8 mm	4½" (114 mm)	
Aluminum/ Copper	1 AWG	23.8 mm	Aluminum	Golden		3/4 inch		34 mm	8 mm	4½" (114 mm)	
Aluminum/ Copper	1/0 AWG	27.0 mm	Aluminum	Maroon		3/4 inch		34 mm	8 mm	4½" (114 mm)	
Aluminum/ Copper	2/0 AWG	34.9 mm	Aluminum	Olive		3/4 inch		34 mm	8 mm	5" (127 mm)	
Aluminum/ Copper	3/0 AWG	38.1 mm	Aluminum	Ruby		3/4 inch		34 mm	8 mm	5" (127 mm)	
Aluminum/ Copper	4/0 AWG	41.3 mm	Aluminum	White		1 inch		34 mm	8 mm	5¼" (133 mm)	
Aluminum/ Copper	250 kcmil	42.7 mm	Aluminum	Red		1 inch		34 mm	8 mm	5¾" (146 mm)	
Aluminum/ Copper	300 kcmil	44.5 mm	Aluminum	Blue		1 inch		34 mm	8 mm	5¾" (146 mm)	
Aluminum/ Copper	350 kcmil	54.0 mm	Aluminum	Brown		1 inch		34 mm	8 mm	6¼" (159 mm)	

OPTIONAL: A flat stainless steel washer can be placed between the connector and the Belleville Washer.

The circumferential crimper of the compression connector is suggested, and the adherence to its manufacturer's recommendations in regard to the number of crimpers and the socket of the tool used for that purpose.

The sizes and materials listed in the table are the ones recommended for an optimal and safe connection.

Material for the connection at an outlet terminal of the CTMIG1401 connector

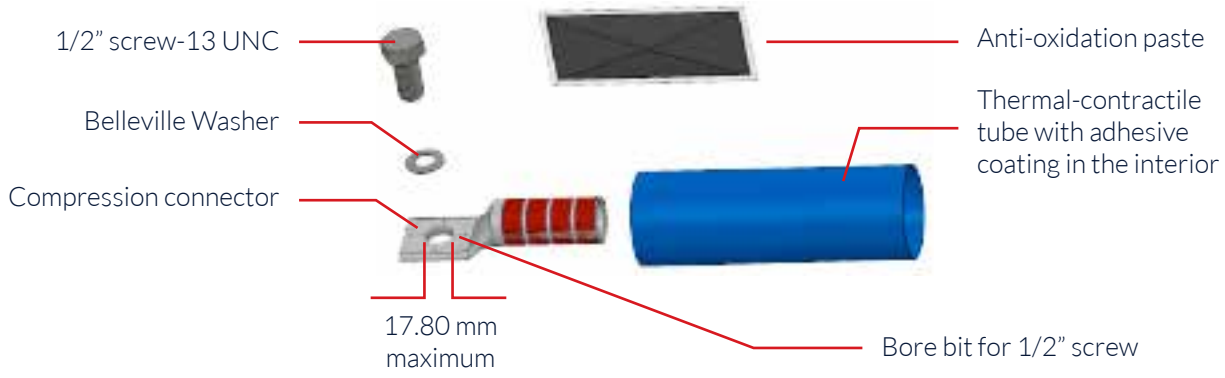


Table for the CTMIG2401 connector
(For the three phase submersible transformers)

Conductor			Connector (Tinned)		Stainless steel screws AISI 316			Thermal-contractile tube (With adhesive coating)			Antioxidant
Material	Gauge	Length of insulation to be removed	Material	Color code	Hexagonal screw	Length of the screw	Belleville Washer	Ø Expanded (Maximum)	Ø Contracted (Minimum)	Length (Minimum)	
Copper	4 AWG	22.2 mm	Copper	Gray	1/2"- 13 UNC	3/4 inch	Elastic type (Similar to DIN 2093 Series B) of 3/8", flattening load: 1418 Newtons maximum	34 mm	8 mm	4" (102 mm)	Anti-oxidation paste, with zinc particles in suspension (Must be compatible with the conductor's insulation)
Copper	2 AWG	23.8 mm	Copper	Brown		3/4 inch		34 mm	8 mm	4" (102 mm)	
Copper	1 AWG	23.8 mm	Copper	Green		3/4 inch		34 mm	8 mm	4½" (114 mm)	
Aluminum/ Copper	1/0 AWG	27.0 mm	Aluminum	Maroon		1 inch		34 mm	8 mm	4½" (114 mm)	
Aluminum/ Copper	2/0 AWG	34.9 mm	Aluminum	Olive		1 inch		34 mm	8 mm	5" (127 mm)	
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Aluminum/ Copper	4/0 AWG	41.3 mm	Aluminum	White		1 inch		34 mm	8 mm	5¼" (133 mm)	
Aluminum/ Copper	250 kcmil	41.3 mm	Aluminum	Red		1 inch		34 mm	8 mm	5¼" (133 mm)	
Aluminum/ Copper	300 kcmil	44.5 mm	Aluminum	Blue		1 inch		34 mm	8 mm	5¾" (146 mm)	
Aluminum/ Copper	350 kcmil	54.0 mm	Aluminum	Brown		1 inch		34 mm	8 mm	6¼" (159 mm)	

OPTIONAL: A flat stainless steel washer can be placed between the connector and the Belleville Washer.

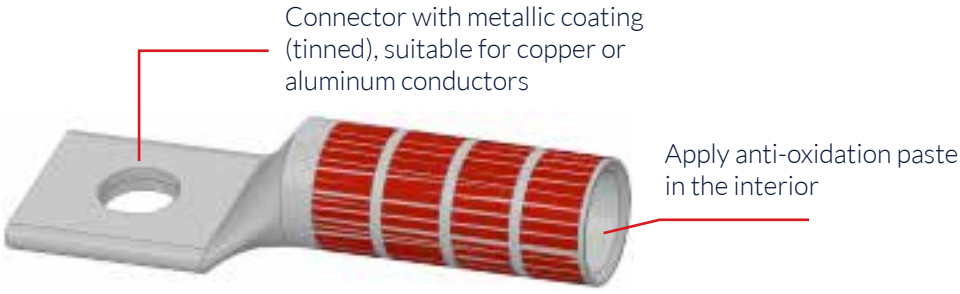
The circumferential crimper of the compression connector is suggested, and the adherence to its manufacturer's recommendations in regard to the number of crimpers and the socket of the tool used for that purpose.

The sizes and materials listed in the table are the ones recommended for an optimal and safe connection.

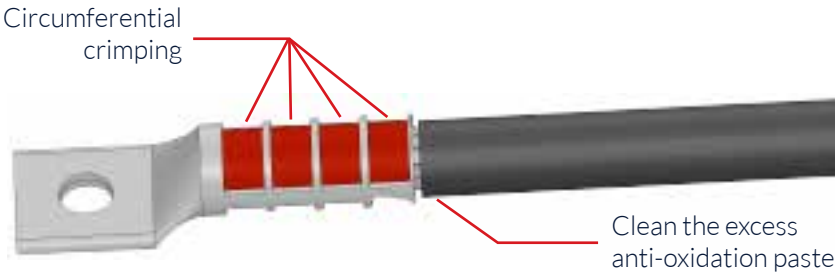
4 Instructions for the connection of the cables to the secondary winding connector

4 Prepare the conductor cable, stripping the insulation length indicated for each connector and cleaning its surface with a steel wire brush and sandpaper until it is shiny (NOTE: the tinned conductors or the conductors with metallic coating should not be cleaned). Immediately after cleaning apply the anti-oxidation paste to the conductor cable strands.

5 Prepare the connector by applying anti-oxidation paste in the lodging for the conductor cable.



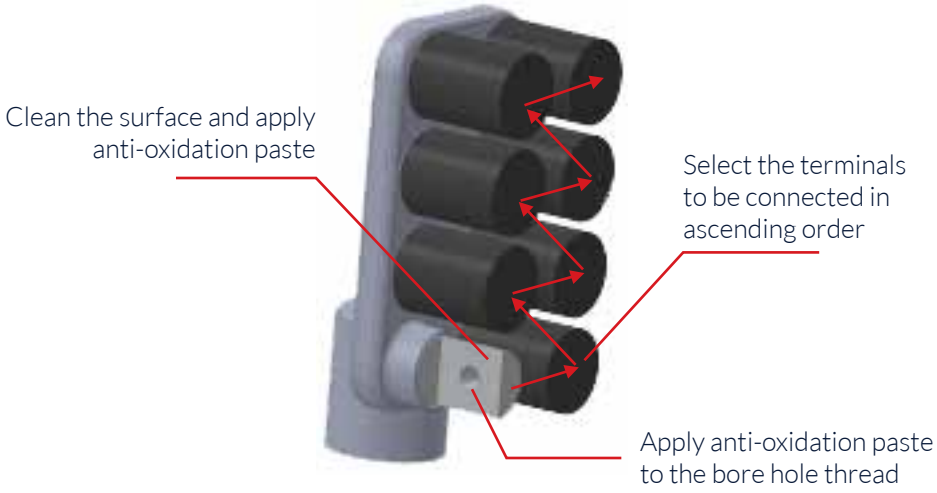
6 Insert the previously prepared point of the conductor totally into the connector and crimp it. Clean the excess anti-oxidation paste that is expulsed, without extending it to the conductor's insulation.



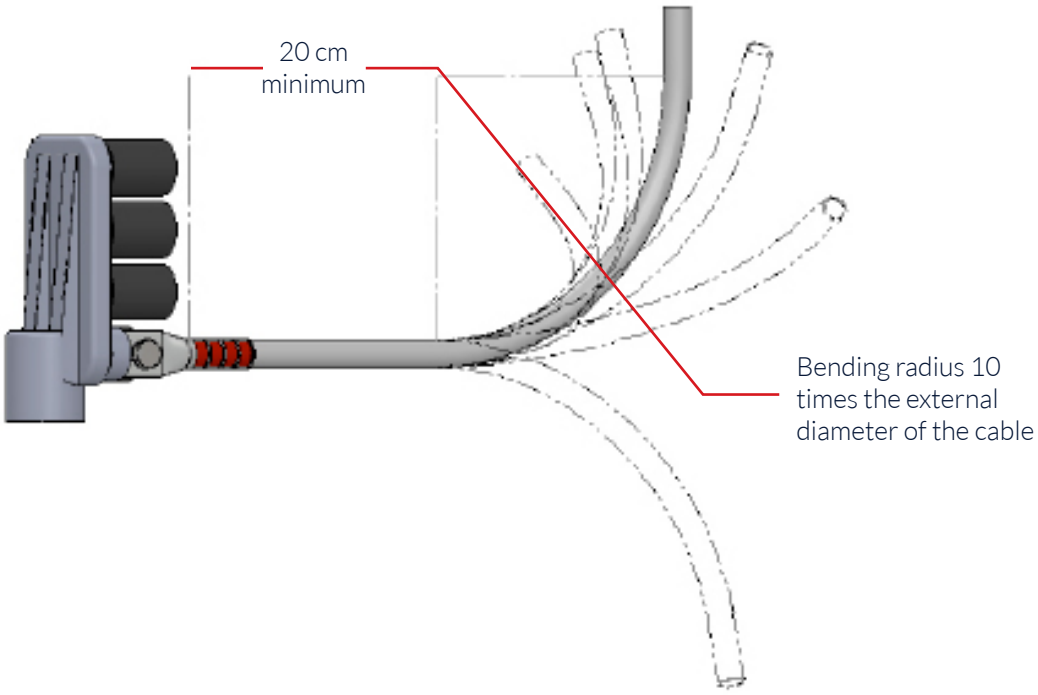
4 Instructions for the connection of the cables to the secondary winding connector

7 Repeat steps 4 and 6 for each conductor that will be joined to the transformer's connector.

8 Select an outlet terminal to make the connection and remove its protector. Work on only one terminal at a time. Select the terminals to be connected, beginning with the lower ones and in an ascending order. Prepare the outlet terminal, cleaning the surface that will be in contact with the connector, using a wire brush and sandpaper, until it is shiny. Apply anti-oxidation paste immediately after cleaning. Apply paste also to the bore hole thread.



9 The cables must enter the connector's outlet terminal in a straight and level form. It is recommended that the entrance cable be curved at least 20 cm after the connection point.



4 Instructions for the connection of the cables to the secondary winding connector

10 To realize the connection, slide the thermal-contractile tube along the connector to the cable's insulation. Place the cable's connector in its outlet terminal and fasten it there with the screw with the Belleville Washer. Tighten it until the washer is completely flat and clean the excess anti-oxidation paste that is squeezed out. Move the thermal-contractile tube until it completely covers the insulated base of the connector's outlet terminal.

11 Apply heat to the thermal-contractile tube by means of the hot air gun with the deflecting shield. Begin the application of heat at the end that is covering the base of the terminal. As soon as that end contracts, move the application of heat slowly along the length of the thermal-contractile tube until it has been uniformly heated around the connection. Hold the tube in place on the base of the terminal while the application of heat is moved cautiously, with your hand protected with a thermal glove, so that the contraction of the thermal-contractile tube will not leave the base uncovered. Hold it in place until there is no more contraction of the tube. Upon finishing, verify that all the connection is completely protected by the thermal-contractile tube, without hollows through which water could penetrate.

12 Repeat steps 8 to 11 for all the other connections that will be carried out on the connectors.

13 Once all the connections have been completed, verify that all the protectors of the outlet terminals that are not used are correctly in place.

14 **CAUTION:** A missing protector in any of the outlet terminals in this type of connectors represents a risk of failure in the transformer in the event of a flood, as well as the creation of unsafe conditions, the risk of personal injuries and life threatening conditions in the vicinity of the installation.

The preceding installation instructions should be carried out by qualified personnel.

“The adherence to these instructions is important for the useful life of the transformer and for the safety of the service it will perform”.