

## **1.0 SCOPE**

This specification covers three-phase, 60 Hz., dead-front, oil immersed, self-cooled, 65° C rise, pad-subway type, loop-feed distribution transformers for manhole or vault installation, with primary voltages of 14,400 V Delta and below, and secondary voltages of 480Y/277 V and below.

## **2.0 APPLICABLE PUBLICATIONS AND STANDARDS**

All items characteristic, definitions and terminology, except as specifically covered in this specification, shall be in accordance with the latest revisions of ANSI/IEEE Standard C57.12.24, Department of Energy and NEMA standards, including US Department of Energy National Efficiency Standard 78 FR 2335.

## **3.0 PRODUCT REQUIREMENTS**

### **3.1. General**

- 3.1.1. All insulating components, oil, paper and wire enamel, shall be made of thermally upgraded materials, which are all compatible at today's industry standard 65 degrees Celsius temperature rise.
- 3.1.2. Transformers shall conform to the latest issue of IEEE Standard C57.12.24 except as specified herein.

### **3.2. Nameplate**

- 3.2.1. In addition to the information specified in ANSI/IEEE C57.12.00 (Nameplate A), latest edition, the nameplate shall contain a PCB statement, the total volume of oil in gallons, and the DIV ID #.
- 3.2.2. Nameplate shall be 300-series stainless steel and affixed to the transformer with 300-series stainless steel or silicon bronze fasteners and readable with cables in place.
- 3.2.3. Lettering to be etched or engraved.

### **3.3. kVA Ratings**

Standard continuous kVA ratings shall be 150, 300, 500, 750, 1000, and 1500.

### **3.4. Primary Voltage Ratings and Basic Impulse Levels**

- 3.4.1. The primary voltage ratings and BIL are shown in Table 1. Transformers shall all be of a loop feed design.

**Table 1: Standard Three-Phase Subway Transformer Voltages**

Voltage Configuration	Voltage (V)	BIL (kV)	Number of Primary Bushings
E	14400	95	6
E x 2E	7200 x 14400	95	6

3.4.2. The transformers shall be equipped with no-load adjustable primary taps for de-energized operation. Taps shall be 2-2½% above and 2-2½% below rated voltage.

3.5. **Secondary Voltage**

The secondary voltage ratings shall be 208Y/120 V and 480Y/277 V.

3.6. **Primary Voltage Terminals**

Transformers shall be dead-front with the following design:

- a) Transformers shall be provided with six loop-feed bushing wells, with molded shield and externally removable stud. Bushing wells are to have provisions for bailing assemblies. Bushing well plugs shall be provided and installed, Elastimold 276BWP or approved equal. Elastimold 15/25 kV dead end caps shall be installed by the manufacturer. Bushing wells shall be permanently marked for identification, such as welded, engraved or stamped.
- b) Bushing wells shall conform to ANSI/IEEE 386.
- c) Bushing wells and parking stands shall be arranged in accordance with IEEE C57.12.24.

3.7. **Secondary Voltage Terminals**

- a) The low voltage terminations shall be tinned, spade type with 9/16” holes spaced on 1-3/4” centers. The neutral bushing shall be provided with an externally removable grounding strap.
- b) Minimum number of spade holes (by KVA size)
  - 1) 75 - 300 KVA 8 holes
  - 2) 500 - 1500 KVA 12 holes

3.8. **Neutral and Tank Grounding**

3.8.1. Grounding provision per IEEE C57.12.24, Section 7.5.9 (b) with a one-hole pad next to each high voltage bushing and a two-hole pad on the wall near the low voltage terminals shall be provided. Holes shall be coat tapped and protected with oxide-inhibiting compound and plug.

3.8.2. All grounding provisions shall be treated with an oxide-inhibiting compound.

3.9. **Tank and Dimensions**

- 3.9.1. The transformer tank, cover and all external appurtenances shall be the subway type, constructed with stainless steel of minimum grade 304L per ASTM A240 standard and type shall be labeled on nameplate. The cover shall be bolted to the tank and shall be sealed with a nitrite gasket or the tank shall be completely welded with an access panel of at least 6” by 6”. The tank surface shall be prepared and finished with a dark coating system. This coating shall be adhesive and corrosive resistant required for submersible transformers in vault installations.
- 3.9.2. In general, the maximum overall width shall not be greater than 47”. The maximum overall length shall not be greater than 88”. The maximum overall height shall not be greater than 90”. For transformers 1000 KVA or larger, the maximum dimensions shall meet ANSI/IEEE C57.12.24.
- 3.9.3. Tank shall meet all the integrity requirements of ANSI/IEEE C57.12.24, Section 7.5.
- 3.9.4. Enclosure design and coating system shall meet all requirements of ANSI/IEEE C57.12.32 Section 4.
- 3.9.5. Lifting provisions shall be provided per ANSI/IEEE C57.12.24 Section 7.5.8.
- 3.9.6. Lifting lugs shall be arranged such that they can also be used to strap the transformer to a flatbed truck without damaging the coolers or other accessories.
- 3.9.7. Additional jacking bosses (steps) shall be provided, one in each corner 9” ± ½” from the bottom of the unit, for jacking with hydraulic transformer jacks
- 3.9.8. At each rail end (4 locations), a 7/16” diameter hole shall be drilled in the rail, centered 4” from the end and 5/8” from the bottom for the purpose of connecting the Cat Track to the transformer.
- 3.9.9. Cover shall include a lifting loop.

3.10. **High Voltage Fuses**

- 3.10.1. The high voltage side shall be equipped with CLT draw out dry-well current fuses or approved equal, capable of safely interrupting 25,000 amps symmetrical and 40,000 amps asymmetrical current.
- 3.10.2. Dual ratio transformers shall be supplied with fuses sized for the lower voltage rating.

3.11. **Integrated Primary Switches**

- 3.11.1. Three (3) internal oil immersed, gang operated, two position load break switches (3 total) for loop feed operation with a continuous current rating of 200 amps shall be provided.

- 3.11.2. The switches must be capable of switching the continuous rated current to permit sectionalizing of the primary loop. Make-and-latch and momentary ratings shall 10,000 amps symmetrical.
- 3.11.3. The switches (3) controls shall be located in the primary compartment, convenient for hot stick operation.
- 3.11.4. The switches shall provide for:
  - a) Feed right
  - b) Feed left
  - c) Feed through with coil on / Feed through with coil off
- 3.11.5. Switch positions shall be permanently marked for identification, such as welded, embossed, engraved, or stamped.
- 3.12. **Dual Voltage Switch**
  - 3.12.1. Dual voltage transformers shall be provided with a changeover switch located on the cover (top) of the transformer.
  - 3.12.2. The switch shall operate so that it cannot be left in any position other than high or low.
  - 3.12.3. The dual voltage switch shall have a pointer handle and the high and low voltage settings shall be clearly and permanently marked so that they can be easily read from a 6' to 8' distance.
  - 3.12.4. Markings using durable decals will be acceptable. Lettering shall have a contrasting color to the background.
  - 3.12.5. Transformers shall be shipped with the switch in the high position.
- 3.13. **Accessories**
  - 3.13.1. A one inch filling plug shall be located at the top of the front panel.
  - 3.13.2. A one-inch globe-type drain valve with 3/8-inch sampling device and one-inch drain plug shall be provided. The valve shall be installed on a stainless steel pipe nipple welded to the tank.
  - 3.13.3. A liquid level indication gauge shall be provided.
  - 3.13.4. An automatic pressure relief device shall be provided.

3.14. **Automatic Pressure Relief Valve**

- 3.14.1. An automatic pressure relief valve shall be provided per ANSI/IEEE C57.12.20, Section 7.2.5.1 with the following clarifications:
- 3.14.2. Indicator shall include an orange or red indicator that becomes visible only after the valve has vented.
- 3.14.3. Cap and pull ring shall cover the valve that separates from the assembly during venting, revealing the orange or red indicator and hanging down from the valve via a chain or strap.
- 3.14.4. Valve threads shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

3.15. **Efficiency**

Transformers manufactured under this specification shall meet both of the following (where applicable):

- 3.15.1. The efficiency requirements as directed by the Department of Energy (DOE) per its Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards, Final Rule – 72 Fed. Reg. 58,191 (2007).
- 3.15.2. The minimum efficiency levels contained in tables 4-1 and 4-2 of National Electrical Manufacturers Association (NEMA) standard TP-1-1996.

3.16. **Required Tests**

Each transformer shall receive all standard routine tests required by ANSI/IEEE C57.12.00 and performed as specified by ANSI/IEEE C57.12.90. As a minimum, the following tests shall be performed. Test results will be provided to DOP upon request.

- a) Insulation resistance test on both primary and secondary windings.
- b) Turns ratio tests on each tap.
- c) Losses: load (corrected to 85° C) and no load (at rated voltage and corrected to 20° C).

3.17. **Approval Drawings and Documentation**

- 3.17.1. The awarded supplier will be required to submit preliminary drawings in one Adobe Acrobat PDF file for approval prior to the manufacturer of the transformers. The drawings will promptly be reviewed by the city and returned approved or with corrections as required.
- 3.17.2. All documentation shall be in English and use customary inch-pound units. The successful bidder shall submit in a single Adobe Acrobat PDF file the following:

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- a) An outline drawing showing the principle view and dimensions and including a descriptive table of the accessories
- b) A nameplate drawing including wiring diagram
- c) No-load (core) losses, load (winding) losses at rated current
- d) Information on compliance with IEEE corrosion resistance standards
- e) Instructional materials demonstrating the proper installation, operation, and maintenance of the equipment
- f) Certified test data for each transformer type bid and for every category listed in ANSI/IEEE C57.12.00 Section 8.7. Format test data using numbering system shown in ANSI/IEEE C57.12.00 Section 8.7.
- g) Estimated delivery days after order

3.17.3. Final drawings, operating manuals, maintenance manuals, and certified test results shall be provided at time of delivery.

3.18. **Standard Transformers**

Division ID	Primary Voltage Configuration	Primary Voltage (V)	Secondary Voltage (V)	Size (kVA)
20752	E	14400	208Y/120	150
20753	E	14400	208Y/120	300
20755	E	14400	208Y/120	500
20757	E	14400	208Y/120	750
20759	E	14400	208Y/120	1000
20754	E	14400	480Y/277	300
20756	E	14400	480Y/277	500
20758	E	14400	480Y/277	750
20760	E	14400	480Y/277	1000
20968	E	14400	480Y/277	1500
77472	E x 2E	7200 x 14400	208Y/120	150
77473	E x 2E	7200 x 14400	208Y/120	300
77474	E x 2E	7200 x 14400	208Y/120	500
77475	E x 2E	7200 x 14400	208Y/120	750
77476	E x 2E	7200 x 14400	208Y/120	1000
77477	E x 2E	7200 x 14400	208Y/120	1500
77478	E x 2E	7200 x 14400	480Y/277	150
77479	E x 2E	7200 x 14400	480Y/277	300
77480	E x 2E	7200 x 14400	480Y/277	500
77481	E x 2E	7200 x 14400	480Y/277	750

**TRANSFORMERS – SUBWAY**

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<b>Division ID</b>	<b>Primary Voltage Configuration</b>	<b>Primary Voltage (V)</b>	<b>Secondary Voltage (V)</b>	<b>Size (kVA)</b>
77482	E x 2E	7200 x 14400	480Y/277	1000
77483	E x 2E	7200 x 14400	480Y/277	1500
20752	E	14400	208Y/120	150
20753	E	14400	208Y/120	300
20755	E	14400	208Y/120	500
20757	E	14400	208Y/120	750
20759	E	14400	208Y/120	1000
20754	E	14400	480Y/277	300
20756	E	14400	480Y/277	500
20758	E	14400	480Y/277	750
20760	E	14400	480Y/277	1000
20968	E	14400	480Y/277	1500
77472	E x 2E	7200 x 14400	208Y/120	150
77473	E x 2E	7200 x 14400	208Y/120	300
77474	E x 2E	7200 x 14400	208Y/120	500
77475	E x 2E	7200 x 14400	208Y/120	750
77476	E x 2E	7200 x 14400	208Y/120	1000
77477	E x 2E	7200 x 14400	208Y/120	1500
77478	E x 2E	7200 x 14400	480Y/277	150
77479	E x 2E	7200 x 14400	480Y/277	300
77480	E x 2E	7200 x 14400	480Y/277	500
77481	E x 2E	7200 x 14400	480Y/277	750
77482	E x 2E	7200 x 14400	480Y/277	1000
77483	E x 2E	7200 x 14400	480Y/277	1500