

**2021**  
CITY OF DOVER  
ELECTRIC DEPARTMENT  
SPECIFYING STANDARD FOR NEW SINGLE PHASE,  
POLE-MOUNTED SELF-COOLED TRANSFORMERS  
DOE 2016 (OR NEWER) COMPLIANT

1. SCOPE

- 1.1 This specification is to establish minimum requirements for single phase, 60 hertz conventional pole mount type outdoor, mineral oil-immersed distribution transformers suitable for operation in the City's 12470GRDY/7200-volt distribution system. Primary voltages are I2470GRDY/7200V, secondary voltages are 120/240, 240/480, and/or 277 with transformer ratings being 25, 50, 75 or 100 KVA.
- 1.2 All material and equipment furnished under this specification shall conform to the latest applicable approved standards of IEEE, ANSI, NEMA and DOE unless otherwise specified herein.
- 1.3 Acceptable manufacturers for these transformers shall be the following: Central Maloney, Howard, ABB, Cooper Power, ERMCO, or other prior approved manufacturers that can demonstrate their ability to provide quality products in a timely manner.

2. RATINGS

- 2.1 All ratings shall be for 60 hertz alternating current, oil immersed, self-cooled transformers capable of continuous operations at rated KVA without exceeding either a 65° C average temperature rise or an 80° C hot spot temperature rise.
- 2.2 No taps will be provided on 25 and 50 KVA sizes. Two 2.5% above and two 2.5% below rated voltage taps shall be provided on units as specified.

3. INSULATION AND TEST LEVELS

- 3.1 Basic lightning impulse levels (BIL) shall be 95KV for I2470GRDY/7200V, and 30 KV for all 240/120V.
- 3.2 Dielectric test levels shall be in accordance with the distribution levels specified in ANSI/IEEE C57.12.00.

#### 4. IMPEDANCE

- 4.1 Percent impedance shall be less than or equal to 2.75% for units rated 100 KVA or less and ANSI compliant.

#### 5. TESTS

- 5.1 Except as specified in 5.2, tests shall be performed in accordance with ANSI/IEEE C57.12.00 and ANSI/IEEE C57.12.90.
- 5.2 No applied-potential test is required. The induced potential test shall be performed by applying between the terminals of one winding, a voltage that will develop from the high-voltage line terminals to ground a voltage of 1000V plus 3.46 times the rated transformer winding voltage, but in no case shall the line to ground voltage developed exceed 40,000V for 125 KV BIL and 50,000 V for 150 KV BIL. For this test the neutral terminal shall be grounded.
- 5.3 The reference temperature to which losses, impedances, regulation, and efficiency are corrected shall be 85 C.
- 5.4 A copy of certified test data shall be provided as specified in item 10.1.

#### 6. CONSTRUCTION

- 6.1 Electrical characteristics for transformer bushings shall be as follows:
- 6.1.1 For a BIL Dry Withstand of 30 KV, 60 KV, and 95KV the Dry One Minute Withstand shall be 10 KV, 21 KV, and 35 KV, and the Wet Ten Second Withstand shall be 6 KV, 20 KV, and 30 KV respectively.
- 6.1.2 For a BIL Dry Withstand of 95KV for 12470, bushings shall have a Creepage Distance of 10.5 inches +/- 1.5 inch.
- 6.1.3 Color of bushings shall match light gray No 70, Munsell notations 5BG7.0/0.4, as specified in ANSI C57.12.20.
- 6.1.4 High voltage bushings shall be equipped with solderless eye bolt connectors. High voltage connector opening size shall be 5/16 inches.
- 6.1.5 Low voltage terminals shall be equipped with eye bolt connector opening to the dimensions shown below.

Opening	at	at	at
Inches	120/240 V	240/480 V	277 V
5/8		25KVA	25KVA
13/16	25-50 KVA	50-100 KVA	50-100KVA
15/16	75KVA		
1-1/4	100 KVA		

6.1.6 Low voltage terminals shall be arranged for vertical take-off.

6.1.7 External spacing between low voltage terminals shall be such as to provide the maximum clearance between live metal parts in the working area.

**For 25 to 50 KVA**, minimum clearance between live metal parts shall be 1.75 inches and maximum spacing between center points of terminals shall be 9 inches. **For 75KVA to 100KVA**, minimum clearance between live metal parts shall be 3 inches and the maximum spacing between center points of terminals shall be 9 inches.

6.1.8 On units with low voltages of 120/240 or 240/480, the internal connections to the terminals on sizes 25 KVA shall be arranged to serve in lieu of a low voltage terminal board. These connections shall conform to C57.12.20.

6.2 Provision characteristics are as shown below.

6.2.1 Where required, an externally operated tap changer switch shall be designed for de-energized operation with the operating handle brought out through the side wall of the tank. Each position shall be clearly identifiable by reference to the nameplate. It shall provide protection against accidental operation by requiring a preliminary step before tap settings can be changed. Tap ratings shall be two at 2.5 % above and two at 2.5 % below the nominal voltage rating.

6.2.2 Liquid level markings shall be provided on the inside tank wall to indicate correct oil level at 25° C.

6.2.3 Lifting lugs shall be permanently attached and arranged on the tank to provide a distributed balanced lift in a vertical direction and shall be designed to provide a safety factor of 5 as established by NEMA MG-2014.

6.2.4 All transformers shall be designed so that all excessive pressure build ups are release without damages to the tank. Each distribution transformer shall be equipped with a non-resettable device which detects and provides external indication of internal transformer faults. This device also incorporates a pressure relief valve. The approved device is manufactured by IFD Corporation or approved equal.

- 6.2.5 Pressure relief shall occur before other components of the tank are displaced or damaged as the cover remains in place. Manual venting capability shall also be provided. The completely assembled unit shall withstand an internal static pressure of 7 PSIG without permanent distortion or leaking. The City reserves the right to request proof of compliance with this specification.
  - 6.2.6 Cover is to be insulated to 15 KV dielectric strength to reduce outages caused by animal contact. Cover to be sloped 150° or greater for moisture run-off to prevent corrosion.
- 6.3 Polarity, terminal markings and nameplate shall be as described below.
- 6.3.1 Polarity shall be additive for all units.
  - 6.3.2 External terminal designations shall be as defined by ANSI C57.12.70.
  - 6.3.3 Internal leads shall be individually identified with the letters A, B, C, and D as indicated in ANSI C57.12.20.
  - 6.3.4 The nameplate shall be made of stainless steel or anodized aluminum. It shall be located as shown in figure 6 of ANSI C57.12.20 and shall provide the information required by ANSI C57.12.00.
  - 6.3.5 The kilovolt-ampere rating and a NON-PCB label shall be permanently marked on the tank below the low voltage terminals. These numerals shall be 2.5 inches in height.
  - 6.3.6 The identification of low voltage internal and external connections shall be shown of the nameplate in accordance with ANSI C57.12.20 Fig 5.
- 6.4 All units shall have a sealed tank construction which seals the interior of the tank from the atmosphere and in which the gas plus the oil volume remains constant. The unit shall remain effectively sealed for a top oil temperature range of -5 C to + 105 C for continuous operation at rated KVA and under conditions as described in ANSI/IEEE C57.91.
- 6.5 Transformers shall have the following provisions.
- 6.5.1 Single hanger support brackets shall be provided for direct pole mounting on the opposite side of the secondary lug location. They shall be designed according to ANSI standards.

- 6.5.2 All 25,50,75 and 100 KVA units with a 120/240 secondary voltage shall be equipped with an external 10kv arrester mounted on side of tank. They shall be designed according to ANSI standards.

Hanger Bracket spacing (Support Lugs) for all specified transformers.

<b>KVA</b>	<b>Hanger bracket spacing</b>	<b>Top of hanger to top of H-i bushing</b>
25-50	11-1/4"	15" +/-3"
75-100	23-1/4"	15" +1-3"

- 6.6 All insulating paper used as layer insulation in transformer coils shall be a bonded type, coated on both sides with a thermosetting adhesive and properly cured prior to impregnating with oil. When properly cured coils shall form an effective bond, both turn to turn and layer to layer.

- 6.7 The following provisions shall be provided:

- 6.7.1 All units shall have tank grounding provisions consisting of a steel pads, with a 1/2 inch 13 NC tapped hole, 7/16 inch deep and located near the bottom of the tank. The threads shall be protected by a corrosion resistant flanged cup pressed into the threaded opening of the ground pad.
- 6.7.2 All units shall have a tank grounding connector and shall be solderless. It will accommodate AWG conductor size No. 8 solid to No.2 stranded.
- 6.7.3 Low voltage grounding provisions shall consist of a steel pad with a 1/2 inch 13 NC tapped hole, 7/16 inch deep. The threads shall be protected by a corrosion resistant flanged cup pressed into the threaded opening of the ground pad.

## 7. EXTERIOR

- 7.1 The unit shall have a corrosion resistant finish capable of meeting the following specification:
- 7.1.1 The tank finish shall conform to light gray No. 70, Munsell Notation 5 BG7.0/0.4, as specified in ANSI C57.12.20. All surfaces of case and cover, both interior and exterior, shall be thoroughly cleaned by means of shot blasting or any of the equally effective method. At least three coats of exterior paint shall be applied. Paint shall be suitable for operation in an outdoor environment at the elevated temperatures associated with this equipment without deterioration.

- 7.1.2 Salt spray (relates to coastal environments and/or presence of snow- melting salts or fertilizers). *Scribe to bare metal and test for 1000 hours in a 5 % salt spray per ASTM B-117. Loss of abrasion from bare metal should not extend more than 1/8" form the scribe. Under film corrosion should not extend more than 1/16" form the scribe.*
- 7.1.3 Crosshatch adhesion (relates to adhesion after scratching of the finish). *Scribe to bare metal a crosshatch pattern and test per ASTM D 3359, latest revision. Use method A for films thicker than 5 mils, method B for films less than or equal to 5 mils. There shall be a 100% adhesion to the bare metal and between layers.*
- 7.1.4 Humidity (relates to environments with high humidity). *Test for 1000 hours subject to 98% humidity at 45 C plus or minus 1 C per ASTM D2247. There should be no blisters.*
- 7.1.5 Impact (relates to transit and handling damage, and abuse by the public). *Impact of the test panel with a 160 in-lb falling dart per ASTM D-2794. There should be no cracking or chipping of the paint on the impact side of the test panel.*
- 7.1.6 Oil resistance (relates to probable contact with mineral oil). *Immersed two test panels in mineral oil (or other liquids, as specified) for 72 hours, one at room temperature (20 to 25 C) and one at 100 C to 105 C. There shall be no apparent changes, such as color shift, blisters, loss of hardness or streaking.*
- 7.1.7 Exposure (relates to exposure to sunlight and rainfall, loss of gloss, color fading and chalking). *Exposure for 500 hours per ASTM G-53 with a cycle for 4 hours UV at 55 C followed by 4 hours condensation of 40 C. Loss of gloss as a result of this test should not exceed 50% per ASTM D-523.*
- 7.1.8 Abrasion Test-Taber Abrader (relates to wear encountered during installation). *Test a panel having the minimum dry build thickness (-0, +0.1 mu) using a SC-10 wheel, 1000 gram weight, per ASTM D-4060, latest revision. The number of cycles of abrasion required to wear the coating through to the substrate shall be at least 3000 cycles.*

## 8. QUALITY PROGRAM

- 8.1 Transformers addressed by this specification shall be subject to a quality program.
- 8.2 The program shall have established requirements to assure that the transformer provided will comply to industry standards or these specifications.

8.3 Manufacturer to have the capability of manufacturing cycle times of less than **15** days to have the ability to provide transformers in emergencies.

8.4 Delivery of normal stock units to Dover site as specified, must be made within 5 working days.

9. NAMEPLATE PCB CERTIFICATION

9.1 Units shall be certified as “non-PCB” for all dielectric fluids in accordance with Federal Regulation 49FR3 1517 dated May 31, 1979. Permanent name plates shall be supplied indicating compliance with these requirements. Name plates shall include the following information:

9.1.1 Type (specific) of dielectric fluid.

9.1.2 Quantity (gallons) of dielectric fluid.

9.1.3 PCB concentration (PPM) of dielectric fluid.

9.1.4 Manufacture date of unit.

9.1.5 Serial number of unit.

9.1.6 Size (KVA) of unit.

9.1.7 Primary and Secondary voltages.

10. BIDS

10.1 Vendors shall furnish loss data for evaluations and guarantee that data is in accordance with tolerances established by ANSI C57.12.00

10.2 The following parameters shall be furnished for evaluation with the bids. (loss data to have 1 significant digits)

10.2.1 Unit price in dollars

10.2.2 Name plate rating in KVA

11. EVALUATION

11.1 Transformers shall be evaluated based on purchase price and delivery.

11.2 The City reserves the right to reject any or all bids.