

DRY-TYPE DISTRIBUTION TRANSFORMERS

(1500 KVA AND BELOW)

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PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.02 RELATED SECTIONS

1.03 REFERENCES

- A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.
- B. Transformers shall meet the requirements of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment"

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Outline dimensions and weights
 - 2. Technical certification sheet
 - 3. Transformer ratings including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Sound level.
 - 4. Product data sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes.
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing and installation process
 - 2. Connection diagrams
 - 3. Installation information
 - ~~4.~~ Seismic certification and equipment anchorage details as specified.

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1.06 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Provide Seismic tested equipment as follows:
 - 1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for the seismic zone specified by the project Architect. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45g's (3.2-11 Hz), and a ZPA of 0.98g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
 - 2. The following minimum mounting and installation guidelines shall be followed for transformer support, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.

The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

- b. Provide a letter of conformance for the support frame, signed and sealed by a Professional Engineer registered in the Project State.
- c. Pre engineered structures such as "GEARSTACKER" products, (www.gearstacker.com), will be acceptable provided the submittal contains complete documentation for the specific support application.

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1.07 REGULATORY REQUIREMENTS

A. All transformers shall be UL listed and bear the UL label.

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Eaton / Cutler-Hammer

B. Square D

C. General Electric

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

A. The kVA and voltage ratings shall be as indicated on the drawings.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

C. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

0	to	9 kVA	40 dB
10	to	50 kVA	45 dB
51	to	150 kVA	50 dB
151	to	300 kVA	55 dB
301	to	500 kVA	60 dB
501	to	700 kVA	62 dB
701	to	1000 kVA	64 dB
1001	to	1500 kVA	65 dB

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- D. Where K-factor transformers are indicated on the drawings, the transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of *[4] [13] [20] without exceeding *[80] [115] [150] degrees C temperature rise.

2.03 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems

1. Transformer insulation system shall be as follows:
 - a. Less than 15 kVA: 185 degrees C insulation system with 115 degree C rise, encapsulated design; 15 kVA and above: 220 degree C insulation system with *[80] [115] [150] degree C rise, ventilated design.

-- *OR--
 - a. 5 – 75 kVA, three-phase (37.5 kVA, single-phase): 185 degrees C insulation system with 115 degree C rise, encapsulated design; 75 kVA and above: 220 degrees C insulation system with *[80] [115] [150] degree C rise, ventilated design.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non aging, 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 with continuous wound construction
2. On three-phase units rated *[75 kVA and below] [45 kVA and below] [30 kVA and below] [15 kVA and below] [9 kVA and below] and single-phase units rated *[37.5 kVA and below] [25 kVA and below] [15 kVA and below] [10 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
3. On three-phase units rated *[15 kVA and above] [30 kVA and above] [45 kVA and above] [75 kVA and above] [112.5 kVA and above] and single-phase units rated *[15 kVA and above] [25 kVA and above] [37.5 kVA and above] [50 kVA and above] 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

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C. Taps

1. Three-phase transformers rated 15 through 500 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage
2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.

D. Electrostatic Shielding

1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.

E. Motor Drive Isolation

1. Where shown on the drawings, provide motor drive isolation transformers
2. Motor drive isolation transformers shall be designed for use with three-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. Thermoguards 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. Transformers shall be low loss type with minimum efficiencies per NEMA TP-1 when operated at 35% of full load capacity

2.04 CONSTRUCTION – K-FACTOR TRANSFORMERS

A. Insulation Systems

1. Transformers shall be insulated with a UL recognized 220 degrees C insulation system
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient and a 24-hour average ambient of 30 degrees C
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non aging, 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 with continuous wound construction. The core shall provide reduced induced currents in the steel caused by the high ratios of peak-to-rms currents and voltages found in harmonic loads

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2. The neutral bus shall be configured to accommodate 200% of the rated current
3. 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

C. Taps

1. Three-phase K-factor rated transformers through 300 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage
2. Single-phase K-factor rated transformers shall be provided with manufacturer's standard tap configuration

D. Electrostatic Shielding

1. Provide K-rated transformers with electrostatic shielding consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.

2.05 WIRING/TERMINATIONS

- A. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.06 ENCLOSURE – GENERAL PURPOSE TRANSFORMERS

- A. 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 degrees C. The core of the transformer shall be grounded to the enclosure.
- B. On three-phase units rated *[75 kVA and below] [45 kVA and below] [30 kVA and below] [15 kVA and below] [9 kVA and below] and single-phase units rated *[37.5 kVA and below] [25 kVA and below] [15 kVA and below] [10 kVA and below] the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 3R, with lifting eyes.
- C. On three-phase units rated *[15 kVA and above] [30 kVA and above] [45 kVA and above] [75 kVA and above] [112.5 kVA and above] and single-phase units rated *[15 kVA and above] [25 kVA and above] [37.5 kVA and above] [50 kVA and above] the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt.

2.07 ENCLOSURE – K-FACTOR TRANSFORMERS

- A. 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 50 degrees C rise above a 40 degree C maximum ambient (90 degrees C.) The core of the transformer shall be grounded to the enclosure.

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- B. The enclosure construction shall be ventilated, NEMA 2 drip-proof, with lifting holes. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weather shields over ventilated openings.

2.08 FINISH

- A. Enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

2.09 ACCESSORIES

- A. On ventilated outdoor units provide suitable weather shields over ventilation openings.
- B. ³Lug kits shall be provided by the Manufacturer of the transformer

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 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

3.02 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. The Contractor shall submit detailed drawings on equipment anchorage and supports methods. Provide calculations for structural support and seismic calculations for the specific zone encountered. Provide an engineered assembly to support transformers where necessary to preserve NEC required clearances and support equipment
- C. The contractor shall provide coordination drawings of electrical room layouts incorporating transformer and supports.

3.03 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

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3.04 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.