2021
CITY OF DOVER
ELECTRIC DEPARTMENT
SPECIFYING STANDARD FOR NEW THREE PHASE,
PAD-MOUNTED, LOOP FEED, SELF-COOLED TRANSFORMERS
DOE 2016 (OR NEWER) COMPLIANT

1. SCOPE

1.1 This specification provides the technical requirements for the design, manufacture, and test of al) newly manufactured pad mounted tamper-resistant transformers. The service conditions shall be as specified in Usual Service Conditions section of C57.12.00.

1.2 This specification covers only the general requirements of the transformer.

1.3 The electrical characteristics and mechanical features of three-phase, oil immersed, self-cooled, pad-mounted, compartmental-type distributions transformers shall be in accordance with IEEE C57.12.34, Table 3 and Table 4, and have the following ratings:

75 through 3000kVA
65° C average winding rise or 80° C hot spot temperature rise
60 hertz
HV: 12470GRDY/7200
HV BIL: 95kV
LV: 208Y/120, 480Y/277, 240/120
Taps — Two @ 2.5% above and two @ 2.5% below nominal high-voltage rating Per IEEE C57.12.34

1.4 The percent impedance voltage, as measured on the rated voltage connection and under full rated load, shall be as follows:

KVA rating	Percent Impedance Voltage	
	Minimum	Maximum
75	1.10	5.75
1 12.5 - 300	1.40	5.75
500	1.70	5.75
750 - 3000	5.75 nominal	

2. CODES AND STANDARDS

2.1 All codes and standards referenced in this specification shall be those in effect at the time of Purchase Order award. Deviations from this specification and referenced codes and standards shall be obtained in writing from Buyer.

2.1 1 American National Standards Institute, Inc. (ANSI)

2.1.1.1 ANSI/IEEE C57.12.00 - General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

2.1.1.2 ANSI/IEEE C57.12.28 - Requirements for Pad-Mounted Equipment Enclosure Integrity

2.1.1.3 ANS)/IEEE C57.12.29 - Requirements for Pad-Mounted Equipment Enclosure Integrity for Coastal Environments

2.1.1.4 ANSI/IEEE C57.12.34 - Requirements for Pad-mounted, Compartmental Type, Self-cooled, Three-phase Distribution Transformers (2500kVA and Smaller) — High-Voltage: 34,500 GrdY/19,920 V and Below; Low-Voltage: 480 Volts and Below

2.1.1.5 ANSI/IEEE C57.12.70 - Standard terminal markings and connections for distribution and power transformers

2.1.1.6 ANSI/IEEE C57.12.80 - Terminology for power and distribution transformers

2.1.1.7 ANSI/IEEE C57.12.90 - Test code for liquid-immersed distribution, power, and regulating transformers

2.1.2 Institute of Electrical and Electronic Engineers (IEEE)

2.1.3 National Electrical Manufacturers Association (NEMA)

2.1.3.1 NEMA TRI - 1993 Transformers, Regulators, and Reactors

2.1.4 American Society of Testing and Materials (ASTM)

2.1.5 National Electrical Code (NEC)

2.1.6 Must meet (DOE) 2016 efficiency standard (or latest version)

3. QUALITY ASSURANCE

3.1 The manufacturer shall have specialized in the design, manufacture and assembly of liquid filled pad mounted tamper-resistant transformers for a minimum of 10 years.

3.2 The manufacturer shall have a well-documented quality assurance program, which includes procedures for all activities in order entry, design, material procurement, manufacturing processes, testing, shipping and post shipment product follow.

3.3 The manufacturer's test floor shall have a documented calibration program. All equipment shall receive regular calibrations. Calibration standards shall be traceable to National Bureau of Standards.

3.4 The transformers shall be manufactured by a company which is certified to ISO 9001:2000. A copy of the certificate of Compliance to this requirement shall be available upon request.

4. TRANSFORMER TECHNICAL REQUIREMENT

4.1 Winding Characteristics

4 1.1 All windings and internal connections shall be copper. The coil insulating paper shall be thermally upgraded and shall have a thermosetting adhesive on both sides to assure coil bonding.

4.1.2 The windings shall be tightly wound utilizing tension devices to place the conductor into the coils.

4.1.3 For optimum dielectric and mechanical strength, epoxy coated insulation shall be placed between each layer in the winding.

4.1.4 Sheet conductor shall be used in secondary winding to minimize vertical short circuit forces. Method of attaching exit leads shall be continuous weld or Owner-Approved equivalent.

4.1.5 The transformer shall be designed and constructed to withstand external short-circuits, as defined by ANSI C57.12.00.

4.1.6 Evidence of compliance to these short-circuit requirements as required in C57.12.00 and C57.12.90 shall be submitted to the Buyer upon request.

4.1.7 The transformer design shall be capable of operating above rated voltage or below rated frequency in accordance with ANSI C57.12.00.

4.1.8 The impedances shall be as specified, and ANSI tolerance shall apply.

4.2 Sound Level

4.2.1 The pad mounted tamper-resistant transformer shall be designed and constructed to minimize the audible noise generated with the transformer energized at rated voltage and shall not exceed the values specified in the latest revision of NEMA Publication TR 1-0.1 1.

4.3 HV Compartment

4.3.1 The transformer shall be furnished with a high voltage compartment located on the left of the centerline per IEEE C57.12.34.

4.3.2 The high voltage compartment shall be furnished with universal bushing wells for dead front elbow terminations. The HV compartment shall be provided with an interlocked door which can only be opened after the LV compartment door has been opened.

4.4 LV Compartment

4.4.1 The transformer shall be furnished with a low voltage compartment located on the right of the centerline per IEEE C57.12.34.

4.4.2 The low voltage compartment shall include a non-corrosive diagrammatic nameplate including a danger label complying to ANSI Z535.

4.5 Cabinet

4.5.1 All hinged or removable cabinet access lids or doors shall be provided with a three-point latch and be provided with a stainless steel or silicone bronze penta-head captive bolt locking device and provisions for padlocking. The penta-head bolt shall be coordinated so that it must be engaged before a padlock can be inserted into or removed from the hasp. All transformers shall meet the requirements for tamper-resistance of NEMA TR-1 and C57.12.28.

4.5.2 All weather covers and tank top should have a minimum of 4 degrees slope to shed water and curtail corrosion.

4.5.3 Cabinets shall be tamper resistant in accordance with C57, 12.28 (or C57.12.29 if applicable)

4.5.4 Cabinets shall be bolted to tanks along the entire tank-to-cabinet interface. Hinges, which tend to weaken the enclosure integrity, may not be used to secure the cabinet to the tank.

4.5.5 Footprint of transformer will be no larger than 72” x 72”. If larger, bottom edges of transformer will be manufactured to provide closure to any open gaps outside the 72” x 72” measurement.

4.6 High Voltage Bushings

4.6.1 High Voltage connectors shall be provided for connection to the distribution system through separable insulated high voltage connectors. The high voltage connectors shall consist of bushing wells and corresponding load break inserts for dead front application. The bushing wells shall be externally clamped, 200-amp rated, load break devices and rated for primary switching per IEEE 386.

4.6.2 Cable accessory parking stands shall be provided.

4.7 Low Voltage Bushings

4.7.1 Number and arrangement of low-voltage terminals shall be in accordance with IEEE C57.12.34.

4.7.2 Transformers shall be equipped with fully insulated, low voltage bushings, in accordance with IEEE C57.12.34 Fig 13(a) and 13(b).

4.7.3 Ten-hole spade pads shall be furnished with additional support, as designed by the manufacturer. The supports shall be attached to the pads at the farthest point from the tank wall and attached in a manner so as to not interfere with the use of the pad's holes.

4.8 Core

4.8.1 The core shall be clamped and braced to resist distortion caused by short-circuit stresses or transportation handling and to prevent the shifting of core laminations.

4.8.2 The core shall be constructed of high-grade, grain oriented, silicon steel laminations, with high magnetic permeability. Core construction shall include step-lap joints to keep core losses, excitation current, and noise level at a minimum.

4.9 De-Energized Tap Changer

4.9.1 A manually operated de-energized tap changer shall be provided for changing the primary winding taps.

4.9.2 Full capacity taps shall be located in the high voltage windings.

4.9 3 The tap changer shall be capable of carrying the full transformer short-circuit current without damage or contact separation.

4.9.4 The tap changer shall be gang operated from a single operating point and shall have a position indicator.

4.9.5 The tap changer operating mechanism shall include provisions for pad locking in each tap position.

4.10 Insulating Fluid and Preservation System

4.10.1 The fluid preservation system shall be a sealed tank type.

4.10.2 The insulating fluid shall be mineral oil or FR3. FR3 units must be labeled on the outside.

4.10.3 The transformer insulating fluid shall be certified to contain no detectable PCB's <1 PPM) at the time of shipment and the tank shall be so labeled. Certification shall also be provided that the transformer and components have not been contaminated with PCB's prior to shipment.

4.10.4 The transformer insulating fluid shall meet or exceed the requirements of toe appropriate ANSI and ASTM fluid Standards. The transformer fluid shall be tested for dielectric breakdown and moisture content during manufacturing.

4.11 Tank Design

4.11.1 The transformer tank shall be designed to withstand, without permanent deformation, pressures consistent with those stipulated in IEEE C57.12.34.

4.11.2 Tank design shall include sufficient expansion volume to allow operation under specified load conditions.

4.11.3 One or more hand holes shall be provided in the tank cover for access to bushing connections, when required. The opening shall be of sufficient size to allow removal of fuses.

4.11.4 The transformer base shall be suitable for rolling or skidding in the direction of either tank base centerline.

4.11.5 The base shall be designed so the center of gravity of the transformer as assembled for transport does not fall outside the base for a tilt of fifteen degrees in any direction.

4.11.6 Lifting lugs shall be provided at each corner of the tank. The lifting lugs shall he designed to provide a minimum safety factor of 5.

4.11.7 Jacking area, pads or bosses shall be provided in accordance with the requirements of C57.12.34

4.12 Gaskets

4.12.1 The gaskets shall be compatible for the insulating fluid in the transformer tank.

4.12.2 Metal surfaces to which gaskets are applied shall be smooth and shall have sufficient rigidity to assure proper compression of the gaskets.

4.13 Cooling System

4.13.1 The transformer shall be self-cooled.

4.13.2 Coolers shall be welded to the tank wall.

4.14 Grounding Provisions

4.14 1 All non-energized metallic components of the transformer shall be grounded.

4.14.2 Tank grounding provisions shall consist of one ground pad in the low-voltage cabinet and two ground pads in the high voltage cabinet. Pads shall be welded to the base or to the tank wall near the base.

4.14.3 Ground pads shall be per NEMA and IEEE C57.12.34

4.15 Nameplates

4.15.1 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.

4.15.2 The nameplate shall contain all connection and rating information in accordance with ANSI C57.12.00, plus the approximate weight of parts to be lifted for un-tanking, and quantity of fluid, and the date of manufacture.

4.15.3 When a de-energized tap changer is required, a non-corrosive dial plate or label located next to the operating handle shall be provided which states the following: “De-energized Operation Only."

4.15.4 The nameplate shall indicate that the PCB content of the said transformer is less than 1 ppm or 'NO DETECTABLE PCB' at the time of manufacturer/shipping.

4.15.5 The bayonet and current limiting fuse part numbers shall be displayed on the nameplate for all pad mount units.

4.16 Exterior Finish

4.16.1 The transformer painting system shall be in compliance with the latest revision of ANSI C57.12.28 (or C57.12.29 if applicable). The transformer shall be thoroughly cleaned and given a phosphatizing bath, then painted with at least one coat of corrosion inhibiting primer and one external finish coat to provide a minimum total dry-film thickness of not less than 3 mils.

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

5. TEST

5.1 Testing

5.1.1 Each transformer shall receive all standard routine tests as required by ANSI C57.12.00 and performed as specified by ANSI C57.12.90.

5.1.2 Short Circuit withstand capability shall be verified by full short circuit tests on similar or larger units in accordance with the latest revision of ANSI C57.12.00 and ANSI C57.12.90. Short Circuit withstand verification shall be submitted to the purchaser upon request, prior to shipment of the transformers.

5.1.3 The test facility used to perform loss tests shall utilize test equipment with calibration traceable to NIST or an approved equal 3rd party laboratory.

5.1.4 A certified test report shall be submitted and shall contain the test data for each transformer serial number manufactured. The certified test report shall as a contain the date as specified in ANSI C57.12.90.

6. ACCESSORIES

6.1 Each transformer shall be equipped with a complete set of standard accessories, including.

- Four lifting lugs
- Bolted-on terminal compartment (18" min. depth) with removable front
- Hinged, lift-off cabinet doors
- Bayonet-type expulsion fuses.
- Tank ground pads (2 in HV, 1 in LV)
- Steel high/low voltage compartment barrier.
- One penta-head bolt must be removed from the flange formed on the steel high/low barrier before the HV door can opened (Hex-head bolt is available)
- Fill plug and self-actuating pressure relief device.
- Removable neutral ground strap.
- Hand hole cover bolted onto tank top.
- Panel-type coolers or corrugated.
- Drain valve and sampling device
- Compartment Weather cover
- Transformer KVA rating and secondary voltage to be provided on exterior of the unit.
- Hinged to allow vertical access or clearance for replacement of the bayonet fuses.
- Can be lifted easily into place and secured with a single supporting arm.
- Requires no additional hold down hardware

6.2 In addition to standard accessories, each transformer 1500KVA and larger shall be properly equipped with the following gauges mounted in the low voltage compartment

6.2.1 Oil Level Gauge

6.2.2 Dial thermometer with maximum top oil temperature indicator and magnetic reset

6.2.3 Tank Pressure Vacuum Gauge

7. DOCUMENTATION

7.1 Drawing Requirements

7.1.1 The outline drawings shall be completely dimensioned and, as a minimum, show the following:

7.1.1.1 Plan, and all elevations, including clearance for bushing and core and coil removal.

7.1.1.2 High voltage and low voltage bushing details.

7.1.1.3 Location of all handholes

7.1.1.4 Location and identification of all accessories

7.1.1.5 Size and location of all conduit entrances for Buyers connections

7.1.1.6 Anchoring details

7.1.1.7 Ground pad locations

7.1.1.8 Weight of core and coil, transformer tank and fittings, weight and gallons of fluid, and total shipping weight.

7.2 Nameplate drawing

7.2.1 A nameplate drawing showing required ANSI information shall be provided after receipt of order as per section 4. 15.

7.3 Installation, Operating, and Maintenance Instructions

7.3.1 The seller shall provide an instruction, operating and maintenance manual covering all equipment furnished.

8. PARTS

8.1 The Seller shall provide a renewal parts list to the Buyer upon request.

9. EVALUATION

9.1 The City of Dover reserves the right to award a bid on the basis of purchase price, delivery date, other parameters, or any combination.

9.2 The City of Dover reserves the right to reject any or all bids.

9 3 The City of Dover shall at any reasonable time be permitted to have a representative visit the Seller's factory for the purpose of witnessing manufacture of the transformers to ascertain if the material and process conforms to this specification.