

**READ THIS FIRST**

Notice to the Design Engineer, this document is part of Facilities and Infrastructure standards for Electrical Systems. Designers are advised to NOT use this template (\*.doc) document as part of any project contract documents. Designers shall use the Port of Seattle MasterSpec specifications from the following link:

<https://www.portseattle.org/page/guide-specifications>.

Designers shall edit the corresponding Port's MasterSpec specification to meet the F&I Electrical Standard outlined in this specification. Note that Port's MasterSpec specifications contain specifications and languages for both Aviation and Maritime Divisions. F&I Standards are strictly for Aviation Division, and any Maritime related specs or languages should be removed from the project specifications.

**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.

**1.2 SUMMARY AND NOTES TO DESIGNER**

- A. This Section includes the following types of transformers with medium-voltage primaries:
  - 1. Liquid-filled distribution and power transformers for outdoor applications.
  - 2. Dry-type distribution and power transformers for indoor applications.
  - 3. Pad-mounted, liquid-filled transformers.
- B. Transformer cooling:
  - 1. Typical is AA/AA/FA for units rated less than 1500 kVA. Cooling system for transformers rated for less than 1500kVA per engineering considerations.
  - 2. Class AA/AA/FA for 1500kVA and greater.

**1.3 DEFINITIONS**

- A. NETA ATS: Acceptance Testing Specification.

**1.4 ACTION 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.

### 1.5 **INFORMATIONAL SUBMITTALS**

- A. 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 and secondary conduit stub-up location.
  2. Dimensioned concrete base, outline of transformer, and required clearances.
  3. Ground rod and grounding cable locations.
- B. Special Submittal Requirements
1. Front view elevation drawings showing all devices.
  2. Transformer outline drawing with actual transformer dimensions and weights with and without oil.
  3. Schematic diagrams.
  4. Nameplate diagram per ANSI requirements.
  5. Nameplate schedule of all interior and exterior labels per Appendix Sheets A8 and A17.
  6. Component list.
  7. Conduit entry/exit locations
  8. Ratings
- C. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Section 260548 "Seismic Controls for Electrical and Communication Work." Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  4. Submit final seismic certification for Medium Voltage Transformer after installation to ensure installation meets all seismic requirements.
- D. Qualification Data: For testing agency.
- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Follow-up service reports.

**1.6 MAINTENANCE MATERIALS SUBMITTALS**

- A. Touchup Paint: One pint container of paint matching enclosure's exterior finish packaged with protective covering for storage and identified with labels.

**1.7 CLOSEOUT SUBMITTALS**

- A. Final record drawings.
- B. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.
- C. Original copies of certified test reports.

**1.8 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 Section 016000 "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.
- 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.
- G. Energy efficiency shall comply with NEMA TP-1.
- H. Signage shall comply with ANSI Z35.1.

**1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subjected to weather, cover transformers to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Provide temporary heating according to manufacturer's written instructions.
- C. Ship with accelerometers: 0.3gs in the x, 0.9gs in the y and z direction.

**1.10 PROJECT CONDITIONS**

- A. Service Conditions: IEEE C37.121, usual service conditions except for the following:
  - 1. Exposure to significant solar radiation.
  - 2. Exposure to fumes, vapors, or dust.
  - 3. Exposure to seismic shock or to abnormal vibration, shock, or tilting.

**1.11 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- 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.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Liquid Filled Pad Mounted Transformers
    - a. GEC Alsthom Balteau
    - b. Eaton
    - c. ASEA Brown Boveri (ABB)
  - 2. Liquid Filled Unit Substation Transformers
    - a. EATON
    - b. Square D
    - c. Cooper

## **2.2 TRANSFORMERS – GENERAL**

- A. Windings: Two-winding, designed for operation with 12,470V OR 12.470/4160V Dual-Voltage – padmount only OR 4160V high voltage to a 3-phase, 4 wire, 60Hz, grounded neutral distribution system.
- B. Winding Material: Copper with Class H insulation.
- C. Sound Level Standards: Sound level standards as defined in NEMA and ANSI OR Low sound level rating of 3dB minimum less than NEMA TR standard sound levels in noise sensitive areas.
- D. Transformers sized at 3750kVA and larger shall be fed from a dedicated feeder.
- E. All transformers above 150kVA shall be furnished with four each full capacity taps above and below normal.
  
- F. Infrared Windows: Provide windows on the front and back of the compartment section. Windows shall provide clear visual of termination points and transformer coils.

## **2.3 LIQUID-FILLED PADMOUNTED TRANSFORMERS**

- A. Description:
  - 1. Live Front Applications: Comply with IEEE C57.12.22.
  - 2. Dead Front Applications: Comply with IEEE C57.12.26.
  - 3. IEEE C57.12.00 and UL 1062, liquid-filled, 2-winding transformers.
- B. Insulating Liquid: Less flammable, silicone-based or hydrocarbon mineral oil 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.
- C. Construction: Compartmental type, self-cooled and tamper resistant for mounting on a pad, designed to restrict the entry of water into the compartments.
- D. kVA Rating: 75kVA through 2500kVA at 65°. Recommended maximum kVA for 3 phase transformers is 2500 kVA at 480Y/277V and 750kVA at 208Y/120V. Higher ratings require F&I approval.
- E. Nominal Primary Voltage: 12.47 Delta OR 4.16/12.47kV Dual Voltage, Delta OR 4.16kV Delta.
- F. Nominal Secondary Voltage: 4160Y/2400V, 3 Ø, 4 wire OR 480Y/277V, 3Ø, 4 wire OR 208Y/120V, 3Ø, 4 wire OR 120/240V, 1Ø, 3 wire.
- G. Insulation Temperature Rise: 65 deg C, based on an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C.
- H. Basic Impulse Level:
  - 1. Medium Voltage: 95kV at 12.47kV OR 60kV at 4.16kV
  - 2. Low Voltage: 30kV

**SECTION 26 12 00: MEDIUM-VOLTAGE TRANSFORMERS** POS SEA-TAC INTERNATIONAL AIRPORT

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- I. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.
- J. Cooling System: Class AA/FFA, self-cooled, and with provisions for future forced-air-cooled rating. Cooling systems shall include auxiliary cooling equipment, automatic controls, and status indicating lights.
- K. Impedance: 2.2% to 5.75% depending on kVA rating.
- L. Features:
  - 1. Configuration: Full height, bolt-on, hand and low voltage cable terminating compartments side-by-side separated with a rigid metal barrier, with the high-voltage compartment on the left. Each compartment shall have separate doors.
  - 2. Locking and Access: The low voltage compartment door equipped with a steel rod handle with provisions for padlocking. Both compartment doors must be capable of being secured with a single padlock. Doors so arranged that accessibility to the high voltage compartment can only be gained after opening the low voltage compartment door and a captive screw released.
  - 3. Hinged Doors: Provide stainless steel hinges equipped with captive hold-open devices.
  - 4. Lifting: Lifting attachments to carry the full weight of the transformer in accordance with ANSI.
  - 5. Jack and Rolling: Provide removable doorsill on compartments to permit rolling or skidding of unit into place over conduit studs in pad.
  - 6. Grounding: Provide grounding in both the high voltage and low voltage compartments.
  - 7. Secondary Bushings: Low voltage bushings shall be tin-plated spade type, arranged for vertical takeoff of outgoing cables.
  - 8. Finish: Painted ANSI 61 olive green color (Nunsell 7GY3.29/1.5) or equal. 3-mil paint thickness required. All hardware shall be corrosion resistant stainless steel. Underside of enclosure including channels, skids, beams and plates shall be undercoated.
- M. High Voltage Switching: Provide a separate pad mounted vacuum interrupter switch per section 261300 Medium Voltage Switchgear, with visible verification of switch position and a 3-phase gang operated load break switch, oil immersed in transformer tank with hook-stick operated handle in the primary compartment, arranged for radial feed, for transformer energization and de-energization.
- N. Primary Fusing By Manufacturer:
  - 1. Internal Isolation Link: Each transformer shall be supplied with a coordinated internal isolation link in series with bayonet type expulsion/ELSP fuses for protection during transformer switching and refusing operations.
  - 2. Overload and Short Circuit Protection: Provide under-oil current-limiting fuses in series with load sensing bayonet expulsion fuses OR Provide full range current-limiting fuses in loadbreak drywell canisters in series with load sensing bayonet expulsion fuses.

- O. Radial Feed Primary Connections: Transformer primary connections shall be deadfront non-loadbreak, separable insulated high voltage connector bushings OR Transformer primary connections shall be live front with NEMA spades and terminals suitable for cable sizes.
- P. High Voltage Terminations and Equipment: Deadfront with universal type bushing well inserts. Include the following: bushing well inserts, lightning arrestors, parking stands, portable insulated bushings OR live front with externally clamped porcelain bushings and cable connectors suitable for terminating primary cable.
- Q. Accessories: Include the following additional accessories:
  - 1. Lightning Arrestors: External distribution-type direct connected to bushings OR piggy-back behind loadbreak elbows OR Internal lightning metal oxide distribution type arrestors.
  - 2. Tap Changer Control: 150 ampere; 300 ampere tap-changer.
  - 3. Secondary Feeder Breaker: Specify maximum rating of molded case breaker for channel mounting in the low voltage compartment, if required.
  - 4. Low Voltage Busway: Specify if busway entrance through secondary compartment cover is required.
  - 5. Metering: Specify metering requirements if required.
- R. Accessories (750kVA and above)
  - 1. One-inch globe type drain valve with sampling device.
  - 2. Dial type thermometer monitoring hot spot of transformer via thermocouple.
  - 3. Liquid-level gauge.
  - 4. Pressure-vacuum gauge.
  - 5. Drain and filter valves.
  - 6. Pressure relief device.
  - 7. Mounting provisions for low voltage CTs and PTs.
  - 8. Alarm contacts for above gauges.
  - 9. Nameplates required per NEC and supplemental nameplates per attached Interior and Exterior Nameplate Schedules shown on attached Sheet A8 and A17, respectively.

## **2.4 LIQUID FILLED UNIT SUBSTATION TRANSFORMERS**

- A. Comply with IEEE C57.12.00 and C57.12.13
- B. Acceptable Manufacturers:
  - 1. GEC Alstom Balteau
  - 2. ASEA Brown Boveri (ABB)
  - 3. EATON
  - 4. Square D
  - 5. Cooper
- C. Insulating Liquid: Mineral oil OR silicone oil OR hydrocarbon less flammable/high fire point liquid.

- D. kVA Rating: 500 kVA through 2500kVA at 65°C insulation temperature rise. Recommended maximum kVA for 3-phase transformers is 2000kVA at 480Y/277V and 750kVA at 208Y/120V. Higher ratings require F&I approval.
- E. Impedance: 2.2% to 5.75% depending on kVA rating.
- F. Nominal Primary Voltage: 12.47kV Delta OR 16kV Delta
- G. Nominal Secondary Voltage: 4160Y/2400V, 3Ø, 4 wire OR 480Y/277V, 3Ø, 4 wire OR 208Y/120V, 3Ø, 4 wire OR 120/240V, 1Ø, 3 wire.
- H. Basic Impulse Level:
  - 1. Medium Voltage: 95kV at 12,470V OR 60kV at 4160V
  - 2. Low Voltage: 30kV
- I. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage.
- J. Cooling System: IEEE C57.12.00, Class OA/FFA above 1500kVA. OA/FA/FA for units rated less than 1500 kVA.
- K. Bushing Mounting Arrangement: Medium voltage and low voltage bushings mounted on opposite sides of transformer.
- L. Accessories:
  - 1. Lightning Arrestors: Utility grade distribution type, connected to medium voltage terminals.
  - 2. Surge Arrestors: Low voltage type, connected to low voltage terminals.
  - 3. Medium Voltage Terminal Compartment: Full height steel for side mounted terminals.
  - 4. Low Voltage Terminal Compartment: Full height steel compartment.
  - 5. One-inch globe type drain valve with sampling device.
  - 6. Dial-type thermometer monitoring hot spot of transformer via thermocouple for units rated 750 kVA and above.
  - 7. Liquid level gauge.
  - 8. Pressure vacuum gauge.
  - 9. Pressure relief device.
  - 10. Mounting provisions for low voltage CTs and PTs, if required.
  - 11. Alarm contacts for above gauges.
  - 12. Nameplates required by POS labeling standards.

## **2.5 DRY-TYPE DISTRIBUTION AND POWER TRANSFORMERS**

- A. Description: NEMA ST 20, IEEE C57.12.01, ANSI C57.12.51 OR ANSI C57.12.52, UL 1562 listed and labeled, dry-type, 2-winding transformers.

1. Indoor, ventilated or Outdoor, ventilated OR Totally enclosed, nonventilated, cast coil/encapsulated coil, with primary and secondary windings individually cast in epoxy; with insulation system rated at 185 deg C with an 80 deg C average winding temperature rise above a maximum ambient temperature of 40 deg C.
- B. Acceptable Manufacturers:
  1. EATON
  2. Square D
  3. ASEA Brown Boveri (ABB)
- C. kVA Rating:
  1. 75kVA through 2500kVA. Recommended maximum kVA for 3Ø transformers is 2500kVA at 480Y/277V and 500kVA at 208Y/120V. Higher ratings require F&I approval.
- D. Impedance: 2.2% to 5.75%, depending on kVA rating.
- E. Nominal Primary Voltage: 12.47kV Delta OR 4.16/12.47kV Dual Voltage Delta OR 4.16kV Delta.
- F. Nominal Secondary Voltage: 480Y/277V, 3Ø, 4 wire OR 208Y/120V, 3Ø, 4 wire OR 240/120V, 1Ø, 3 wire.
- G. Basic Impulse Level:
  1. Medium Voltage: 95kV at 12.47kV OR 60kV at 4.16kV.
  2. Low Voltage: 10kV.
- H. Primary Connection: Air terminal compartment with hinged door. Tin-plated copper bar for incoming line termination, predrilled to accept terminals for indicated conductors.
- I. Secondary Connection: Transition terminal compartment with hinged door, with connection pattern to match switchgear.
- J. Insulation Materials: IEEE C57.12.01, rated at 185 deg C.
- K. Insulation Temperature Rise: 115 deg C, maximum rise above 40 deg C. Dry type transformers with an insulation temperature rise of 150° are not acceptable.
- L. Full-Capacity Voltage Taps: Four nominal 2.5 percent taps, 2 above and 2 below rated primary voltage.
- M. Cooling System: Complying with IEEE C57.12.01, equipped for forced air cooling; Class AA/FA for above 500kVA.
- N. Sound Level Standards: Sound level standards as defined in NEMA and ANSI OR Low-sound level rating of 3 dB minimum less than NEMA TR standard sound levels - in noise sensitive areas.

O. Accessories:

1. External Medium Voltage Lightning Arrestors: Distribution type, low spark-over metal oxide varistor type.
2. External Low Voltage Lightning Arrestors: Metal oxide varistor type.
3. High Voltage Terminal Compartment: Full height steel to match transformer.
4. Low Voltage Terminal Compartment: Full height steel to match transformer.
5. High Temperature Alarm: Sensor at transformer with local audible and visual alarm and contacts for remote alarm. Provide manual switch override for audible alarm. Provide LED display with current temperature display and highest temp hold and reset functions.

## 2.6 **IDENTIFICATION DEVICES**

- A. Comply with requirements in Section 260533 "Identification for Electrical Systems."
- B. Port Standard Labeling and I.D. Tag Requirements: Label interior and exterior transformer equipment items and components as described on attached sheets A-8 and A-17. A sample listing includes:
1. Exterior (Stenciled in Yellow Paint – 2" high):
    - a. Port of Seattle Assigned Equipment Number
    - b. Transformer kVA Size
    - c. Primary/Secondary
  2. Interior (Plastic Labels Black on White – 1" High minimum) Pad Mounted Transformers Only:
    - a. Both sets of high voltage bushing wells (H1A, H2A, H3A, and H1B, H2B H3B)
    - b. Secondary Bushings (X0, X1, X2, X3)
    - c. Liquid level gauge (750kVA and above)
    - d. Dial type thermometer (750kVA and above)
    - e. One inch drain valve and sampler (750kVA)
- C. Torque Values: Provide self-adhesive machine printed label with connection torque values.

## 2.7 **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 OR IEEE C57.12.91 as applicable for project.
- 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. The Port 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 Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 1 ohm 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. Anchor transformers to concrete bases according to manufacturer's written instructions, seismic codes at Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit and 3.5 inches high.
    - a. Concrete bases shall be leveled to no more than 0.25 inches of deviation for every 3 feet in ALL directions.

- b. Contractor shall notify F&I and AV Maintenance prior to concrete pour to measure concrete base and assess base's levelness.
  - c. Concrete bases shall have smooth finishes. Broom finishes are prohibited.
  3. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.
  4. Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  5. Install epoxy-coated anchor bolts, for supported equipment, that extend through concrete base and anchor into structural concrete floor.
  6. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  7. 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.
- C. Bring transformer to room temperature or a minimum of 65°F for a period of 24 hours prior to energizing. Temperature as measured at transformer hot spot.

### **3.3 IDENTIFICATION**

- A. Identify field-installed wiring and components and provide warning signs as specified in Section 260553 "Identification for Electrical Systems."
1. Provide primary and secondary nameplates per Port requirements on attached sheets A8 and A17.

### **3.4 CONNECTIONS**

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals to manufacturer's published torque tightening values. After torqued, install a spot of red paint on connectors.
- D. Seismic Anchoring: Install transformer on concrete base and meet seismic zone 3 requirements.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to assist in installation and start-up for a period of two working days. Manufacturer's representative shall provide technical direction and assistance to Contractor in general

assembly of equipment, connections and adjustments, and testing weld-assembled components and equipment installation, including connections. Report results in writing.

- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections according to ANSI test codes C57.12.90 for liquid units and ANSI C57.12.91 for dry type units 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. Inspect bolted electrical connections for tightness.
  3. After installing transformers and after electrical circuitry has been energized, test for compliance with requirements.
  4. Perform visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
  5. For dry-type transformers include internal inspection through access panels and doors.
  6. Perform insulation resistance tests using a megohmmeter, winding to winding and each winding to ground with test voltage.
  7. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  8. Infrared Scanning: Perform as specified in Section 261300 "Medium-Voltage Switchgear."
- 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.
  4. See Transformer Equipment and Insulation Test Report.
- E. Test Labeling: Upon satisfactory completion of tests, manufacturer's representative shall attach a dated and signed "Satisfactory Test" label to certify that equipment was installed, adjusted and tested in accordance with their recommendation.
- F. Field/Design Evaluation: For pad mounted transformers, Contractor shall hire a testing agency to perform a field/design evaluation at completion of installation, inasmuch as UL listings are unavailable for pad mount transformers.
1. Provide test report to Port of Seattle.

### **3.6 ADJUSTING**

- A. Touch up scratches and mars on finish to match original finish.
- B. Adjust transformer taps to provide optimum secondary voltage. Record voltages and tap settings to submit with test results.

- C. Certificate of Compliance: A qualified, factory trained manufacturer's representative shall certify in writing that equipment has been installed, adjusted and tested in accordance with manufacturer's recommendations
  - 1. Contractor to provide three copies of Certificate.

### **3.7 DEMONSTRATION**

- A. Training: Provide a factory authorized service representative to demonstrate transformer operation and maintenance and provide training for Port maintenance for one 8 hour workday at the job site location.
  - 1. Training program shall include instructions on transformers, auxiliary devices, protective devices and other accessories.
  - 2. Schedule training with minimum of 7 days advance notice.

### **3.8 STANDBY PARTS**

- A. For Padmounted transformers, furnish three standby primary fuse assemblies complete with all fuses, fuse links, cartridges and holders housed in a separate pocket in primary compartment door. Provide phenolic label "Standby Fuses".

END OF SECTION 261200

Except as noted below:

Interior Nameplate Schedule (Sheet A8)

Exterior Nameplate Schedule (Sheet A17)

Transformer Equipment and Insulation Test Report