

**Specification Number: 26 12 13.30.FL**  
**Product Name: SUBSTATION TRANSFORMERS**

**SECTION 26 12 13.30.FL**  
**SUBSTATION TRANSFORMERS**

**Liquid-filled - three-phase, substation type transformers** are used in a wide variety of commercial and industrial applications. All units are manufactured in accordance with applicable ANSI/IEEE C57 standards. The fluid filled transformers are offered with one of four different fluids:  
Mineral oil – Type 2 biodegradable oil for outdoors  
561\_silicone fluid (dimethyl polysiloxane) by Dow Corning  
Less flammable seed-oil based fluid

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

A. Liquid-filled substation transformers.

**1.02 REFERENCES**

- A. IEEE C57.12.00 - Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- B. ANSI C57.12.10 - Standard for Transformers—230 kV and Below 833/958 through 8333/10 417 kVA, Single-Phase, and 750/862 Through 60 000/80 000/100 000 kVA, Three-Phase Without Load Tap Changing; and 3750/4687 Through 60 000/80 000/100 000 kVA with Load Tap Changing— Safety Requirements
- C. IEEE C57.12.70 - Terminal Markings and Connections for Distribution and Power Transformers
- D. IEEE C57.12.80 - Standard Terminology for Power and Distribution Transformers
- E. IEEE C57.12.90 - Standard Test Code for Liquid-Immersed Distribution Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
- G. IEEE C57.13 - Requirements for Instrument Transformers
- H. ASTM D877 - Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
- I. CAN/CSA-C88-M90 - Electrical Power Systems and Equipment

**1.03 SUBMITTALS**

- A. Submit shop drawings indicating outline dimensions, connection and support points, weight, specified ratings and materials.
- B. Submit product data indicating standard model design tests and options.
- C. Submit manufacturer's installation instructions.

**1.04 OPERATION AND MAINTENANCE DATA**

- A. Include procedures for [sampling and maintaining fluid,] cleaning and maintaining unit, and replacing components.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in distribution transformers with [three] [ ] years [documented] experience.

**PART 2 PRODUCT**

**2.01 MANUFACTURERS**

- A. Square D Company [no equal] [or approved equal].

**2.02 LIQUID-FILLED SUBSTATION TRANSFORMERS**

- A. The transformer(s) shall be the substation type with [side-wall mounted primary and secondary terminations] [cover mounted primary and secondary terminations].
- B. The average temperature rise of the windings, measured by the resistance method, shall be [55°] [65°] [55/65 ] C when the transformer is operated at rated kVA output. The transformer(s) shall be capable of being operated at rated load in a 30° C average, 40° C maximum ambient, as defined by IEEE C57.12.00 , without loss of service life expectancy.

**C.** Coolant and insulating fluid shall be [inhibited mineral oil] [dimethyl polysiloxane 561-silicone transformer fluid by Dow Corning] [Less flammable seed-oil based fluid].

**D.** Side-wall mounted terminals shall be for: [close-coupling to high and low voltage switchgear sections] [close-coupling to high voltage switchgear on the primary side and terminating in an air-filled terminal chamber for cable connections to the low voltage side] [close-coupling to low voltage switchgear on the secondary side and termination in an air-filled terminal compartment on the primary side for cable entrance] [terminations within air-filled terminal chambers on both high voltage and low voltage side for cable entrance and exit].

**E.** Primary and secondary locators shall be as follows: [primary: ANSI Segment 2, i.e. to observer's left when facing the transformer front; secondary: ANSI Segment 4, i.e. to observer's right when facing the transformer front] [primary: ANSI Segment 4, i.e. to observer's right when facing the transformer front; secondary: ANSI Segment 2, i.e. to observer's left when facing the transformer front] [primary: ANSI Segment 3, secondary: ANSI Segment 1].

**F.** Bushing location and phase rotation shall be coordinated with primary and secondary switchgear to provide correct alignment when switchgear and transformer are connected in the field.

**G.** The transformer(s) shall be rated [ kVA ONAN] [ kVA ONAN/FONAF] [ kVA ONAN/ONAF]. Primary voltage [delta] [wye], secondary voltage [delta] [wye], [3- wire] [4-wire], 60 Hz with two 2-1/2% full capacity above normal and two 2-1/2% full capacity below normal taps. Impedance shall be [ %] Manufacturer's standard impedance],  $\pm 7-1/2\%$ . Basic impulse level of the primary winding shall be [ kV]. As specified in IEEE C57.12.00 for comparable kV class.

**H.** Transformer sound levels shall be warranted by the manufacturer not to exceed the values specified in NEMA TR 1.

**I.** The transformers shall be of sealed-tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. The cover shall be welded. The transformer shall remain effectively sealed for a top oil temperature range of -5° C to 105° C. When required, cooling radiators will be provided on the back and front of the tank. Lifting eyes and jacking pads will be provided.

**J.** Coils shall be wound with [copper] [aluminum] conductors.

**K.** All cores to be constructed of high grade, grain-oriented, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point.

**L.** Tank, radiators, and terminal chambers, if provided, shall be treated to remove oil and scale by either shotblast or phosphatizing treatment to provide proper paint adhesion. All exterior surfaces shall be primed, using a high quality solid two-paint catalyzed epoxy. Minimum dry film thickness shall be 2 mils. A durably hard polyurethane topcoat with a minimum dry film thickness of 1 mil shall be applied to all primed surfaces. The color of the finish coat shall be [ANSI 49] [ANSI 61] [ANSI 70] [ANSI 24] and shall be coordinated with the switchgear manufacturer in order to match the color of the switchgear.

**M.** Accessories - The following accessories shall be included on all substation transformers:

1. Tap changer with silver-plated stationary and movable contacts, for de-energized operation only, which is externally operable and padlockable.
2. Upper filling plug and filter press connection
3. Drain valve with a 3/8 inch sampler
4. Dial type thermometer
5. Pressure/vacuum gauge [with] [without] bleeder connection
6. Magnetic liquid level gauge
7. Pressure relief valve, with manual bleeder and automatic resealing, set to operate at 10 psi with a flow rate of [35 scfm] [50 scfm]:

**N.** Additional Accessories

1. Alarm contacts on [all gauges] [dial thermometer] [liquid level gauge] [pressure vacuum gauge]
2. Pressure relief diaphragm to operate at 10 psi and relieve 10,000 scfm at 15 psi
3. Sudden pressure relay permitting remote alarm or trip due to a predetermined rate of pressure rise [with] [without] seal-in delay

**O.** The transformer shall be equipped with forced air cooling or be designed for the future addition of forced air cooling. The fan control equipment will be actuated by contacts that sense [the temperature of the top liquid] [the average winding temperature] of the transformer. Temperature sensors, motor starter for fan motors, test modes of operation, as well as fans and fan motors, will be

provided on units designated ONAN/ONAF. Temperature sensors and details for future mounting of fans and controls will be provided on units designated ONAN/FONAF. Fan motors will operate from a 240 V, single-phase, 60 Hz source of power provided by the user.

**P. Testing** - Tests shall be conducted in accordance with the provisions of IEEE C57.12.90 and shall include, as a minimum, the following tests:

1. Ratio
2. Polarity
3. Phase Rotation
4. No-Load Loss
5. Excitation Current
6. Impedance Voltage
7. Load Loss
8. Applied Potential
9. Induced Potential
10. Impulse Test
11. Temperature Test (typical data from previous unit is acceptable)
12. Sound Test (typical data from previous unit is acceptable)