

1.0 SCOPE

This specification covers single-phase, oil-immersed transformers, 25 kVA to 500 kVA rating for overhead service as well as step-down or step-up applications.

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 C57.12.20, 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 latest issue of ANSI/IEEE Standard C57.12.20 except as specified herein.

3.2. Nameplate

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 #.

3.3. Tank Markings

- 3.3.1. A 12" x 6" label shall be affixed to each transformer. The label will include ownership ("Division of Power"), Primary Voltage, Secondary Voltage, and DIV ID #. The label shall be located on the tank wall 180° from pole mounting lug or under the secondary bushings and ground strap.
- 3.3.2. An additional information label or stencil indicating the kVA size shall be installed under the information label. The text size shall be black and 2" high.
- 3.3.3. An empty 12" x 5" space shall be provided above the information label to allow for additional city-provided labeling.

3.3.4. Non-PCB Label

- a) A separate “non-PCB” label, stating such, shall be affixed to the transformer and located on the same surface as the nameplate.
- b) The label shall be affixed to the transformer under or aside the kVA marking and no closer than 3" from the bottom of the tank. This label shall contain the words "Non-PCB" and state the PCB concentration in ppm (typically "contains less than _____ ppm at time of manufacture"). Lettering shall be white on blue background.
- c) All supplied equipment is to be complete with oil (NON-PCB), and all accessories, mounting hardware, lifting provisions, suitable and ready for their intended use upon delivery.
- d) The primary voltage ratings of the transformers specified herein are designated as per ANSI/IEEE C57.12.00.

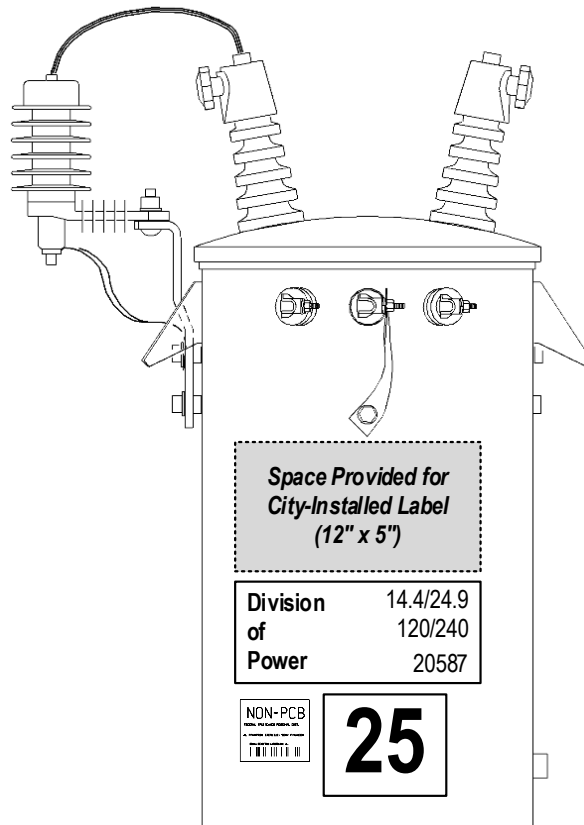


Figure 1: Transformer Labeling

3.4. Primary Voltage Ratings, Basic Impulse Levels, and Arrester Ratings

The primary voltage ratings, BIL, and arrester size are shown in Table 1

Table 1: Standard Overhead Transformer Voltages

Voltage Configuration	Voltage (V)	BIL (kV)	Arrester (kV)
E / E1 Y	14400/24940Y	125 kV	12 **
E / E1 Y	7200/12470Y	95 kV	9 **
E / E1 Y x E / E1 Y	7200/12470Y x 8320/14400Y	95 kV	12 **
E1 Grd Y / E	14400 Grd Y/8320	95 kV	12

** = Provide two arresters

3.5. Primary Bushings

The primary bushings shall be made of porcelain, and shall be cover mounted and conveniently replaceable. There shall be two primary bushings for non-grounded-wye configured primary voltages.

3.6. Secondary Voltages and Bushings

3.6.1. Conventional Transformers

- a) Standard secondary voltages for conventional transformers are 120/240, 240/480, and 277/480Y Volts.
- b) All conventional transformers shall be rated 30 kV BIL for secondary windings.
- c) The secondary bushings shall be individually sidewall mounted and conveniently replaceable.
- d) Bushings shall be permanently stamped secondary leads to ensure proper identification.
- e) Internal secondary connections shall be designed and constructed in such a manner that sufficient flexibility and length are given to the internal leads. This requirement is to facilitate the removal of the cover in conjunction with paralleling of the transformer's secondary windings for three phase applications.
- f) Low voltage bushing housing/body can be either polymer or porcelain.

3.6.2. Step-Up transformers

- a) Secondary voltage for step-down transformers is 7200/12470Y.
- b) Step-up transformers shall have secondary windings rated for 95 kV.
- c) Secondary bushings shall be cover mounted.

3.7. kVA Ratings

Standard kVA ratings for conventional transformers are 25, 50, 75, 100, 167, 250, 333, and 500. The kVA ratings are to be at 65 degrees Celsius rating.

3.8. **Taps**

- 3.8.1. The transformers shall be equipped with no-load adjustable primary taps for de-energized operation.
- 3.8.2. Taps shall be 2-2½% above and 2-2½% below rated voltage.
- 3.8.3. On dual-ratio transformers, adjustable taps shall be included for both voltages.

3.9. **Grounding**

- 3.9.1. Tanks shall have a ground connector.
- 3.9.2. All grounding provisions shall be treated with an oxide-inhibiting compound.
- 3.9.3. Conventional single-bushing (grounded wye) transformers shall be supplied with a grounding strap between the X2 bushing and the tank.
- 3.9.4. Conventional two-bushing (delta) transformers shall be supplied with a grounding strap connected only to the tank.
- 3.9.5. Tank ground provision with a standard ground connector with a range of #1STR to #10STR shall be provided on all transformers.

3.10. **Dual Voltage Switch**

- 3.10.1. Dual voltage transformers shall be provided with an external changeover switch located on the side of the transformer.
- 3.10.2. The switch shall operate so that it cannot be left in any position other than high or low.
- 3.10.3. The switch shall be locked with a non-corrosive, slotted fastener.
- 3.10.4. 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 seen by a lineworker on the pole.
- 3.10.5. Markings using durable decals will be acceptable. Lettering shall have a contrasting color to the background.
- 3.10.6. Transformers shall be shipped with the switch in the high position.

3.11. **Surge Arresters**

- 3.11.1. Provisions for mounting a direct connected distribution class surge arrester on the transformer tank shall be made at each high voltage bushing.

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3.11.2. Conventional Single-Bushing Transformers

Each transformer shall be provided with one direct connected polymer housed metal oxide varistor heavy duty distribution class surge arrester with disconnecter and mounted with galvanized hardware at the H1 bushing.

3.11.3. Conventional Two-Bushing Transformers

Each transformer shall be provided with two direct connected polymer housed metal oxide varistor heavy duty distribution class surge arresters with disconnecters and mounted with galvanized hardware at the H1 and H2 bushings.

3.11.4. Step-Down Transformers

Each transformer shall be provided with four direct connected polymer housed metal oxide varistor heavy duty distribution class surge arresters with disconnecters and mounted with galvanized hardware at the H1, H2, X1, and X2 bushings. H1 and H2 bushings shall be supplied with 12 kV arresters. X1 and X2 bushings shall be supplied with 9 kV arresters.

3.11.5. The arrester shall be provided with a wildlife protector with a hole (not a slot) for the arrester lead. The wildlife cover shall completely cover all metal parts of the arrester lead connector area.

3.11.6. The disconnecter end of the arrester shall be connected to the tank by a flexible lead.

3.11.7. Each arrester shall be provided with a minimum #6 copper 600 volt insulated conductor thoroughly covered to provide wildlife protection and having ring tongue terminals crimped on both ends. The conductor shall be permanently connected to the arrester and the transformer high voltage bushing at the factory.

3.11.8. Dual ratio transformers shall be provided with one surge arrester sized to the higher voltage rating unless otherwise specified.

3.12. **Wildlife Protectors**

Central Moloney 703803 series with 703804-50 handwheel shall be provided on all cover mounted primary bushings.

3.13. **Automatic Pressure Relief Valve**

3.13.1. An automatic pressure relief valve shall be provided per ANSI/IEEE C57.12.20, Section 7.2.5.1 with the following clarifications:

3.13.2. Indicator shall include an orange or red indicator that becomes visible only after the valve has vented.

- 3.13.3. 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.
- 3.13.4. Valve threads shall be sealed with a liquid pipe thread compound such as Rectorseal, liquid Teflon, or similar, not Teflon tape.

3.14. **Short Circuit Capability (Step-Down Transformers Only)**

Short circuit capability shall be in accordance with latest IEEE/ANSI Standard C57.12.00 except the maximum current shall be the current that flows when rated voltage is applied to the primary winding of the transformer with a bolted short on the secondary. The duration of short circuit current withstand is as follows:

Table 2: Short Circuit Current Withstand Duration

RMS Symmetrical Current In Any Winding	Time Period (s)
40 Times Base Current	0.9
37 Times Base Current	1.0
25 Times Base Current	2.0
20 Times Base Current	3.0
16.6 Times Base Current	4.0
14.3 or Less Times Base Current	5.0

Manufacturer shall perform suitable tests in order to insure conformity to the above requirements.

3.15. **Tank**

- 3.15.1. Tanks shall be cylindrical in shape, fabricated of heavy gauge steel (14-gauge minimum) and coated outside with a corrosion resistant finish per ANSI/IEEE C57.12.28.
- 3.15.2. The cover shall be joined to the tank with an oil tight and weatherproof seal and be electrically bonded to the tank.
- 3.15.3. The cover shall be coated to momentarily insulate it for 1.3 times the highest primary voltage to minimize terminal to tank flashover for animal or bird contact. Transformers rated 22.9 kV or above are exempt from this requirement.
- 3.15.4. The tank shall include hanger brackets, lift lugs and an automatic pressure relief device.

3.16. **Color**

- 3.16.1. Tank shall be furnished in a gray color conforming to Munsell 5BG7.0/0.4.
- 3.16.2. Tank coating shall meet or exceed latest ANSI/IEEE Standard C57.12.31.

3.16.3. Primary and secondary bushings, and wildlife protectors shall also be gray.

3.16.4. When measured with a Magnetic Thickness Gauge, the paint thickness shall be the following:

- a) Cover 8 mils thick, minimum
- b) Tank 3 mils thick, minimum

3.17. **Efficiency**

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

3.17.1. 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).

3.17.2. The minimum efficiency levels contained in tables 4-1 and 4-2 of National Electrical Manufacturers Association (NEMA) standard TP-1-1996.

3.18. **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).

3.19. **Approval Drawings and Documentation**

3.19.1. 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.

3.19.2. 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:

- 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

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

3.20. **Standard Transformers**

Division ID	Primary Voltage Configuration	Primary Voltage (V)	Secondary Voltage (V)	Size (kVA)
77445	E1 Grd Y / E	14400 Grd Y/8320	120/240	25
77446	E1 Grd Y / E	14400 Grd Y/8320	120/240	50
77447	E1 Grd Y / E	14400 Grd Y/8320	120/240	75
77448	E1 Grd Y / E	14400 Grd Y/8320	120/240	100
77449	E1 Grd Y / E	14400 Grd Y/8320	120/240	167
77450	E1 Grd Y / E	14400 Grd Y/8320	277/480Y	25
77451	E1 Grd Y / E	14400 Grd Y/8320	277/480Y	50
77452	E1 Grd Y / E	14400 Grd Y/8320	277/480Y	75
77453	E1 Grd Y / E	14400 Grd Y/8320	277/480Y	100
77454	E1 Grd Y / E	14400 Grd Y/8320	277/480Y	167
20587	E / E1 Y	14400/24940Y	120/240	25
20664	E / E1 Y	14400/24940Y	120/240	50
20681	E / E1 Y	14400/24940Y	120/240	75
20606	E / E1 Y	14400/24940Y	120/240	100
20620	E / E1 Y	14400/24940Y	120/240	167
20588	E / E1 Y	14400/24940Y	240/480	25
20665	E / E1 Y	14400/24940Y	240/480	50
20682	E / E1 Y	14400/24940Y	240/480	75
20607	E / E1 Y	14400/24940Y	240/480	100
20621	E / E1 Y	14400/24940Y	240/480	167
20589	E / E1 Y	14400/24940Y	277/480Y	25
20666	E / E1 Y	14400/24940Y	277/480Y	50
20683	E / E1 Y	14400/24940Y	277/480Y	75
20608	E / E1 Y	14400/24940Y	277/480Y	100
20622	E / E1 Y	14400/24940Y	277/480Y	167
77455	E / E1 Y	14400/24940Y	7200/12470Y	167

TRANSFORMERS – OVERHEAD

Single-Phase – Conventional and Step-Down

Specification

TDMIS-9070

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Division ID	Primary Voltage Configuration	Primary Voltage (V)	Secondary Voltage (V)	Size (kVA)
77456	E / E1 Y	14400/24940Y	7200/12470Y	250
77457	E / E1 Y	14400/24940Y	7200/12470Y	333
77458	E / E1 Y	14400/24940Y	7200/12470Y	500
20592	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	120/240	25
20669	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	120/240	50
20597	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	120/240	75
20609	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	120/240	100
20623	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	120/240	167
20610	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	240/480	100
20624	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	240/480	167
77459	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	277/480Y	25
77460	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	277/480Y	50
77461	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	277/480Y	75
77462	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	277/480Y	100
77463	E / E1Y x E / E1Y	7200/12470Y x 8320/14400Y	277/480Y	167