

**SINGLE-PHASE  
POLE MOUNT  
TRANSFORMER SPECIFICATION**





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## 1.0 GENERAL

- 1.1 This specification covers the electrical and mechanical characteristics of single-phase overhead-type distribution transformers. All transformers supplied under this specification shall be the conventional type with two high voltage bushings.
- 1.2 All characteristics, definitions, and terminology, except as specifically covered in this specification, shall be in accordance with the latest revision of the following ANSI standards and shall comply with the latest requirements of the Rural Utility Service (RUS) specifications associated with pole mount transformers.

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

C57.12.20 - Overhead-Type Distribution Transformers, 500 KVA and Smaller: High Voltage, 34500 Volts and Below: Low Voltage, 7970/13800Y Volts and Below.

C57.12.35 - Bar Coding for Distribution Transformers.

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

C57.91 - Guide for Loading Mineral-Oil-Immersed Overhead and Pad-Mounted Transformers rated 500 kVA and less with 55°C or 65°C average winding rise.

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

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

C57.12.91 - Guide for Loading Mineral-Oil-Immersed Overhead and Pad-Mounted Transformers Rated 500 kVA and Less with 65°C or 55°C Average Winding Rise.

- 1.3 Manufacturers shall include both actual and evaluated prices on all bids. Prices quoted shall include all options and accessories covered in this specification, shipping and handling charges, Washington sales tax, and losses in accordance with Section 9.3.
- 1.4 Pend Oreille Public Utility District #1 reserves the right to reject any bids that do not comply with the provisions of this specification.

2.0 RATINGS

- 2.1 The transformer shall be designed in accordance with this specification and shall have one of the following kVA ratings:

15, 25, 37.5, 50, 75, 100, 167

The applicable kVA ratings shall be specified on the inquiry.

**Table 1  
Transformer and Connector High-voltage Ratings and Electrical Characteristics**

Transformer High-voltage		Minimum kVA Rating For Low-voltage Rating of:	
Rating (V)	BIL (kV)	120/240* (V)	277 or 240/480* (V)
12470GrdY/7200	95	15	15
24490GrdY/14400	125	15	15
12470GrdY/7200 x 24940GrdY/14400	95 x 125	15	15

\* Low-voltage rating of 120/240 volts or 240/480 volts is suitable for series, multiple, or three-wire service.

The applicable voltage rating shall be specified on the inquiry.

2.2 The applicable voltage rating and BIL shall be specified on the inquiry. Dual voltage primaries shall utilize an externally operable switch. Unit must be de-energized prior to changing voltages. The BIL level for dual voltage units will correspond to each connection.

2.3 The secondary voltage shall be one of the following. The basic insulation level (BIL) of the secondary voltage shall be 30 kV.

- 120 (2 bushings)
- 120/240 (3 bushings)
- 240/480 (3 bushings)
- 277 (2 bushings)

The applicable secondary voltage shall be specified on the inquiry.

2.4 The transformer shall be furnished with full capacity high-voltage taps. The taps shall be +/- (2) 2<sup>1</sup>/<sub>2</sub>% above and below nominal voltage. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer as required in Section 6.2.1 of ANSI C57.12.20.

3.0 HIGH VOLTAGE BUSHINGS AND TERMINALS

3.1 Two high-voltage bushings shall be provided on each transformer. The high-voltage bushings provided shall be in accordance with Table 2 and shall be situated per Figure 10 of ANSI C57.12.20-1997 Table 7.

**Table 2  
Electrical Characteristics of Bushings**

BIL Withstand (kV)	Creepage Distance* InchesMillimeters	60-Hz Dry 1-Minute Withstand (kV)	60-Hz Wet 10-Second Withstand (kV)
30	- -	10	6
95	10½ ± ½ 267 ± 13	35	30
125	16½ ± 1½ 419 ± 38	42	36

\* Creepage distances are minimum values where no tolerance is specified.

3.2 The bushing terminals provided shall be tin plated to accommodate both aluminum and copper conductors. The size of these terminals shall be in accordance with Table 3.

**Table 3  
High-voltage Terminal Sizes for Single-phase Transformers**

Size of Terminal Opening Inches Millimeters	AWG Size of Conductor Terminal will Accommodate	kVA Range for High-Voltage Rating of:
5/16 7.9 5/8 15.9	No 8 Solid to No 2 Stranded No 6 Solid to 4/0	15-167 250-500

3.3 The color of the bushings shall match Light Gray Number 70, Munsell Notation 5BG7.0/0.4.

4.0 LOW VOLTAGE BUSHINGS AND TERMINALS

- 4.1 The low-voltage bushings provided shall be in accordance with Table 2.
- 4.2 The bushing terminals provided shall be tin plated to accommodate both aluminum and copper conductors. The size of the terminals shall be in accordance with Table 4.

**Table 4  
Low-voltage Terminal Sizes for Single-phase Transformers**

Size of Terminal Opening Inches Millimeters		AWG Size of Conductor Terminal will Accommodate	Transformer Low Voltage Rating (volts)		
			120/240	240/480	277
5/8	15.9	No 6 Solid to No 4/0-19 Stranded	10-15	10-25	10-25
13/16	20.6	No 2 Solid to 350 kcmil-19 Stranded	25-50	37 ½ - 100	37 ½ - 100
15/16	23.8	No 1/0 Solid to 500 kcmil-37 Stranded	75	-	-
1-1/4	31.8	No 2/0 Solid to 1000 kcmil-61 Stranded	100	-	-
Spade H	---	---	167-250	167-500	167-250
Spade J	---	---	333-500	-	333-500

- 4.3 The internal secondary leads shall be permanently embossed with the letters A, B, C, and D per ANSI C57.12.00 and C57.12.20. This marking can be used as a means to locate such leads with respect to one another for internal reconnection.

## 5.0 PROTECTION

- 5.1 The protection scheme provided with the transformer shall consist of the following attributes. If for any reason a special protection scheme is required it will be clearly stated on the inquiry.

5.1.1 Primary overvoltage protection will be provided by an externally mounted, heavy-duty, MOV arrester. Arrester shall be tank mounted and connected to the H1 bushing. Ratings of arresters provided shall be as specified below:

- a. 7,200 Volt primary rating transformers shall have arresters with an MCOV rating of 8.4 kV.
- b. 14,400 Volt primary rating transformers shall have arresters with an MCOV rating of 15.3 kV.
- c. Dual voltage transformers shall be provided with arresters with MCOV ratings sized for the higher of the two primary voltage ratings.

5.1.2 Primary overcurrent protection shall be provided by an internally mounted weak link fuse.

## 6.0 TANK

6.1 The core and coil shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer will be filled with preheated filtered degassed insulating fluid. The core shall be manufactured from burr-free, grain-oriented silicon steel and shall be precisely stacked to eliminate gaps in the corner joints. The coil shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper.

6.2 The dielectric coolant in the transformer must be highly refined inhibited new PCB free, mineral oil and meet the minimum requirements as specified in Table 1, "Functional Property Requirements," of ASTM D3487 and ANSI C57.106.

- 6.3 The tank shall include a pressure relief device as a means to relieve pressure in excess of pressure resulting from normal operation. The venting and sealing characteristics shall be as follows:

Cracking pressure: 10 psig  $\pm$  2 psig  
Resealing pressure: 6 psig minimum  
Zero leakage from reseal pressure to -8 psig  
Flow at 15 psig: 35 SCFM minimum

- 6.4 The tank coating shall meet all requirements in ANSI C57.12.31 including:

Salt spray  
Crosshatch adhesion  
Humidity  
Impact  
Oil resistance  
Ultraviolet accelerated weathering  
Abrasion resistance - taber abraser

- 6.5 The tank provided shall have a recessed tank bottom which offers protection when sliding over rough surfaces.

- 6.6 The tank shall have an internal mark, which indicates the proper oil level per Section 6.2.3 of ANSI C57.12.20.

- 6.7 The tank shall be provided with a mild steel cover ring with stainless steel cover ring loops and a stainless steel bolt. A bronze nut shall also be provided to eliminate corrosion problems and avoid galling.

- 6.8 The tank shall be complete with an anodized aluminum laser engraved nameplate. Nameplate shall conform to ANSI C57.12.00, nameplate A.

- 6.9 The tank shall include arrester mounting brackets near each high voltage bushing, grounding provisions, ANSI support lugs (hanger brackets) and lift lugs. The type of hanger brackets (double) shall be specified on the inquiry.



## 7.0 ACCESSORIES

7.1 The following checked accessories shall be provided:

- a. Stainless steel hardware
- b. Stainless steel cover band
- c. ½” drain with plug.
- d. Tank ground connector (double bushing units)
- e. Standard ANSI pole mounting bracket
- f. Lifting brackets or ears

## 8.0 SHIPPING

- 8.1 Unit shall be banded, blocked or bolted to a suitable skid with 2½ inches of clearance for shipment.
- 8.2 Units shall be shipped FOB “Free on Board” Destination to Pend Oreille Public Utility District’s warehouse at 112 S Union Ave, Newport, WA 99156
- 8.3 Delivery will be “Flatbed Side-load only”.

## 9.0 TESTING AND LOSSES

- 9.1 All units shall be tested for no-load (85°C) losses, total (85°C) losses, percent impedance (85°C), excitation current (100% voltage). Each unit shall be subjected to a full wave voltage impulse and leak test. The manufacturer shall provide certification upon request for all design and other tests listed in Table 19 of ANSI C57.12.00 including verification that the design has passed short circuit criteria per ANSI C57.12.00 and C57.12.90.
- 9.2 The manufacturer shall provide the guaranteed average no-load and load losses for the unit at 85°C. These losses will be subject to the tolerances listed in Table 5.

**Table 5  
Tolerances for Transformer Losses**

Number of Units on One Order	Basis of Determination	No-Load Losses (%)	Total Losses (%)
1	1 unit	10	6
2 or more	Each Unit	10	6
2 or more	Average of all units	0	0

### 9.3 Loss Formula and Evaluated Purchase Price

Transformer prices will be evaluated on the following formula:

$$\text{Evaluated Price} = (3.5 \times \text{NLL}) + (1.25 \times \text{FLL}) + \text{Delivered Price}$$

Where:

**NLL** is the no-load loss in watts.

**FLL** is the load loss in watts at the transformer's rated load.

**Delivered Price** is the per unit price for the transformer including the cost of the transformer, shipping and handling charges, and all applicable taxes.

Manufacturers shall provide both actual and evaluated prices on all bids along with NLL and FLL values for each transformer quoted.

## 10.0 BAR CODING

- 10.1 A temporary bar code label shall be attached to the exterior of the transformer in accordance with ANSI C57.12.35.