

Design Standard Medium-Voltage Transformers

Purpose:

This design standard has the purpose of creating a consistent application of liquid-filled transformers throughout the East Side Union High School District, therefore achieving a standard of quality for maintenance, reliability and operational efficiency throughout all renovation and new building projects.

Design Standard:

1. Liquid-Filled Transformers

- A. Design and specify liquid-filled transformers to step-down high voltage power for exterior installations. The liquid-filled transformers shall have the following characteristics based on Code requirements and standard industry practices:
 - i. Provide compartmental type, self cooled, tamperproof and weatherproof with pad mounting provisions. Comply within the latest applicable standards of NEMA and ANSI, and PG&E if applicable. Provide transformer with no exposed screws, bolts or other fastening devices which are externally removable.
 - ii. All transformers should be free of PCB.
 - iii. Voltage: Unless otherwise indicated on Drawings, operate transformers at 3 phase, nominal delta primary to 3 phase wye secondary. Provide standard NEMA, ANSI 3 phase primary taps; that is, 10 percent range of tap voltage adjustment for transformers smaller than 30KVA and 15 percent range tap voltage adjustment for 30KVA and larger.
 - iv. Rating: Unless otherwise indicated on Drawings, provide transformer ratings continuous, with an average temperature rise, by resistance, not to exceed 65C in a 30C ambient with 100 percent of rated nameplate load connected to the secondary.
 - v. Provide sealed tank construction of sufficient strength to withstand a pressure of 7 psi without permanent distortion. Provide welded cover with the fastening tamperproof. Provide exterior cooling panels, lifting eyes, jacking pads, and welded cover.
 - vi. Provide core and coil assembly core type with aluminum windings. Where wye wye is specified or required provide triplex or 5 legged core design.
 - vii. Provide tap changing mechanism for deenergized operation only and externally operable with two or three 2.5 percent full capacity taps above and two or three 2.5 percent full capacity taps below normal rated primary voltage.

- viii. Provide high and low voltage compartments located side-by-side separated by a steel barrier. Provide full height air filled terminal compartments with individual doors. Provide high voltage door fastenings that are not accessible until the low voltage door has been opened. Provide the low voltage door with a three point latching mechanism with vault type handle having provisions for a single padlock. Provide doors with lift off type stainless steel hinges and door stops. Provide removable front sills and ANSI tank grounding provisions in each compartment.
 - ix. Provide dead front construction with load break gang operated immersed switch with switch hand located in the high voltage compartment for operating with distribution hot stick. Provide 2 position on-off for radial feed unless loop feed is indicated on Drawings. If loop feed is indicated provide 4 position switch. Provide dry well canister mounted current limiting fuses externally replaceable with distribution hot stick. Size fuses to manufacturer's recommendation to final design load. Provide Series NX Arc-Strangler fuses. Provide distribution class lightning arrester mounted in the high voltage compartment.
 - x. Provide low voltage bushings, 6 hole spade, molded epoxy with blade type spade terminals for NEMA standard hole spacing arranged for vertical take-off. Provide low voltage neutral with insulated busing grounded to the transformer tank by removable grounding strap. Wye-wye connected transformers are provided with the high and low voltage neutrals internally tied with a removable link for testing.
 - xi. Provide the following accessories:
 - i. 1 inch drain valve/sampling device
 - ii. Dial type thermometer
 - iii. Magnetic liquid level gauge
 - iv. Pressure/vacuum gauge
 - v. Pressure relief valve
 - vi. 1000KVA and larger provide sudden pressure relay
 - xii. Provide transformer coils of continuous wire wound construction.
 - xiii. Provide each coil layer with end fillers or tie-downs to provide maximum mechanical strength. Braze tap terminations directly to bus stubs or lugs firmly mounted.
 - xiv. Provide windings continuous from start to finish. Splicing is unacceptable. Materials incorporated must have at least a minimum of 1 year of proven field usage. Accelerated laboratory test not acceptable.
 - xv. Sound levels guaranteed by manufacturer, 45dB through 150KVA and 50dB through 300KVA.
- B. Degrease, clean, phosphatize, prime and finish enclosures with baked enamel in gray color. Visibly ground the core of the transformer to this enclosure by means of a flexible ground strap.

- C. Mount transformers core and coil on vibration mounting pads designed to suppress transmission of 120 cycle frequencies and harmonics thereof. Arrange and select pads in consideration of core and coil weight. Provide additional noise suppressing mountings external to transformers where transformers are located in mechanical spaces.
- D. Liquid-filled transformers shall meet the following installation requirements based on Code and standard industry practices:
 - i. Provide transformers with a concrete reinforced pad.
 - ii. Mount transformers not closer to combustible materials than allowed by CEC and NFPA. Provide adequate ventilation, mount transformers away from structure as recommended by manufacturer and power utility.
 - iii. Provide transformers with 8-inch round by 36-inch (above and below grade) concrete and steel bollards where subject to vehicular traffic.
 - iv. Where transformers are grouped exterior together or with switchgear, refinish transformer or switchgear resulting in transformers and switchgear finishes matching in color and type.

2. Dry-Type Transformers

- A. Design and specify dry-type transformers to step-down high voltage power to end-user voltages (ex. 277V for lighting, 120V for convenience receptacles).
 - i. Provide transformer coils of the continuous wire wound construction and impregnate with nonhygroscopic, thermosetting varnish prior to baking.
 - ii. Maximum temperature rise at full load: 150 degrees above 40C ambient temperature. NEMA TP-1 compliant.
 - iii. Provide windings continuous from start to finish. Splicing is unacceptable. Materials incorporated must have at least a minimum of 1 year of proven field usage. Accelerated laboratory test not acceptable.
 - iv. All cores manufactured from a high-grade, nonaging silicon steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are kept well below saturation to allow for a minimum of 10 percent over-voltage excitation.
 - v. Ventilated openings must be designed in a manner as to prevent accidental access to live parts.
 - vi. Transformers shall be dry-type, with copper windings.
- B. In locations where the transformer serves computer classrooms, the transformer shall at the least be “K13” rated. Due to code requirements for California, all transformers shall be energy efficient and be rated TP-1.
- C. Mount all transformers, core and coil, on vibration mounting pads designed to suppress transmission of 120 cycle frequencies and harmonics thereof. Arrange and select pads in consideration of core and coil weight. Provide additional noise suppressing mountings external to transformers where transformers are located in mechanical spaces.
- D. Maximum case temperature, 35C above ambient.

- E. Sound levels guaranteed by manufacturer, 45dB through 150KVA and 50dB through 300KVA.
- F. Winding Taps:
 - i. Less than 15KVA: 4-2-1/2 percent FCBN, FCAN.
 - ii. 15KVA and Larger: 4-2-1/2 percent-2+2-.
- G. Where possible, all transformers shall be placed within the building.
 - i. Only under special circumstances and as approved by the Facilities Director shall a transformer be allowed to be exterior pad mounted. If the design team provides an exterior yard for equipment, pad mounted transformers may be considered.
 - ii. Provide weather resistant enclosure and factory rating for exterior installations.
 - iii. Provide transformers with 8-inch round by 36-inch (above and below grade) concrete and steel bollards where subject to vehicular traffic.
- H. Transformers up to 45KVA may be floor mounted, wall mounted or suspended. Floor mount all transformers above 45KVA rating.
- I. Transformer Supports: Provide additional vibration isolation hangers and pads, brackets and supports as may be required for a complete installation.
- J. Provide transformers with concrete working or housekeeping pad minimum 8 inches larger than transformer and minimum 3 inches above finish grade. Install plumb and level. Provide exterior pads of 2500 to 3000 psi concrete reinforced with 8 gauge wire fabric or No. 6 reinforcing bars on 12-inch centers. Provide 10-inch thick base of gravel below pad for support. [1] Provide 3/4-inch by 10-foot ground rod at each corner thermally bonded to No. 2 copper ground conductor, bonded to transformer, and concrete reinforcement.
- K. Do not mount transformers closer to combustible materials than allowed by CEC.
- L. Provide adequate ventilation; mount transformers away from adjacent surfaces as recommended by manufacturer. Coordinate to ensure that provisions for visual screening or landscaping do not obstruct ventilation.
- M. Use flexible conduit, 18 inches minimum length, for connections to transformer case. Make connections to side panel or bottom of enclosure. Include ground conductor in flex.
- N. Mount wall mounted transformers with a minimum of 6'-6" headroom below unit.
- O. Provide seismic restraints per local requirements.

Approved Manufacturers:

- Square D

Substitutes Allowed:

No substitutes allowed.

Pursuant to Section 3400 of the Public Contract Code: Square D transformers are now in use on the particular public improvement described as East Side Union High School District. At each instance in these specifications that a transformer is designated by the brand name “Square D”, that product is designated to support the existing electrical system that is in place at East Side Union High School District. The Contractor will furnish and apply only “Square D” transformers as required, and no substitutions shall be deemed to be “or equal” or allowed.

Associated Design Standards and Construction Specifications:

- Division 26 Electrical Design Standards

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