

SECTION 26 22 00 – DRY TYPE TRANSFORMERS

1.01 SUMMARY:

- A. **Basic Function:** Dry type distribution transformers step down voltage from distribution voltage level to utilization voltage for the lighting, general power, shore power, welding outlets, control power or any other electrical load that requires power at a voltage level different than 480 volts.
- B. **Scope of Work:** All single-phase and three-phase general purpose dry-type distribution transformers shall be installed indoors, in buildings of the new locks complexes, or where the design requires their installation.

1.02 ^{A16}REFERENCES:^{A16}

- A. **American National Standards Institute (ANSI) Standards:**
 - C84.1- 06 Electrical Power Systems and Equipment – Voltage Ratings (60 Hertz)
- B. **American Society for Testing and Materials (ASTM) International Standard:**
 - C 635 – 06 C84.1- 06 Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- C. **Institute of Electrical and Electronics Engineers (IEEE) Publications:**
 - C57.12.01 – 05 Standards for General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid-Cast and/or Resin Encapsulated Windings
 - C57.12.91 – 01 Test Code for Dry-Type Distribution and Power Transformers
 - C57.94 – 06 Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
 - C57.96 – 05 Guide for Loading Dry Type Distribution and Power Transformers
- D. **National Electrical Manufacturers Association (NEMA) Standard:**
 - ST 20 – 97 Dry Type Transformers for General Applications
- E. **National Fire Protection Association (NFPA) Standard:**
 - 70 – 08 National Electrical Code

F. Underwriters Laboratories (UL) Standard:

1561 -- 05

Dry – Type General Purpose and Power Transformers

1.03 REQUIREMENTS:

A. General:

1. Dry-type transformers shall be installed indoor; any exception shall be submitted to the Employer's Representative for review.
2. Distribution transformers could be single-phase or three-phase. Three-phase transformer always shall have primary windings in delta connection. Transformers with wye-wye connections are not allowed to be used.
3. Standards: Dry type transformers shall conform to the requirements of ANSI C57.12.01, UL 1561 and NEMA ST 20.

B. Capacity:

1. Transformers feeding critical loads essential for the continued uninterrupted operation of the locks complex shall be sized to carry the maximum design connected load at 50% of its full load rating. Other transformers feeding non critical loads, shall be sized to carry the maximum design connected load at 75% of its full load rating.
2. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, normal life expectancy, and with short time loading in excess of rated kva in accordance with ANSI C57.96.

C. Standard Products: Materials and equipment submitted for approval shall be standard cataloged products of concerns regularly engaged in the commercial production of these products and shall be the latest standard design that conforms to the specifications. Voltage ratings shall comply with ANSI C84.1.

D. Nameplates: Equipment shall have manufacturer's name, address, catalog number, model, style or type identified and technical data as kVA, voltages, current, Hz, etc. on a plate securely and conspicuously attached to each item of equipment. Nameplates for electrical apparatus shall conform to IEEE C57.12.01.

E. Identification: Transformers shall be identified in accordance with Section 26 05 53 (*Identification for Electrical Equipment*).

1.04 DESIGN CRITERIA / SYSTEM DESCRIPTION AND PERFORMANCE

A. Ratings:

1. Transformers shall have the kVA and voltage ratings as specified on the design.

2. Dry type transformers shall be designed and constructed to withstand the mechanical and thermal stresses for the short circuit current levels determined by the study required in Section 26 05 73 (*Short Circuit and Load Flow Coordination Study*). Test shall conform to IEEE C57.12.91.

B. Transformer Construction:

1. Insulation Systems:

- a. Transformers shall be insulated as follows:
 - 1) **2 kVA and below:** 150°C insulation system based upon 80°C rise
 - 2) **3 to 15 kVA:** 185°C insulation system based upon 115°C rise
 - 3) **15 kVA and above:** 220°C insulation system based upon 150°C rise
- b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40°C maximum ambient.
- c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM D 635.

2. Core and Coil Assemblies:

- a. Dry type transformer core shall be constructed with high-grade, non-aging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum continuous wound construction.
- b. On units rated 15 kVA and below, the core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
- c. On units rated above 15 kVA, the core and coil assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture. The assembly shall be installed on vibration-absorbing pads. Taps shall be two (2) steps above and four (4) steps below nominal voltage in 2.5% increments.
- d. Taps: Dry type transformer shall be provided with voltage taps. Two (2) steps above and four (4) steps below nominal voltage in 2.5% increments.

- e. **Harmonics:** The Contractor shall analyze the load to determine the harmonics content, in order to make provisions to size neutrals and provide K rated transformers as indicated in UL 1561, and listed by UL.
- 3. **Sound Levels:** Sound levels shall not exceed the limits set by ANSI C57.12.01 and NEMA ST 20.
- 4. **Electrostatic Shielding:** An electrostatic shield consisting of a single turn of aluminum shall be placed between the primary and secondary winding and grounded.
- 5. **Motor Drive Isolation:** Motor drive isolation transformer, if required, shall be designed for use with 3-phase AC adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. These drives minimize the line disturbances caused by SCR firing within the drive unit. Thermo-guards shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of drive currents. The transformer shall provide reduced short-circuit currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor, and as such will be mechanically braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating.
- C. **Wiring/Terminations:** Recommended external cable shall be rated 90°C (sized at 75°C ampacity) for encapsulated and 75°C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.
- D. **Enclosure:**
 - 1. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90°C. The core of the transformer shall be grounded to the enclosure.
 - 2. On units rated 15 kVA and below, encapsulated the enclosure construction shall be totally enclosed, non-ventilated, NEMA 3R, with lifting provisions.
 - 3. On units rated above 15 kVA, the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.
 - 4. Enclosures shall be finished with ANSI 61, light gray color weather-resistant enamel. Enclosures shall be protected against corrosion inside and outside, with manufacturer recommended coatings conforming to Section 09 96 00 (*Corrosion Control Coatings*).
- E. **Installation:** Transformers shall be installed to conform to ANSI 57.94. Separation from building walls and combustible materials shall comply with NFPA 70.

1.05 SUBMITTALS

A. Before Manufacture:

1. **Certification:** Submit certification of compliance with standards and UL listing.
2. **Drawings and Descriptive Literature:** The Contractor shall submit to the Employer's Representative for review before manufacturing copies of drawings and technical literature describing the equipment to be furnished and including, but not limited to, the following items:
 - a. Detailed dimension drawings and weight of the transformers, and accessory equipment.
 - b. Connection diagrams.
 - c. Insulation class and temperature rise
 - d. Impedance
 - e. Transformer ratings including:
 - 1) kVA
 - 2) Voltage
 - 3) Taps
 - 4) Primary and secondary continuous current
 - 5) Sound level
 - 6) BIL level
 - 7) Short circuit withstand level

B. Before Shipment:

1. **Final manufacturing Drawings:** After the transformer has been manufactured, and before installation, the Contractor shall furnish drawings of each final drawing, and shall include all changes and revisions.
- ^{A16}2. (Reserved) ^{A16}
3. **Factory Test Reports:** Submit certified factory test reports of all factory tests performed by the manufacturer, including tests required by the applicable standards. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted following successful completion of the tests. Factory tests shall conform to IEEE C57.12.91.
4. **Field Test Plan:** Submit a proposed field test plan, prior to testing equipment and subsystems. No field test shall be performed until the test plan has been reviewed by the Employer's Representative. The test plan shall consist of complete field test procedures, including tests to be performed, qualifications of personnel performing the testing, test equipment required, field test procedures,

including the manufacturer's pass/fail criteria, and tolerance limits. After completion of field testing, submit Certified Field Test Reports.

C. Before Taking Over:

1. **Equipment List:** Shall provide an electronic database of all installed dry-type transformers with the following information:
 - a. Unit Identification (name or number)
 - b. Manufacturer & Serial Number
 - c. Catalog number
 - d. Voltages primary/secondary
 - e. kVA rating
 - f. Location
 - g. Temperature rating
 - h. Tap position
 - i. Enclosure type
2. **Field Tests Report:** Submit certified report of all field tests performed, including the results of each one of the tests recommended by the manufacturer.

1.06 QUALITY ASSURANCE:

- A. **Manufacturer:** The manufacturer shall be a firm specializing in manufacturing dry type transformers with minimum five years documented experience.
- B. **Defective Material:** Defective material or material damaged in the course of shipment, transportation or test shall be replaced or repaired in a manner meeting with the approval of the Employer's Representative.
- C. **Factory Tests:** Factory tests shall be in accordance with the standard specified in paragraph 1.05 B 3. In addition tests shall include:
 1. Ratio tests at the rated voltage connection and at all tap connections
 2. Polarity and phase relation tests on the rated voltage connection
 3. Applied potential tests
 4. Induced potential test
 5. No-load and excitation current at rated voltage on the rated voltage connection.
- D. **Field Tests:** *The Contractor shall perform field tests as detailed in Section 26 90 00 (Testing Electrical Systems).*

END OF SECTION