

1. Scope

This Specification covers the requirements for furnishing and delivering three-phase, 60-Hz, mineral-oil-immersed, self-cooled, compartmental-type, pad-mounted distribution transformer(s) rated 2500 kVA and smaller, suitable for use on a 12.47 Grounded Y/7.2kV electrical distribution system. Transformers shall be loop feed type unless otherwise specified on the Special Provision Sheet.

2. Reference Standards

All characteristics, definitions, terminology, voltage designations and tests, except as otherwise specified herein, shall

be in accordance with the following industry standards for distribution, power and regulating transformers. When the following standards are superseded by an approved revision, the revision shall apply.

Industry Standards

ANSI/AIM BC2-1995 Uniform Symbology Specification - Code 39

ANSI C57.12.00-2010 IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers

ANSI C57.12.28-2014 IEEE Standard for Pad-Mounted Equipment — Enclosure Integrity

ANSI C57.12.34-2009 IEEE Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15kV Nominal System Voltage and Below

ANSI C57.12.35-2013 IEEE Standard for Bar Coding for Distribution Transformers

ANSI C57.12.37-2006 IEEE Standard for the Electronic Reporting of Distribution Transformer Test Data

ANSI C57.12.70-2011 IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers

ANSI C57.12.80-2010 IEEE Standard Terminology for Power and Distribution Transformers

ANSI C57.12.90-2010 IEEE Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and IEEE Guide for Short Circuit Testing of Distribution and Power Transformers

IEEE 386-2006 IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V

DOE Title 10 Part 431.191 Distribution Transformers — Energy Conservation Standards and Their Effective Dates

NEMA 260-1996 (R2004) Safety Labels for Pad-Mounted Switchgear and Transformers Sited in Public Areas

NEMA TR 1 (R2000) Transformers, Regulators & Reactors

District Standards

Material Standard 386202.1 2-1/4" Labels for Marking District Owned Equipment

Material Standard 890526.1 Padmount Equipment Danger Label

Material Standard 890534.1 Padmount Equipment Warning Label

Material Standard 1000212.1 Non-PCB Label

3. losses and efficiency

3.1 No-Load Losses

No-load losses (core losses) shall be quoted in watts, referenced at 20°C in accordance with ANSI C57.12.00-2010.

3.2 Load Losses

Load losses (winding losses) shall be quoted in watts, referenced at 85°C in accordance with ANSI C57.12.00-2010.

3.3 Efficiency

Transformers shall meet the efficiency requirements of the U.S. Department of Energy as stated in DOE 10 CFR Part 431, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule, as applicable.

4. Electrical Ratings, Material ID numbers & DOE Minimum efficiencies

kVA Size	High Voltage	Low Voltage	Material ID	DOE Min. Efficiency
75	12.47GrdY/7.2	208Y/120 480Y/277	636318 636334	99.03%
112.5	12.47GrdY/7.2	208Y/120 480Y/277	636516 636532	99.11%
150	12.47GrdY/7.2	208Y/120 480Y/277	636714 636730	99.16%
225	12.47GrdY/7.2	208Y/120 480Y/277	636912 636938	99.23%
300	12.47GrdY/7.2	208Y/120 480Y/277	637019 637035	99.27%
500	12.47GrdY/7.2	208Y/120 480Y/277	637217 637233	99.35%
750	12.47GrdY/7.2	208Y/120 480Y/277	637415 637431	99.40%
1000	12.47GrdY/7.2	208Y/120 480Y/277	637605 637613	99.43%
1500	12.47GrdY/7.2	480Y/277	637811	99.48%
2000	12.47GrdY/7.2	480Y/277	638017	99.51%
2500	12.47GrdY/7.2	480Y/277	638215	99.53%

5. Construction

The padmounted transformer shall consist of the transformer tank, high-voltage cable termination compartment and low-voltage cable termination compartment. All three of these components shall be assembled as an integral unit, tamper resistant, and weather resistant, designed for flush mounting on a rigid pad. The padmounted transformer shall meet the construction and security requirements of ANSI C57.12.34-2009 and ANSI C57.12.28-2014.

5.1 Transformer Tank

The supporting frame shall be sufficiently strong to prevent noticeable deflection or distortion to the cabinet during installation and use.

The transformer cover shall be either bolted or welded, with provisions for access to the internal weak link fuses and replacement of bushings. When transformer covers are bolted or handholes are provided, they shall be of a tamper-resistant design, with provisions for locking.

The transformer tank roof shall be crowned so as to shed water.

5.2 Transformer Cabinet

The high-voltage and low-voltage cable terminating compartments shall be separated by a removable rigid metal barrier.

The roof(s) shall be sufficiently strong to support approximately 500 pounds of weight distributed over the entire top with a concentrated load of 200 pounds applied at any point.

The cabinet roof(s) shall be constructed so as to shed water. If two roofs are used, water shall not collect at the intersection of the two roofs.

5.3 Transformer Doors

The doors covering the high-voltage and low-voltage compartments shall be:

- Of sufficient size to provide adequate operating and working space when open.
- Side-hinged to swing open horizontally. Top-hinged, clam-shell type doors are unacceptable.
- Equipped for latching in the open position.

The access doors shall be secured with a captive and recessed pentahead bolt in accordance with ANSI C57.12.28-2014, Figure 1. Bolts shall be stainless steel or bronze and their design shall minimize the possibility of misalignment and cross threading. All transformers shall include provisions for padlocking designed so the padlock cannot be inserted until the pentahead bolt is fully engaged.

5.4 Limiting Overall Dimensions

Overall transformer cabinet dimensions shall not exceed the values listed below:

kVA Size	Width	Depth	Height
75-500	5'-10"	5'-10"	6'-6"
750-2500	7'-6"	8'-10"	6'-6"

5.5 Grounding

Tank grounding pads shall conform to ANSI C57.12.34-2009, Section 8.11 and be located on the outside corners of the transformer tank high voltage and low voltage compartments. The grounding pad threads shall be fitted with removable plastic plugs prior to transformer shipment. Each tapped hole shall be preinstalled with a compatible bronze grounding lug per the following table:

Manufacturer	Part Number
Fargo Mfg.	CG-207
Richards Mfg.	RTG512-M
Macleam Power Systems	BVC-207
Eritech Specialty Products	CC-207

5.6 Finish

The transformer shall have a corrosion resistant finish that meets or exceeds the coating system requirements of ANSI C57.12.28-2014. The topcoat color of paint shall be semi-gloss Munsell Number 7GY 3.29/1.5, pad-mount green. All finish components shall be lead free.

6. Components

The low-voltage and high-voltage compartments shall be designated and dimensioned as shown in ANSI C57.12.34-2009, Figure 12.

6.1 High-Voltage Terminals

For units 2500 kVA and smaller, high-voltage connectors shall be provided. The connectors shall consist of bushing wells conforming to IEEE 386, latest revision, designed to accommodate 8.3/14.4kV 200A load-break bushings. The bushing wells shall be mounted in accordance with ANSI C57.12.34-2009, Figure 14A. Bushings shall be removable from the outside for maintenance and replacement. Each phase position shall be provided with a parking stand.

Each transformer shall be supplied with factory installed 8.3/14.4kV 200A loadbreak bushing inserts per the following table:

Manufacturer	Part Number
Cooper Power Systems	LBI215
T&B/Elastimold	1601A3R/1601A4
Hubbell Power Systems	215BI

Bushing inserts shall be covered with dust caps prior to shipment to prevent contamination or damage.

6.2 Low-Voltage Terminals

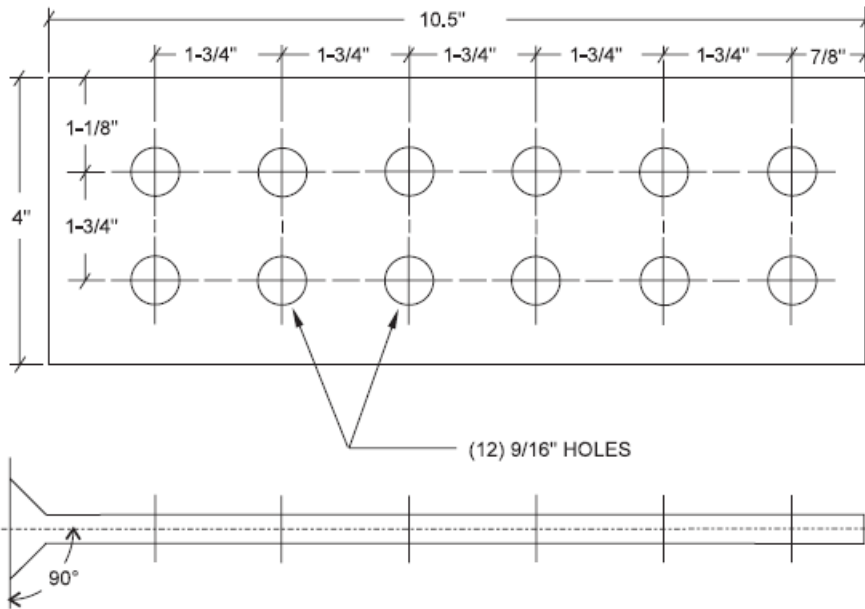


FIGURE 1

kVA	Voltage
500 - 2500	208Y/120
500 - 2500	480Y/277

NOTE: All dimensions are in inches.

Low-voltage terminals shall be arranged in accordance with ANSI C57.12.34-2009, Figure 8(a).

Transformers 300kVA and smaller shall be equipped with copper studs dimensioned and threaded per ANSI C57.12.34-2009, Figure 15B.

Transformers 500kVA and larger shall be equipped with one-piece NEMA tinned copper spades with a minimum of twelve usable holes configured per Figure 1 of this Specification. Spades shall be equipped with bushing supports.

6.3 Primary Taps

Transformer(s) with 208Y/120 volt low-voltage ratings shall not have taps unless specified on the Special Provision Sheet.

Transformer(s) with 480Y/277 volt low-voltage ratings shall have two (2) 2.5% taps above and below rated voltage unless otherwise specified on the Special Provision Sheet. Tap changers when furnished shall be externally operable.

6.4 Transformer Oil

The transformer shall be shipped with the proper quantity of mineral insulating oil. Oil shall meet the requirements of ASTM D 3487 for Type II (inhibited) oil. At the time the oil is put into the tank it shall contain less than (1) ppm PCB certifiable by a laboratory test approved by the United States Environmental Protection Agency. The insulating oil, or any of its components, shall not be listed by IARC, NTP, OSHA or ACGIH as carcinogens. The successful bidder shall supply an MSDS sheet for each distinct formulation of insulating oil supplied to the District.

Alternative insulating fluids, including ester-based and silicone-based oils may be supplied with prior District review and approval.

6.5 Fusing

Each transformer shall be provided with a bayonet style fuse holder assemblies equipped with a valve to minimize oil spillage when the fuse holder is removed. Fuse holders shall be externally removable with a hot stick. Each fuse holder assembly shall be provided with an oil-catching drain or drip plate. The drip shield shall extend out from the transformer tank approximately four inches. Fuse holder shall be fully compatible with Cooper Bay-O-Net fuses. Fuse assemblies for 1000 kVA and larger transformers shall have silver plated contacts.

All transformers 750 kVA and smaller shall be provided with Cooper Bay-O-Net dual sensing fuses in series with isolation links per the following table:

kVA Size	Fuse Size (amperes)	Fuse Curve No.	Load Sensing Fuse Element Cooper Cat. No.	Isolation Link Cooper Cat. No.
75	8	C5	4000358C05	3001861A02
112.5	15	C8	4000358C08	3001861A03
150	15	C8	4000358C08	3001861A03
225	25	C10	4000358C10	3001861A05
300	25	C10	4000358C10	3001861A05
500	50	C12	4000358C12	3001861A06
750	50	C12	4000358C12	3001861A06
The time current curve is Cooper R240-91-51				

Transformers 1,000 kVA and larger shall be provided with Cooper High Ampere Overload Bay-O-Net fuses in series with Cooper ELSP current-limiting backup fuses per the following table:

kVA Size	Fuse Size (amperes)	Load Sensing Fuse Element Cooper Cat. No.	ELSP Current-Limiting Fuse Cooper Cat. No.
1000	100	4038361C04CB	3544125M71M
1500	100	4038361C04CB	3544125M71M
2000	125	4038361C05CB	3544125M71M
2500	125	4038361C05CB	3544125M71M
The time current curve is Cooper R240-91-53			

7. Noise

Transformer sound levels shall not exceed the values listed below when measured in accordance with ANSI C57.12.90-2010:

Equivalent Two-winding kVA	Average Sound Level (decibels)
0-50	48
51-100	51
101-300	55
301-500	56
750	57
1000	58
1500	60
2000	61
2500	62

8. Identification

8.1 Nameplate

A corrosion-resistant nameplate shall be provided which conforms to ANSI C57.12.00-2010. Additionally, the nameplate shall show gallons of oil and total transformer weight with oil.

The following statement shall appear on the nameplate: "Contains less than 1 ppm PCB at the time of manufacture".

Nameplates shall be bar coded in accordance with ANSI C57.12.35-2013.

8.2 Safety Labels

Safety labels, if specified in the Special Provisions Sheet, shall meet the following requirements.

One WARNING sign decal shall be attached to the outside front of each cable termination compartment access door and one DANGER sign decal shall be attached to the inside of each cable termination compartment access door. WARNING decals shall conform to the latest revision of District Material Standard 890534.1 and DANGER decals shall conform to the latest revision of District Material Standard 890526.1.

The decals shall be centered in the upper one-half of the access door both inside and outside, per Figure 2 of this specification. The bottom edge of the outside warning decal shall be a minimum of eight (8) inches above the bottom edge of the access door.

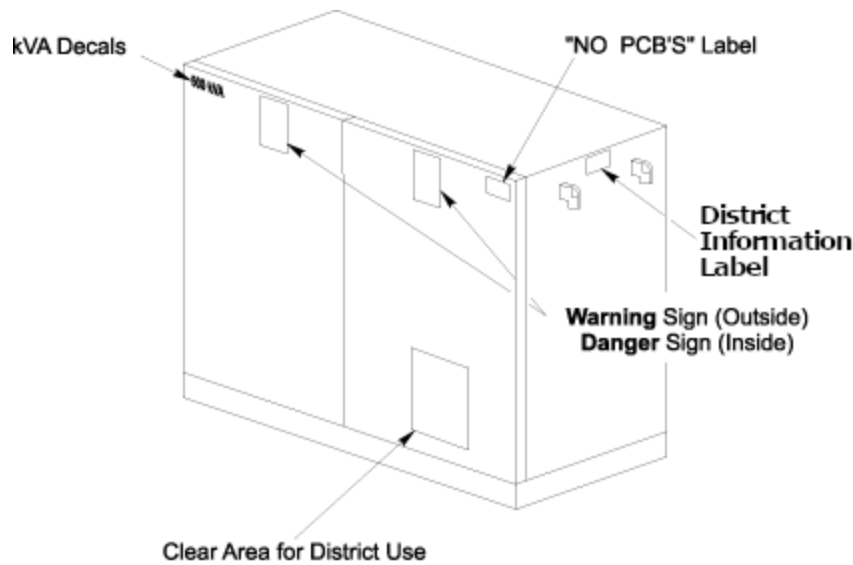


Figure 2

8.3 kVA Decals

kVA decals, if specified in the Special Provisions Sheet, shall meet the following requirements.

The kVA size of the transformer shall be marked with 2¼" yellow reflective decals in the upper left-hand corner of the front surface of the access door as shown in Figure 2 of this Specification. Marking decals shall conform to the latest revision of District Material Standard 386202.1.

8.4 Non-PCB Decal

A "NON-PCB" decal, if specified in the Special Provisions Sheet, shall meet the following requirements.

One "NON-PCB" decal shall be attached to each transformer. "NON-PCB" decals shall conform to the latest revision of District Material Standard 1000212.1 (refer to Figure 3 of this specification).

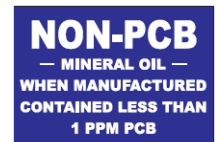


FIGURE 3

The decals shall be positioned in the upper right corner of the low-voltage compartment door (refer to Figure 2 of this specification). The top edge of the decal shall align with the top edge of the access door.

8.5 Labeling

Each transformer shall be labelled with the following information:

Line	Data	Length	Example
1	District's Material Number*	11	"00006303130" *The number 0 must prefix the catalog number to fill 11 characters
2	District's Material Description	<= 50	"Transformer, Underground 15 kVA Padmount (L) 240/120"
3	Date	8	"05/22/03"
4	"PO/REL" <i>space</i> PO Number (8 Characters) <i>space</i> Release Number (5 Characters)	12	"PO/REL 00001111 00001"
5	Transformer Serial Number	12	"000125875632"

The decal shall be durable and weather resistant. The decal shall be placed on the transformer tank cover.

9. Guarantee

The failure of any transformer due to defective design, material and/or workmanship within 12 months after being energized or 18 months after delivery, whichever comes first, shall be repaired or replaced without cost to the District. Any defect in design, material and/or construction discovered within this period shall be corrected on all transformers furnished on this order at the manufacturer's expense, either by repair or by replacement.

10. Test Reports

The bidder shall furnish certified copies of the short-circuit tests they have performed on each transformer design.

Short-circuit tests shall be in accordance with ANSI/IEEE C57.12.00-2010 and C57.12.90-2010.

The District may reject any bid, when in its judgment, the bidder has not taken sufficient steps to meet the mechanical short-circuit requirements as detailed in the ANSI/IEEE standards.

11. Inspection and Testing

After delivery, all of the delivered lot will be inspected for defects and conformance to this Specification and tested for proper internal connections. The manufacturer (or his representative) will be notified of all defects and mutual arrangements shall be made for correcting the defects at no expense to the District. All subsequent testing required due to the defects will be at the manufacturer's expense.

12. Packaging

Transformers shall be shipped secured to individual nonreturnable wooden pallets suitable for handling with a forklift.

300 kVA and smaller transformers shall be shipped in an enclosed van. Transformers 300 kVA and smaller shipped on flat-bed trucks, even if tarped or otherwise protected shall be refused and returned to vendor. Transformers 500 kVA and up shall be shipped on flatbed or soft-sided carriers. 2,000kVA and larger transformers must be accessible for overhead lifting. Pro-

visions shall be made to protect transformers shipped on flatbed trucks from contamination of the transformer exterior and cable chambers from rocks, dirt, insects and other foreign materials encountered in shipment.

13. Bidder's Data

For each transformer line item, all bidders shall supply:

- One certified copy of all design tests as called for in ANSI C57.12.00-2010, Table 18.
- All data and information as requested on the attached bidder's data file.

A description of any proposed changes, additions or exceptions to the Specification shall be submitted along with reasons for the departure.

14. Data to be Furnished by the Successful Bidder

14.1 CAD Drawings

A CAD drawing outline dimensions of each transformer line item with accessories. Acceptable formats include Microstation, AutoCAD or DXF.

14.2 Certified Transformer Test Data

Certified data for each transformer shall be submitted for each transformer at the time of shipment or other mutually agreed upon interval. Test data shall reported in electronic form, supplied as an ASCII file with variable length records, comma delimited. Fields shall be stripped of leading and trailing blanks. The data set shall include the standard and extended data sets per ANSI C57.12.37-2006 modified as given:

Field	Field Name	Data Type	Sample Data	Valid Values
1	User Name	Char(20)	SNOHOMISH COUNTY PUD	SNOHOMISH COUNTY PUD
2	User Purchase Order Number	Char(8)	00026350	PO number including leading zeros.
3	User Stock Number	Char(10)	0000630592	Mat. ID number including leading zeros.
4	Producer Identification	Char(2)	HI	See ANSI C57.12.35-2007.
5	Producer Order Number	Char(14)	4337	
6	Producer Catalog Number	Char(15)	1037-418997-000	
7	Producer Serial Number	Char(13)	1765201303	
8	Product Type	Char(2)	PM	See ANSI C57.12.37-2006, 4.2.8.
9	Number of Phases	Int(1)	1	1,2 or 3
10	kVA Rating	Numeric(7,1)	37.5	Nominal ONAN kVA to 1 decimal point.
11	Primary Voltage	Char(47)	12 470GrdY/7200	See ANSI C57.12.00-2006.
12	Secondary Voltage	Char(28)	240/120	See ANSI C57.12.00-2006.
13	Polarity	Char(1)	S	A (Additive), S (Subtractive), Null (3Ø).
14	Quoted No-Load Loss	Int(5)	45	Quoted no-load losses in watts at nominal kVA, Pri. voltage & 20°C.

Field	Field Name	Data Type	Sample Data	Valid Values
15	Quoted Load Loss	Int(6)	201	Quoted load losses in watts at nominal kVA, Pri. voltage & 85°C.
16	Quoted Impedance Voltage (IZ)	Numeric(4,2)	2.57	Quoted IZ in percent at nominal kVA, Pri. voltage & 85°C.
17	Quoted Excited Current (IEX)	Numeric(4,2)	0.27	Quoted IEX in percent at nominal kVA, Pri. voltage & 85°C.
18	Tested No-Load Loss	Int(5)	44	Tested no-load losses in watts at nominal kVA, Pri. voltage & 20°C.
19	Tested Load Loss	Int(6)	189	Tested load losses in watts at nominal kVA, Pri. voltage & 85°C.
20	Tested Impedance Voltage (IZ)	Numeric(4,2)	2.6	Tested IZ in percent at nominal kVA, Pri. voltage & 85°C.
21	Tested Resistance Voltage (IR)	Numeric(4,2)	1.66	Tested IR in percent at nominal kVA, Pri. voltage & 85°C.
22	Tested Exciting Current (IEX)	Numeric(4,2)	0.30	Tested IEX in percent at nominal kVA, Pri. voltage & 85°C.
23	Total Mass	Int(5)	892	Total mass, including accessories & oil.
24	Mass Unit of Measure	Char(2)	lb	lb (pounds), kg (kilograms).
25	Date of Manufacture	Char(7)	2005/05	Alphanumeric in yyyy/mm format.
26	Test Data Reporting Lot	Char(7)	2005/05	yyyy/mm or yyyy/qx where qx is Q1, Q2, Q3 or Q4.
27	User Release Number	Char(5)	00107	Release number including leading zeros.
28	Producer Plant Location	Char(10)	MSLAUREL	See ANSI C57.12.00-2006, 4.3.2.
29	Quoted Loss Guarantee Type	Char(2)	GA	See ANSI C57.12.00-2006, 4.3.3.
30	No-Load Loss Evaluation Factor	Numeric(5,2)	5.2	00.00 to 99.99
31	Load Loss Evaluation Factor	Numeric(5,2)	1.23	00.00 to 99.99
32	Frequency	Int(2)	60	Nominal operating frequency in hertz, 0 to 99.
33	Cooling Class	Char(9)	ONAN	ONAN, ONAN/ONAF, KNAN/KNAF or LNaN/LNAF.
34	Average Winding Temperature Rise	Char(5)	65	55, 55/65, 65 or other as specified.
35	Type of Insulating Fluid	Char(8)	MIN_OIL	MIN_OIL, FR3, EnviroTemp, R TEMP or as specified.
36	No-Load Loss Reference Temperature	Int(2)	20	0 to 99.
37	Load Loss Reference Temperature	Int(2)	85	0 to 99.
38	Total Volume of Oil	Int(4)	47	0 to 9999.
39	Volume Unit of Measure	Char(2)	GL	GL (gallons) or LT (liters).

14.3 Equipment Data Sheet

Each shipment of transformers shall include a digital spreadsheet including all transformers in the shipment and their nameplate data. The spreadsheet shall be formatted to the District's requirements and shall be emailed to the District's Standards Department prior to delivery of each transformer shipment. The District will provide the required spreadsheet template to the manufacturer.