2018

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

1. SCOPE

1.1 This specification covers electrical, dimensional, and mechanical characteristics of a loop-fed, single phase, 60 Hz, mineral oil immersed, self-cooled, pad mounted, distribution transformer with separable insulated high-voltage connectors and low voltage stud connectors. Primary voltages are 1247OGRDY/7200V (operating/phase to ground). Secondary voltage is 240/120V. Transformer will all be dead front construction and ratings shall be 250 KVA and below. All ANSI standards are for reference and all applicable, revised/updated standards shall apply. Must meet (DOE) 2016 efficiency standard or newer.

1.2 The equipment covered by this specification shall be designed, tested, and assembled in accordance with the latest applicable standards as prepared by NEMA, ANSI, and IEEE.

1.3 Acceptable manufacturers for these transformers shall be the following: Central Maloney, Howard, ABB, Cooper Power, Ermco or other prior approved manufactures that can demonstrate their ability to provide quality products in a timely manner.

2. RATINGS

2.1 Kilovolt-ampere ratings are continuous and based on not exceeding either a 65° C average winding temperature rise or an 80° C hot spot conductor temperature rise. The temperature rise of the insulating oil shall not exceed 65° C when measured near the top of the tank.

2.2 No voltage taps shall be provided.

3. INSULATION AND TEST LEVELS

3.1 Basic lightning impulse levels (BIL) shall be 95KV for 1247OGRDY/7200V, and 30KV for all 240/120V.

3.2 Dielectric test levels shall be in accordance with the distribution levels specified in Section 4 of ANSI/IEEEC57. 12.00-1980.

4. IMPEDANCE

4.1 Percent impedance shall be less than or equal to *2.75%* for units rated 100 KVA or less.

4.2 Percent impedance shall be less than 4.0% for units rated 250 KVA.

5. TESTS

5.1 Except as specified in 5.2, all tests shall be performed in accordance with ANSI/IEEE C57.12.00 and 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 1000 V plus 3.46 times the rated transformer winding voltage, but in no case shall the line to ground voltage developed exceed 40,000V for 125KV BIL and 50,000V for 150KV 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.

6. CONSTRUCTION

6.1 All transformers will be manufactured as dead front type transformers. The transformer shall consist of a tank with high- and low-voltage cable terminating compartments. Tank and compartment shall be assembled as an integral unit suitable for flush mounting on a flat rigid surface. The assembly shall restrict the entry of water into the compartment so as not to impair the operation of the transformer. Maximum overall dimensions are 35 inches (front) by 41 inches (side) by 35 inches (height). Minimum height is 24 inches.

6.1.1 Cabinet security as described below shall be evaluated in accordance with the test procedures and requirements of the design test method for cabinet security described in the NEMA Standards Publication for Transformers, Regulators, and Reactors, NEMA TR 1-1980.

6.1.2 The high-voltage and low voltage portions of the compartment shall be located side-by-side on one side of the tank. When viewed from the front, the low-voltage side shall be on the right.

6.1.3 A single door is required, and the door shall have a single point latching system with a captivated Penta-head bolt. Hinge pins and associated barrels shall be of corrosion-resistant material, passivated ANSI Type 304 or the equivalent.

6.1.4 The transformer tank and compartment shall be so constructed as to limit disassembly, breakage, and prying open of any doors, panels, and sills with the doors in the closed position.

6.1.5 There shall be no exposed screws, bolts, hinging, or fastening devices that are externally removable. In addition, there shall be no opening through which foreign objects such as sticks, rods, or wires might be inserted to contact live parts.

6.1.6 A door handle shall be provided to assist personnel with entry into the transformer. The door handle and the provision for locking device shall be designed and located to limit prying, cutting, or breaking of the locking mechanism.

6.1.7 The captive and recessed penta-head bolt shall be provided for additional security of the compartment door and provisions shall be included for the field installation of padlock, or similar device. A blind bolt hole shall be provided. The design of the captive and recessed bolt shall be in accordance with recognized ANSI standards. Bolts shall be constructed of a corrosion-resistant material, and the design shall minimize the possibility of misalignment and cross threading.

6.1.8 Transformers with hand holes shall have a cover that is removable only after being unfastened from inside the compartment.

6.1.9 The bottom edges of the compartment shall be so constructed as to provide for the use of hold-down devices that are accessible only from inside the compartment and the unit will be furnished with the hold down device.

6.1.10 Construction of the unit shall be such that it can be lifted, skidded, or slid, or any combination of these into place on the mounting surface without disturbing the high-voltage or low-voltage cables.

6.1.11 All compartment and transformer surfaces in contact with mounting surfaces and a minimum of 1 inch above the mounting surface shall be designed or treated to minimize corrosion. The underside of the tank, when within 1 inch of the mounting surface, shall also be designed or treated to minimize corrosion.

6.2 The electrical characteristics of the completely assembled high-voltage connectors shall be 8.3KV phase to ground and 8.3/14.4KV phase to phase and shall have a 60-Hz Dry One Minute Withstand of 34KV for 12470GRDY/7200V. The electrical characteristics and clearances of the completely assembled low-voltage terminals shall be 10KV for 240/ 120V, with a minimum clearance of 1 inch between live parts and ground and live parts.

6.2.1 The number, location, and arrangement of the high-voltage connectors and the low-voltage terminals shall be as described in paragraph 6.1.

6.2.3 High-voltage connectors shall be provided for connection to the distribution system through separable insulated high-voltage connectors. The high-voltage connectors shall be bushing wells with bushing inserts. Cable accessory parking stands shall be provided. Separable insulated high-voltage connectors that shall be designed for operation after the transformer is in place and shall be operable with hot-line tools.

6.2.4 The H2 end of the high-voltage winding shall be connected to the tank internally, and this connection shall be independent of all other connections.

6.2.5 Low-voltage line and neutral terminals shall be arranged for vertical take-off. Terminals shall be threaded copper stud only and comply with the following specifications:

KVA Rating	Tread Size	Min. Length
25-75	0.625-11 UNC-2A	1.25”
100-250	1.000-14 UNC-2S	1.75”

6.2.6 The low-voltage neutral shall be a fully insulated bushing. A ground pad shall be provided on the outer surface of the tank. One or more removable ground straps suitably sized for the short-circuit rating of the transformer, as defined in ANSI/IEEE C57.12.00, shall be provided and connected between the low voltage neutral terminal and the ground pad.

6.3 The compartment door shall be of sufficient size to provide adequate operating and working space when removed or open. The door shall either be equipped for latching in the open position or designed for manual removal.

6.4 The following accessories are to be provided.

6.4.1 Suitable means for indicating the correct oil level at 25° C shall be provided.

6.4.2 The transformer base shall be arranged for rolling parallel and at right angles to one side.

6.4.3 Lifting provisions shall be arranged on the tank to provide a balanced lift in the vertical direction with a safety factor of 5 to 1.

6.4.4 Connector and terminal designations shall be as defined in ANSI C57.12.70. The high-voltage connector and low-voltage terminal identification shall be shown on the nameplate described below.

6.4.5 The instruction nameplate shall be located in the low-voltage portion of the compartment and shall be readable with the cables in place. The manufacturer’s name and unit serial number shall be affixed to non-removable part of the unit. See Item 9 for more detailed information about nameplate requirements.

6.4.5.1 Transformer shall be furnished with a non-corrosive diagrammatic nameplate, permanently attached with non-corrosive hardware on interior and exterior of transformer. The diagrammatic nameplate shall include the name of the manufacturer of the equipment as well as the location where the transformer was manufactured and tested. In addition, the transformer

manufacturer and location of manufacture is to be supplied at the time of quotation.

6.4.6 A replaceable valve to relieve excess pressures shall be furnished in the low voltage compartment on the tank wall above the 140° C top oil level, per manufacturer's calculation, and shall be located so as not to interfere with the use of the low-voltage terminals.

6.4.6.1 The valve shall be constructed as described in ANSI/IEEE C57.12.25.

6.4.7 A "NON-PCB" sticker shall be provided on the external surface of the door to indicate oil quality.

6.5 Transformers shall be of sealed-tank construction which seals the interior of the tank from the atmosphere and in which the gas volume plus the oil volume remains constant. The transformer shall remain effectively sealed for a top-oil temperature range of -5° C to +105° C, continuous, and under the operating conditions described in ANSI/IEEE C57.91 and C57.92.

6.6 The tank shall be of sufficient strength to withstand a pressure of 7 PSIG without permanent distortion. A ½ inch minimum upper plug or cap for filling and pressure testing shall be provided. A ½ inch minimum NPT drain plug or cap shall be provided.

6.6.1 The cover shall be welded or bolted in place with adequate gasketing.

6.6.2 Tank ground provision shall consist of two steel pads, each with a ½-13 UNC tapped hole, 7/16 inch deep. These ground pads shall be welded on or near the transformer base: one in the high-voltage compartment and one in the low-voltage compartment.

6.7 The minimum current carrying capabilities of components for looped primary systems shall be 200 amperes rms (continuous current rating) and 10,000 amperes rms symmetrical for 0.17 seconds (short time current rating) for transformers with or without high-voltage switching.

6.8 All insulating paper used as layer insulation in transformer coils shall be bonded type and properly cured prior to impregnating with oil or the coils shall be wound with primary conductor containing a thermosetting adhesive that when properly cured will form an effective bond, both turn to turn and layer to layer.

6.8.1 Transformer core should be made of silicone steel.

6.9 High-voltage protection shall be provided by a bayonet type fuse which is an oil immersed draw-out expulsion type designed to protect the unit from internal secondary faults and over loading. Fuses shall be externally replaceable and hot stick operable. An oil catch device shall be provided to catch any oil that may be lost during the removal of the bayonet fuse holder.

6.9.1 Fuse specifications include 15.5 KV voltage class, 1800 rms interrupting capacity, and 135% at 80% pf load break capability.

6.10 A single parking stand shall be provided.

6.11 The finish shall be Green, Munsell No. 7GY/3.2/1 .5.

7. EXTERIOR

7.1 The unit shall have a corrosion resistant finish capable of meeting the following specification:

7.1.1 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.

7.1.2 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

7.1.3 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 D-2247. There should be no blisters.

7.1.4 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.

7.1.5 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.

7.1.6 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.

7.1.7 Abrasion Test-Taber Abrader (relates to wear encountered during installation). Test a panel having the minimum dry build thickness (-0, +0.1 mil) 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.

7.2 Transformer KVA rating is to be provided on the exterior of the unit as well as the NON-PCB label. Numbering and NON-PCB label shall be permanent and at least 2 inches in height.

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 Manufactures to have the capability of manufacturing cycle times of less than 15 days in order to have 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 compliances with these requirements as well as the requirements specified in paragraph 10.3. Nameplates shall include the following information:

9.1.1 Type (specific) of dielectric fluid used.

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 & Secondary voltages.

10. BIDS

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

10.2.1 Unit price in dollars

10.2.2 Name plate rating in KVA

10.2.3 Core loss (TNLL) in Watts

10.2.4 Winding loss (TFLL) in Watts

10.2.5 Total loss (TLL) in Watts

10.2.6 Impedance (%Z) in percent

10.2.7 Exciting Current (El) in percent

10.2.8 Temperature Rise (TR) in C

10.2.9 Manufacturer of unit

10.3 The successful bidder shall supply the following certified test data confirming these parameters within 30 days of shipment of unit(s). Failure to supply all of this information on the test report shall result in delay of payment until the correct information is supplied. The report shall include the following information for each unit: (loss data to have 1 significant digit)

10.3.1 Manufacturer of unit

10.3.2 Name plate rating in KVA

10.3.3 Serial Number

10.3.4 Shipping date

10.3.5 Core loss (TNLL) in Watts (each unit, average for total units, shipped, and quoted losses from bid)

10.3.6 Winding loss (TFLL) in Watts (each unit, average for total units shipped, and quoted losses from bid)

10.3.7 Total loss (TLL) in Watts

10.3.8 Impedance (%Z) in percent

10.3.9 Exciting Current (El) in percent

10.3.10 Temperature Rise (TR) in C

10.3.11 Statement of PCB content (i.e. Transformers contain no detectable PCB in oil at time of manufacture)

10.3.12 Test data report to have technicians name and data that certifies the results.

10.3.13 Transformer Turns Ratio (TTR) Report.

11. EVALUATION

11.1 Transformers shall be evaluated on the basis of meeting specification, purchase price and physical size of the foot print to assure that unit meets current pad stock.

11.2 The City reserves the right to award a bid on the basis of purchase price, loss costs, delivery date, other parameters or any combination thereof.

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

REVISED DATE: August 6, 2018