

SECTION 26 22 13
LOW-VOLTAGE DISTRIBUTION TRANSFORMER, HARMONIC MITIGATING –
DOE 2016

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish and install dry type harmonic mitigating isolation transformers of the types, sizes and quantities indicated on the contract drawings. Provide all lugs, accessories and mounting hardware necessary for proper installation and operation.

1.2 RELATED DOCUMENTS

- A. All drawings and general provisions of the Contract including General and Supplementary Conditions apply to this section.

1.3 SUBMITTALS

- A. Provide product information prior to fabrication and installation. Product data shall include all dimensions, weights, electrical ratings, wiring diagrams and required clearances.
- B. Provide typical transformer loss and efficiency data as follows:
 - 1. No load loss (core loss).
 - 2. Full load winding conductor loss.
 - 3. Full load loss.
 - 4. Percent efficiency at 25, 35, 50, 75 and 100 percent load.
- C. Provide additional product data and certifications necessary to show conformance with this specification.
- D. Provide information for record purposes including field test reports and maintenance data as required.
- E. *[Provide factory test reports for audible sound test per NEMA ST20 or below as specified for record purposes.]*

1.4 RELATED STANDARDS

- A. Provide transformers in accordance with the following standards, where applicable:
 - 1. Underwriter's Laboratory 1561, Standard for Safety for Dry-Type General Purpose and Power Transformers
 - 2. Underwriter's Laboratory 506, Standard for Safety for Specialty Transformers
 - 3. NEMA ST 20, Dry Type Transformers for General Applications
 - 4. ANSI / IEEE C57.12.91, Standard Test Code for Dry-Type Distribution and Power Transformers
 - 5. ANSI / IEEE C57.110, Standard
 - 6. CSA # CSA C9-02 and C22.2 No. 47 (CUL)
 - 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.
- B. *[Manufacturer Seismic Qualification: Transformers shall be designed and manufactured to comply with the specification, "IBC 2006; Section 1613; Earthquake Loads" with the site specific parameters of "Occupancy Category III: Special Occupancy": IP=1.25 and "Site Profile Type: SD=Stiff Soil" with the seismic forces defined as "Spectral Acceleration for Short Periods: SS=1.0g". Applicable to floor mounted units only.]*

1.5 QUALITY ASSURANCE

- A. Manufacturer shall have produced similar electrical equipment for a minimum period of 10 years.
- B. Products shall be listed by Underwriters Laboratories, Inc.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Handle transformers in accordance manufacturer's recommendations. Utilize factory provisions for all lifting, rigging, or hoisting.
- B. Store transformers prior to installation in a temperature and humidity controlled space. If such a space is not available, apply temporary heat in accordance with the manufacturer's instructions within each ventilated type transformer case to exclude moisture and condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide Sentron harmonic mitigating transformers by Siemens or pre-approved equal. Approved manufacturers are as follows:
 - 1. SIEMENS – Sentron
 - 2. []
- A. Transformers specified in this Section and power distribution equipment feeding and being fed by the transformers shall be warranted and serviced by the same manufacturer. Manufacturer shall have a local field service organization available on an as needed basis.

2.2 GENERAL REQUIREMENTS

- A. Transformers shall be of the Harmonic Mitigating, self cooled, dry type designed for 60 Hz operation. Transformers shall be designed, manufactured and tested in accordance with the latest ANSI, NEMA and IEEE Standards and shall be listed and labeled in accordance with UL 1561.
- B. Single-Output Harmonic Mitigating Transformers (0° or -30° primary-secondary angular displacement):
 - 1. Transformer primary winding and secondary winding shall be configuration designed to mitigate 3rd, 9th and 15th in addition to other zero sequence harmonics generated by non-linear loads and prevent these harmonics from circulating in the primary windings by canceling their magnetic fluxes in the secondary at low impedance.
 - 2. Harmonics of the 5th, 7th, 17th and 19th-order shall be mitigated at the common transformer primary bus by use of a combination of multiple transformers with 0° and 30° phase shift supplying loads of similar harmonic content.
 - 3. Location of Single-Output Harmonic Mitigating Transformers and primary-secondary phase shift are shown on the drawings.
- C. Transformer shall have demonstrated temperature rise with non-linear K-13 load and efficiency under linear and non-linear loads.
- D. Insulation System
 - 1. Transformers 15 KVA and larger shall be of the ventilated type and have a UL recognized 220°C insulation systems. The KVA ratings shall be based on an allowable 150°C winding temperature rise above a 30°C hot spot. (Provide optional 115°C or 80°C rise when specified).
 - 2. Transformer design KVA rating shall be suitable for a 30°C average, 40°C maximum ambient temperatures.
- E. Core and Coil
 - 1. Copper Windings consisting of wire wrapped in Nomex or equal and/or copper sheet separated by high quality non-aging Nomex or mica sheet insulation shall be used.

Spacers between primary and secondary coils, support beams and separators shall be of heat resistant non-aging fiberglass and resins.

2. Ventilated windings shall be arranged to brace coil layers and provide maximum ventilation. Core and coil assemblies shall be constructed to provide short circuit withstand capability as defined by ANSI and NEMA standards. The complete assembly shall be installed on vibration dampening pads to reduce noise and securely bolted to the enclosure base. A flexible grounding conductor shall be installed between the core and coil assembly and the transformer enclosure.
3. Core and coil sealing process shall be vacuum impregnated polyester resin encapsulation of windings shall insure complete encapsulation and coating of conductors and insulation materials. Resin coating shall resist collection of dust in the air passages, protect the windings from the environment and add to design life.
4. Core lamination clamping angle shall be of adequate thickness and hardness to insure a tight and rigid core assembly to eliminate movement of core plates. Welded core designs shall include multiple beads as necessary to insure a tight and rigid core assembly to eliminate core plate movement.
5. Secondary windings shall have 0.95% or less in zero sequence impedance and less than 0.3% zero sequence reactance to reduce fundamental current imbalance up to 150kva and 1.0% and <0.5% for 225kVA and 300 kVA respectively. For 500 kva the designs shall have no more than 1.5% zero sequence impedance and 1.0 % reactance at 60Hz.
6. Noise attenuation with copper foil full width insulated electrostatic shield(s), separating primary windings from secondary windings for filtering common mode and transverse mode high frequency noise. The electrostatic shield design and installation shall limit capacitance to a maximum of 33 Pico farads over a frequency range of 20 Hz to 1 MHz between the primary and secondary. Designs available shall include noise attenuation of up to 60dB common mode and 10dB transverse (Normal) mode. The design shall include the **[standard single shield for 60dB common mode noise attenuation.] [double shield design for Common Mode: 100dB: Between 60Hz – 1kHz, 90dB: Between 1kHz – 10kHz, 80dB: Between 10kHz – 100kHz. Transverse Mode: 10dB: At 10kHz, 20dB: At 100kHz, 40dB: At 1000kHz.]**
7. Lug landing pads shall conform to standard hole patterns for KVA and shall be neatly arranged, straight (+/- 3 degrees) and cleaned of all weld residue.
8. Transformers shall have a neutral sized at 200% of the ampacity of the secondary phase conductors for extra protection against triplen harmonics and unbalanced single phase loads.
9. Provide full capacity taps in the high-voltage windings as follows:
 - a. 15 KVA through 500 KVA step-down transformers: 2 – 2½ % full capacity above normal and 4 – 2½ % full capacity below normal.
 - b. 750 KVA and above step-down transformers: 2 – 2½ % full capacity above normal and 2 – 2½% full capacity below normal.
 - c. Below 15 KVA three phase step-down transformers: 2 – 5% full capacity below normal.

F. Enclosures

1. Ventilated enclosures shall be of heavy gauge steel construction of Type 3R construction. Front and rear covers shall be removable to provide access to terminal compartment(s). Terminals shall be fully sized to carry the transformer full load current and shall be arranged to accept UL listed cable connectors.
2. Position of lug landings shall allow for adequate bending space for maximum sized cable for KVA. Cable entry shall be allowed from either side
3. Finish enclosures in ANSI 61 gray paint with powder coat application.
4. Each transformer shall have a securely attached nameplate providing complete electrical ratings, wiring diagram, tap connections and catalog number, as applicable.

G. Sound

1. Unless otherwise specified, sound levels shall be in accordance with values allowed by NEMA ST-20.

2. *[Provide transformers with sound level rating of 3dB below NEMA ST20 standard.]*
 3. *[Provide transformers with sound level rating of 5dB below NEMA ST20 standard.]*
- H. Accessories
1. *[Over-Temperature switches wired to internal terminal strip. Temperatures specified for use with class 220°C insulation systems. Standard configuration is N.C. opening on high temperature. Optional configuration is N.O. closing on high temperature.*
 - a. *Installation:*
 - 1.) *[One switch: 170°C or 200°C on center coil]*
 - 2.) *[Two switches: 170°C and 200°C on center coil]*
 - 3.) *[Six switches: one 170°C and one 200°C on each of the 3 coils]*
 2. *[Provide SPD (Surge Protection Device) to include “metal oxide varistor” type surge suppressors on the secondary side for surge/ spike protection. The varistors shall be capable of discharging 800,000 amperes of transient current.] The SPD shall also include low pass filtering.]*

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install transformer in accordance with manufacturers written instructions.
- B. Install transformers on Korfund Elasto-Grip, Wafer, spring style vibration isolators, or approved equal vibration isolation pads under each corner of the transformer.
- C. Install primary and secondary conductors with a minimum of 2 feet of flexible conduit to the transformer enclosure.

3.2 ADJUSTMENTS AND CLEANING

- A. On completion of installation, inspect components, remove paint splatters and other spots, dirt and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings and submit with test results.

3.3 TESTING

- A. *[Factory tests each transformer for audible sound to prove compliance with NEMA ST20 standards or below ST20 standard as specified. Provide test results in operation and maintenance manuals.]*
- B. Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.
 1. Inspect accessible components for cleanliness, mechanical and electrical integrity and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
 2. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
 3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.
 - a. Minimum Test Voltage: 1000 V, dc.
 - b. Minimum Insulation Resistance: 500 megohms.
 - c. Duration of Each Test: 10 minutes.
 - d. Temperature Correction: Correct results for test temperature deviation from 20 deg C standard.

3.4 WARRANTY

- A. A ten year pro-rated warranty with standard liability limitations shall apply to this product.

END OF SECTION