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**Part 1 GENERAL**

**1.1 SECTION INCLUDES**

- .1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

**1.2 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-C22.2 No.47-(2013), Air-Cooled Transformers (Dry Type).
  - .2 CSA C9-(2017), Dry-Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

**1.3 SUBMITTALS**

- .1 Product Data for each type and size of transformer indicated.
  - .1 Physical: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features.
  - .2 Product warranty.
  - .3 Efficiency Data
    - .1 No load and full load losses per NEMA TP-1.
    - .2 Linear load Efficiency data @ 1/6, 1/4, 1/2, 3/4, & full load.
    - .3 Linear Load Efficiency @ 35% loading tested per NEMA TP-2.
    - .4 Efficiency under K7 load profile at 15%, 25%, 50%, 75%, 100% of nameplate rating.
  - .2 Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
    - .1 Wiring Diagrams: Power, signal, and control wiring.
- .3 Qualification Data: For testing agency.
- .4 Source quality-control test reports.
- .5 Field quality-control test reports.
- .6 Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

**1.4 QUALITY ASSURANCE**

- .1 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

- .1 Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- .2 Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- .3 Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- .4 Electrical Components, Devices and Accessories: Listed and labelled as defined in NFPA 70, Article 100, and to Canadian Electrical Code (CEC), by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- .5 Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."
- .6 Comply with IEEE C57.110-1998-IEEE recommended practise for establishing transformer capability when feeding non-sinusoidal load currents.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- .1 Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

## **Part 2 PRODUCTS**

### **2.1 TRANSFORMERS**

- .1 Description: Factory-assembled and tested, air-cooled units for 60 Hz service
- .2 Cores: Grain-oriented, non-aging silicon steel.
- .3 Coils: Continuous windings without splices except for taps.
  - .1 Internal Coil Connections: Brazed or pressure type.
  - .2 Coil Material: Copper

### **2.2 DISTRIBUTION TRANSFORMERS**

- .1 Provide a 10-year pro-rated product Warranty
- .2 Comply with NEMA ST 20, and list and label as complying with UL 1561.
- .3 Cores: One leg per phase.
- .4 Enclosure: Ventilated, NEMA 250, Type 2.

- .1 Core and coil shall be impregnated within resin compound, sealing out moisture and air.
- .5 Transformer Enclosure Finish: Comply with NEMA 250.
  - .1 Finish Color: Manufacturer's Standard.
- .6 Taps for Transformers smaller than 3 kVA: None.
- .7 Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- .8 Taps for Transformers 25 kVA and larger: Two 2.5 percent taps above and four 2.0 percent taps below normal full capacity.
  - .1 Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 130 deg C rise above 40 deg C ambient temperature
- .9 Energy Efficiency for Transformers Rated 15 kVA and larger:
  - .1 Comply with 10 CFR Part 430, July 29, 2004, FEDERAL Register – US Department of Energy, Office of Energy Efficiency and Renewable Energy. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers; Proposed Rule.
  - .2 Meet or exceed DOE 10 CFR Part 430 CSL3 Efficiency, tested per NEMA TP-2:
    - .1 15kVA: 97.6%
    - .2 30kVA: 98.1%
    - .3 45kVA: 98.3%
    - .4 75kVA: 98.6%
    - .5 112.5kVA: 98.8%
    - .6 150kVA: 98.9%
    - .7 225kVA: 98.9%
    - .8 300kVA: 99.0%
    - .9 500kVA: 99.1%
    - .10 750kVA: 99.2%
- .10 Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.
  - .1 Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  - .2 Include special terminal for grounding the shield.
  - .3 Shield Effectiveness:
    - .1 Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    - .2 Common-Mode Noise Attenuation: Minimum of minus 120 dB at 0.5 to 1.5 kHz; minimum of minus 65 dB at 1.5 to 100 kHz.
    - .3 Normal-Mode Noise Attenuation: Minimum of minus 52 dB at 1.5 to 10 kHz.
- .11 Wall Brackets: Manufacturer's standard brackets.

- .12 Fungus Proofing: Permanent fungicidal treatment for coil and core.
- .13 Low-Sound-Level Requirements: NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91

### **2.3 EQUIPMENT IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Label size: 7.

## **Part 3 EXECUTION**

### **3.1 INSTALLATION**

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.
- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.

### **3.2 FIELD QUALITY CONTROL**

- .1 Perform tests and inspections and prepare test reports.
  - .1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- .2 Tests and Inspections:
  - .1 Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - .2 Test transformers for losses and efficiency. Verify results are consistent with the loss data provided on the submittal documenting compliance with DOE CSL 3 class efficiency.
- .3 Remove and replace units that do not pass tests or inspections and retest as specified above.

- .4 Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
  - .1 Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - .2 Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
  - .3 Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- .5 Test Labelling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### **3.3 ADJUSTING**

- .1 Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding name plate voltage plus 10 percent and not being lower than name plate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- .2 Connect buck-boost transformers to provide name plate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.
- .3 Output Settings Report: Prepare a written report recording output voltages and tap settings.

### **3.4 CLEANING**

- .1 Vacuum dirt and debris; do not use compressed air to assist in cleaning

**END OF SECTION**