

## SECTION [26 22 13.16] [16270]

### LOW VOLTAGE GENERAL PURPOSE TRANSFORMERS – ENCAPSULATED

#### Square D™ LV General Purpose Resin Encapsulated Transformers by Schneider Electric

##### Schneider Electric Editor's Note:

This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings.

To properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+\*) simultaneously. Except for these introductory and closing paragraphs, green hidden text will not print. Text in red is optional. Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted or changed to hidden text.

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration and installation for low voltage distribution dry-type transformers (also identified as transformer, XFMR or T) as required for the complete performance of the Work, as shown on the Drawings, as specified herein.
- B. Section includes transformers with a nominal primary and secondary rating of 600 V and less, with capacities 0.050 to 75 kVA
- C. Related Sections: Related sections include, but shall not be limited to, the following:
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
  - 3. Nonventilated transformer Core and Coil completely imbedded in Sand- Resin preventing external air circulation through the coils of the transformer while operating at zero gauge pressure (Except from NRCAN and DOE regulations)

### 1.2 REFERENCES

- A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
  - 1. American Society of Civil Engineers (ASCE)
    - a. ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures."
  - 2. Canadian Standards Association (CSA)
    - a. C22.2 No. 66.1, Low Voltage Transformers - Part 1: General Requirements
    - b. C22.2 No. 66.2, Low Voltage Transformers - Part 2: General Purpose Transformers
    - c. C22.1 Canadian Electrical Code, Part I (CEC)
  - 3. Institute of Electrical and Electronics Engineers (IEEE)
    - a. The following IEEE/ANSI standards when referenced in NEMA ST-20 or UL 1561:
      - 1) C57.94 "Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers"
      - 2) C57.96, "IEEE Guide for Loading Dry-Type Distribution and Power Transformers"

- 3) C57.12.91, " IEEE Standard Test Code for Dry-Type Distribution and Power Transformers"
  - 4) C57.12.01, "IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin Encapsulated Windings"
  - 5) C57.12.70, "Standard Terminal Markings and Connections for Distribution and Power Transformers"
4. International Code Council (ICC):
    - a. ICC IBC, "International Building Code."
    - b. ICC UBC, "Uniform Building Code"
    - c. AC156, "Acceptance criteria for Seismic Certification by Shake Table Testing of Nonstructural Components"
  5. International Organization for Standardization (ISO):
    - a. ISO 9001, "Quality Management Systems – Requirements"
    - b. ISO 14001, "Environmental management systems -- Requirements with guidance for use"
  6. National Electrical Manufacture Association (NEMA)
    - a. NEMA ST-20, "Dry Type Transformers for General Application"
  7. National Fire Protection Association
    - a. NFPA 70, "National Electrical Code (NEC)"
    - b. NFPA 70E, Standard for Electrical Safety in the Work Place
    - c. NFPA 5000, "Building Construction and Safety Code"
    - d. NBC, "National Building Code of Canada"
  8. NBC, "National Building Code of Canada"
  9. Occupational Health and Safety Assessment Series (OHSAS)
    - a. OHSAS 18011, "Occupational Health and Safety Management Certification"
  10. Underwriters Laboratories, Inc. (UL):
    - a. UL 5085-1, UL 5085-02 -Dry-Type General Purpose and Power Transformers
    - b. UL50, Enclosures for Electrical Equipment, Non-Environmental Considerations
    - c. UL50E, Enclosures for Electrical Equipment, Environmental Considerations (Units self-certified to NEMA 250 shall not be accepted – must have Third Party Testing)
    - d. UL 969, Marking and Labelling Systems
  11. Local Building Codes
    - a. California Building Code

### 1.3 DEFINITIONS

A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

1. Low-voltage general purpose transformer:
  - a. Has an input voltage of 600V or less
  - b. Has an output voltage of 600V or less
  - c. Covers step-up and step-down transformers
  - d. Is rated for operation at a frequency of 60 Hz
  - e. 0.050 kVA to 75 kVA for dry-type units
  - f. Is air-cooled; and
  - g. Non-ventilated transformer Core and Coil completely embedded in sand- resin preventing external air circulation through the coils of the transformer while operating at zero gauge pressure (Exempt from NRCAN and DOE regulations)

## 1.4 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section [01 33 00][01300] Submittals and Section [26 00 10][16010] Electrical Requirements, in addition to those specified herein.
1. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.
  2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.
  3. Product Data and Shop Drawings: Submit required product data and shop drawings specific to each product and accessory proposed. In addition, include the following information:
    - a. Copy of ISO 9001 Certification of manufacturing operations
    - b. Copy of ISO 14001 Certification of manufacturing operations
    - c. Confirmation that the selected transformer(s) comply with UL 1561 via third party inspection and Listing
    - d. Construction Detail including enclosure dimensions; kVA; Primary and Secondary Nominal Voltage, voltage taps, and unit weight
      - 1) Conduit / Wire Way Access Points, including distance for wiring routing to meeting minimum bending radius
      - 2) Location for ground lug to be field installed without covering ventilated air flow slots or holes
      - 3) Center of Gravity
    - e. Basic Performance characteristics including insulation class, temperature rise, coil material, impedances, no load and full load losses & audible noise level, unit weight, inrush data expressed in either Amperes RMS or Times Rated input current.
      - 1) Efficiency Data per NEMA ST20 and special 35% 10 CFR Part 431 loading point
      - 2) No load and full load losses will be calculated per NEMA ST20 test methods
      - 3) Efficiency at 25%, 50%, 75%, and 100% load points
    - f. Minimum Distance from all sides of the product
      - 1) Rear
      - 2) Side
      - 3) Front Access

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
  2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.
- B. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Equipment, assemblies and materials shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.6 DELIVERY STORAGE AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.
- D. Transformer Wrapping
  - 1. Transformers shall be protected by Cardboard or Wood protective material – all plastic wraps will not be accepted.
  - 2. Plastic wraps will only be accepted on units 500kVA and greater.
- E. Transformer Shipping Base
  - 1. Transformers shall be shipped on a wood pallets and crates.
  - 2. Pallets shall conform to INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES Revision of ISPM No. 15 REGULATION OF WOOD PACKAGING MATERIAL IN INTERNATIONAL TRADE

## 1.7 WARRANTY

- A. General: Refer to [\[Section 01 77 00 - Closeout Procedures\]](#) [\[Section 01770 - Closeout Procedures\]](#).
- B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

## 1.8 SPECIAL TOOL AND SPARE PARTS [- NOT USED]

- A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
  - 1. Contact information for the closest parts stocking location to the Owner.
  - 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
  - 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.
- B. Spare parts shall be provided for each type and size of unit installed. At a minimum, the following shall be provided:
  - 1. Provide the minimum spare parts recommended by the manufacturer.
- C. Any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:

- D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. **[Basis-of-Design Product: Subject to compliance with requirements, provide Square D General Purpose Resin Encapsulated Transformers by Schneider Electric.]**
- B. Acceptable Products: Energy efficient low voltage distribution transformers specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:
  - 1. Square D General Purpose Resin Encapsulated Transformers by Schneider Electric
  - 2. **[2nd manufacturer and model]**
  - 3. **[3rd manufacturer and model]**

### 2.2 PERFORMANCE REQUIREMENTS

- A. The transformer(s) shall be rated as indicated in the following schedule:
  - 1. Identification Number(s)
  - 2. Phase (shall be specified on Drawings or Panel Schedules)
    - a. Single
    - b. Three
  - 3. kVA Rating (shall be specified on Drawings or Panel Schedules)
    - a. Single: 0.050, 0.100, 0.150, 0.250, 0.500, 0.750, 1, 1.5, 2, 3, 5, 7.5, 10, 15, 25
    - b. Three: 3, 6, 9, 15, 30, 45, 75
  - 4. Available Voltages Three Phase (shall be specified on Drawings or Panel Schedules)
    - a. Secondary
      - 1) 208Y/120, 480Y/277, 600Y/347
      - 2) 240 Delta
      - 3) 380Y/220, 400Y/230, 415Y/240
    - b. Primary
      - 1) 208 Delta, 240 Delta, 480 Delta, 600 Delta
      - 2) 380 Delta, 400 Delta, 415 Delta
      - 3) 440 Delta
  - 5. Available Voltages Single Phase
    - a. Secondary
      - 1) 120/240
        - a) 120 Only
        - b) 240 only
        - c) 120/240 three-wire
      - 2) 277
      - 3) 208, 480, 600
      - 4) 380, 400, 415
    - b. Primary
      - 1) 240x480
        - a) 240 Only
        - b) 480 Only

- 2) 208, 600
- 3) 220, 230, 277
- 4) 380, 400, 415
- 5) 190/200/208/220x380/400/416/440

6. Frequency – 60 Hertz

B. All insulating materials are to exceed standards and be rated for 180°C UL component recognized insulation system.

- 1. [Temperature Rise 115°C]
- 2. [Temperature Rise 80°C]

C. Maximum Enclosure Temperature shall not exceed 50°C above 40°C Ambient

D. Sound Level shall be warranted by the manufacturer not to exceed the NEMA ST-20 Table Average Sound Levels Decibels by kVA

- 1. Lower than standard sound level SPECIFIED ON DRAWINGS or Panel Schedule
  - a. [3dB Below to obtain ½ the amount of sound]
  - b. [6dB Below to obtain ¼ the amount of sound]

A. Common Mode Noise Attenuation

- 1. Delta to Wye Isolation Transformer, with Secondary Grounded
  - a. With transformers connected under normal, loaded operating conditions, the attenuation of line noise shall equal or exceed the following limits: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB
- 2. Delta to Delta Isolation Transformer with Secondary Grounded (ground via Center tap or Corner Grounding)
  - a. With transformers connected under normal, loaded operating conditions, the attenuation of line noise shall equal or exceed the following limits: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB
- 3. Isolation Transformer without grounding the secondary
  - a. ADD Electrostatic Shield full width electrostatic shields resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads
    - 1) With transformers connected under normal, loaded operating conditions, the attenuation of line noise shall equal or exceed the following limits: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB

B. Transverse Mode Noise Attenuation

- 1. Address with the latest technology of Trans Voltage Surge Suppression, installed at the most advantageous electrical distribution system locations, i.e., Panels and Switchboards
  - a. Shall not be installed in Distribution Transformers

## 2.3 DESIGN AND FABRICATION

A. Transformers shall be designed to withstand Seismic Forces

- 1. Forces without added brackets or braces
  - a.  $F_p/W_p = 2.28$  G's, (Sds – 1.42)
  - b. Ground Level or Roof Top installation shall not change values
- 2. Will allow field installed brackets or bracing.
  - a.  $F_p/W_p = 304$  G's, (Sds – 1.90)
  - b. Ground Level or Roof Top installation shall not change values

3. Forces must be verified via Tri-Axial shake table test results in accordance with the AC156 test protocol
  4. Supplier shall upon request provide self-certification of seismic conformance for transformers installed at a specific cite (zip code, latitude/longitude, street address) per the following building codes
    - a. International Building Code
    - b. Uniform Building Code
    - c. California Building Code
    - d. NFPA 5000 Building Construction
    - e. National Building Code of Canada
- B. Transformer coils shall be of the continuous wound construction
1. Aluminum Windings or Copper Windings
  2. Shall have wire wrapped with 180°C Insulation material or Higher
    - a. Wire left bare will not be accepted – all conductors must have insulation material
- C. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating
- D. Core and Coil shall be embedded in sand resin mixture encapsulating the core and coil completely, to be accepted
- E. Transformers shall have the following tap options available
1. 240x480
    - a. None
  2. 120;208; 277; 600
    - a. None
    - b. 2-5% FCBN
  3. 240 or 480
    - a. 2-5% FCBN
  4. Specified on Drawings or Panel Schedules
- F. Electrical Connections
1. Terminal will be a stripped Lead -capable of connecting to either aluminum or copper conductors or a terminal pad capable of using a AL9CU Lug
  2. Primary terminals must be clearly marked and must be able to accommodate wire sized for 125% of nameplate current
  3. Secondary terminals must be clearly marked and must be able to accommodate wire sized for 125% of nameplate current
- G. The transformer enclosures shall be fabricated of heavy gauge, sheet steel construction (factory option for stainless steel) The entire enclosure shall be finished utilizing a continuous UL Component Recognized paint process
1. Color Grey
  2. 600-hour UL Salt Spray Test minimum

## 2.4 MARKINGS AND LABELING

- A. All identification, warning labels and nameplates mounted on the exterior shall be resistant to weather, UV, and their intended installation environment.

- B. Nameplate shall contain the minimum information required by latest version of NEC and NEMA ST-20 and be part of a UL Component Recognized outdoor marking system
- C. Other information shall also be supplied
  - 1. Statement on Nameplate identifying that it is a Distribution Transformer, or why it is not
    - a. Exempt from 10 CFR 431 – Nonventilated Resin Encapsulated
- D. Warning labels and nameplates shall be present at access locations to advise personnel of possible hazards.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section ~~[26 00 10]~~[16010] and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. **Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory trained manufacturer's representative field service engineer. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment. Report to the Engineer any discrepancies or issues with the installation.**
- G. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

### 3.2 INSTALLATION

- A. If transformer needs to be stored, follow manufacture instructions – (storage shall also include after installation, if units are not immediately energized)
  - 1. During storage make sure all ventilated openings do not allow for dust or other debris to enter transformers
  - 2. Transformer cannot be stored outdoors, even if Type 3R, without maintaining uniform temperature above dew point
- B. Mount transformers per drawings, location shall be readily accessible. When mounted on walls, columns, or other support structure in visible site are not required to be readily accessible.
  - 1. Verify that minimum distance from rear and side are in compliance with manufacture drawings and information on nameplate
- C. Follow manufactures instructions for vibration and sound isolation system



- D. Using Flexible raceways, conduits, and connectors – connected in locations identified by manufacture drawings or instruction manuals
- E. Land wire on proper terminals, tight all connections via calibrated torque wrench
- F. Grounding – comply with Electrical Code and manufacturer’s instructions
  - 1. Ground Bar or Ground Bus
  - 2. Verify that core assembly is factory grounded to enclosure
- G. Bonding – comply with Electrical Code and manufacturer’s instructions

### **3.3 TESTING**

- A. Established safety procedures shall be followed including but not limited to
  - 1. Proper Personal Protective Equipment, accordance with incident energy levels
- B. Megger Transformer to verify all connections are cleared from ground
- C. Take Measurements of Primary Voltages – match nameplate
- D. Take Measurements of Secondary Voltages – match nameplate
- E. With front cover installed verify that the transformer when energized is not emitting excess if noise – contact manufacture if noise is not 120 hertz constant hum

END OF SECTION [26 22 13.16][16270]

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