

TECHNICAL SPECIFICATIONS THREE PHASE PAD MOUNTED TRANSFORMERS

1. SCOPE
 - 1.1 This specification covers the electrical and mechanical requirements for three phase, sixty cycle, wye-wye connected, pad mounted, distribution transformers, in various kVA ratings for use on an underground electric distribution system.
2. APPLICABLE DOCUMENTS
 - 2.1 Unless otherwise indicated all transformers shall conform to the latest issue of the following American National Standards Institute (ANSI) documents:
 - (1) IEEE C57.12.00-2006 or latest revision, General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - (2) ANSI C57.12.28-2005 or latest revision, Switchgear and Transformers, Pad-Mounted Equipment-Enclosure Integrity.
 - (3) IEEE C57.12.34 - 2009 or latest revision, Standard 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, 15 kV Nominal System Voltage and Below .
 - (4) IEEE C57.12.90-2006 or latest revision, Test Code for Liquid-Immersed Distribution Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers.
 - (5) ANSI/IEEE 386 - 1985 or latest revision, Separable Insulated Connectors for Power Distribution Systems above 600 V.
 - (6) Department of Energy (DOE), 10 CFR Part 431, Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards, Final Rule RIN 1904-AB08, [Docket Number: EE-RM/STD-00-550]
3. RATINGS
 - 3.1 All ratings shall be based on not exceeding a 65 degree C. winding temperature rise. The high voltage basic impulse insulation level (B.I.L) shall be 95 kV.
 - 3.2 Transformers that currently exceed the January 1, 2016, DOE minimum efficiency levels shall remain at these efficiency levels. All other transformers shall meet or exceed the January 1, 2016, DOE minimum efficiency levels, effective 1/1/16.
- 3.3 High voltage: 12470 Grd.Y/7200
- 3.4 Low voltage: 208 Grd.Y/120 or 480 Grd.Y/277, as indicated on the request for quotation.
- 3.5 Size (kVA): 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, as indicated on the request for quotation.
4. DESIGN AND CONSTRUCTION
 - 4.1 General
 - (1) The transformer shall be constructed in compliance with ANSI C57.12.34-2009, and ANSI C57.12.28-2005.
 - (2) *The transformer shall be 100% Stainless Steel (S.S. 304) construction.*
 - (3) The transformer shall be a pad mounted compartmental type, which when assembled shall be an integral unit for mounting on a pad.
 - (4) The transformer shall be a loop-feed design and comply with those specific dimensions specified in Figures 11, and 12, ANSI C57.12.34-2009, for high voltage connections. Arrangement of low voltage terminals shall be as shown in Figure 4 of ANSI C57.12.34-2009, with dimensions as shown in figure 2, of this specification (page T-95.16).
 - (5) Transformers shall be designed to comply with the short circuit capability requirements of IEEE 57.12.00, 2006.
 - (6) Transformers shall not deviate from the allowable dimensional limitations shown in figure 2. of this specification.
 - (7) Transformer cores shall be constructed of high grade, cold reduced, grain oriented silicon steel with low hysteresis and eddy current losses or constructed of amorphous metal.
 - 4.2 Bushings and Terminals
 - (1) The number, location and arrangement of the high voltage and low voltage bushings and terminals shall be as shown in Figures 4, 11, and 12 of ANSI C57.12.34 2009.
 - (2) The transformer shall be supplied with 8.3/14.4 kV class bushing wells and loadbreak bushing inserts for the high voltage connections which conform to the requirements of ANSI/IEEE standard 386-1985. Bushing wells shall be externally clamped and shall be provided

Revision Date: 7-22-15 KLC 9-22-15 KLC 3-27-19 KLC 6-3-19 KLC 7-29-19 KLC	 Gainesville Regional Utilities Electric System Approved Materials Manual ITEM NAME TRANSFORMER, THREE PHASE (PAD) (TECHNICAL SPECIFICATIONS)
---	---

for a loop feed system with dimensions as shown in Figure 11 of ANSI C57.12.34-2009.

- (3) Low voltage line and neutral terminals shall be six (6) hole spade type, as shown in Figure 15A of ANSI C57.12.34-2009, for the 500 kVA and smaller units. Low voltage line and neutral terminals shall be ten (10) hole spade type, as shown in Figure 15A of ANSI C57.12.34-2009, for the 750 kVA to 2500 kVA units.
- (4) Low voltage bushings on units rated 500 kVA and smaller shall be epoxy or porcelain with six (6) hole terminals and shall be externally clamped. Low voltage terminals shall be arranged staggered as shown in Figure 4 of ANSI C57.12.34-2009.
- (5) Low voltage bushings on units rated 750 kVA and larger shall be epoxy or porcelain with ten (10) hole terminals and shall be externally clamped. Low voltage terminals shall be arranged staggered as shown in Figure 4 of ANSI C57.12.34-2009.
- (6) The low voltage bushings on all units shall be supported with an insulating material in a manner designed to counteract any downward forces resulting from the connection of multiple cables to the bushings.
- (7) The low voltage neutral shall be a fully insulating bushing. A ground pad shall be provided on the outer surface of the tank with a removable ground strap sized for the rating of the transformer provided and connected between the neutral bushing and the ground pad.
- (8) The high voltage neutral shall be connected to the low voltage neutral internally with provisions for opening this connection for high potential testing; this provision shall be accessible from the hand hole, or a switch shall be provided for this purpose.

4.3 High and Low Voltage Segment

- (1) The high and low voltage segment shall be as shown in Figure 9 of ANSI C57.12.34-2009, with the exception stated in paragraph 4.3 subparagraph (5) below, and subject to figure 2, of this specification.
- (2) A rigid *stainless steel* partition shall be provided separating the high and low voltage compartments as designated in Figure 6 of ANSI C57.12.34-2009.
- (3) Locking provisions shall be in accordance with paragraph 9 of ANSI C57.12.34-2009 utilizing a captive penta head bolt. Enclosure security shall conform with ANSI C57.12.28-2005.

- (4) Compartment doors shall be equipped with latching in the open position. Hinge assemblies and pins shall be stainless steel. The door of the high voltage compartment shall be held closed by a captive stainless steel bolt which is accessible only after the low voltage door is opened.
- (5) All units ~~750 kVA and larger~~ shall be provided with a compartment which is a minimum depth of thirty (30) inches (from the tank wall to the doors).

4.4 Accessory Equipment

- (1) The transformer shall be provided with permanently attached lifting provisions arranged on the tank to provide a distributed balanced lift in a vertical direction for the completely assembled transformer.
- (2) A permanently marked diagrammatic instruction nameplate shall be located inside the low voltage compartment and be in accordance with all provisions contained in ANSI C57.12.34-2009, paragraph 8.8.
- (3) Extension provisions for mounting a user identification plate are required. This provision shall be placed immediately below the nameplate. The extension shall have a minimum horizontal width of 3.25 inches and shall be provided with two 0.104 inch diameter holes, 3 inches between center lines, and shall extend 1 inch vertically below the nameplate with center line of holes 1/2 inch vertically below the nameplate.
- (4) The transformer shall be furnished with the following options located in the Low-Voltage compartment; an oil temperature gauge, and an oil level gauge.
- (5) The transformer shall be furnished with the following options located in the High-Voltage compartment; an oil drain valve, an oil sampling device, and one (1) inch filter press connection.
- (6) Each transformer shall be equipped with a non-resettable device which detects and provides external indication of internal transformer faults, and also incorporates pressure relief functionality. The approved device is manufactured by IFD Corporation or approved equal. This device shall be installed on the transformer and located within the Low-Voltage compartment.
- (7) ~~High voltage taps, (2) 2-1/2% above and (2) 2-1/2% below, shall be provided on all transformers. A no-load tap changer and operating handle for external operation shall be provided and located in the high voltage compartment. By operating the handle all three~~

Revision Date:

7-22-15 KLC
9-22-15 KLC
3-27-19 KLC
6-3-19 KLC
7-29-19 KLC



ITEM NAME

Gainesville Regional Utilities Electric System Approved Materials Manual

TRANSFORMER, THREE PHASE (PAD) (TECHNICAL SPECIFICATIONS)

~~phases shall be operated simultaneously. Tap position shall be clearly marked and a locking mechanism shall be provided to prevent accidental operation.~~

- (8) Transformers shall be provided with a four position, T-blade *make before break*, hookstick operable, gang operated, three phase, loadbreak, primary under-oil switch. The four positions shall be as follows:

- (a) Source A and B as supply for transformer.
- (b) Source A only as supply for transformer.
- (c) Source B only as supply for transformer.
- (d) Transformer de-energized with a feed through between source A and source B.

The switch positions must be permanently identified with markings located close to the switch. The switch shall be accessible in the high voltage compartment.

4.5 Dielectric Oil

- (1) Transformers shall be furnished complete with oil or a Fire Resistant Natural Ester Based Dielectric Fluid (to be specified at the time of bid), which does not contain more than 1 ppm PCB's (see paragraph (3) below) and shall be labeled as not contaminated.

- (a) Note: if the transformer is furnished with "Natural Ester Based Dielectric Fluid" the transformer shall be labeled with this information on the outside and inside of the transformer.

- (2) The transformer shall be of a sealed tank construction. The transformer shall remain effectively sealed for top oil temperature range of -5 degrees to +105 degrees C.

- (3) The manufacturer shall certify that the liquid dielectric or any component of the liquid dielectric is not listed in the Federal Register, Vol. 45, No. 98, issued Monday, May 19, 1980, 40FR Part 761, appendix VIII Subpart D - Identification and Listing of Hazardous Waste.

4.6 Tanks

- (1) The transformer tanks shall be of an all-welded *stainless steel* (S.S. 304) construction.
- (2) The tank shall be provided with a rectangular bolted handhole, having a minimum size of 11" by 22", designed and located for inspection and repair of the transformer. Access to the handhole shall be provided

only after removing the false tank cover which shall be mechanically interlocked with the compartment cover.

- (3) Transformers shall be provided with a domed cover to aid water run-off.

4.7 Enclosure Coating System and Labels

- (1) The enclosure coating system shall conform to the requirements of ANSI C57.12.28-2005.
- (2) The finish coat shall be Munsell-7GY 3.29/1.5 padmount green. The paint thickness shall be a minimum of 2.5 mils.
- (3) Transformers shall be provided with the following labels, designed for outside application, permanently affixed to the front of each unit (see figure 1, this specification, page T-95.14):

- (a) kVA rating label
- (b) Secondary voltage label
- (c) NEMA "Mr. Ouch" Warning Label, English/ Spanish bilingual, horizontal design.
- (d) "Loop Feed" designation label on high voltage compartment door.
- (e) "No PCBs" label in conformance with EPA 40 CFR Part 761.
- *(f) "Contains Natural Ester Dielectric Fluid"

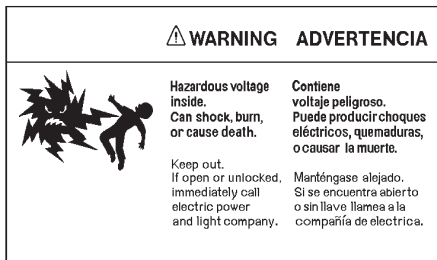
* Note: This Fluid label is only necessary when transformers are filled with "Natural Ester Dielectric Fluids". This label should not be used for mineral oils filled transformers.

Revision Date: 7-22-15 KLC 9-22-15 KLC 3-27-19 KLC 6-3-19 KLC 7-29-19 KLC	 Gainesville Regional Utilities Electric System Approved Materials Manual ITEM NAME TRANSFORMER, THREE PHASE (PAD) (TECHNICAL SPECIFICATIONS)
---	---

150 kVA Size
(Typical)

277/480 Secondary Voltage
(Typical)

LOOPFEED



NO PCBs

**CONTAINS NATURAL
ESTER DIELECTRIC FLUIDS**

Note: Labels shall be located on the centerline of the High Voltage Compartment Door.

Arrangement of Labels
Figure 1.

4.8 Overcurrent Protection

- (1) Each transformer shall be provided with oil-immersed, weak-link fuses designed to isolate the transformer in case of internal failure.
- (2) The weak link fuse shall be replaceable by either removing a high voltage bushing well or by access through the handhole as provided for in paragraph 4.6 subparagraph (2).

4.9 Impedance

- (1) The percent impedance (%IZ) as measured at the rated voltage shall be as follows:

kVA rating	maximum %IZ	minimum %IZ
75 through 500	5.0	1.40
750 through 2500	5.75	5.32

- (2) The tolerance for percent impedance on transformers rated 750 kVA through 2500 kVA shall be plus or minus 7.5% of the maximum %IZ value specified above, and not less than the minimum %IZ above.

5. TESTS

- 5.1 Tests shall be performed in accordance with paragraph 7. of ANSI C57.12.34-2009.
- 5.2 The transformer design shall be tested for short circuit withstand capability in accordance with IEEE C57.12.90-2006.

6. TRANSFORMER EFFICIENCY

- 6.1 All Transformers shall meet or exceed the January 1, 2016, D.O.E. efficiency levels for liquid filled distribution transformers.
- 6.2 The efficiency levels shall be determined with the following formula:

$$\% \text{ Eff} = 100 * (KVA * (0.5)) / (KVA * (0.5) + NLL + LL * (0.5)^2)$$
- 6.3 D.O.E. January 1, 2016, Efficiency Levels for Three Phase Transformers:

KVA	DOE Rule (%)
75	99.03
112.5	99.11
150	99.16
225	99.23
300	99.27
500	99.35
750	99.40
1000	99.43
1500	99.48
2000	99.51
2500	99.53

7. CERTIFIED TEST REPORTS AND SUBMITTAL DATA REQUIRED

- 7.1 An approval drawing showing complete dimensional data, accessories and estimated weight shall be submitted for approval prior to fabrication.

Revision Date:

7-22-15 KLC
9-22-15 KLC
3-27-19 KLC
6-3-19 KLC
7-29-19 KLC



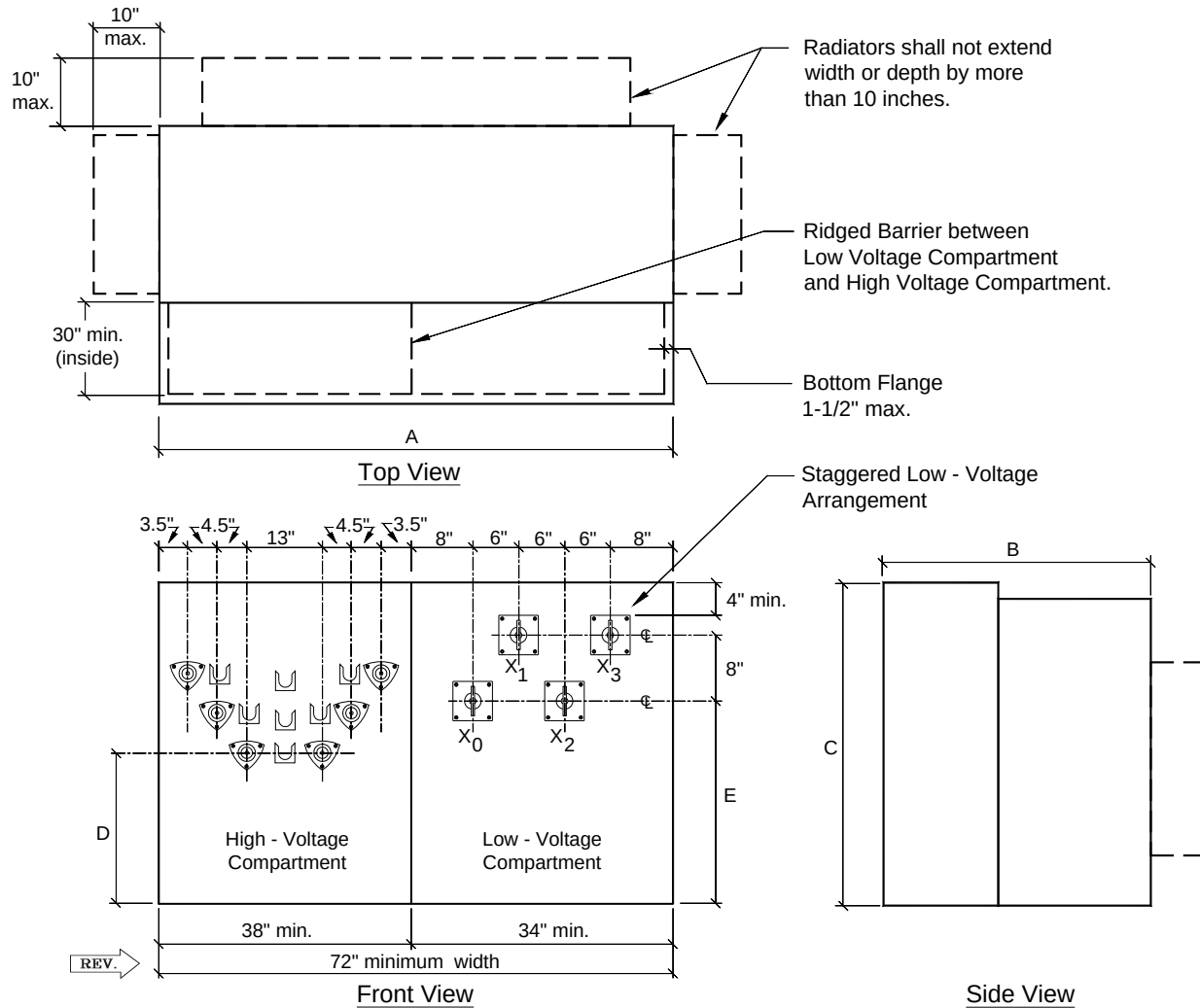
ITEM NAME

Gainesville Regional Utilities
Electric System Approved Materials Manual

TRANSFORMER, THREE PHASE (PAD)
(TECHNICAL SPECIFICATIONS)

- 7.2 At the time of delivery the manufacturer shall provide a certified test report for all transformers in a given order, indicating the actual loss data for each unit delivered. The certified test reports shall be included with the shipment, with an additional copy directed to the address in paragraph 6.3 of this specification.
- 7.3 Approval drawings and certified test reports shall be sent to:
Gainesville Regional Utilities
Energy Delivery Standards
P.O. Box 147117, Station A128
Gainesville, FL 32614-7117
8. BID EVALUATION AND AWARD
- 8.1 All bids received will be evaluated based on conformance to this specification, the equivalent first cost and delivery. Equivalent first cost is the total cost of the transformer and shipping. ~~The method used to determine equivalent first cost is documented in A Method for Economic Evaluation of Distribution Transformers, published by the Edison Electric Institute, April 1981.~~
- 8.2 All bidders shall supply NO LOAD, LOAD and TOTAL losses on the form provided in the bid documents.
- 8.3 Losses shall be quoted in watts at 85 degrees C. for calculating Equivalent First Cost and in watts at 20 degrees C. for No Load Losses and 55 degrees C. for Load Losses, per DOE, 10 CFR Part 431, Appendix A, Subpart K.
- 8.4 ~~The equivalent first cost shall be determined with the following formula using Load and No Load Losses calculated at 85 degrees C:~~
- ~~Equivalent First Cost (in dollars) = (7.93 x No Load Losses in Watts) + (1.33 x Load Losses in Watts) + Price~~
- 8.5 Quoted losses shall be the guaranteed average of all transformers in a specific order of a given size and type. However, no transformer shall measure less than the tolerances specified in the January 1, 2016, D.O.E. 10 CFR Part 431 minimum efficiency levels.
9. QUALITY CONTROL
- 9.1 Upon receipt, all transformers will be visually inspected by Gainesville Regional Utilities personnel to determine compliance with the specifications.
- 9.2 At the time of receipt the NO LOAD, LOAD and the TOTAL LOSSES will be measured by Gainesville Regional Utilities.
- 9.3 All losses quoted are the guaranteed average for all units contained in an order, however, no individual unit shall exceed the following tolerances:
- (1) The measured NO LOAD LOSSES on any unit shall not exceed the quoted NO LOAD LOSSES by more than 10%.
 - (2) The measured TOTAL LOSSES on any unit shall not exceed the quoted TOTAL LOSSES by more than 6%.
 - (3) All transformers shall meet or exceed the January 1, 2016, DOE minimum efficiency levels. effective 1/1/16.
10. NONCONFORMING TRANSFORMERS
- 10.1 Should any transformer fail to conform to the specifications in any way, the vendor shall replace the nonconforming transformer with a transformer that conforms to the GRU Specifications and bear all associated costs.

Revision Date: 7-22-15 KLC 9-22-15 KLC 3-27-19 KLC 6-3-19 KLC 7-29-19 KLC	 Gainesville Regional Utilities Electric System Approved Materials Manual ITEM NAME TRANSFORMER, THREE PHASE (PAD) (TECHNICAL SPECIFICATIONS)
---	---



kVA Rating	A	B	C	*D	*E
75 - 150	75	75	64	27	27
225 - 500	75	75	64	27	31
750 - 2500	87	75	**72	27	46

* tolerance for dimensions D & E
= $\pm$ 0.5 inches

Maximum Allowable Dimensions (inches)

Figure 2.

Notes:

- 1) Low-Voltage terminal arrangements and dimensions are for applications requiring certain specific dimensions.
 - 2) All dimensions are in inches.
 - 3) Tolerance on all dimensions are $\pm$ 0.25 inches, unless otherwise specified.
 - 4) Dimensions are to rigid barrier between high-voltage and low-voltage compartments.
 - 5) All Transformers shall have an air compartment of 30" minimum (inside dimension)
- ** 1500, 2000 and 2500 KVA 480V. transformers height maybe 74" to 92", 750 and 1000 208V. transformers maybe 74" (7/22/15 - KLC)

Revision Date:

7-22-15 KLC
9-22-15 KLC
3-27-19 KLC
6-3-19 KLC
7-29-19 KLC



ITEM NAME

Gainesville Regional Utilities

Electric System Approved Materials Manual

TRANSFORMER, THREE PHASE (PAD) (TECHNICAL SPECIFICATIONS)