

SECTION 261200 - MEDIUM-VOLTAGE TRANSFORMERS

Latest Update 5-6-2017 See underlined text for Edits.

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all "Underlines".)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

- A. This Section includes the following types of transformers with medium-voltage primaries:
 - 1. Liquid-filled distribution and power transformers.
 - 2. Dry-type distribution and power transformers.
 - 3. Pad-mounted, liquid-filled transformers.

1.3 DEFINITIONS

- A. NETA ATS: Acceptance Testing Specification.

1.4 SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Underground [primary] [secondary] [primary and secondary] conduit stub-up location. <Insert underground type>
 - 2. Dimensioned concrete base, outline of transformer, and required clearances.

3. Ground rod and grounding cable locations.
4. <Insert details.>

- D. Qualification Data: For testing agency.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Follow-up service reports.
- H. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with IEEE C2 and NESC.
- E. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.
- F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store transformers protected from weather so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.7 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions except for the following:

1. Exposure to significant solar radiation.
2. Altitudes above 3300 feet.
3. Exposure to fumes, vapors, or dust.
4. Exposure to explosive environments.
5. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
6. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
7. Exposure to excessively high or low temperatures.
8. Unusual transportation or storage conditions.
9. Unusual grounding-resistance conditions.
10. Unusual space limitations.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

1.9 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section “Basic Electrical Requirements” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. GE Electrical Distribution & Control.
2. Square D; Schneider Electric.
3. Virginia Transformer Corp.
4. ABB Power T&D Co. Inc.
5. Sunbelt Transformer
6. Waukesha Electric Systems, Inc.

2.2 LIQUID-FILLED DISTRIBUTION AND POWER TRANSFORMERS

- A. Description: IEEE C57.12.00 and UL 1062, liquid-filled, 2-winding transformers designed for operation with high-voltage windings connected to a 3-phase, 3-wire, 60-Hz, grounded neutral distribution system.
- B. Insulating Liquid: Less flammable, edible-seed-oil based dielectric and UL listed as complying with NFPA 70 requirements for fire point of not less than 300°C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- C. Insulating Liquid: Less flammable, hydrocarbon-based dielectric and UL listed as complying with NFPA 70 requirements for fire point of not less than 300°C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- D. Insulating Liquid: Less flammable, silicone-based dielectric and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall have low toxicity and be nonhazardous.
- E. Insulation Temperature Rise: 60°C, based on an average ambient temperature of 30°C over 24 hours with a maximum ambient temperature of 40°C.
- F. Basic Impulse Level: 95kV.
- G. Full-Capacity Voltage Taps: Four nominal 2.5% taps, two (2) above and two (2) below rated primary voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- H. Cooling System: Class OA/FA, self-cooled, and with forced-air-cooled rating. Cooling systems shall include auxiliary cooling equipment, temperature-sensing devices, automatic controls complete with housing and status indicating lights, conduit and wiring.
 - 1. Cooling Fan Operation: Automatically and sequentially controlled by temperature-sensing devices.
 - 2. Manually Operated Switch: Connected in parallel with the automatic control contacts.
 - 3. Enclosure for Controls: Cabinet located on the side of the transformer at a height not greater than sixty (60) inches (1500 mm) above the base.
 - 4. Cooling Fans: Propeller type, with aluminum blades and TEFC motors, direct drive. Motor circuits are individually fused or thermally protected. Fans shall have OSHA guards.
 - 5. Fan Control: Thermally operated winding, temperature-sensing devices.
- I. Sound level may not exceed sound levels listed in NEMA TR 1, without fans operating.
- J. Impedance: 5.75% +/- 7.5% tolerance.

K. Accessories: Grounding pads, lifting lugs, and provisions for jacking under base. Transformers shall have a steel base and frame allowing use of pipe rollers in any direction, and an insulated, low-voltage, neutral bushing with removable ground strap. Include the following additional accessories:

1. Liquid-level gage.
2. Pressure-vacuum gage.
3. Liquid temperature indicator.
4. Drain and filter valves.
5. Pressure relief device.

2.3 DRY-TYPE DISTRIBUTION AND POWER TRANSFORMERS

A. Description: NEMA ST 20, IEEE C57.12.01, [ANSI C57.12.50] [ANSI C57.12.51] [ANSI C57.12.52], [UL 1562 listed and labeled], dry-type, two (2) winding transformers. <Insert regulation types>

1. Indoor, ventilated, cast coil/encapsulated coil, with primary and secondary windings individually cast in epoxy; with insulation system rated at 185°C with an 80°C average winding temperature rise above a maximum ambient temperature of 40°C.
2. Indoor, ventilated, vacuum-pressure impregnated and with insulation system rated at 220°C with an 80°C average winding temperature rise above a maximum ambient temperature of 40°C.

B. Primary Connection: Air terminal compartment with [removable] [hinged] <Insert door type> door. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.

C. Primary Connection: Transition terminal compartment with connection pattern to match switchgear.

D. Secondary Connection: Air terminal compartment with [removable] [hinged] door <Insert door type>. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.

E. Secondary Connection: Transition terminal compartment with connection pattern to match [switchgear] [bus duct] <Insert connection pattern>.

F. Insulation Materials: IEEE C57.12.01, rated at 220°C.

G. Insulation Temperature Rise: 115°C, maximum rise above 40°C.

H. Basic Impulse Level: 95kV.

- I. Full-Capacity Voltage Taps: Four nominal 2.5% taps, two (2) above and two (2) below rated primary voltage.
- J. Cooling System: Class AA/FA, self-cooled, and with forced-air-cooled rating, complying with IEEE C57.12.01.
- K. Sound level may not exceed sound levels listed in NEMA TR 1, without fans operating.
- L. Impedance: 5.75% +/-7.5% tolerance.
- M. High-Temperature Alarm: Sensor at transformer with local audible and visual alarm and contacts for remote alarm. Square-D, Model 98 Transformer Temperature Monitor for remote recording of transformer winding temperatures.

2.4 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

- A. Description: ANSI C57.12.13, [ANSI C57.12.26,] IEEE C57.12.00,[IEEE C57.12.22,] pad-mounted, 2-winding transformers designed for operation with high-voltage windings connected to a 3-phase, 3-wire, 60-Hz, grounded neutral distribution system. Stainless-steel tank base [and cabinet] [, cabinet, and sills] **<Insert cabinet type>**.
- B. Insulating Liquid: Less flammable, edible-seed-oil based dielectric, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300°C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- C. Insulating Liquid: Less flammable, hydrocarbon-based dielectric and UL listed as complying with NFPA 70 requirements for fire point of not less than 300°C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.
- D. Insulating Liquid: Less flammable, silicone-based dielectric and UL listed as complying with NFPA 70 requirements for fire point of not less than 300°C when tested according to ASTM D 92. Liquid shall have low toxicity and be nonhazardous.
- E. Insulation Temperature Rise: [55°C] [65°C] **<Insert temperature>** when operated at rated kVA output in a 40° C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30°C over 24 hours with a maximum ambient temperature of 40°C without loss of service life expectancy.
- F. Basic Impulse Level: 95 kV.
- G. Full-Capacity Voltage Taps: Four 2.5% taps, two (2) above and two (2) below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- H. High-Voltage Switch: [200] [300] [400] A **<Insert number>**, make-and-latch rating of 10-kA RMS, symmetrical, arranged for radial feed with 3-phase, two (2) position, gang-

operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.

- I. High-Voltage Switch: [200] [300] [400] A <Insert number>, make-and-latch rating of 10-kA RMS, symmetrical, arranged for loop feed with 3-phase, four (4) position, gang-operated, load-break switch that is oil immersed in transformer tank with hook-stick operating handle in primary compartment.
- J. Primary Fuses: 150-kV fuse assembly with fuses complying with IEEE C37.47. [Rating of current-limiting fuses shall be 50-kA RMS at specified system voltage.] < Edit for project >
 1. Current-limiting type in dry-fuse holder wells, mechanically interlocked with liquid-immersed switch in transformer tank to prevent disconnect under load.
 2. Internal liquid-immersed cartridge fuses.
 3. Bay-O-Net liquid-immersed fuses that are externally replaceable without opening transformer tank.
 4. Bay-O-Net liquid-immersed fuses in series with liquid-immersed current-limiting fuses. Bay-O-Net fuses shall be externally replaceable without opening transformer tank.
 5. Bay-O-Net liquid-immersed current-limiting fuses that are externally replaceable without opening transformer tank.
- K. Surge Arresters: Distribution class, one for each primary phase; complying with IEEE C62.11 and NEMA LA 1; support from tank wall within high-voltage compartment. Transformers shall have [three arresters for radial-feed] [three arresters for loop-feed] [six arresters for loop-feed] circuits.
- L. High-Voltage Terminations and Equipment: Live front with externally clamped porcelain bushings and cable connectors suitable for terminating primary cable.
- M. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:
 1. Bushing-Well Inserts: One (1) for each high-voltage bushing well.
 2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.
 3. Parking Stands: One (1) for each high-voltage bushing well.
 4. Portable Insulated Bushings: Arranged for parking insulated, high-voltage, load-break cable terminators; one for each primary feeder conductor terminating at transformer.
- N. Accessories:
 1. Drain Valve: One (1) inch, with sampling device.
 2. Dial-type thermometer.

3. Liquid-level gage.
4. Pressure-vacuum gage.
5. Pressure Relief Device: Self-sealing with an indicator.
6. Mounting provisions for low-voltage current transformers.
7. Mounting provisions for low-voltage potential transformers.
8. Busway terminal connection at low-voltage compartment.
9. Alarm contacts for gages and thermometer listed above.

2.5 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

- A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to [ANSI C57.12.50] [ANSI C57.12.51] [IEEE C57.12.90] [IEEE C57.12.91].
- B. Factory Tests: Perform the following factory-certified tests on each transformer:
 1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.
 2. Ratios on rated-voltage connection and on tap extreme connections.
 3. Polarity and phase relation on rated-voltage connection.
 4. No-load loss at rated voltage on rated-voltage connection.
 5. Excitation current at rated voltage on rated-voltage connection.
 6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.
 7. Applied potential.
 8. Induced potential.
 9. Temperature Test: If transformer is supplied with auxiliary cooling equipment to provide more than one rating, test at lowest kilovolt-ampere Class OA or Class AA rating and highest kilovolt-ampere Class OA/FA or Class AA/FA rating.
 - a. Temperature test is not required if record of temperature test on an essentially duplicate unit is available.
 10. Owner will witness all required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.
- B. Examine roughing-in of conduits and grounding systems to verify the following:
 - 1. Wiring entries comply with layout requirements.
 - 2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install transformers on concrete bases.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit and 4 inches high.
 - 2. Use [3000-psi concrete] [4500-psi concrete] twenty eight (28) day compressive-strength, and reinforcement as specified in Division 03 Section "[Cast-in-Place Concrete] [Miscellaneous Cast-in-Place Concrete]."
 - 3. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on eighteen (18) inch centers around full perimeter of base.
 - 4. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
 - 5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 6. Tack-weld or bolt transformers to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.
- B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Connect wiring according to Division 26 Section "Medium-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
 - 1. After installing transformers but before primary is energized, verify that grounding system at substation is tested at specified value or less.
 - 2. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
 - 3. Perform visual and mechanical inspection and electrical tests stated in NETA ATS. Certify compliance with test parameters.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Test Reports: Prepare written reports to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective actions taken to achieve compliance with requirements.

3.6 FOLLOW-UP SERVICE

- A. Voltage Monitoring and Adjusting: If requested by owner, perform the following voltage monitoring after Substantial Completion but not more than six months after Final Acceptance:
1. During a period of normal load cycles as evaluated by owner, perform seven days of three-phase voltage recording at secondary terminals of each transformer. [Use analog voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not greater than 1 inch per hour.][Use 3-phase digital voltmeter with sampling rate not less than 100 per second and 100MB of storage minimum.] Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5% during test period, is unacceptable.
 2. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:
 - a. Adjust transformer taps.
 3. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.
 4. Report: Prepare written report covering monitoring and corrective actions performed.
- B. Infrared Scanning: Perform as specified in Division 26 Section "Medium-Voltage Switchgear."

END OF SECTION 261200