CITY OF FORT WAYNE MASTER UPDATED: 11/16/18

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

1. GENERAL
   1. DESCRIPTION
      1. Scope:
         1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install dry type low-voltage distribution transformers.
      2. Related Sections:

NTS: List below only sections covering products, construction, and equipment specifically identified in this section and specified in another section and directly referenced in this specification. Do not list administrative and procedural division 01 sections.

* + - 1. Section 03 30 00, Cast-in place Concrete.
      2. Section 26 05 05, General Provisions for Electrical Systems.
      3. Section 26 05 26, Grounding and Bonding for Electrical Systems.
      4. Section 26 05 53, Identification for Electrical Systems.
  1. REFERENCES
     1. Standards referenced in this Section are:

NTS: Retain applicable standards and add others as required.

* + - 1. ANSI C57.12.28., Requirements for Pad-Mounted Equipment
      2. ANSI C57.12.91., Power Transformer
      3. DOE 2016 Efficiency Standards: Low Voltage Distribution Transformers
      4. IEEE C2, Safety Code
      5. NEC 450, Transformers and Transformer Vaults
      6. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
      7. NEMA ST-20, Dry Type Transformers for General Applications.
      8. NEMA TP-2, Standard Test Method for Measuring the Energy Consumption for Distribution Transformers.
      9. UL 506, Standard for Safety for Specialty Transformers
      10. UL 1561, Dry Type General Purpose and Power Transformers.

NTS: Edit article “1.3” below to suit the Project. DO NOT DELETE (NOT USED) ITEMS.

* 1. SUBMITTALS
     1. Action Submittals: Submit the following:
        1. Product Data
           1. Supplier’s technical information for transformers proposed for use.
           2. Include data on features, components, ratings, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.
        2. Shop Drawings
           1. Schedule of transformers to be furnished with ratings and other required technical data.
           2. Proposed location for each transformer, including pad layout, dimensions, and appurtenances.
        3. Samples (NOT USED)
     2. Informational Submittals: Submit the following:
        1. Certificates (NOT USED)
        2. Delegated Design Submittal (NOT USED)
        3. Test and Evaluation Reports (NOT USED)
        4. Manufacturers’ Instructions (NOT USED)
        5. Source Quality Control Submittals (NOT USED)
        6. Field Quality Control Submittals (NOT USED)
        7. Manufacturer Reports (NOT USED)
        8. Sustainable Design Submittals (NOT USED)
        9. Special Procedure Submittals (NOT USED)
        10. Qualifications Statements (NOT USED)
     3. Closeout Submittals. (NOT USED)
        1. Maintenance Contracts (NOT USED)
        2. Operation and Maintenance Data
           1. Submit Operation and Maintenance Data in accordance with Section 01 78 23.
           2. Include acceptable test reports, maintenance data and schedules, and wiring diagrams.
        3. Bonds (NOT USED)
        4. Warranty Documentation (NOT USED)
        5. Record Documentation (NOT USED)
        6. Sustainable Design Closeout (NOT USED)
        7. Software (NOT USED)
     4. Maintenance Material Submittals. (NOT USED)
        1. Spare Parts (NOT USED)
        2. Extra Stock Materials (NOT USED)
        3. Tools (NOT USED)
  2. QUALITY ASSURANCE
     1. Regulatory Requirements:

NTS: Retain applicable standards and add others as required.

* + - 1. NEC Article 450, Transformers and Transformer Vault (Including Secondary Ties).
      2. National Electrical Code (NEC): Components and installation shall comply with National Fire Protection Association (NFPA) 70.
      3. Comply with IEEE C2.
  1. DELIVERY, STORAGE, AND HANDLING
     1. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in space that is continuously under normal control of temperature and humidity.
     2. Delivery, storage, and handling shall comply with manufacturer’s recommendations.

1. PRODUCTS
   1. MATERIALS
      1. Transformers, General Requirements
         1. Factory-assembled and -tested, air-cooled units of types specified, designed for 60 Hz service.
         2. Cores: Grain-oriented, non-aging silicon steel.

NTS: Retain correct winding material and delete the remaining material.

* + - 1. Coils: Continuous aluminum or copper windings without splices, except for taps.
      2. Internal Coil Connections: Brazed or pressure type.
      3. Enclosure: Class complies with NEMA 250 for environment in which installed.
      4. Wall-Mounting Brackets: Manufacturer's standard brackets for transformers up to 75 kVA.
    1. Dry Type Two-Winding Transformer Requirements:
       1. Type: Dry type, air cooled, low temperature rise. Transformers 15 kVA and larger shall be energy efficient, complying with NEMA TP-1 Class 1 efficiency levels. Transformers less than 15 kVA shall be general purpose.
       2. Rating: KVA, primary voltage and connection, secondary voltage and connection, frequency and number of phases shall be as shown on the Drawings.
       3. Insulation: Insulation and average winding temperature rise (in a 40 degree C maximum ambient) for rated kVA per the following table. Energy efficient transformers shall be capable of 15 percent continuous overload at 150 degrees C temperature rise.

|  |  |  |
| --- | --- | --- |
| **kVA Rating** | **Insulation Class**  **(degrees C)** | **Temperature Rise**  **(degrees C)** |
| 1 to 15 kVA | 185 | 115 |
| 25 to 500 kVA | 220 | 115 |

* + - 1. Winding Taps, Transformers 15 kVA and Less: Two 5-percent below rated voltage, full capacity taps on primary winding.
      2. Winding Taps, Transformers 25 kVA and Larger: Two 2-1/2-percent above rated voltage and four 2-1/2+ percent below rated voltage, full capacity taps on primary.
      3. Basic impulse level shall be 10 kV.
      4. Sound Level: NEMA ST-20 standard.
      5. Enclosure: UL listed for the application.
      6. Identification: Identify transformers in accordance with Section 26 05 53, Identification for Electrical Systems, with the transformer number and voltages, connection data, kVA ratings, impedance, and overload capacity.
      7. Transformers shall comply with NEMA ST-20, DOE 2016, NEMA TP-2, and UL 1561.
      8. Transformers shall bear the label of the Underwriters’ Laboratories, Inc.
    1. Non-Linear Load, K Factor Rated Transformer Requirements:

NTS: Designate non-linear load transformers on drawings by adding “K-factor rated” to kVA and voltage ratings. Edit the K factor specified below to suit Project.

* + - 1. K Factor rated transformers shall meet the requirements specified in this Section for dry-type two-winding transformers and, in addition, the following:
         1. Type: 100 percent non-linear rated, specifically designed to handle non-linear loads with double size neutral. Transformer shall include an electrostatic shield grounded to the transformer core.
         2. UL K Factor: K = 13.
         3. Impedance: Three percent minimum, five percent maximum.
    1. Dry Type Buck and Boost Transformer Requirements:
       1. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506 or UL 1561.
       2. Self-cooled dry type, rated for continuous duty, and connected as autotransformers to provide percentage of buck or boost indicated.
       3. Insulation and average winding temperature rise for rated kVA as follows:

|  |  |  |
| --- | --- | --- |
| **kVA Rating** | **Insulation Class**  **(degree C)** | **Temperature Rise**  **(degree C)** |
| 0.25 to 2 kVA | 185 | 115 |
| 3 to 7.5 kVA | 185 | 115 |

* + 1. Dry Type Shielded Isolation Transformer Requirements:
       1. Shielded isolation transformers shall meet the requirements specified in this Section for dry-type two-winding transformers, except as specified below:
          1. Transformers shall be provided with quality, full width electrostatic shields in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the limits listed in the table in Paragraph 2.1.D.1.b of this Section:.
          2. Common mode noise attenuation:

|  |  |
| --- | --- |
| **Frequency** | **Attenuation** |
| 0 to 1.5k Hz | 120 db |
| 1.5 k Hz to 10k Hz | 90 db |
| 10 k Hz to 100k Hz | 65 db |
| 100 k Hz to 1M Hz | 40 db |

* + - * 1. Transverse mode noise attenuation:

|  |  |
| --- | --- |
| **Frequency** | **Attenuation** |
| 1.5 to 10k Hz | 52 kb |
| 10 to 100k Hz | 30 db |
| 100k to 1M Hz | 30 db |

* + - * 1. Provide electrostatic shield between the primary and secondary winding and grounded to the transformer core.
        2. Isolate core and coil from enclosure using vibration absorbing mounts.
    1. Control And Signal Transformer Requirements:
       1. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.
       2. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50% minimum.
       3. Self-cooled, 2 windings.
  1. FINISHES
     1. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.
     2. Outdoor Units: Comply with ANSI C57.12.28.
  2. SOURCE QUALITY CONTROL
     1. Factory Tests: Design and routine tests shall comply with referenced standards.

1. EXECUTION
   1. INSPECTION
      1. Examine the conditions under which the dry type transformers are to be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.
   2. INSTALLATION
      1. Install transformers on walls or floors at locations shown. Install floor mounted transformers on 3 ½” raised concrete base. Base shall include #4 rebar on 12 inch centers in each direction. Provide sufficient access and working space for convenient and safe operation and maintenance.
      2. Mount transformers so that vibrations are not transmitted to the building structural parts and other equipment. Make connections to transformers with flexible conduit.
      3. Adjust tap settings to provide proper voltage at panelboards.
      4. Install dry type transformers in conformance with governing codes and manufacturer’s instructions and recommendations, and the Contract Documents.
      5. Comply with safety requirements of IEEE C2.
   3. GROUNDING
      1. Comply with NFPA 70 requirements separately derived systems for connecting to grounding electrodes and for bonding to metallic piping near transformer.
      2. Comply with Section 26 05 26 for materials and installation requirements.
   4. CLEANING
      1. 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.
   5. TESTING
      1. Testing: Perform field quality-control testing.
         1. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to Contract Documents, and is suitable for energizing.
         2. Report: Submit written report of observations and tests. Report defective materials and installation.
         3. Tests: Include 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.
            3. Insulation Resistance: Perform megohmmeter tests of primary and secondary winding to winding and winding to ground.

Minimum Test Voltage: 1000 V, dc.

Minimum Insulation Resistance: 500 megohms.

Duration of Each Test: 10 min.

Temperature Correction: Correct results for test temperature deviation from 20°C standard.

* + - 1. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.
  1. ADJUSTING
     1. After installing and cleaning, touch up scratches and mars on finish to match original finish.
     2. Adjust transformer taps and connections to provide optimum voltage conditions at utilization equipment throughout normal operating cycle of facility. Record primary and secondary voltages and tap settings or connections and submit with test results.

+ + END OF SECTION + +