THE CITY OF COLUMBUS
DEPARTMENT OF PUBLIC UTILITIES
DIVISION OF POWER

TRANSFORMERS – PAD-MOUNTED

Three-Phase – Conventional

Specification

TDMIS-9072

Revised 11/2019

1.0 SCOPE

This specification covers three-phase, 60 Hz., dead-front, oil immersed, self-cooled, 65° C rise, pad-mounted, outdoor, loop-feed distribution transformers, 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 C57.12.26, 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 C57.12.26 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.

3.2.4. Two nameplates shall be provided total – one nameplate attached inside of door and one nameplate attached outside of door.

3.3. kVA Ratings

Standard continuous kVA ratings shall be 75, 150, 300, 500, 750, 1000, 1500, 2000, and 2500.

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

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 Pad-Mounted Transformer Voltages

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

3.5. **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 loop-feed and be provided with six externally clamped and externally removable bushing wells with molded shield and externally removable stud arranged in a "V" configuration. Bushing wells and parking stands shall be arranged in accordance with figure 6a & b of IEEE C57.12.26. Primary compartment width shall not exceed 41.5".

b) Bushing wells shall conform to ANSI/IEEE 386.

c) Provide and install bushing well inserts, Cooper LBI 215 or approved equal. Bond per manufacturer's instructions.

3.7. **Secondary Voltage Terminals**

a) The low voltage line bushings shall be provided with tinned copper spades. The bushings shall be bolted on and externally clamped.

b) Minimum number of spade holes (by KVA size)

1) 75 - 300 KVA 8 holes

2) 500 - 2500 KVA 12 holes

c) Insulated support required for all secondary bushings on units with 12 holes spades.

d) The configuration of the secondary shall be in accordance with a staggered terminal arrangement for specific dimensions as illustrated in IEEE C57.12.26 figure 8a.

e) The low voltage terminals shall be constructed to allow the mounting of bushing-type meter class current transformers, e.g., ABB type CMV or GE types JAB-O and JAD-O. The mounting of these slip-on CTs shall not hinder the use of the holes in the terminals. If these CTs will block any of the holes, then a spade with 2 additional holes is to be provided. In this case, the extra holes will not be utilized for conductor connections.

f) The low voltage neutral shall be a fully insulated bushing. One or more removable ground straps suitably sized for the short circuit rating of the transformer shall be provided and connected between the base of the neutral bushing and a ground pad on the outer surface of the tank. The attachment of the grounding strap to the neutral bushing shall be made such that the number of available holes on the spade are not reduced from the requirements in Section 3.7.b).

3.8. Taps

3.8.1. The high voltage section shall be equipped with a tap changer for de-energized operation only, and must be externally operable with a hot-stick and must require at least two (2) operator actions to change taps.

3.8.2. Taps shall be 2-2½% above and 2-2½% below rated voltage.

3.9. Neutral and Tank Grounding

3.9.1. Clamp-type tank grounding connections shall be provided in accordance with ANSI/IEEE C57.12.26.

3.9.2. Tank ground connectors shall be provided in both the low voltage and high voltage sections for tank grounding.

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

3.10. Tank, Core, Coil, and Terminal Compartment

a) Primary and secondary coils shall be five legged or equivalent to minimize tank heating during unbalance conditions.

b) The transformer shall meet the requirements for tamper resistance set forth in ANSI/IEEE C57.12.28.

c) The compartment depth shall be in accordance with specific dimensions as shown in ANSI/IEEE C57.12.26.

d) Transformers shall fit on precast concrete foundations as detailed on Division of Power TDMIS 9221 and 9222, latest edition. Radiators shall not extend more than 24" in any direction beyond the transformer tank.

e) The tank coating shall meet all requirements in ANSI/IEEE C57.12.28 and shall be painted pad-mount green (Munsell 7GY 3.29/1.5).

f) Enclosure integrity and finish shall conform to ANSI/IEEE C57.12.28. Doors shall have provision for locking with one padlock (minimum 1/2" hole for shackle) in accordance with ANSI/IEEE C57.12.28. The compartment doors shall be removable to facilitate cable pulling and connection. A penta head bolt shall secure the high voltage compartment.

g) The sill shall be removable to permit sliding of the transformer unit on or off the pad without disturbing the cables or conduits.

3.11. Base Dimensions – Connector Compartments and Accessory Equipment

a) An 18" minimum depth connection compartment shall be attached to the transformer, and a ¾" to 1½" wide flange shall be provided around the bottom of the compartment.

b) The high voltage and low voltage compartments shall be separated by a suitable barrier.

c) Transformer radiators are not to extend more than 24" in any direction beyond transformer tank.

d) The transformer base shall fit on the foundation, DOP TDMIS 9221 or TDMIS 9222, without any overhang. Refer to Figure 1 and Figure 2.

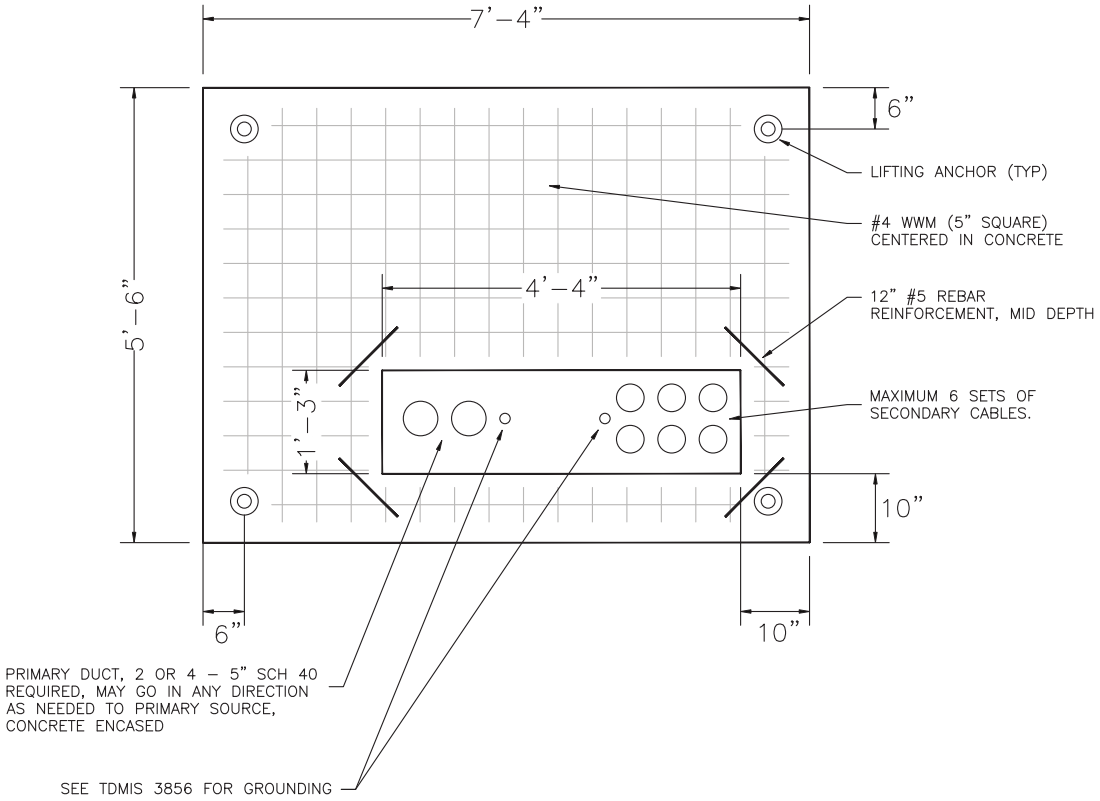

Figure 1: TDMIS 9221 – Pad for Three-Phase Transformer (75 to 500 kVA)

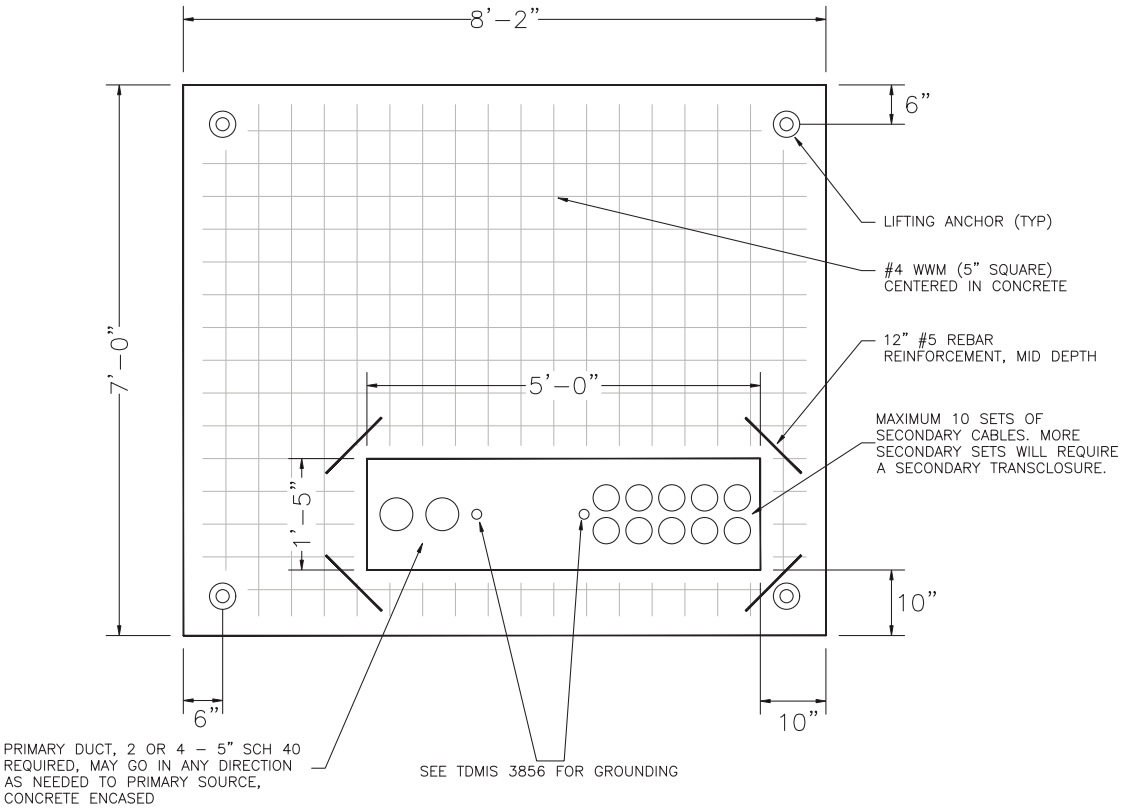

Figure 2: TDMIS 9222 – Pad for Three-Phase Transformer (750 to 2500 kVA)

e) The compartment dimensions, bushing and accessory dimensions shall comply with Figure 3.

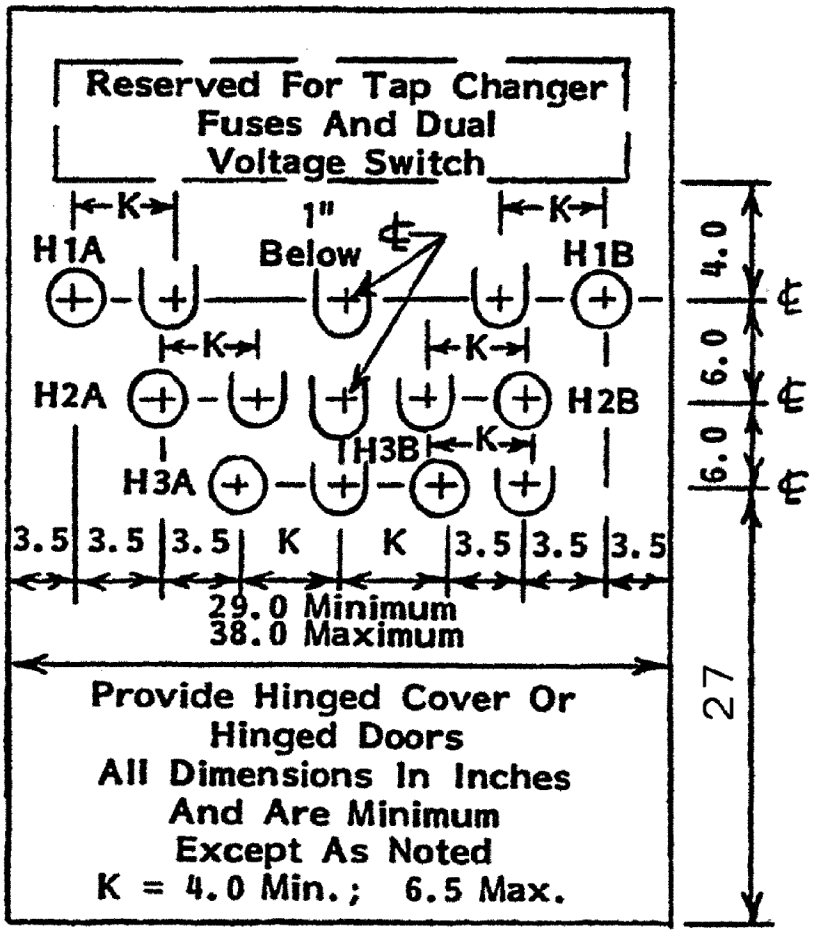

Figure 3: Transformer Primary Compartment Dimensions

3.12. **<u>High Voltage Fuses</u>**

3.12.1. Transformers shall be equipped with a Cooper Bay-O-Net current sensing fuse in series with a partial range current limiting fuse under oil. The current limiting fuse shall be inaccessible and electrically located on the source side of the Bay-O-Net fuse. The Bay-O-Net assembly shall be equipped with a flapper valve and drip cup to minimize oil spillage.

3.12.2. Dual ratio transformers shall be supplied with Cooper Bay-O-Net fuses sized for the lower voltage rating.

3.12.3. Fuse link, fuse cartridge and end plug are to be placed in a plastic bag and attached to the fuse handle.

3.12.4. The transformer manufacturer shall size the partial range current limiting fuse to coordinate with the listed Cooper current sensing Bay-O-Net fuse.

3.13. **Integrated Primary Switches**

3.13.1. 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.

3.13.2. 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.

3.13.3. The switches (3) controls shall be located in the primary compartment, convenient for hot stick operation.

3.13.4. The switches shall provide for:

a) Feed right

b) Feed left

c) Feed through with coil on / Feed through with coil off

3.13.5. Switch positions shall be permanently marked for identification, such as welded, embossed, engraved, or stamped.

3.14. **Dual Voltage Switch**

3.14.1. Dual voltage transformers shall be provided with a changeover switch located in the high voltage compartment.

3.14.2. The switch shall operate so that it cannot be left in any position other than high or low.

3.14.3. 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.

3.14.4. Markings using durable decals will be acceptable. Lettering shall have a contrasting color to the background.

3.14.5. Transformers shall be shipped with the switch in the high position.

3.15. **Accessories**

3.15.1. A one inch filling plug shall be located at the top of the front panel.

3.15.2. A one inch drain valve with sampler and one inch plug shall be provided.

3.15.3. A liquid level indication gauge shall be provided.

3.15.4. An automatic pressure relief device shall be provided.

3.16. **Automatic Pressure Relief Valve**

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

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

3.16.3. 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.

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

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)
20792	E	14400	208Y/120	75
20799	E	14400	208Y/120	150
20808	E	14400	208Y/120	300
20815	E	14400	208Y/120	500
20821	E	14400	208Y/120	750
20824	E	14400	208Y/120	1000
77464	E	14400	208Y/120	1500
20800	E	14400	480Y/277	150
20809	E	14400	480Y/277	300
20816	E	14400	480Y/277	500
20822	E	14400	480Y/277	750
20825	E	14400	480Y/277	1000
20826	E	14400	480Y/277	1500
20829	E	14400	480Y/277	2000
20724	E	14400	480Y/277	2500
77465	E x 2E	7200 x 14400	208Y/120	75
61529	E x 2E	7200 x 14400	208Y/120	150
61530	E x 2E	7200 x 14400	208Y/120	300
61531	E x 2E	7200 x 14400	208Y/120	500
61532	E x 2E	7200 x 14400	208Y/120	750

Division ID	Primary Voltage Configuration	Primary Voltage (V)	Secondary Voltage (V)	Size (kVA)
61533	E x 2E	7200 x 14400	208Y/120	1000
61534	E x 2E	7200 x 14400	208Y/120	1500
61535	E x 2E	7200 x 14400	480Y/277	150
61537	E x 2E	7200 x 14400	480Y/277	300
61538	E x 2E	7200 x 14400	480Y/277	500
61539	E x 2E	7200 x 14400	480Y/277	750
61540	E x 2E	7200 x 14400	480Y/277	1000
61541	E x 2E	7200 x 14400	480Y/277	1500
77466	E x 2E	7200 x 14400	480Y/277	2000
77467	E x 2E	7200 x 14400	480Y/277	2500
61534	E x 2E	7200 x 14400	208Y/120	1500
61535	E x 2E	7200 x 14400	480Y/277	150
61537	E x 2E	7200 x 14400	480Y/277	300
61538	E x 2E	7200 x 14400	480Y/277	500
61539	E x 2E	7200 x 14400	480Y/277	750
61540	E x 2E	7200 x 14400	480Y/277	1000
61541	E x 2E	7200 x 14400	480Y/277	1500