

**SECTION 26 12 19**  
**MEDIUM-VOLTAGE TRANSFORMER, LIQUID-FILLED, PAD-MOUNTED – DOE 2016**

**PART 1 - GENERAL**

1.1 SCOPE

- A. This specification provides the technical requirements for the design, manufacture and testing of a padmounted distribution transformer. Provide all accessories and equipment as described herein and shown on Project Drawings as necessary for a complete installation.

1.2 RELATED DOCUMENTS

- A. *[Related Sections included the following:*  
1. *Section 26 01 26 – Maintenance and Testing of Electrical Systems]*

1.3 SUBMITTALS

- A. The manufacturer shall provide the following information for review and evaluation by the Engineer:
1. Shop Drawings showing layout, dimensions, voltage, phasing and continuous current capacity.
  2. Conduit entry location, cable termination sizes, mounting.
- B. Manufacturer shall provide final, as- built drawings. Installation, Operation and Maintenance manuals shall also be supplied.

1.4 RELATED STANDARDS

- A. 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.
- B. The transformers devices in this specification are designed and manufactured according to latest revision of the following standards:
1. American National Standards Institute, Inc. (ANSI): C57.12.00, C57.12.22, C57.12.26, C57.12.28, C57.12.29, C57.12.70, C57.12.80, C57.12.90, C57.12.91
  2. Institute of Electrical and Electronic Engineers (IEEE)
  3. American Society of Testing and Materials (ASTM)
  4. National Electrical Code (NEC)
  5. The service conditions shall be as specified in Usual Service Conditions section of C57.12.00.
  6. This specification covers only the general requirements of the transformer.
  7. *[U.S. Department of Energy 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, dated April 18, 2013. These efficiency standards shall take effect January 1, 2016. All transformers covered in the scope of this document and this specification, manufactured after December 31, 2015, shall be compliant with the new standard.]*  
*[Editor's note: This standard, known as DOE 2016, applies to transformers rated 2500 kVa or less. For transformers 2501 kVa and larger, this RELATED STANDARD does not apply.]*

1.5 QUALITY ASSURANCE

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

- C. 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.
- D. 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 is available upon request.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manuals. One (1) copy of this document to be provided with the equipment at time of shipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. The padmounted distribution transformer shall be provided by Siemens or pre-approved equal. Approved manufacturers are as follows:
  1. SIEMENS Industry
  2. ABB
  3. [ ]

### 2.2 TECHNICAL REQUIREMENTS

- A. Construction
  1. 3 Phase kVa Rating: [45] [75] [112.5] [150] [225] [300] [500] [750] [1000] [1500] [2000] [2500] [3000] [OTHER]
  2. Frequency: [60] [50] Hertz
  3. Impedance: [5.75%] [ ]
  4. Temperature Rise: [65] [55] degree C
  5. Primary Voltage: [4160] [4800] [8320] [12000] [12470] [13200] [13800] [14400] [ ]
  6. Primary Connection: [Grounded Wye] [Delta]
  7. Primary Taps: [None] [-2FCBN and +2FCAN] [OTHER]
  8. Primary BIL (kV): [60] [75] [95] [125] [150] [OTHER]
  9. Primary Termination: [Dead Front (wells only, well w/removable studs, inserts, integral)] [Live Front (porcelain)]
  10. Secondary Voltage: [208Y/120] [480Y/277] [OTHER]
  11. Secondary BIL (kV): [30] [OTHER]
  12. Secondary Connection: [Delta] [Wye]
  13. Secondary Termination: [Studs] [4] [6] [8] [10] [12] [16] [20]-hole Spades] [OTHER]
  14. Insulating Fluid: [Mineral oil] [Biotemp] [R-temp]
  15. Application Location: [Outdoor] [OTHER]
  16. Sound Level: [ ]
  17. Other Special Instructions: [ ]
- B. Winding Characteristics
  1. All windings and internal connections shall be [copper] [aluminum] [as shown on drawings]. The coil insulating paper shall be thermally upgraded and shall have a thermosetting adhesive on both sides to assure coil bonding.
  2. The windings shall be tightly wound utilizing tension devices to place the conductor into the coils.
  3. For optimum dielectric and mechanical strength, epoxy coated insulation shall be placed between each layer in the winding.
  4. Sheet conductor shall be used in secondary winding to minimize vertical short circuit forces.
  5. The transformer shall be designed and constructed to withstand external short-circuits, as defined by ANSI C57. 12.00.
  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.

7. The transformer design shall be capable of operating above rated voltage or below rated frequency in accordance with ANSI C57.12.00.
  8. The impedance shall be as specified on the Transformer Data Sheet. ANSI tolerance shall apply.
- C. Sound Level
1. The padmounted tamper-resistant transformer shall be designed and constructed to minimize the audible noise generated with the transformer energized at rated voltage.
- D. High Voltage Compartment
1. The transformer shall be furnished with a high voltage compartment located on the left of the centerline in ANSI Segment 1. The high voltage compartment shall be furnished with porcelain bushings for live front or universal bushing wells for dead front. The HV compartment shall be provided with an interlocked door which can only be opened after the LV compartment door has been opened.
- E. Low Voltage Compartment
1. The transformer shall be furnished with a low voltage compartment located on the right of the centerline in ANSI Segment 1. The low voltage compartment shall be provided with a three-point latch with provisions for padlocking. The low voltage compartment shall include indicating devices and fittings that are to be supplied, along with a non-corrosive diagrammatic nameplate.
- F. Cabinet
1. All weather covers and tank tops should have a minimum 4 degree slope to shed water and curtail corrosion.
  2. Tamper resistance shall be enhanced by continuous steel baffling on all edges of the cabinet without the use of welded or bolted on parts.
  3. 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.
- G. Bushings
1. High voltage and low voltage bushings shall be furnished as shown on the Transformer Data Sheet.
  2. The bushings shall be side wall mounted and suitable for high and low voltage terminations as indicated on the Transformer Data Sheet.
  3. Bushing location other than side wall must be documented on the Transformer Data Sheet.
- H. Core
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.
  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.
- I. De-Energized Tap Changer
1. A manually operated de-energized tap changer (when requested) shall be provided for changing the primary winding taps.
  2. Full capacity taps shall be located in the high voltage windings and shall be in accordance with the Transformer Data Sheet.
  3. The tap changer shall be capable of carrying the full transformer short-circuit current without damage or contact separation.
  4. The tap changer shall be gang operated from a single operating point and shall have a position indicator.
  5. The tap changer operating mechanism shall include provisions for pad locking in each tap position.
- J. Insulating Fluid and Preservation System
1. The fluid preservation system shall be a sealed tank type.

2. The insulating fluid shall be as specified on the Transformer Data Sheet.
  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. The transformer insulating fluid shall meet or exceed the requirements of the appropriate ANSI and ASTM fluid Standards. The transformer fluid shall be tested for dielectric breakdown and moisture content during manufacturing.
- K. Tank Design
1. The transformer tank shall be designed to withstand, without permanent deformation, pressures consistent with those stipulated in ANSI C57.12-26 or C57.12.22.
  2. Tank design shall include sufficient expansion volume to allow operation under specified load conditions.
  3. The main cover shall be welded onto the tank.
  4. One or more handholes 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.
  5. The transformer base shall be suitable for rolling or skidding in the direction of either tank base centerline.
  6. 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.
  7. Lifting lugs shall be provided at each corner of the tank. The lifting lugs shall be designed to provide a minimum safety factor of 5.
  8. Jacking area, pads or bosses shall be provided.
  9. Pulling provisions, for towing the transformer parallel to either centerline, shall be provided.
  10. Most oil restraining welds shall be robotically applied to severely limit the incidence of oil leaks and corrosion.
- L. Gaskets
1. The gaskets shall be compatible for the insulating fluid in the transformer tank.
  2. Metal surfaces to which gaskets are applied shall be smooth and shall have sufficient rigidity to assure proper compression of the gaskets.
- M. Cooling System
1. The transformer shall be self-cooled.
  2. Coolers shall be rigidly welded to the tank wall.
- N. Grounding Provisions
1. All non-energized metallic components of the transformer shall be grounded.
  2. Tank grounding provisions shall consist of two ground pads, welded to the base or to the tank wall near the base.
  3. Ground pads shall be per ANSI standards.
- O. Nameplates
1. Transformer shall be furnished with a non-corrosive diagrammatic nameplate, permanently attached with non-corrosive hardware. 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.
  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, type and quantity of fluid and the date of manufacture.
  3. A non-corrosive dial plate located next to the operating handle of the de-energized tap changer, when required, shall be provided which states the following: "De-energized Operation Only."
- P. Exterior Finish

1. The transformer painting system shall be in compliance with ANSI C57.12.28. The transformer shall be thoroughly cleaned and phosphatized, 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.
2. The finish shall be Bell Telephone Green, Munsell No. 7GY/3.2/1.5.

### 2.3 TESTING

- A. Each transformer shall receive all standard routine tests as required by ANSI C57.12.00 and performed as specified by ANSI C57.12.90.
- B. 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.
- C. The test facility used to perform loss tests shall utilize test equipment with calibration traceable to NIST or an approved equal 3rd party laboratory.
- D. 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 minimum contain the data as specified in ANSI C57.12.90.

### 2.4 ACCESSORIES

- A. The transformer shall be equipped with a complete set of standard accessories, including.
  1. Four lifting lugs
  2. Bolted-on terminal compartment (18" min. depth) with removable front sill
  3. Hinged, lift-off cabinet doors
  4. Interlocked *[standard penta-head bolt] [(optional) hex-head bolt]*/padlock handle operates a cam assembly that is part of the 3-point door latching mechanism.
  5. *[Live front, radial feed HV construction, externally clamped high voltage porcelain bushings with a single eyebolt, clamp-type connector.] [Dead front, [radial] [loop] feed HV construction, externally clamped high voltage bushings wells for loadbreak] [non-loadbreak] inserts.*
  6. Lightning arrester mounting pads (live front only).
  7. Tank ground pads (1 in HV, 1 in LV)
  8. Steel high/low voltage compartment barrier.
  9. One 1/2" *[standard penta-head bolt] [hex-head bolt]* must be removed from the flange formed on the steel high/low barrier before the HV door can be opened
  10. Externally clamped LV bushings with threaded copper stud for full load current below 2100 amps. Externally clamped integral LV bushings for current above 2100 amps.
  11. Non-corrosive nameplate
  12. Fill plug and self-actuating pressure relief device.
  13. Drain plug
  14. Removable neutral ground strap.
  15. Handhole cover bolted onto tank top.
  16. *[Panel-type coolers (if necessary) ]*
  17. NEMA safety labels.
  18. Compartment Weather Cover
    - a. Hinged to allow vertical access or clearance for replacement of the bayonet fuses.
    - b. Sloped to shed water.
    - c. Can be lifted easily into place and secured with a single supporting arm.
    - d. Requires no additional hold-down hardware
- B. *[Optional accessories]*
  1. *[Primary Termination]*
    - a. *Integral loadbreak bushings.*
    - b. *Integral non-loadbreak 600 amp bushings. ]*
  2. *[Secondary Termination]*

- a. *Externally clamped bushings with NEMA [4] [8] [10] [12] [16] [20]-hole spades*
- b. *Spade supports (if 10-hole spades or greater are used) ]*
- 3. *[Primary Switching*
  - a. *Rotary three-pole oil switch: one for radial; two for loop feed. ]*
- 4. *[Overcurrent Protection*
  - a. *Internal primary protective links.*
  - b. *Bayonet-type expulsion fuses.*
  - c. *Internal, partial-range current limiting fuses*
  - d. *Full range current limiting fuses ]*
- 5. *[Overvoltage Protection*
  - a. *Distribution class, metal oxide arresters, 3-36 KV ]*
- 6. *[Construction Options*
  - a. *24" and 30" deep terminal cabinet.*
  - b. *Drain valve and sampling device*
  - c. *Mounting plate for CT's or PT's.*
  - d. *HV Inter-phase barriers (live front only)*
  - e. *Molded case external secondary breaker.*
  - f. *Substation Accessories (oil gauge, thermometer, drain valve and sampler, pressure-vacuum gauge provision). ]*

## 2.5 DOCUMENTATION

- A. Drawing Requirements
  - 1. The required drawing format is specified on the Transformer Data Sheet.
  - 2. The outline drawings shall be completely dimensioned and, as a minimum, show the following:
    - a. Plan and all elevations, including clearance for bushing and core and coil removal.
    - b. High voltage and low voltage bushing details.
    - c. Location of all handholes.
    - d. Location and identification of all accessories.
    - e. Size and location of all conduit entrances for Buyers connections.
    - f. Anchoring details.
    - g. Ground pad locations.
    - h. Weight of core and coil, transformer tank and fittings, weight and gallons of fluid and total shipping weight.
- B. Nameplate Drawing
  - 1. A nameplate drawing showing required ANSI information shall be provided after receipt of order.
- C. Parts
  - 1. The Seller shall provide a renewal parts list to the Buyer upon request.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install transformer as shown on Project Drawings and in accordance with manufacturer's Instruction/Installation Manual.
- B. Provide concrete pad with sufficient structural support and in accordance with local codes and standards. Concrete pad requirements should be coordinated with transformer manufacturer.
- C. Grounding should be per Project Drawings and in accordance with local codes and standards and in compliance with the NEC.

### 3.2 ADJUSTMENTS AND CLEANING

- A. Remove debris from job site and wipe dust and dirt from all components.

- B. Repaint marred and scratched surfaces with touch up paint to match original finish.

### 3.3 TESTING

- A. *[Field-testing will be conducted at the expense of the Owner, if required for final acceptance.]*
- B. Refer to Section *[26 xx xx] [16040]*, “Electrical Tests, Adjustments and Inspection.”

### 3.4 WARRANTY

- A. Equipment manufacturer warrants that all goods supplied are free of non-conformities in workmanship and materials for one year from date of initial operation, but not more than eighteen months from date of shipment.

**END OF SECTION**