

**S. C. Electric Cooperative's**  
**Specification for a Single-Phase, Single Bushing (Self-Protected) Overhead Distribution**  
**Transformer**  
(Revised 10/2015)

**1.0 GENERAL**

**1.1** This specification covers the electrical and mechanical characteristics of Single-Phase, Single Bushing, Self-Protected, Oil-Filled (certified non-PCB) Overhead Distribution Transformers.

**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.

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.

C57.12.90 - 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 55°C or 65°C average winding rise.

**1.3** In addition to the above requirements, the transformers shall also meet the requirements of the Rural Utility Service (RUS-formerly REA) Specification D-10 and Department of Energy (DOE) 10 CFR Part 431 Efficiency Compliance.

**2.0 RATINGS**

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

10, 15 , 25, 37.5, 50, 75, 100, 167

*<The applicable kVA rating shall be specified on Attachment A.>*

**2.2** The primary voltage and the basic insulation level (BIL) shall be 95 kV for 12,470 Grd. Y/7200 volts, 125 kV for 24,940 Grd. Y/14,400 volts and 95 X 125 kV for 12,470 Grd. Y/7200 X 24,940 Grd. Y/14,400 volts (dual voltage primary).

*<The primary voltage shall be specified on Attachment A.>*

**2.2.1** Dual voltage transformer shall have dual voltage primary windings connected to an externally operable, dual voltage selector switch for de-energized operation only. Two operations (minimum) shall be required to change switch position. Unit to be shipped with voltage selector switch in highest voltage position.

**2.3** The secondary voltage shall be 120/240 volts. The basic insulation level (BIL) of the secondary shall be 30 kV. All secondary windings for 10, 15 and 25 kVA ratings shall be interlaced.

**2.4** *If specified on Attachment A*, the transformer shall be furnished with full capacity high-voltage taps. The tap changer shall be clearly labeled to reflect that the transformer must be de-energized before operating the tap changer. If taps are required on dual voltage units, the taps shall be on the higher voltage (series) position. The unit shall have one of the following tap configurations:

Two - 2½% taps above and below rated voltage

Four - 2½% taps below rated voltage

### **3.0 HIGH VOLTAGE BUSHINGS AND TERMINALS**

**3.1** The high-voltage bushings provided shall be wet process porcelain in accordance with Table 6 of ANSI C57.12.20. The high voltage bushing shall be located 180° from the secondary neutral bushing.

**3.2** The bushing terminals provided shall be tin plated, eyebolt type to accommodate both copper and aluminum conductors. The size of these terminals shall be in accordance with Table 10 of ANSI C57.12.20.

**3.3** The bushing terminals shall be equipped with one of the following:

PVC Birdguards

Handwheel birdguards

No birdguards

*<The applicable terminal configuration shall be specified on Attachment A.>*

### **4.0 LOW VOLTAGE BUSHINGS AND TERMINALS**

**4.1** The low-voltage bushings provided shall be in accordance with Table 6 of ANSI C57.12.20.

**4.2** The bushing terminals provided shall be tin plated, ½” studded (threads) eyebolt type to accommodate both aluminum and copper conductors. The size of the terminals shall be in accordance with Table 12 of ANSI C57.12.20.

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.

4.4 The neutral bushing shall be connected to the tank by means of an adequately sized copper ground strap. Tank-end connection of the ground strap shall be made using a silicon-bronze or 300 series stainless steel bolt.

## 5.0 PROTECTION

5.1 The overvoltage protection shall be provided by a polymer housed, tank mounted, MOV surge arrester with ground lead isolator. Arrester shall be 10 kA (heavy duty) minimum duty cycle. Furnish 10 kV Class for 95 kV BIL and 18 kV class for 125 kV BIL. Arrester shall have an insulating PVC birdguard and shall be connected to the high voltage bushing with an insulated wire suitable for outdoor exposure. Mounting bolts on arrester bracket shall be made using a silicon-bronze or 300 series stainless steel bolt.

*<The arrester housing material shall be specified on Attachment A.>*

5.2 A primary oil-immersed expulsion fuse (weak link) shall be installed to electrically isolate the transformer in case of internal failure.

5.3 An oil-immersed secondary breaker that protects the transformer from secondary overloads and short circuits shall be provided. **If specified on Attachment A**, the secondary breaker shall have an optional overload capability shall be furnished.

## 6.0 TANK

6.1 The tank shall include a pressure relief device, located on the tank above the 140° C top-oil level between the hanger bracket in segment four and the primary bushing, as a means to relieve pressure in excess of pressure resulting from normal operation. The venting and sealing characteristics shall be as follows:

1. Cracking Pressure - 10 psig  $\pm$  2 psig
2. Resealing Pressure - 6 psig minimum
3. Zero leakage from reseal pressure to -8 psig
4. Flow at 15 psig - 40 SCFM minimum

The pressure relief device shall have a pull ring for manually reducing pressure to atmospheric level using a standard hook-stick and shall be capable of withstanding a static pull force of 25 pounds for one minute without permanent deformation.

6.2 The tank coating shall meet all requirements in ANSI C57.12.31 (Gray color).

- 6.3 The tank provided shall have a recessed tank bottom which offers protection when sliding over rough surfaces.
- 6.4 The tank shall have an internal mark which indicates the proper oil level per Section 6.2.3 of ANSI C57.12.20.
- 6.5 The tank shall be provided with a mild steel cover ring or center bolt design cover and a stainless steel bolt and washer with a stainless steel or silicon bronze nut.
- 6.6 The tank shall be complete with an anodized aluminum or stainless steel laser engraved nameplate. This nameplate shall meet ANSI Standard C57.12.00 - 1993 for Nameplate B. The nameplate shall be visible when facing the secondary terminals and mounted on the lower hanger bracket in segment two.
- 6.7 The tank shall include arrester mounting pads, two complete grounding terminals mounted on the lower portion of the tank below the secondary terminals and adjacent to the hanger bracket, two sets of hanger brackets located on opposite sides of the tank and 90° from the secondary bushings, and lift lugs.
- 6.8 The kVA rating shall be durably marked in numerals not less than 2 ½ inches high on both sides of tank, one located on the tank under the secondary bushings and the other located opposite.

## 7.0 SHIPPING

- 7.1 Unit shall be banded, blocked or bolted to a suitable wooden pallet with 2½ inch clearance for shipment.
- 7.2 A temporary bar code label shall be attached to the exterior of the transformer in accordance with ANSI C57.12.35.
- 7.3 The customer shall be notified at least 24 hours in advance of shipment *as specified on Attachment A*. Shipper shall give total number of units to be shipped and the weight of the heaviest unit(s).

## 8.0 TESTING AND LOSSES

- 8.1 All units shall be tested for no-load (20°C) losses, load (85°C) losses, percent impedance (85°C), and excitation current (100% voltage). Losses attributable to auxiliary devices (e.g., circuit breaker) installed in the transformer but not a part of the core/coil assembly shall be deducted from the load losses when calculating DOE efficiency. 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 17 of ANSI C57.12.00 including verification that the design has passed Short Circuit Criteria per ANSI C57.12.00 and ANSI C57.12.90.

**8.2** The manufacturer shall provide and send electronically and by mail (if requested by Purchaser on Attachment A) Certified Test Reports (CTR) in IEEE 1388 format. The CTR shall guarantee the average no-load and load losses. **No individual unit shall be shipped that exceeds guaranteed losses by more than 10% no load and/or 6% total loss. . If actual average losses exceed the guaranteed value, the penalty will be as specified on Attachment A.**

**8.3** The CTR shall also report the following DOE efficiency values:

1. Standard Efficiency Level as specified in DOE Chart, Table I.1
2. Absolute Minimum Efficiency for any one unit calculated using DOE formula  $n=1$ .
3. Minimum Average Efficiency for number of units in the basic model as calculated using DOE's formula.
4. Number of units (n) in the basic model
5. Tested or calculated DOE Efficiency for each unit
6. Average of the Tested DOE Efficiency for number of units in the basic model.

**8.4** The radio influence voltage shall not exceed 100 micro-volts at 1000 kHz when measured at 110% of rated voltage.

**Any exceptions to these specifications must be stated by the manufacturer when submitting the proposal.**

RCD 4/22/02 (Original)

**Attachment "A"**  
**Single Phase, Single Bushing (Self-Protected) Overhead**  
**Distribution Transformer**

\_\_\_\_\_ Electric Cooperative    Dated \_\_\_\_\_

**I. Rating (kVA) [Quantity of each]:**

\_\_\_ 10 \_\_\_ 15 \_\_\_ 25 \_\_\_ 37.5 \_\_\_ 50 \_\_\_ 75 \_\_\_ 100 \_\_\_ 167

**II. Primary Voltage (volts):**

\_\_\_ 12,470 Grd Y/ 7200 \_\_\_ 24,940 Grd Y/14,400  
\_\_\_ 12,470 Grd Y/7200 X 24,940 Grd Y/14,400

**III. Primary taps:**            \_\_\_ None \_\_\_ Two-2 1/2% above and below \_\_\_ Four below

**IV. HV Bushing Terminals:**

\_\_\_ No Birdguards \_\_\_ PVC Birdguards \_\_\_ Handwheel Birdguards

**V. Overload Capability on Secondary Breaker:**                    \_\_\_None\_\_\_ Furnish Overload Capability

**VI. Loss Formula (Based on Present Worth):**

Total Owning Cost (TOC) = (1.5 X initial unit cost) + ( \$8.00 X NL losses) +  
( \$2.00 X Load losses).  
Units within a +3% window of lowest TOC will be considered equal.

**VII. Penalty for Exceeding Guaranteed Losses:**

Total Penalty =     [\$ \_\_\_\_\_ X (Average NL losses furnished - NL losses guaranteed) + \$ \_\_\_\_\_  
X (Average Load losses furnished – Load losses guaranteed)] X Total number of Units. This will apply for all  
units in each line item of the purchase order with no credits back to manufacturer.

**VIII. The Certified Test Reports (CTR) shall be sent:**

\_\_\_\_\_ At time of shipment \_\_\_ monthly \_\_\_\_\_ quarterly \_\_\_ other \_\_\_\_\_  
\_\_\_\_\_ By mail to \_\_\_\_\_

**IX. Shipping**

Notify \_\_\_\_\_ at phone # \_\_\_\_\_ at least 24 hours  
before shipment. Receiving hours are \_\_\_\_\_ Monday through Friday. Ship to \_\_\_\_\_  
\_\_\_\_\_ office in \_\_\_\_\_, SC.

**X. Other Special requirements:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_