

Document Title:
Three-Phase Power Converter Distribution Transformers (Legacy)

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Author

Miguel J. Rios Lopez, PE (Lic. 16636)
General Engineer, Distribution Standards & Materials

Signature and Date:



Aug 27, 2025

Reviewer

Rodolfo A. Flores Ortiz, PE (Lic. 27131)
Senior Engineer, Distribution Standards & Materials

Signature and Date:



Aug 27, 2025

Approver

Ricardo Castro Gómez, PE (Lic. 12135)
Manager, Distribution Standards & Materials

Signature and Date:



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Management Approval (If apply)

Approver

Name
Position

Signature and Date:

Related/Referenced Documents

N/A

Version History

Version	Date	Revision
01	Aug. 27, 2025	Initial release for Items 032-87719 and 032-87720. Once these Items have been depleted, this document will be eliminated and the document 4350.017 will prevail for the Power Converters.

Item Version History

Warehouse Catalog #	Asset Suite #	Version	Date
032-87719	87719	1	08/27/2025
032-87720	87720	1	08/27/2025



1. Introduction

This is a general specification that covers the minimum requirements for three-phase power converter transformers to be used in the distribution system in Puerto Rico. Further information will be provided by LUMA Energy at the time of order placement and will provide information on site specific conditions, quantity, and other requirements. This document includes the general characteristics of the equipment/material.

2. Special Requirements

- 2.1. Samples shall be furnished as requested by LUMA Energy. Vendors that have supplied this equipment/material to LUMA on previous orders will not have to furnish samples at bid opening. The equipment/material will be received at LUMA's general warehouse (011) at Palo Seco, Puerto Rico. Shipping will include transportation and unloading at the indicated warehouse.
- 2.2. Prior to any changes to the supplier's approved designs, the Distribution Materials Section shall be notified in writing for approval. For changes to quality routines, inspection procedures, or processes, formal notification shall be given to the Distribution Materials Section for review. Any changes made shall be documented by written communication as to how they will enhance the quality of the product or maintain its present quality level.
- 2.3. Products shall be evaluated and approved by LUMA Energy. If the offered product has not been approved by LUMA Energy, the bidder must submit drawings with all details of the equipment and electrical testing of the prototype to be evaluated with their offer. Bidders shall comply with this paragraph, therefore, offers that do not comply shall be declared non-responded.

3. Literature

- 3.1. Descriptive and technical literature must be supplied by the vendor at time of bidding. This literature must include, but is not limited to, details of material, drawings, documented testing, and instructions for use and installation. **The literature must be an official document from and certified by the manufacturer.** Failure to submit documents on time and duly certified by the manufacturer will cause bidder disqualification.
- 3.2. If required by LUMA, final drawings and documentation shall be submitted by the vendor before the manufacturing and shipping process for approval.

4. Compatible with

For compatible manufacturer and model see Table 1. These models are examples of the equipment/material described in this document and do not represent a preference. LUMA will evaluate equally any model not listed here during any acquisition event.

5. Markings

- 5.1. Containers shall be marked outside with LUMA Energy's purchase order and item number.
- 5.2. Individual package(s) shall be clearly marked with manufacturer name and item information (part number, serial number, quantity, etc.).
- 5.3. Packaging labels and tags shall be waterproof.

6. Packaging

- 6.1. All equipment/material shall be packaged and marked in such a way as to facilitate handling and protection from damage and that the receiving warehouse can readily identify it and send it, in one complete unit, to a field location without opening crates or boxes to sort items and/or parts.
- 6.2. A list of all parts included in the container and/or package must be provided at delivery time so the receiving personnel can verify that everything requested is present, avoiding any delay in the receiving process.

- 6.3. Each unit shall be banded to a two-way entry, disposable pallet of the manufacturer's own design. The pallet shall be of such dimensions as to provide a minimum of one inch (1") clearance at the transformers widest outside measurements, on all four sides. It shall provide a minimum of two and a half inches (2-1/2") of fork under clearance.
- 6.4. The transformer shall be banded to the pallet, using non-metallic banding, to prevent rust and shifting of the unit during transit, while allowing the unit to be handed by sling or fork truck without removing the banding.
- 6.5. LUMA shall allow the use of metallic banding ONLY if such banding is protected in the places in which the band is in direct contact with the transformer tank.
- 6.6. The banding method to be used shall be submitted by the awarded bidder for LUMA's approval.
- 6.7. The transformers shall be shipped completely assembled except for items of equipment which must be removed to meet transportation clearances or for protection from damage. At the time of shipment, the supplier shall promptly inform the purchaser concerning the accessories which were removed for this purpose. These items shall be in the same shipment as the transformer and when the order covers more than one transformer, the unmounted equipment/accessories shall be boxed separately for each transformer and marked accordingly.

7. Number Per Package (Logistics)

Standard package: One (1) unit per package or as requested by LUMA.

8. Acceptance Criteria

- 8.1. Product shall be manufactured in accordance with the latest issue below (section 8.2). When conflicts occur between purchaser's specifications and the latest issue below, the purchaser's specification shall prevail.
- 8.2. All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the ASTM, AWS, NEMA, and any other applicable codes, standards, and other regulations, in addition of the following standards:
 - a. C57.12.00: General requirements for liquid- immersed distribution, power, and regulating transformers.

- b. C57.12.10: Standard requirements for 3Ø, 750kVA and above, liquid-immersed power transformers.
- c. C57.12.29: Tests and requirements for the integrity of above grade pad-mounted enclosures intended for installation in coastal environments.
- d. C57.12.35: IEEE standard bar coding for distribution transformers and step-voltage regulators.
- e. C57.12.80: Standard terminology for power and distribution transformers.
- f. C57.12.90: Test code for liquid-immersed distribution, power, and regulating transformers and guide for short-circuit testing of distribution and power transformers.
- g. C57.91: Guide for loading mineral-oil-immersed transformers with insulating system rated for 65°C or 55°C average winding temperature rise at rated load.
- h. C57.125: This document provides a methodology by which the most probable cause of any transformer failure may be determined.
- i. NEMA TR1: Transformers, regulators, and reactors.
- j. ANSI Z535: Sign standards for utility installations.

8.3. Samples of typical routine and design tests for the units to be quoted shall be submitted together with the drawings for the approval of LUMA Energy. The bidder shall submit a written certification stating that all tests have been performed according to the latest codes, standards, and regulations to provide a product of quality. In addition, the brand and models of the equipment to be used for those tests must be submitted.

8.4. The following routine tests shall be performed on each unit:

- a. Voltage ratio
- b. Polarity
- c. Phase relationship
- d. Core losses (no-load losses)
- e. Exciting current
- f. Winding losses (load losses)
- g. Tank leaks

- h. Impedance
- i. Applied potential
- j. Induced potential
- k. Impulse tests
- l. Insulation power factor
- m. Low frequency
- n. Winding & core insulation resistance

8.5. Typical design tests data shall include the following:

- a. Lightning impulse
- b. Temperature rise
- c. Over excitation
- d. Radio interference
- e. Oil tests
- f. Noise tests as per NEMA Standard TR 1 latest revision.
- g. Tanks withstand pressure

8.6. The temperature at which the tests were performed must be included in the document.

8.7. Parameters of resistance (%R), reactance (%X), and impedance (%Z) for each transformer shall be included in the document.

8.8. The tests mentioned at 8.3 shall be performed on the fully assembled unit at the manufacturer's location.

TESTS SHALL BE PERFORMED IN THE UNITS WITH ALL ITS ACCESSORIES AND/OR PARTS INSTALLED.

8.9. Any exceptions to the tests mentioned in sections 8.4 and 8.5 shall be specified at bid opening.

8.10. These documents shall be submitted to LUMA Energy **BEFORE** delivery of the transformer and shall be part of the project file.

- 8.11. If requested, the buyer or his representative shall be given free access to the manufacturing facilities to inspect and report on work in all phases of design, manufacture, examination, and testing.
- 8.12. If any other standards different from the ones indicated in this document are used, the supplier must provide information showing compatibility with the required ones.

9. Description

- 9.1. Distribution transformers, 60 Hz, three phase, 65°C (149°F) average winding rise, oil immerse, used as step-up or step-down to provide voltage transformation in the electric power distribution system at a primary level.
- 9.2. The transformer shall consist of a tank, core, bushings, insulating oil, tap changer, etc.
- 9.3. The transformer shall be designed in accordance with this specification. For kVA ratings see the Table in Section 12.
- 9.4. All kVA ratings are continuous and shall be based on not exceeding either a 65°C (149°F) average winding temperature rise of an 80°C (176°F) hot spot temperature rise. LUMA Energy reserves the right to specify units with different capacities in kVA.
- 9.5. Voltage Ratings and Basic Insulation Level as per IEEE C57.12.10:

HIGH VOLTAGE (V)	BIL (kV)
8320Y/4800	75
LOW VOLTAGE (V)	BIL (kV)
4160Y/2400	60

- 9.6. The transformers shall be supplied with dual voltages on the high or low sides as per Table in Section 12.
- 9.7. The transformers shall be supplied with a high-power factor and low core and winding losses. Note that the winding losses specified are corrected to 85°C (176°F).
- 9.8. Painting
 - a. The tank and cover shall be protected against environmental conditions and corrosion by means of an adequate process of painting.

- b. All steel surfaces to be painted shall receive a Phosphatize Treatment or equivalent prior to application of paint. External and internal surfaces shall be coated with at least one coat of corrosion resisting paint. Internal detail parts may have metallic plating or equivalent in lieu of finish paint.
- c. The paint shall be light gray No. 70, Munsell Notation 5 BG 7.0/0.4. The entire unit, including the interior surfaces, shall be painted this color.
- d. The paint shall be suitable for tropical climate conditions as per ANSI C57.12.29.
- e. The paint shall have a great retention of brightness and color in surfaces like aluminum and ferrous and non-ferrous materials. It shall be resistant, during long term, to ultraviolet rays, humidity, corrosion due to acids, salts, organic solvents, gases, and others. It shall comply with federal regulations on temperature and environment.
- f. To be evaluated, technical and descriptive literature shall be supplied at the bid opening. This literature shall include, but shall not be limited to, the process, type of painting and description, material safety data sheet, etc.

9.9. Nameplate

- a. Shall be mounted in such a manner that there are no sharp edges exposed. The material (aluminum or copper) used in each winding, date of manufacture, total weight, serial number, non-PCB compliance, manufacturers' name & part number, among all the other information as per ANSI C57.12.00 (Nameplate C), shall be shown on the nameplate.
- b. The information on the nameplate shall be engraved or stamped. Any of the two processes shall ensure legibility for the life of the transformer.
- c. Nameplate shall be made of stainless steel or aluminum.
- d. A sample of the nameplate as requested in this section shall be submitted by the awarded bidder.

9.10. Welding

- a. Welds to be used shall be in accordance with the material that will be welded and as per American Welding Society (AWS) 1.1 or latest revision.
- b. All welds at the exterior of the tank shall be continuous. It shall include the welding ON ALL SIDES of lifting lugs, mounting brackets, grounding provisions, etc. to prevent accumulation of humidity.

- c. The parts mounted on the cover can be screwed.

9.11. Core and Windings

- a. Cores:

1. Shall be made from high quality grain-oriented silicon steel with flat, rolled, and low loss permeability laminations.
2. The core shall be made free of buckles and wave surface defects.

- b. Windings:

1. Shall be non-telescoping with high and lower tension windings assembly forming an integral unit.
2. The winding polarization index shall be 2.0 or more as per ANSI C57.125-2015.
3. The bidder shall specify the material of the primary and secondary windings in the bid offer.

9.12. Noise

The design and construction of the transformer shall be such that the noise from the energized transformer and its accessories will be low as possible. When a low noise level transformer is specified, the sound level shall not exceed 55 dBA in accordance with ANSI C57.12.90.

9.13. Transformer Losses and Bidding Procedure

- a. The bidder shall submit the no load losses at 20°C, load losses at 85°C full load, and load losses at 55°C at 50% of load to calculate the efficiency and life cycle cost.
- b. All losses information will be used to evaluate the life cycle cost (LCC) of each bidder according to the following formula:

$$LCC = (UC) + (\$8.95) * NLL + (\$4.73) * LL, \text{ where}$$

UC = unit cost (\$)

NLL = No load losses (W) at 20°C

LL = Load losses (W) at 85°C full load

9.14. Tap Changer

- a. Shall be of the no load rotating type with an externally operated handle designed for de-energized operation.
- b. Shall be located under oil level with five (5) taps, including nominal voltage, each of two and a half percent (2.5%) of rated primary voltage.
- c. The tap range shall be two taps above (+2) and two taps below (-2) from rated primary voltage.
- d. The tap changer shall have stops at each position to set the desired voltage.
- e. A label shall be placed below the tap changer indicating that the transformer must be de-energized prior to the operation of the tap changer. A sample of this label shall be submitted if requested by LUMA.
- f. The tap changer shall be fixed in a place not exposed to possible damage due to the handling of the transformer.

9.15. Insulating Oil

- a. Each transformer shall be furnished with its tank filled with oil with a polychlorinated biphenyl (PCB) concentration of less than 1 PPM (less than 2 PPM could be accepted). The nameplate shall indicate this compliance. A label indicating NO PCB shall be affixed to the transformer in a visible place. The label shall have the same duration as the transformer under normal operating conditions.
- b. The insulating oil shall comply with ANSI/ASTM D3487 and LUMA requirements.

In addition, the oil shall comply with the following:

1. 30 kV minimum breakdown voltage
2. Neutralization number of 0.25.
3. Viscosity of:
 - 81.25 centistokes at 25°C as per ASTM D445-86.
 - 15.00 centistokes at 100°C as per ASTM D445-86.

- c. The awarded bidder shall submit the following:

1. A certificate stating that, at all moments, the transformers supplied to LUMA shall have a concentration of less than 1 PPM of PCB.
2. Safety Data Sheet (SDS) of the oil.

9.16. Pressure Relief Valve

- a. The body of the pressure relief valve shall be an **internal fault detector** type compatible with IFD Corporation. Shall be made of bronze or stainless steel.
- b. The relief valve shall allow the pressure inside the tank to be released but no air is admitted when the unit is cool or lightly loaded.
- c. Minimum flow rate of 5000 SCFM (142 m³/min) at an operating pressure of 10 psi (69 kPa) as per ANSI C.57.12.10.
- d. Resealing on falling pressure shall occur between five (5) and eight (8) psi.
- e. The valve shall have provisions for manual venting with the use of a live line hook stick.
- f. The release valve shall be situated on the side of the tank so that such release will be in a safe direction.
- g. The valve shall be threaded into a smaller boss welded to the tank above the 140°C (284°F) top oil level.

9.17. Insulation

- a. Shall be made with, at least, Class A (105 °C) insulation system as per ANSI C57.12.80.
- b. The insulation tests shall be as per ANSI C57.12.00. Minimum requirements for production line impulse testing shall be conducted at the highest voltage tap.
- c. The insulation power factor shall be as per ANSI C57.12.90.10.9 (60 Hz).
- d. Technical information about the insulation shall be submitted by the awarded supplier.

9.18. Additional Labels

- a. All labels shall be made of Thermal Transfer Polyester as per section 9.19 below.
- b. The transformer shall have the following labels:

1. kVA Rating:

This label shall be placed, whenever possible, below the secondary voltage bushings. Dimensions as per section 9.18.d.

2. Stainless Steel:

This label shall be placed directly under the kVA rating label. Dimensions as per section 9.18.d.

3. A label in Spanish and English indicating “Peligro - Alto Voltaje” / “Danger - High Voltage”. This is descriptive information. The information regarding this label shall be as specified by the regulatory agencies (ANSI, IEEE, etc.). This label shall be placed on the center of the cover for the high voltage bushing’s cabinet. It shall be of the same size as the NON-PCB label (see table below). Sizing shall be in accordance with ANSI Z535 Sign Standards for Utility Installations.

c. Each number for any of the labels’ dimensions mentioned above shall have a width of a minimum of 0.75 inches (1.9 cm) and a maximum of one (1) inch (2.54 cm). The height shall be two (2) inches (5.08 cm).

d. The following table summarizes the dimensions of the required labels:

SECTION	LABEL DESCRIPTION	WIDTH (IN.)		HEIGHT (IN.)			
		MIN.	MAX.	MIN.	MAX.		
9.14.e.	TAP CHANGER	INDUSTRY STANDARD					
9.15.a.	NO-PCB						
9.18.b.1.	kVA RATING	7	8	3	4		
9.18.b.2.	STAINLESS STEEL	12	13	3			
9.18.b.3.	“PELIGRO - ALTO VOLTAJE”	(Preferably of the NON-PCB same size)					
FOR DETAILS ON THIS LABEL REFERS TO THE MENTIONED SECTIONS.							

9.19. Thermal Transfer Polyester Label

a. Substrate specifications:

1. Material: Polyester
2. Shall resist abrasion, acids, chemicals, corrosives, solvent, moisture and humidity, cold, and tearing.
3. Temperature range: 0°C to 50°C (32°F to 122°F)

- b. Adhesive specifications:
 - 1. Adhesive type shall be acrylic.
 - 2. Shall be compatible with dirt, high-energy and low-energy plastics, painted metal, polyethylene, metals and untreated metals, and irregular surfaces.
 - 3. Color: The numbers will be black over a white base to assure legibility from about 35 ft.
- c. The label shall last a minimum of 20 years when installed on the transformer under normal operating conditions.

9.20. Tank

- a. Shall be made of stainless-steel 304, gauge 14, for outdoor use and severe corrosion areas (salt spray).
- b. Constructed in accordance with the latest revisions of ANSI C57.12.10.
- c. Tamper-resistant construction must be used throughout. The transformer shall have no exposed screws, bolts, or other fastening devices, which are externally removable. There shall be no openings through which foreign objects such as sticks, rods, or wires might be inserted to contact live parts. If a handhole is used, a false cover shall be provided.
- d. Rectangular shape and weatherproof.
- e. Suitable for mounting on flat surfaces.
- f. Fitted with lifting lugs and grounding provisions permanently affixed. Grounding provision shall consist of a tin-plated copper connector suitable for 2/0 AWG conductor welded to the tank.
- g. Stainless steel alloy ground pads shall be welded to the tank on the primary and secondary sides. The primary ground pad shall be affixed to the lower right-hand corner of the tank.
- h. The tank shall have an internal mark, which indicates the proper oil level.
- i. No wood materials shall be used inside the tank.
- j. An oil draining plug shall be provided near the center of the tank. This plug shall be located in an area clear of grounding pads, bushings, etc., to allow access for removal.

- k. All external hardware such as transformer's corners, lifting lugs, and jacking facilities, among others, shall be provided in such a manner that there are no sharp edges exposed.

9.21. High Voltage Bushings and Terminals

- a. Three class 5 primary porcelain bushings in light gray No. 70, Munsell Notation 5 BG 7.0/0.4.
- b. Bushings shall be provided with NEMA 4-hole spade type terminals, tin-plated for copper and aluminum conductors, and rated to withstand the transformer current capacity.
- c. Bushings shall be located at the left side of the transformer in an air terminal chamber (bottom entry). That chamber shall be weather resistant and constructed with the same material as the tank. Shall include a lift-off panel with two handles. Approximate measurements of the chamber shall be 34" (83.4 cm) tall, 38.3" (97.3 cm) wide, and 18" (45.7 cm) deep.
- d. Clearance as per ANSI C57.12.00.
- e. External terminal designations and vector relationships shall be in accordance with IEEE/ANSI C57.12.10 and shall also be stenciled on the tank.

9.22. Low Voltage Bushings and Terminals

- a. Four class 5 secondary porcelain bushings in light gray No. 70, Munsell Notation 5 BG 7.0/0.4.
- b. Shall include H0X0 neutral bushing with terminals for ground connection. The neutral of wye connected windings shall be ungrounded inside the transformer tank and shall be brought outside through a bushing for external grounding. The neutral bushing shall be of the same rating as the line bushings furnished for the same winding.
- c. Bushings shall be provided with NEMA 4-hole spade type terminals, tin-plated for copper and aluminum conductors, and rated to withstand the transformer current capacity.
- d. Bushings shall be located at the right side of the transformer in an air terminal chamber (bottom entry). That chamber shall be weather resistant and constructed with the same material as the tank. Shall include a lift-off panel with two handles. Approximate measurements of the chamber shall be 34" (83.4 cm) tall, 38.3" (97.3 cm) wide, and 18" (45.7 cm) deep.
- e. Clearance as per ANSI C57.12.00.

f. External terminal designations and vector relationships shall be in accordance with IEEE/ANSI C57.12.10 and shall also be stenciled on the tank.

9.23. Installation and Mounting

The transformers shall be compatible with mounting type H and include all required mounting equipment.

9.24. Accessories

a. Transformers shall be provided with the following accessories:

1. Temperature gauge
2. Liquid level gauge
3. One inch (1" (2.54 cm)) stainless steel fill valve
4. Drain valve
5. Dial type thermometer
6. Pressure vacuum gauge
7. Gas filling and sampling valve (may be incorporated into the pressure vacuum bleeder device if furnished).

9.25. Impedance

- a. Transformers shall be supplied with impedance between 1.2% and 5.75%. The tolerances shall be as described in ANSI C57.12.00.9.2.
- b. Transformers shall meet the short circuit requirements as specified in ANSI C57.12.00.

9.26. Weight

The maximum weight shall not exceed 20,000 lbs. (9,072 kg).

9.27. Warranty

- a. The supplier shall guarantee for a period of twenty (24) months after delivery or twelve (12) months from installation that the equipment supplied is free from defects in material and workmanship.
- b. If, during the warranty period, the unit or its components are proving to be defective, the Supplier shall replace or repair such unit at no cost to the buyer.

c. The guarantee period mentioned in section 9.27.a. shall begin at the moment which the project is energized in by LUMA Energy. The supplier shall be responsible for complying with this guarantee clause. Any expenses by LUMA Energy due to the malfunction of the equipment during the guarantee period shall be invoiced to the contractor, project owner, or person in charge of the project.

10. Inspection

10.1. Upon inspection of incoming equipment/material, the purchaser reserves the right to refuse product shipments and to determine the acceptability or rejection of the product received. The supplier shall be liable for all costs incurred for a product that is rejected.

10.2. The acceptance of any equipment/material shall in no way relieve the vendor from his responsibility to meet all the requirements of this specification, and it would not prevent subsequent rejection if such equipment/materials were found later to be defective.

11. Proposal Information

11.1. Submitted proposals must include:

- Technical information, drawings, and tests.
- Table of Compliance completed by the bidder with reference (see Appendix 1).

12. Table 1: Warehouse and Asset Suite Identification Number

Warehouse Catalog #	Asset Suite #	Capacity (kVA)	High Voltage (kV)	Low Voltage (kV)	Manufacturer & Model
032-87719	87719	2000	8320Y/4800	4160Y/2400	Eaton (00000A15C6MA)
032-87720	87720	3000	8320Y/4800	4160Y/2400	Eaton (00000A70C2NA)

—End of Specification —

Appendix

Appendix 1: Table of Compliance

Line	Description	Pass/Fail (P / F)	Comments
1	Compliance with the document 4300.50.362		
2	Industry standards: ANSI/IEEE C57. (12.00, 12.10, 12.29, 12.35, 12.80, 12.90, 91, 125). If different ones are used, it must comply with section 8.12.		
3	Tech. info., tests, and drawings provided.		
4	3Ø Power Converter		
5	kVA, Primary Voltage Y - Secondary Voltage, (H - L kVBIL)		
6	No load losses at 20°C, load losses at 85°C full load, and load losses at 55°C at 50% of load provided.		
7	Stainless Steel (SS) 304, 14-gauge, rectangular shape Tank with "H" mounting type. Construction as per ANSI C57.12.10. Compliance with section 9.20.		
8	Tank and cover shall be painted conform to light gray number 70, according to ANSI C57. Shall comply with section 9.8.		
9	CU or AL Windings (HV-LV)		
10	SS or AL Nameplate		
11	Winding material, date of manufacture, total weight, serial number, among all the other information as per ANSI C57.12.00 (Nameplate C) requirements shall be shown on the nameplate.		
12	Meet the requirements for the core and windings as stated in section 9.11.		
13	5-positions Tap Changer (2 + and 2 - rated primary voltage) located under oil level. Each tap shall be 2.5% of rated primary voltage. As per section 9.14.		
14	Tank filled with oil, complying with ANSI/ASTM D3487 and LUMA requirements, with a PCB concentration of less than 1 PPM (NO PCB). Requirements as per section 9.15.		
15	Internal fault detector type pressure relief valve. Bronze or SS. Requirements as per section 9.16.		
16	Insulation: at least, Class A (105 °C) as per section 9.17.		
17	Labels: Thermal Transfer Polyester material. Requirements as per sections 9.18 & 9.19.		

18	High (x 3) and Low (x 4) tension, HOX0 included, Class 5, grey porcelain insulated bushings with NEMA spade type terminals, tin-plated, for CU and AL conductors. Requirements as per sections 9.21 & 9.22.		
19	Bushing's location on the sides.		
20	Accessories as per section 9.24.		

NOTE: This table is only a checklist for reference. The compliance must be with the complete document. Filling out the table with "PASS" won't be accepted as a compliance without the technical information required to certify it.

4300.50.362 Legacy Converter (8-27-25)

Final Audit Report

2025-08-28

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