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**DISTRIBUTION ENGINEERING DEPARTMENT
OVERHEAD STANDARDS AND PLANNING**

**EO-5015
REVISION 23**

**TECHNICAL SPECIFICATION FOR THREE-PHASE, OIL-FILLED, METAL
ENCLOSED, PAD-MOUNTED DISTRIBUTION TRANSFORMERS**

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1.0 **PURPOSE**

This document specifies the design and test requirements for three-phase oil-immersed pad-mount transformers for operation on the 4kV, 13kV, and 27kV Underground Residential Development (URD) systems of Consolidated Edison Co. of New York (CECONY) and Orange & Rockland Utilities (O&R or O&RU). The design and test requirements specified in this document apply to all CECONY and O&R three-phase oil-immersed pad-mount transformer purchase orders.

2.0 **APPLICABLE STANDARDS**

Except as otherwise specified in this specification, all characteristics, definitions, and terminology shall follow the most recent revision of the following ANSI®, IEEE®, ASTM, Department of Energy, and NEMA® standards.

- 2.1** IEEE Std C57.12.00™ IEEE Standard for General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
- 2.2** IEEE C57.12.34™ IEEE Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High-Voltage, 34.5 kV Nominal System Voltage and Below; Low-Voltage, 15 kV Nominal System Voltage and Below
- 2.3** IEEE Std 386™ IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
- 2.4** IEEE Std C57.12.70™ - IEEE Standard for Standard Terminal Markings and Connections for Distribution and Power Transformers
- 2.5** IEEE Std C57.12.35™—IEEE Standard Bar Coding for Distribution Transformers and Step-Voltage Regulators
- 2.6** IEEE Std C57.12.90™—IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
- 2.7** IEEE Std C57.154™ IEEE Standard for the Design, Testing, and Application of Liquid-Immersed Distribution, Power, and Regulating Transformers using High-Temperature Insulation Systems and Operating at Elevated

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Temperatures

- 2.8** IEEE Std C57.131™ IEEE Standard Requirements for Tap Changers
- 2.9** IEEE Std. C37.74™ IEEE Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV
- 2.10** IEEE Std C57.91™–IEEE Guide for Loading Mineral-Oil-Immersed Transformers and Step-Voltage Regulators
- 2.11** IEEE Std C57.130™ IEEE Guide for the Use of Dissolved Gas Analysis Applied to Factory Temperature Rise Tests for the Evaluation of Mineral Oil-Immersed Transformers and Reactors
- 2.12** IEEE Std C57.104™ IEEE Guide for the Interpretation of Gases Generated in Mineral Oil-Immersed Transformers
- 2.13** IEEE Std C57.106™ IEEE Guide for Acceptance and Maintenance of Insulating Mineral Oil in Electrical Equipment
- 2.14** IEEE Std C57.147™, IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers
- 2.15** ASTM D117 Standard Guide for Sampling, Test Methods, and Specifications for Electrical Insulating Liquids
- 2.16** ASTM D3487 Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
- 2.17** ASTM D3612 Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography
- 2.18** ASTM D4059 Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography
- 2.19** NEMA TR 1 (R2000)–Transformers, Regulators and Reactors, Audible Sound Levels for Liquid-Immersed Power Transformers
- 2.20** 10 CFR Part 431–Department of Energy–Energy Conservation Program:

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3.0 **GENERAL REQUIREMENTS**

3.1 All requirements outlined in this document shall apply to both CECONY and O&R unless otherwise noted.

3.2 All characteristics, definitions, terminology, ratings, and tests (except as otherwise stated in this specification), shall be in accordance with the latest revision of standards, stipulated in [Section 2.0](#), for distribution transformers. Where there is a conflict between the said standards, the more stringent requirements shall apply.

3.3 All transformers shall comply with the latest D.O.E. efficiency requirements outlined in Subpart K of Part 431 of Chapter II of Title 10 of the Code of Federal Regulations (CFR).

3.4 Three-phase pad-mount transformers shall be oil immersed, self-cooled, 60 Hertz, and "dead front" primary constructed with no exposed live parts in the primary compartment.

3.5 Transformers with amorphous cores are permitted. The approval drawing must note the core material.

3.6 The purchased transformers shall be radial feed type equipped with a single three-phase primary source of supply.

3.7 Manufacturer shall provide feed thru insert (aka "Wish Bone Tees" or "Binoculars") for each of the three high voltage bushings for all 200 Amp primary rated transformers to allow conversions from Radial feed to Loop feed.

Note: Transformers equipped with 600 Amp primary bushings are for radial feed only.

3.8 All transformers shall have sufficient clearance to permit the conversion of Radial Feed to Loop Feed via the insertion of feed-thru inserts.

3.9 Transformers shall have adequate clearance to accommodate cable terminals installed on the feed-through inserts.

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3.10 Transformers shall be equipped with three high voltage bushings, three parking stands, and six ground clamps in accordance with Drawing No. [328373](#).

3.11 Transformers shall be capable of accepting 27kV rated plug-in type dead front surge arresters. However, the arresters are not part of this specification and shall not be provided with the transformer.

3.12 Refer to [EO-5000](#) for instructions on the bid process, awarding of contracts, inspection and tests, equipment warranty, manufacturer proposal & guarantees, evaluation of the proposal, and shipping and transport.

3.13 Refer to [EO-4999](#) for overhead pole type distribution transformer purchase order catalog, for CECONY and O&R, detailing equipment stock numbers, transformer kVA capacity, voltage ratings, tap changers, internal fusing, and/or switches.

4.0 ELECTRICAL REQUIREMENTS

4.1 BASIC INSULATION LEVEL

4.1.1 See [Appendix A](#) for Basic Insulation Level (BIL) requirement.

4.1.2 The BIL rating of all low voltages (208/120V and 480/277V) shall be 30kV.

4.1.3 Fully insulated 480V or 208V secondaries are acceptable alternates for the "GrdY" reduced insulation system specified and should be indicated in proposals and on nameplates when offered.

4.2 IMPEDANCE

See [Appendix D](#) for transformer percent impedance requirements, as measured on the rated voltage connection in accordance with *Table 2 – Nominal percent impedance voltage* of IEEE Std. C57.12.34.

4.3 TOLERANCE OF IMPEDANCE

4.3.1 The tolerance on the percent impedance shall be +/- 7.5% of the

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nominal value for percent impedance values greater than 2.5%. The tolerance on the percent impedance shall be +/- 10.0% of the nominal value for percent impedance values less than or equal to 2.5%.

4.3.2 When two or more units of a given rating are produced by the same manufacturer at the same time, differences in percent impedance between duplicate two-winding transformers shall not exceed 7.5% and three winding or zigzag transformers shall not exceed 10%.

4.4 SHORT CIRCUIT WITHSTAND

All transformers shall be designed to withstand short circuit stresses in accordance with Section 12 of IEEE Standard C57.12.90 entitled, "IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers."

4.5 TRANSFORMER WINDINGS AND CORE CONSTRUCTION

Transformer windings and core construction shall be as follows:

KV	Winding	Core Construction
4	Y-Y	5-Legged
4/13 Dual	Y-Y	5-Legged
13 (Con Ed)	Delta-Y	3-Legged or 5-Legged
13 (O&R)	Y-Y	3-Legged or 5-Legged
13 (Con Ed)	Y-Y	5-Legged
27 (Con Ed)	Y-Y	5-Legged

4.6 HIGH VOLTAGE BUSHINGS

4.6.1 All high voltage bushings shall be designed in accordance with the *Connectors, bushings, and Terminals* section of IEEE C57.12.34 standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers.

4.6.2 All high voltage bushing wells shall meet IEEE 386 Standard for Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV.

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- 4.6.3 All high voltage bushings, located in the high voltage compartment, shall be of a completely "dead front" design.
- 4.6.4 All transformers shall be equipped with three radial high voltage bushings H₁, H₂, and H₃ arranged in accordance with Drawing No. [328373](#).
- 4.6.5 High voltage bushings rated 200 amps shall be Elastimold "Flowerpot" short shank bushing wells with bail tabs and replaceable stud or equal.
- 4.6.6 High voltage bushing wells shall be gasketed to the tank.
- 4.6.7 High voltage bushing well shall be rated for 35kV with a minimum Basic Insulation Level (BIL) rating of 150kV.
- 4.6.8 High voltage bushing wells shall be capable of directly accepting 15kV and 25kV inserts.
- 4.6.9 High voltage bushing wells shall be installed complete with bail tabs.
- 4.6.10 Acceptable manufacturer and catalog numbers for high voltage bushing wells are Elastimold L1601-PC-S1, Eaton/Cooper Power BW150R, ABB 609C030G01 or 609C030G02, Colt 3-701911-50, or a CECONY or O&R engineering approved equal.
- 4.6.11 All high voltage bushing wells shall have four tabs, each with a hole to accept primary elbow hold-down bails. These tabs shall be mounted at a 45° angle from the vertical and horizontal plane.
- 4.6.12 High voltage bushing wells shall be installed such that the clamping bolts and the "hold down" bail tabs shall not extend more than 3/8" above the top surface of the bushing well.
- 4.6.13 Stand-off brackets and brackets for feed-through devices must be solidly welded to the tank.
- 4.6.14 For transformers rated 1000kVA thru 2500kVA with either 4kV or dual 13x4kV primaries, the high voltage terminals shall have a minimum continuous rating of 600 amperes RMS and a momentary

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fault withstand rating of 40,000 amps, RMS, symmetrical. All internal ties and connections shall be designed to carry the rated current of the transformer continuously for at least three consecutive days, without damage.

- 4.6.15** High voltage terminals rated 600 Amp shall be solid epoxy bushing, top mounted Elastimold Catalog No. 600T1 or equal.
- 4.6.16** There shall be no bushing wells or feed-through inserts for 600 Amp primary units.
- 4.6.17** The 600 Amp bushings shall be rated 15kV and shall be gasketed to the tank.
- 4.6.18** High voltage bushings shall be marked with “H₁”, “H₂”, and “H₃” stencils or labels below the corresponding bushings. Phases “A”, “B”, and “C” shall be marked above the corresponding bushings. All high voltage bushing and phase markings shall be in accordance with Drawing No. [328373](#).
- 4.6.19** High voltage bushing and phase stencils or labels shall be 1.75 inches high and painted yellow.
- 4.6.20** If the label is chosen to designate the high voltage bushings or phases, the label shall meet the following requirements:
 - a) Label shall last the life expectancy of the transformer without loss of readability or adhesion.
 - b) The Label shall withstand a temperature range of -20° to 150° F, moisture, and ultraviolet light without loss of readability and adhesion.
 - c) Label shall be applied in such a manner that air bubbles or curling corners will not occur.

4.7 LOW VOLTAGE BUSHINGS

- 4.7.1** All low voltage bushings shall be designed in accordance with the *Connectors, bushings, and Terminals* section of IEEE C57.12.34

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standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers.

- 4.7.2 Low voltage bushings shall be made of a non-porcelain material.
- 4.7.3 There shall be three low voltage phase bushings, X₁, X₂, X₃, and one grounded neutral bushing H₀X₀ for GrdY-GrdY transformers or X₀ for Delta-Wye transformers located in the low voltage compartment.
- 4.7.4 The low voltage and grounded-neutral bushings shall be arranged in a staggered configuration in accordance with Drawing No [328373](#).
- 4.7.5 The low voltage and neutral terminals and/or internal leads shall be easily detachable from the handhole.
- 4.7.6 The continuous rating and fault withstand rating of the low voltage terminals shall be in accordance with IEEE and NEMA Standards.
- 4.7.7 All low voltage terminals and the X₀ or H₀X₀ secondary grounded neutral shall consist of tinned copper or bronze spades. The thickness of these spades shall be 3/8" for 75 thru 500 kVA, and 1/2" for 1000 thru 2500 kVA. These spades shall have standard IEEE hole drilling and standard vertical and horizontal hole spacing. The number of holes required, and dimensions shall be in accordance with Drawing No. [349474](#).
- 4.7.8 **FOR CECONY PURCHASE ORDERS:** Transformers without primary fuses (i.e., 13/4kV dual or 4kV straight 1000kVA and larger transformers) shall have a low voltage spade hole-to-hole horizontal spacing of 2.50 inches to provide clearance for low voltage cable limiter lugs, see Drawing No. [349474](#). See **Table A** and **Table B** of [Appendix C](#), for transformers not equipped with primary fuses.
- 4.7.9 On all units, the X₀ or H₀X₀ secondary neutral terminal shall be either solidly welded to the tank, with the ground strap internally bolted to the tank, and easily accessible from the handhole or employ an insulated neutral bushing with an external ground strap bolted to the tank. The external ground strap must be capable of carrying full short circuit current and must not occupy any of the above-required cable

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hole sets.

- 4.7.10** On GrdY-GrdY units, the H₀ (high voltage neutral) and X₀ (low voltage neutral) shall be internally connected through a removable link (located below, and accessible through, the handhole).
- 4.7.11** The manufacturer shall provide easily removable (for maintenance) insulated mechanical supports for the low voltage and neutral spades for all transformers. The insulated mechanical supports shall be connected between the spades and the cabinet frame such that the spades can support the weight of ten, fourteen, or twenty 500MCM copper cables with limiters, each six feet long.
- 4.7.12** Insulated mechanical supports utilizing the tank or cabinet shall be full-rated insulators between phase terminals and compartment.
- 4.7.13** The low voltage bushings shall be marked with “X₁”, “X₂”, and “X₃”. The grounded-neutral shall be marked with “H₀X₀” for GrdY-GrdY type transformer or “X₀” for Delta-Wye type transformer. The low voltage and grounded-neutral bushing markings shall be either stencils or labels placed below the corresponding bushing in accordance with Drawing No. [328373](#).
- 4.7.14** Low voltage and grounded-neutral bushing stencils or labels shall be 1.75 inches high and painted yellow.
- 4.7.15** If the label is chosen to designate the low voltage and grounded-neutral bushings, the label shall meet the following requirements:
- a) Label shall last the life expectancy of the transformer without loss of readability or adhesion.
 - b) The Label shall withstand a temperature range of -20° to 150° F, moisture, and ultraviolet light without loss of readability and adhesion.
 - c) Label shall be applied in such a manner that air bubbles or curling corners will not occur.

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4.8 **PRIMARY THREE-PHASE TWO-POSITION LOAD BREAK SWITCH**

4.8.1 The load break switch shall meet the design and test requirements specified in the latest revision of IEEE Std. C37.74 (IEEE Standard Requirements for Subsurface, Vault, and Padmounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems up to 38 kV).

4.8.2 The manufacturer shall equip 4kV, 13kV, and 4/13kV (dual voltage) transformers with Eaton/Cooper Power 3-phase two-position load break switch Catalog No: **LS2R515H3N2A** rated for 550 Amps and 15.5kV.

4.8.3 The manufacturer shall equip 27kV transformers with Eaton/Cooper Power 3-phase two-position load break switch Catalog No: **LS2R427H3N2A** rated for 400 Amps and 27.6kV.

4.8.4 Any exception to the Eaton/Cooper Power 3-phase two-position load break switches specified in sections [4.8.2](#) and [4.8.3](#); shall be an equivalent load break switch that meets the minimum electrical requirements specified in [Appendix B](#).

Note: It is unacceptable to provide three single-phase switches instead of a single three-phase switch.

4.8.5 The primary two-position load-break switch shall be operable remotely with a hot-stick. The load-break switch shall have a load-break capability for a PF of 70% to 80% lagging and shall be capable of closing in on the maximum fault without damage.

4.8.6 The primary two positions load-break switch shall be located in the high voltage compartment above the high voltage bushings in accordance with Drawing No [328373](#).

4.8.7 The two positions of the load break switch shall be marked correspondingly to “Open” and “Closed”.

4.9 **PRIMARY FUSES AND HOLDER**

4.9.1 Fuse link ratings, terminology, characteristics, and tests shall be in

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accordance with the latest revision of IEEE Std C37.42 Standard Specifications for High-Voltage (>1000 V) Fuses and Accessories and IEEE Std C37.47 Standard Specifications for High Voltage (>1000 V) Distribution Class Current-Limiting Type Fuses and Fuse Disconnecting Switches.

4.9.2 Primary fuses shall be located in the high voltage compartment above the high voltage bushings in accordance with Drawing No. [328373](#).

4.9.3 Each phase shall be equipped with a partial range current limiting fuse in series with an expulsion fuse.

4.9.4 The expulsion fuses shall be Bay-O-Net type, full range, with drip shields located directly below the fuses in the primary compartment. The fuse shall be contained in gasketed and tightly sealed Bay-O-Net assembly and shall be field replaceable.

4.9.5 The Bay-O-Net fuse assembly shall have a flapper valve to minimize oil spillage upon removal. This shall be Eaton/Cooper Power Systems Catalog Number 4000361C99FV or the Company Distribution Engineering Department approved equivalent.

4.9.6 The Bay-O-Net fuse assembly shall be of load break construction with standard hot stick operable hook eye handle.

4.9.7 The current carrying element of the Bay-O-Net fuse shall be fully supported with a structural material that does not generate gasses that could lead to subsequent pressure build-ups during fuse operation.

4.9.8 The Bay-O-Net fuse shall be sized for continuous current carrying duty at nameplate current ratings multiplied by an overload factor of 1.5.

4.9.9 The Bay-O-Net fuse shall be rated for long-time performance (greater than 1000 seconds) to accommodate high inrush current without blowing.

4.9.10 The current limiting fuse shall be partial range, non-gassing, and

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submersible rated for current interruption capability at equal to or greater than 25,000 amps RMS symmetrical.

4.9.11 Catalog numbers for all approved current limiting fuse and Bay-O-Net fuse combinations are listed in [Appendix C](#).

4.9.12 The manufacturer shall equip 13/4kV dual voltage transformers with **8.3kV rated current limiting fuses with ampacity for transformer operation at 4.16kV** as noted in fuse **Table A** of [Appendix C](#).

4.9.13 **FOR CECONY PURCHASE ORDER:** The manufacturer shall equip 13/4kV dual voltage transformers with **8.3kV rated Bay-O-Net fuses with ampacity for transformer operation at 13.2kV** as noted in fuse **Table A** of [Appendix C](#). There shall be a label or stencil in the primary compartment near the Bay-O-Net fuse holders stating, **“Fused by Manufacturer for 13.2kV Operation”**.

4.9.14 **FOR O&R PURCHASE ORDER:** The manufacturer shall equip 13/4kV dual voltage transformers with **8.3kV rated Bay-O-Net fuses with ampacity for transformer operation at 4.16kV** as noted in fuse **Table A** of [Appendix C](#). There shall be a label or stencil in the primary compartment near the Bay-O-Net fuse holders stating, **“Fused by Manufacturer for 4.16kV Operation”**.

4.9.15 Any exception to the fuses stated in [Appendix C](#) shall be submitted to CECONY or O&R Distribution Engineering for review and approval.

4.9.16 **“LOAD BREAK”** shall be labeled or stenciled above the Bay-O-Net fuse holders in 1-inch-high yellow lettering.

4.10 **DE-ENERGIZED TAP CHANGER**

4.10.1 De-energized tap changer shall be designed and tested in accordance with IEEE C57.131 Standard for Tap Changer.

4.10.2 All units shall be equipped with a de-energized high voltage tap changer located in the high voltage compartment above the high voltage bushings in accordance with Drawing No. [328373](#).

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- 4.10.3** De-energized tap changer shall have an external operating handle with mechanical stops.
- 4.10.4** The corresponding voltage for each tap position shall be noted on the nameplate.
- 4.10.5** Notations (numbers or letters) for the positions of the external tap changer shall be the same sequence that appears on the nameplate. Only numbers or only letters shall be used.
- 4.10.6** All transformers shall be equipped with five positions de-energized tap changer with two 2 ½% taps above and two 2 ½% taps below nominal high voltage.
- 4.10.7** For 13/4kV dual voltage transformers, the tap changer shall be on the 13kV high voltage winding.
- 4.10.8** The tap positions shall be marked on the de-energized tap changer as follows, two tap positions above nominal voltage shall be **1** or **A**, one tap position above nominal voltage shall be **2** or **B**, nominal voltage tap position shall be **3** or **C**, one tap position below nominal voltage shall be **4** or **D**, two tap positions below nominal voltage shall be **5** or **E**.
- 4.10.9** Tap Changer handle and operating mechanism shall be constructed of suitable materials and shall maintain contact alignment despite repeated or infrequent operations, to provide increased reliability.
- 4.10.10** There shall be a warning label noting to de-energize the transformer before operating the tap changer.

4.11 DUAL VOLTAGE SWITCH

- 4.11.1** All dual voltage transformers shall be equipped with an external dual voltage switch located inside the primary compartment above the high voltage bushings as shown in Drawing No. [328373](#)
- 4.11.2** The dual voltage switch shall indicate the voltage positions (i.e., 13.2kV and 4.16kV) with a minimum 1½ inch high yellow numbered

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labels or stencils.

- 4.11.3 The dual voltage switch shall be labeled with a warning to de-energize before operation.
- 4.11.4 The dual voltage switch shall contain a locking device that must be released before the switch can be operated.
- 4.11.5 Dual voltage switch handle and operating mechanisms shall be constructed of suitable materials and shall maintain contact alignment despite repeated or infrequent operations, in order to provide increased reliability.

5.0 MECHANICAL REQUIREMENTS

5.1 GENERAL CONSTRUCTION

- 5.1.1 The enclosure design, coating, security, and tests shall be in accordance with IEEE C57.12.28, Standard for Pad-Mounted Equipment—Enclosure Integrity.
- 5.1.2 The pad mount transformer consists of a cabinet and tank. The cabinet consists of one high voltage compartment, one low voltage compartment, and two separate doors.
- 5.1.3 The general arrangements for the cabinet and tank shall be in accordance with Drawing No. [328371](#). All metal sections of the entire unit shall be adequately joined together.
- 5.1.4 The tank and the compartment shall be assembled as an integral unit, and shall be metal enclosed, weather-resistant, and tamper resistant.
- 5.1.5 The transformer shall be designed for anchoring on a pad without additional housing, fences, or other provisions to make the unit safe for direct contact with the public.
- 5.1.6 The overall transformer footprint shall be as follows:

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5.1.6.1 FOR CECONY PURCHASE ORDERS: Transformers shall be designed to fit on the concrete pad as shown in Drawing No. [EO-13775-B](#) without overhanging the slab or exposing cable entrance openings through the slabs. Coolers, however, if required, may overhang out from the tank enclosure, and slab a maximum of 30 inches.

5.1.6.2 FOR O&R PURCHASE ORDERS: Units shall be designed to fit on the concrete pad as shown in O&R drawing **C-13-051**.

5.1.7 The transformer material shall have the following minimum thicknesses:

- Cabinet ----- 0.090 inches (13 gauge)
- Tank Walls ----- 0.179 inches (7 gauge)
- Auxiliary Coolers----- 0.048 inches (18 gauge)

5.1.8 The entire surface of the pad-mount transformer shall be treated to minimize corrosion. The enclosure coating system shall comply with **IEEE C57.12.28, Standard for Pad-Mounted Equipment—Enclosure Integrity**.

5.1.9 The entire cabinet and tank shall be coated with weather-resistant, chip-resistant paint. The final paint finish shall be a dark, green color, either Munsell Notation 5.5 GY 2.76/2.1 or 7 GY 3.29/1.5.

5.1.10 Transformers (up to and including the 2500kVA size) shall be equipped with integral bottom support bars and be so constructed that they can be lifted using a forklift, using a crane, or skidded, and slid into place without damage to the cabinet or tank components. It shall not be necessary to have to use a crane to move and position the unit. However, provisions for crane lifting shall also be provided.

5.1.11 All transformer cabinets shall have two separate outside metal doors. One door shall provide access to the low voltage compartment and one to the high voltage compartment. Each door shall have welded on, inside non-corrosive hinges. Bolted-on hinges are acceptable provided the mounting hardware is brass, bronze, or

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stainless steel and the hinges are secured so that there are no exposed screws, bolts, or other fastening or devices that are externally removable (except for the Penta head bolts provided for extra security) that could provide access to energized parts in the enclosure.

5.1.12 All doors shall have non-corrosive, tamper-resistant hinges.

5.1.13 The front sill shall be removable.

5.1.14 Transformer sill and risers shall be manufactured of 304 Stainless Steel.

5.2 CABINET CONSTRUCTION

5.2.1 Cabinet doors shall be of sufficient size to provide adequate working space when opened between 160° and 180°. The doors shall be provided with latch stops, installed by the manufacturer, for latching the door in the open position at 100°.

5.2.2 The low and high-voltage compartment doors shall be adequately reinforced from the inside to prevent entrance into the compartments and misalignment of the doors and locking mechanisms.

5.2.3 A flange (¾-inch minimum width; 2-inch maximum width) shall be provided at the base of both the high voltage and low voltage compartments to provide a means for anchoring the unit to the pad.

5.2.4 **FOR CECONY PURCHASE ORDERS:** Doors with a maximum opening of 90° are acceptable, provided there is a 12" minimum clearance between high voltage bushing H1 and the door.

5.2.5 The height of the high voltage bushings shall be 27 inches from the bottom of the transformer in accordance with Drawing No. [32373](#).

5.2.6 The height of the low voltage bushings and neutral bushing shall be in accordance with the dimension table shown in Drawing No. [32373](#).

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- 5.2.7 All units shall have a minimum 43" width high voltage compartment.
- 5.2.8 See dimension table in Drawing No. [328373](#) for minimum width requirement for low voltage compartment.
- 5.2.9 For 4kV, 13kV, and dual 13/4kV transformers, the minimum depth of the high and the low voltage compartments shall be 20".
- 5.2.10 For 27kV units, the minimum depth of the high and the low voltage compartments shall be 23".
- 5.2.11 **FOR O&R PURCHASE ORDERS:** For units that are 750kVA and greater, the minimum low voltage compartment depth shall be 24" (inches) regardless of the high voltage rating.
- 5.2.12 The high voltage – low voltage partition shall be constructed of a non-conductive material or shall have an insulating barrier suitable for 7.62 kV to ground applications installed on the high voltage side of the metal.
- 5.2.13 There shall minimum clearance of 4.5" between the H₃ bushing well and the surface of the insulating barrier.
- 5.2.14 The low voltage compartment door shall be equipped with a handle, which has a three-point latching device. The latching shall be at the top, bottom, and center. The center shall fasten to the metal compartment divider.
- 5.2.15 In addition to the above, all access doors shall be fastened with a device that requires a Penta-head tool to permit unlatching the door only after the padlock has been removed. Hex head bolts are not acceptable. The Penta-head device or Penta-head captive bolt shall be coordinated such that the padlock may not be inserted into the hasp until the access door is fully latched and the Penta-head device is secured.
- 5.2.16 A minimum of one Penta-head device or captive bolt and padlocking means shall be provided. The Penta-head device or bolt shall be surrounded by a non-rotating guard or shall be recessed such that the Penta-head device or bolt can be engaged only by the proper

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tools. The dimensions of the Penta-head bolt and non-rotating recess or guard shall comply with IEEE C57.12.28, Fig. 1- Captive and recessed Penta-head bolts.

5.2.17 The Penta-head device or bolt shall not be readily removable until the padlock has been removed.

5.2.18 If the Penta-head bolt is missing, the design shall be such that the cabinet shall remain inaccessible through the bolt hole. The bolt hole shall be blocked from the back and all sides to prevent wire entry into the cabinet.

5.2.19 A float-type liquid level gauge shall be installed in the high voltage compartment near the Bay-O-Net fuses and provide a visual indication of the oil level. The liquid level gauge shall be mounted such that when it indicates the oil level is low, it is unsafe to operate the Bay-O-Net fuse as a load break or load make. The liquid level gauge shall be Heartland Liquid Level Gauge Catalog #HLG-1000 or approved equivalent.

Note: The liquid level gauge's float shall be located at the top of the sight glass when the insulating oil is at the full mark.

5.2.20 A standard top-oil temperature gauge shall be supplied and installed in the low voltage compartment.

5.2.21 An oil-sampling valve shall be supplied and located in the bottom left corner of the low voltage compartment, between 3 inches and 6 inches from the HV/LV barrier as shown in Drawing No. [328373](#).

5.3 TANK CONSTRUCTION

5.3.1 All units shall be provided with a handhole. The handhole cover shall be bolted on for all units and shall be covered with a false tamper-resistant roof.

5.3.2 The handhole shall provide functional access to all components. A rectangular handhole 12" min. X 18" min. or a round handhole with an 18" min. diameter is required. As an alternate, for units with a tank width of less than 62" a handhole of 9.5" min. X 17.5" min. may

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be provided. For units with a tank width of 62" and greater, two handholes shall be provided - each a minimum of 9.5" X 17.5".

- 5.3.3 The tank and the compartment shall be assembled as an integral unit, and shall be metal enclosed, weather-resistant, and tamper resistant.
- 5.3.4 The unit shall be designed for anchoring on a pad without additional housing, fences, or other provisions to make the unit safe for direct contact with the public.
- 5.3.5 As part of the quotation, the manufacturer shall confirm on Attachment 1 - Non-network Distribution Transformer General Information Report of [EO-5000](#) that the design complies with the test procedures and requirements of the design test method for cabinet security described in IEEE C57.12.28, Standard for Pad-Mounted Equipment—Enclosure Integrity

5.4 INTERNAL FAULT DETECTOR - (IFD)

- 5.4.1 All transformers shall be equipped with an Internal Fault Detector (IFD), which is a non-resettable maintenance-free mechanical device that detects internal transformer faults by reacting to a sudden pressure rise caused by a low impedance internal arcing fault inside the transformer. Refer to [EO-5076](#) for detail.
- 5.4.2 When the internal fault detector mechanism activates, a highly visible orange indicator is released as a warning to the maintenance crews that the transformer:
 - a. Has failed internally
 - b. Must not be re-energized
 - c. Must be replaced
- 5.4.3 The IFD shall be located a minimum of three inches away from the lifting lugs.
- 5.4.4 This device also incorporates pressure relief functionality that will operate to relieve excess static pressure.
- 5.4.5 The pressure relief valve shall have provision to be operated using

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a hot stick.

5.4.6 Each IFD-equipped transformer shall be identified by the transformer manufacturer(s) by attaching the IFD identification labels made of silver reflective material on the transformer tank in the following locations:

a. Directly underneath the IFD

b. Underneath the transformer to facilitate easy identification of an IFD equipped unit during fault locating.

5.4.7 The IFD device is manufactured by IFD Corporation or an approved equal.

5.5 OPERATING TEMPERATURE

5.5.1 Transformer operating temperature shall be in accordance with IEEE Standard C57.12.00 General Requirements for Liquid Immersed Distribution Transformers.

5.5.2 The average winding temperature rise above ambient temperature shall not exceed 65°C at rated kVA under continuous full load.

5.5.3 The maximum (hottest-spot) winding temperature rise above ambient temperature shall not exceed 80 °C at rated kVA under continuous full load.

5.5.4 Metallic parts in contact with current-carrying conductor insulation shall not attain a temperature rise in excess of the winding hottest-spot temperature rise.

5.5.5 The insulating liquid temperature rise above ambient temperature shall not exceed 65 °C when measured near the top of the tank.

5.5.6 The insulation shall be improved Class A insulation, designed to withstand 65°C rise continuously.

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5.6 **COOLING RADIATORS & FINS**

- 5.6.1 Manufacturer to determine if transformer cooling radiators or fins are required to maintain a maximum of 65°C winding temperature rise above ambient.
- 5.6.2 Cooling radiators or fins may be located on the rear or side portions of the transformer tank, refer to Drawing No. [328371](#) for details.

5.7 **PARKING STANDS**

- 5.7.1 Parking stands shall be provided in the high voltage compartment in accordance with the arrangement shown in Drawing No. [328371](#).
- 5.7.2 These parking stands shall accommodate all primary load-break accessories.
- 5.7.3 The letters, associated with the primary phases' "A", "B" and "C" shall be stenciled or labeled over each parking stand in accordance with Drawing No. [328373](#).
- 5.7.4 The stencils or labels shall be 0.75 inches high and painted yellow.
- 5.7.5 Parking stands shall be extended a sufficient distance from the front face of the transformer tank wall to allow installation and operation of cables and terminations when loop feed adapters (Feed Thru Inserts "Wish Bone Tees" or "Binoculars") are installed on the high voltage bushings.
- 5.7.6 Sufficient vertical clearance shall also be provided between the parking stands and the high voltage bushings to allow the insertion of the feed thru inserts without abrasion.
- 5.7.7 The bushing well mounting bolts shall be cut short enough to not interfere with the inserts.
- 5.7.8 Cables and terminators "parked" shall not interfere with cables and terminators connected to the loop feed adapters.
- 5.7.9 Sufficient clearance shall be provided to permit the installation of

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bushing mounted, elbow-type surge arresters in all units.

5.8 **GROUNDING**

5.8.1 A copper or stainless-steel tank ground pad shall be brazed or welded to both the high and low voltage compartments. This pad shall consist of two 1/2"-13 NC tapped holes (3/4" deep), spaced 1-3/4" distance between centers.

5.8.2 Ground clamps shall be provided in the high voltage compartment for terminating high voltage cable neutrals. These clamps shall be capable of accepting #8 to 2/0 AWG stranded copper conductors. They shall be screwed into a tapped boss that is welded to the tank. Two clamps per bushing are required.

5.9 **NAMEPLATE**

5.9.1 Except otherwise specified, nameplate information shall be in accordance with "Nameplate C" from the table entitled *Nameplate information* in IEEE C57.12.00 standard.

5.9.2 Manufacturer shall provide two nameplates. One nameplate shall be affixed on the inside of the low voltage compartment door and the other, above the low voltage bushings.

5.9.3 Nameplate shall have a "**PCB-FREE**" statement such as "oil-filled equipment in this assembly contains no detectable concentrations of PCB" or "contains less than 1 ppm PCB, at the time of manufacture."

5.9.4 Each transformer nameplate shall contain the month and year of production.

5.9.5 Nameplate shall contain the transformer's serial number.

5.9.6 The transformer's serial number shall contain the week and month of manufacture.

5.9.7 For transformers equipped with de-energized tap changers, the nameplate shall contain all tap positions and their respective

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voltages, see section [4.10](#).

5.9.8 **FOR CECONY PURCHASE ORDERS:** Nameplate shall include the transformer line number.

5.9.9 The preferred location for the permanent transformer bar code shall be the nameplate of the transformer. An alternate location for the bar code shall be a separate nameplate adjacent to the transformer nameplate. See section [5.10](#) Permanent Barcode for more detail.

5.9.10 Nameplate shall be made of corrosion-resistant material.

5.9.11 The corners of the nameplate shall be rounded.

5.10 **PERMANENT BARCODE**

5.10.1 Permanent barcode shall be applied to the transformer in accordance with IEEE C57.12.35 Standard Bar Coding for Distribution Transformers and Step-Voltage Regulators.

5.10.2 The barcode shall be encoded with the manufacturer identification code, two-digit month and two-digit year of manufacture, and serial number.

5.10.3 The nameplate of the transformer is the preferred location for the permanent barcode and its corresponding human-readable interpretation.

5.10.4 The alternate location for the barcode shall be a separate nameplate installed on the inside of the low voltage door below the transformer nameplate.

5.10.5 The symbology utilized for the barcode shall be Code 39.

5.10.6 The height of the barcode shall be no less than 0.61 cm (0.24 in)

5.10.7 There shall be a human-readable interpretation of the barcode data immediately beneath the barcode.

5.10.8 The height of the human human-readable interpretation of the

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barcode data shall be 0.25 cm (0.10 in).

5.10.9 The barcode shall be commonly readable with a commonly available scanner for the required lifetime for the equipment nameplate.

5.10.10 The proposed barcode shall be submitted to both CECONY and O&R for approval.

5.10.11 The barcode shall be tested for quality and durability in accordance with C57.12.35.

5.11 TEMPORARY BARCODE LABEL FOR O&R PURCHASE ORDERS

5.11.1 The temporary barcode labels shall be fabricated and installed as per the latest issue of Orange & Rockland Utilities, Inc. Material Standard [M-11-80](#).

5.11.2 A sample (an actual O&R label is required) shall be submitted to the Orange & Rockland Materials Management Department for approval prior to use or installation on any transformer supplied to O&R.

5.12 TEMPORARY BARCODE LABEL FOR CECONY PURCHASE ORDERS

5.12.1 The temporary bar code labels shall be in accordance with the latest revision of IEEE Standard C57.12.35 Bar Coding for Distribution Transformers and Step-Voltage Regulators.

5.12.2 The following information shall be included as barcoded data:

a) Manufacturer Identification Code:

- i) AB – ABB
- ii) PP- POWER PARTNERS
- iii) GE - GENERAL ELECTRIC
- iv) HI - HOWARD INDUSTRIES
- v) CP - COOPER POWER SYSTEMS
- vi) ER - ERMCO DISTRIBUTION TRANSFORMERS

b) Transformer Serial Number

c) CECONY Line-Item Number

d) Interpretation line for all the above

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- 5.12.3** Manufacturers not listed in section 5.12.2 (a) shall use two unique letters for the manufacturer identification code.
- 5.12.4** The barcode symbology utilized on the temporary label shall be Code 39, also referred to as Code 3-of-9.
- 5.12.5** The top barcode shall include the manufacturer's identification code and the transformer serial number between a start and stop character.
- 5.12.6** The serial number in the bar code must be identical to the serial number located on the transformer's nameplate.
- 5.12.7** The bottom barcode shall be a CECONY line-item number. This will consist of six alphanumeric characters beginning with the letter 'T' (data identifier) followed by five alphanumerical characters which represent the CECONY line-item number. A start character shall precede the complete CECONY line-item number, immediately followed by a stop character.
- 5.12.8** The logo, "CECONY", shall be printed in the lower corner to the left of the CECONY line-item number bar code.
- 5.12.9** A quiet zone of ¼ inch minimum shall immediately precede and immediately follow each bar code.
- 5.12.10** An interpretation line shall be provided directly beneath the bar-coded manufacturer's identification code and serial number. The interpretation line for the CECONY line-item number shall be directly above the barcoded CECONY line-item number.
- 5.12.11** The bar code height shall be ½ inch minimum. Specification between bar code lines shall be 2/5 to 3/5 inch. The interpretation line shall be a minimum of .10 inch to facilitate scanning. The overall size of the label shall be 2 ½ by 1 ¾ inch.
- 5.12.12** The temporary bar code label shall be located on the front of the transformer, in the upper left-hand corner on or above the door, not to exceed six feet in height, see Figure 1.

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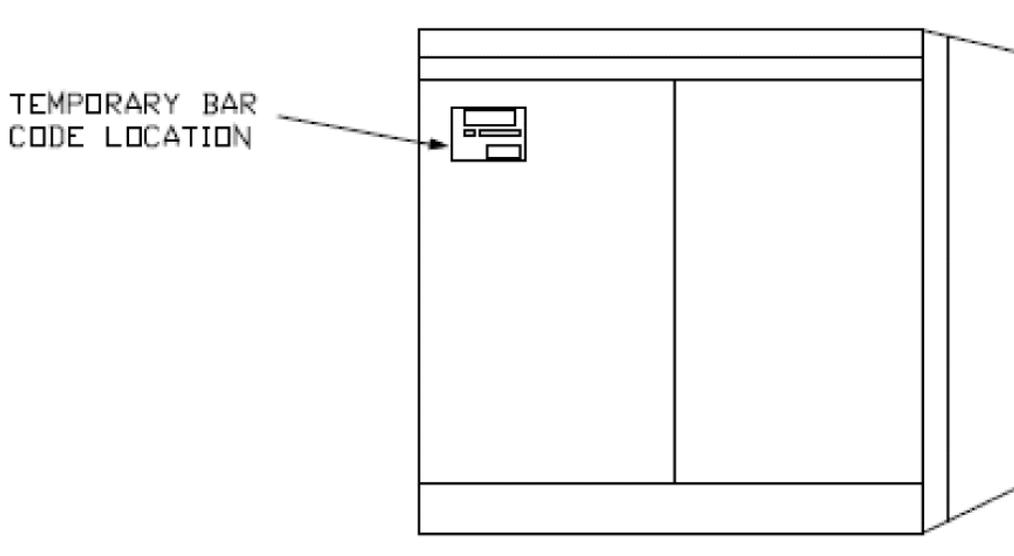


Figure 1 Temporary Barcode Location for Three Phase Pad-mount Transformer

5.12.13 Temporary Barcode Layout:

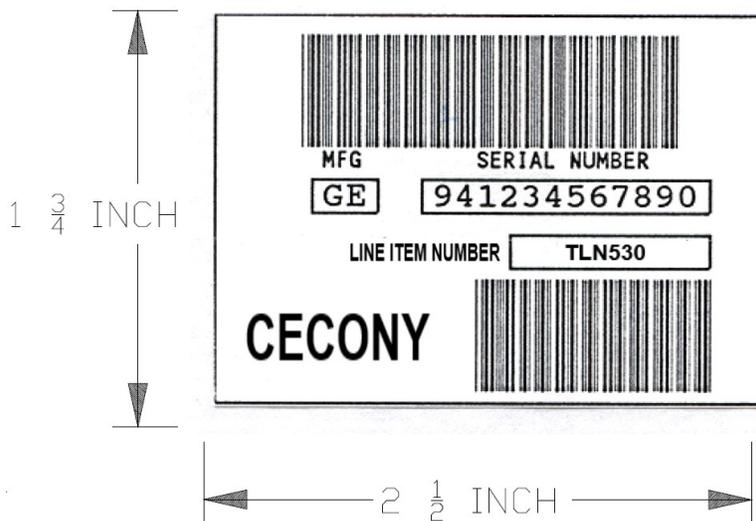


Figure 2 Example of Temporary Barcode

5.12.14 The temporary bar code labels shall have a minimum life of two years without loss of readability or adhesion.

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5.12.15 The temporary label is required to withstand the following conditions without loss of readability and adhesion for a period not less than two years.

- a) -20° to 150° F temperature
- b) Repetitive contact scanning
- c) Oil resistant
- d) Abrasion resistant
- e) Smear resistant
- f) Fade from exposure to ultraviolet

5.12.16 The label shall be applied in such a manner that air bubbles or curling corners will not occur.

5.12.17 The label must be strong enough to resist scrapes, scuffs, and other damage that is common in transportation, installation, and material handling.

5.12.18 The adhesive used shall not adversely affect the surface on which it is attached.

5.12.19 The barcode shall meet the quality/durability requirements and tests outlined in IEEE C57.12.35.

5.13 INSULATING OIL

5.13.1 The oil to be used in the transformer shall be hydro-refined, containing 0.15% to 0.18% DBPC inhibitor by weight. The type of oil to be used must be specified in the proposal. The approved oils are listed in [EO-10812](#).

5.13.2 The oil used in the transformer shall have no detectable concentrations of polychlorinated biphenyls (PCBs). A detectable concentration is defined as greater than 1.0 ppm.

5.13.3 The manufacturer shall specify on the Certified Test Report (CTR) for each transformer by serial number that the transformer contains no detectable level of PCB (less than 1 PPM) at the time of manufacture.

5.13.4 A [PCB Free](#) statement must be included on the nameplate. Refer to

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Section [5.9 Nameplate](#) for detail.

5.14 **FEEDER & BANK TAG HOLDER FOR CECONY PURCHASE ORDERS**

The manufacturer shall provide a feeder and bank tag holder bracket on the inside of the low voltage compartment door. This bracket shall be in accordance with Drawing No. [328374](#).

5.15 **IDENTIFICATION & LABELS / STENCILS**

5.15.1 **FOR CECONY PURCHASE ORDERS:**

5.15.1.3 The following class letters shall be stenciled on the inside of the low voltage compartment door as indicated on Drawing No. [328374](#) with 1.75" minimum yellow lettering:

Type of Unit	Class Letters
4kV Radial	PM - 4R
13kV Radial	PM - 13R
4x13kV Radial	PM - 4/13DR
27kV Radial	PM - 27R

PM (Pad-mount); D (Dual Voltage); R (Radial)

5.15.1.4 The transformer serial number, class letters, primary and secondary voltages and Line-Item Number shall be stenciled externally on the upper quadrant of either side of the transformer.

Notes: Stenciling numbers only on the transformer tanks without identifying the units associated with them is unacceptable. The letters "LN" for Line-Item Number of each unit shall be stenciled before the number and "KVA" shall be stenciled after the transformer size. See Drawing No. [328374](#).

5.15.1.5 For units with a low voltage rating of 277/480V, "**CAUTION 480 VOLTS SECONDARY**" shall be stenciled or labeled on the inside of the low voltage compartment door in yellow 1.75" minimum letters, and above the low voltage bushings

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in red 1.75" minimum letters, respectively.

5.15.1.6 For units with a low voltage rating of 120/208V, "**120/208V**" shall be stenciled or labeled on the inside of the low voltage compartment door and above the low voltage bushings in yellow 1.75" minimum letters.

5.15.1.7 Transformer manufacturer shall manufacture the "**CAUTION**", "**WARNING**", "**NOTICE**" and "**DANGER**" labels in accordance with [EO-3101](#).

5.15.1.8 Transformer manufacturer shall adhere the "**CAUTION**", "**WARNING**", and "**NOTICE**" labels on the upper right side of the exterior of the low voltage compartment door and adhere "**DANGER**" label on the interior of the low voltage compartment door, in accordance with **Attachment 2** of [EO-3116](#).

5.15.1.9 For 13/4kV dual voltage transformers, there shall be a label or stencil in the primary compartment near the Bay-O-Net fuse holders stating, "**Fused by Manufacturer for 13.2kV Operation**".

5.15.2 FOR O&R PURCHASE ORDERS:

5.15.2.1 The Orange & Rockland Utilities' material number shall be painted on the outside of the high voltage compartment door in the lower left corner. The lettering shall be yellow 1.0" high.

5.15.2.2 The transformer size, primary and secondary voltages, serial number, and impedance shall be stenciled externally on the upper quadrant of either side of the transformer.

5.15.2.3 For 13/4kV dual voltage transformers, there shall be a label or stencil in the primary compartment near the Bay-O-Net fuse holders stating, "**Fused by Manufacturer for 4.16kV Operation**".

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- 5.15.3 There shall be stencils or labels to indicate the location of the De-energized Tap Changer and Dual Voltage Switch (i.e., Dual Voltage Switch & De-energized Tap Changer). The stenciled or labeled letters shall be 0.75 inches high and painted yellow.
- 5.15.4 “LOAD BREAK” shall be labeled or stenciled above the Bay-O-Net fuse holders in 1-inch-high yellow lettering.
- 5.15.5 The voltages (13.2kV & 4.16kV) corresponding to the dual voltage switch positions shall be stenciled or labeled on the tank with 0.75 inches high letters, painted yellow.
- 5.15.6 De-energized tap changer switch positions shall be stenciled or labeled in accordance with [4.10](#).
- 5.15.7 The high voltage bushings and phases shall be stenciled or labeled in accordance with [4.6.18](#).
- 5.15.8 The low voltage and grounded-neutral bushings shall be stenciled or labeled in accordance with section [4.7.12](#).
- 5.15.9 The parking stands shall be stenciled or labeled in accordance with section [5.7.3](#).
- 5.15.10 Labels shall last the life expectancy of the transformer without loss of readability or adhesion.
- 5.15.11 Labels shall withstand a temperature range of -20° to 150° F, moisture, and ultraviolet light without loss of readability and adhesion.
- 5.15.12 Labels shall be applied in such a manner that air bubbles or curling corners will not occur.

5.16 ACCESSORIES

The following accessories shall be provided by the manufacturer on all units and shall all be located in the compartment as indicated.

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- 5.16.1 Liquid level gauge, float type located in the High Voltage Compartment. The liquid level gauge shall be Heartland Liquid Level Gauge Catalog #HLG-1000 or approved equivalent.
- 5.16.2 Standard top-oil temperature gauge (Low Voltage Compartment).
- 5.16.3 A 1" fill plug (Low Voltage Compartment) A 1" drain valve with sampling fitting or any other type of equivalent device. The device shall be located in the low voltage compartment, between 3 to 6 inches from the HV/LV barrier as shown in Drawing No. [328374](#). This will enable trained personnel to sample the insulating fluid at any time, while the transformer is energized and in operation. Under no circumstances shall a sampling device be provided, which requires de-energization of the transformer, for insulating fluid sampling.

5.17 FEED THRU LOAD BREAK INSERTS FOR CECONY PURCHASES ORDERS

- 5.17.1 The manufacturer shall install feed-thru load break inserts on all transformers. The inserts shall be rotatable at 360° to allow the operator to orient them to the best position.
- 5.17.2 The following table lists the acceptable feed-thru load break inserts for each primary voltage class:

Rating (kV)	Manufacturer	Catalog Number
15	Thomas & Betts (ABB)	1602A3R
15	Cooper Power (Eaton)	LF1215
25	Thomas & Betts (ABB)	2702A1
25	Cooper Power (Eaton)	LF1225
35	Thomas & Betts (ABB)	3702A1

6.0 REFERENCES

The following drawings and standards have been referenced within this specification.

Number	Title
EO-10812	Acceptance Tests of All New Transformer Insulating Fluids
EO-3101	Purchase Requirements for Equipment Safety Labels and Warning Tags
EO-3116	Purchase Recommendations and Placement of Equipment Safety Labels and Warning Tags
EO-5000	Bidding, Approval, And Contract Awarding Process for Electric Distribution Equipment
EO-4999	Non-Network Transformer Catalog
EO-5076	Purchase And Test Requirements of Internal Fault Detectors or Pressure Relief Valves for Non-Network Electrical Equipment
M-11-80	O&R Material Standard for Temporary Barcode Label
328371	General Outline for Three Phase Padmount Transformers
EO-13775-B	Pad Dimensions and Three Phase Padmount Transformer
328373	Interior Arrangement for Three Phase Padmount Transformer
328374	Bracket Assembly for Combination Feeder and Bank Tag Holder
349474	Low Voltage Terminal for Three Phase Padmount Transformer
C-13-051	O&R – Three Phase Pad-mount Transformer Concrete Pad Specifications

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7.0 REVISION SUMMARY

REVISION 23:

1. Changed the title of the specification.
2. Re-arranged, renamed, and added sections for clarity and logical flow. Changes are shaded in grey.
3. Updated “ANSI” to “IEEE” standard throughout the document.
4. Updated section 1.0 Purpose.
5. Added section 2.0 Applicable Standards.
6. Under section 3.0 General:
 - Removed Quality Assurance Specification 7100, Level D.
 - Added acceptance of amorphous core, EO-5000 Bidding and Approval Process for Electric Distribution Equipment, and EO-4999 Non-Network Transformer Catalog.
7. Under section 4.0 Electrical Requirements:
 - Removed Tap Changer identification tables and updated 4kV transformer tap settings with two 2 ½% taps above and two 2 ½% taps below nominal high voltage.
 - Removed Transformer Ratings and Line Number section.
 - Updated impedance voltage percent values.
 - Added 4kV and 13kV straight voltage transformers to Transformer Windings and Core Construction table.
 - Updated primary fuse tables and relocated to [Appendix C](#).
 - Updated Primary Three Phase Two Position Load Break Switch catalog numbers and minimum electrical characteristic requirements.
 - Updated impedance voltage percent values to align with IEEE C57.12.34 standard.
 - Added Section 4.1 De-energized Tap changer.
8. Under section 5.0 Mechanical Requirements:
 - Added Section 5.4 Internal Fault Detector; Section 5.5 Operating Temperature; Section 5.6 Cooling Radiators & Fins; Section 5.9 Nameplate; Section 5.10 Permanent Barcode; Section 5.11 Temporary Barcode Label For O&R Purchase Orders; Section 5.12 Temporary Barcode Label for CECONY Purchase Orders; Section 5.15 Identification & Labels / Stencils.
 - Updated Feed Thru Insert parts numbers in Section 5.17
9. Removed sections Invitation to Bid; Manufacturer’s Proposals Submittal; Evaluation of Proposals; Awarding of Contracts; Purchase Orders; Modification of Design; Inspections & Tests; Certified Test Reports; Company Inspections

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and Tests; Delivery Warranty and Unit Returned Under Warranty; Shipping and Transportation section.

10. Under section 6.0 References:

Added EO-4999 Non-Network Transformer Catalog; EO-5000 Bidding, Approval, and Contract Awarding Process for Electric Distribution Equipment; EO-3116 Purchase Recommendations and Placement of Equipment Safety Labels and Warning Tags; EO-13775-B Pad Dimensions and Three Phase Padmount Transformer; M-11-80 O&R Material Standard for Temporary Barcode Label; C-13-051 O&R – Three Phase Pad-mount Transformer Concrete Pad Specifications.

11. Removed Attachment:

- Attachment 1 – Three Phase Padmount Transformer Guarantee Report
- Attachment 2 – Check List for Proposal Requirements

12. Removed Drawing Attachments:

- 328371-General Outline for Three Phase Padmount Transformers
- 328372-Pad Dimensions and Openings for Three Phase Padmount Transformers
- 328373-Interior Arrangement for Three Phase Padmount Transformers
- 328374-Bracket Assembly for Combination Feeder and Bank tag Holder
- 349474 – Padmount Transformer Low Voltage Terminal
- C-13-051 – O&RU Padmount Transformer Installation

13. Added Appendix A - Transformer Specification Summary

14. Added Appendix B – Three-Phase Two Position Load Break Switch Minimum Electrical Characteristics

15. Added Appendix C - Primary Fuse Tables for Three Phase Padmount Transformers

16. Added Appendix D – Impedance Percent

FILE:

Purchase and Test Manual No.6,
Section No. 25 - Transformer and Accessories

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APPENDIX A –TRANSFORMER SPECIFICATION SUMMARY

Primary Voltage (V)	Secondary Voltage (V)	Capacity (kVA)	BIL (kV) Pri/Sec	Tap Changer	Primary Bushing rating (Amps)	Primary Fuses / Switch
13200 Delta	208GrdY/120	150	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch
		300				
		500				
		750				
		1000				
		1500				
13200 Delta	480GrdY/277	500	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch
		750				
		1000				
		1500				
		2000				
4160GrdY/7620	208GrdY/120	150	60 / 30	5 pos. ±1.25% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch
		300				
		500				
		750				
		1000				
4160GrdY/7620	480 GrdY/277	150	60 / 30	5 pos. ±1.25% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch
		300				No Fuse / No Switch
		500			600 A	No Fuse / 3-Phase Load Break Switch
		750				No Fuse / No Switch
		1000				
		1500				
		2000				

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4265GrdY/2462	480 GrdY/277	1000	60 / 30	5 pos. ±2.5% incr.	600 A	No Fuse / 3-Phase Load Break Switch
13200GrdY/7620	208 GrdY/120	75	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3- Phase Load Break Switch
		150				
		300				
		500				
		750				
13200GrdY/7620	480 GrdY/277	1000	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3- Phase Load Break Switch
		750				
		1500				
		2500				
		75				
		150				
		300				
13200GrdY/7620	208 GrdY/120	75	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3- Phase Load Break Switch & DV Switch
		150				
		300				

x 4160GrdY/2400		500				
		1000				
13200GrdY/7620 x 4330GrdY/2500	480GrdY/277	150	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch & DV Switch
		500				No fuse / 3-Phase Load Break Switch & DV Switch
		1000			600 A	No Fuse / DV Switch
		2000				
13200GrdY/7620 x 4160GrdY/2400	480GrdY/277	75	95 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch & DV Switch
		150				
		300				Fuse for O&R Purchase Orders Only: Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch & DV Switch
		500				
		750				
25750GrdY/14865	208GrdY/120	500	150 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3-Phase Load Break Switch
		1000				

25750GrdY/14865	480GrdY/277	500	150 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3- Phase Load Break Switch
		1000				
26400GrdY/15240	480GrdY/277	500	150 / 30	5 pos. ±2.5% incr.	200 A	Bay-O-Net Fuse & CLF / 3- Phase Load Break Switch
		1000				

APPENDIX B – LOAD BREAK SWITCH MINIMUM ELECTRICAL REQUIREMENTS

Electrical Characteristics	4kV,13kV, & 4/13kV (Dual Voltage) Transformers	27kV Transformers
Phase-to-Ground	8.9kV Max.	15.6kV Max.
Phase-to-Phase	15.5kV Max.	27.6kV Max.
Power Frequency Withstand	34kV, 60HZ, 1 min.	40kV, 60HZ, 1 min.
DC Withstand	53kV, 5 mins.	78kV, 5 mins.
Corona Extinction Voltage	26kV	26kV
BIL	95 kV 1.2x50 microsecond wave	125kV 1.2x50 microsecond wave
Continuous Load Current	550 amperes	400 amperes
Magnetizing Interrupting Current	21 amperes	21 amperes
Fault Withstand Current (Momentary)	12.5kA RMS Symmetrical & 19.2kA RMS Asymmetrical for 10 Cycles	12.5kA RMS Symmetrical & 19.2kA RMS Asymmetrical for 10 Cycles
Fault Close and Latch	12.5kA RMS Symmetrical & 19.2kA RMS Asymmetrical for 10 Cycles	12.5kA RMS Symmetrical & 19.2kA RMS Asymmetrical for 10 Cycles

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APPENDIX C - PRIMARY FUSE TABLES

Table A: 13/4kV GrdY-GrdY Dual Voltage Transformers								
Voltage (kV)	Size (kVA)	Transformer Primary Full Load Amps	Field Replaceable Bay-O-Net Style Expulsion Fuse			Non-Field Replaceable Current Limiting Fuse (CLF)		
			Bay-O-Net Voltage Rating (kV)	Bay-O-Net Current Rating (Amps)	Bay-O-Net Cooper Power Catalog Number	CLF Voltage Rating (kV)	CLF Current Rating (Amps)	CLF Cooper Power Catalog Number
4 ^c	75	10.42	8.3kV (Phase to Ground)	25	4000353C10	8.3kV (Phase to Ground)	80	CBUC08080C100
	150	20.84		40	4000353C12		150	CBUC08150D100
	300	41.68		65	4000353C14		150	CBUC08150D100
	500	69.47		140	4000353C17		150 (300) ^a	CBUC08150D100 ^a (Qty. 2 in Parallel)
	750	104.21		140	4000358C18 ^b		250 (500) ^a	CBUC08250D100 ^a (Qty. 2 in Parallel)
13 ^d	75	3.28		10	4000353C06		80	CBUC08080C100
	150	6.56		15	4000353C08		150	CBUC08150D100
	300	13.12		25	4000353C10		150	CBUC08150D100
	500	21.87		40	4000353C12		150 (300) ^a	CBUC08150D100 ^a (Qty. 2 in Parallel)
	750	32.80		65	4000358C14 ^b		250 (500) ^a	CBUC08250D100 ^a (Qty. 2 in Parallel)
	<p>a. CLF fuses in parallel.</p> <p>b. Eaton Cooper Power: Dual Sensing Bay-O-Net Fuse - 200% transformer loading for 2 hours, 160% loading for 7 hours.</p> <p>c. For O&R Purchase Orders: Bay-O-Net fuses supplied by transformer manufacturer shall be rated for 4.16kV operation.</p> <p>d. For CECONY Purchase Orders: Bay-O-Net fuses supplied by transformer manufacturer shall be rated for 13.2kV operation.</p>							
<p>Note:</p> <p>1. Transformer primary full load amps were calculated using 13.2kV and 4.16kV.</p> <p>2. Transformer overload factor of 1.5 was used to calculate the Current Sensing Bay-O-Net fuse size.</p>								

Table B: 4kV GrdY-GrdY Transformers								
Voltage (kV)	Size (kVA)	Transformer Primary Full Load Amps	Field Replaceable Bay-O-Net Style Expulsion Fuse			Non-Field Replaceable Current Limiting Fuse (CLF)		
			Bay-O-Net Voltage Rating (kV)	Bay-O-Net Current Rating (Amps)	Bay-O-Net Cooper Power Catalog Number	CLF Voltage Rating (kV)	CLF Current Rating (Amps)	CLF Cooper Power Catalog Number
4	75	10.42	8.3kV (Phase to Ground)	25	4000353C10	8.3kV (Phase to Ground)	80	CBUC08080C100
	150	20.84		40	4000353C12		150	CBUC08150D100
	300	41.68		65	4000353C14		150	CBUC08150D100
	500	69.47		140	4000353C17		150 (300) ^a	CBUC08150D100 ^a (Qty. 2 in Parallel)
	750	104.21		140	4000358C18 ^b		250 (500) ^a	CBUC08250D100 ^a (Qty. 2 in Parallel)

a. CLF fuses in parallel.
b. Eaton Cooper Power: Dual Sensing Bay-O-Net Fuse - 200% transformer loading for 2 hours, 160% loading for 7 hours.

Note:
1. Transformer primary full load amps were calculated using 4.16kV.
2. Transformer overload factor of 1.5 was used to calculate the Bay-O-Net fuse size.

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Table C: 13kV GrdY-GrdY Transformers								
Voltage (kV)	Size (kVA)	Transformer Primary Full Load Amps	Field Replaceable Bay-O-Net Style Expulsion Fuse			Non-Field Replaceable Current Limiting Fuse (CLF)		
			Bay-O-Net Voltage Rating (kV)	Bay-O-Net Current Rating (Amps)	Bay-O-Net Cooper Power Catalog Number	CLF Voltage Rating (kV)	CLF Current Rating (Amps)	CLF Cooper Power Catalog Number
13	75	3.28	8.3kV (Phase to Ground)	10	4000353C06	8.3kV (Phase to Ground)	30	CBUC08030C100
	150	6.56		15	4000353C08		50	CBUC08050D100
	300	13.12		25	4000353C10		80	CBUC08080D100
	500	21.87		40	4000353C12		150	CBUC08150D100
	750	32.80		65	4000353C14		150	CBUC08150D100
	1000	43.74		65	4000353C14		150	CBUC08150D100
	1500	65.61		140	4000353C17		150 (300) ^a	CBUC08150D100 ^a (Qty. 2 in Parallel)
	2000	87.48		140	4000353C17		150 (300) ^a	CBUC08150D100 ^a (Qty. 2 in Parallel)
	2500	109.34		140	4000358C18 ^b		250 (500) ^a	CBUC08250D100 ^a (Qty. 2 in Parallel)

a. CLF fuses in parallel.
b. Eaton Cooper Dual Sensing Bay-O-Net Fuse - 200% transformer loading for 2 hours, 160% loading for 7 hours.

Note:

- Transformer primary full load amps were calculated using 13.2kV.
- Transformer overload factor of 1.5 was used to calculate the Current Sensing Bay-O-Net fuse size.

Table D: 13kV Delta - GrdY Transformers

Voltage (kV)	Size (kVA)	Transformer Primary Full Load Amps	Field Replaceable Bay-O-Net Style Expulsion Fuse			Non-Field Replaceable Current Limiting Fuse (CLF)		
			Bay-O-Net Voltage Rating (kV)	Bay-O-Net Current Rating (Amps)	Bay-O-Net Cooper Power Catalog Number	CLF Voltage Rating (kV)	CLF Current Rating (Amps)	CLF Cooper Power Catalog Number
13	150	6.56	15.5kV (Phase to Phase)	15	4000353C08	15.5kV (Phase to Phase)	50	CBUC15050C100
	300	13.12		25	4000353C10		80	CBUC15080C100
	500	21.87		40	4000353C12		150	CBUC15150D100
	750	32.80		65	4000353C14		150	CBUC15150D100
	1000	43.74		65	4000353C14		165	CBUC15165D100
	1500	65.61		140	4000353C17		150 (300) ^a	CBUC15150D100 ^a (Qty. 2 in Parallel)
	2000	87.48		140	4000353C17		150 (300) ^a	CBUC15150D100 ^a (Qty. 2 in Parallel)

a. CLF fuses in parallel

Note:

1. Transformer primary full load amps were calculated using 13.2kV.
2. Transformer overload factor of 1.5 was used to calculate the Bay-O-Net fuse size.

Table E: 27kV GrdY-GrdY Transformer								
Voltage (kV)	Size (kVA)	Transformer Primary Full Load Amps at 25.750kV	Field Replaceable Bay-O-Net Style Expulsion Fuse			Non-Field Replaceable Current Limiting Fuse (CLF)		
			Bay-O-Net Voltage Rating (kV)	Bay-O-Net Current Rating (Amps)	Bay-O-Net Cooper Power Catalog Number	CLF Voltage Rating (kV)	CLF Current Rating (Amps)	Bay-O-Net Voltage Rating (kV)
27	500	11.55	23kV (Phase to Ground)	25	4000353C10	23kV (Phase to Ground)	100	CBUC23100C100
	750	16.82		40	4000353C12		165	CBUC23165D100
	1000	22.42		40	4000353C12		165	CBUC23165D100
	1500	33.63		65	4000353C14		150 (300) ^a	CBUC23150D100 ^a (Qty. 2 in Parallel)
	2000	44.84		100	4000353C16		150 (300) ^a	CBUC23150D100 ^a (Qty. 2 in Parallel)

a. CLF fuses in parallel

Note:

- Transformer primary full load amps were calculated using 25.75kV.
- Transformer overload factor of 1.5 was used to calculate the Bay-O-Net fuse size.

APPENDIX D – IMPEDANCE PERCENT

Three Phase Rating (kVA)	Impedance Percent Range at 85°C
45	2.70% to 5.75%
75	
150	3.10% to 5.75%
225	
300	
500	4.35% to 5.75%
750	5.75%
1000	
1500	
2000	
2500	

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