ENERGY DELIVERY ENGINEERING

SPECIFICATION

EDEN-212

SPECIFICATION
FOR
THREE-PHASE PAD-MOUNT
DISTRIBUTION TRANSFORMERS
3000 KVA AND SMALLER

LAKELAND ELECTRIC
ENERGY DELIVERY ENGINEERING
LAKELAND, FL

REVISED: 12/14/2012

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GENERAL REQUIREMENTS

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1. SCOPE

1.1. This specification provides for the furnishing of three-phase, 60 hertz, dead-front, pad-mount (loop-feed), compartmental type, self cooled, mineral oil immersed transformers, 3000 KVA and smaller. KVA SIZE'S SHALL BE SPECIFIED IN THE REQUEST FOR QUOTATION.

1.2. All characteristics, definitions and terminology except as specifically covered in this specification, shall be in accordance with ANSI/IEEE C57.12.34, latest revision, and all specifications referenced therein.

2. RATINGS

2.1. The high voltage shall be 7200 / 12470 Y volts.

2.2. A primary voltage tap changer shall be installed in transformers rated 300 KVA and above with a secondary voltage of 208 Y/120 volts and in all transformers with a secondary voltage of 480 Y/277 volts. If a tap changer is required for any other transformer, it will be specified in the request for quotation. The tap changer shall have two(2) 2-1/2% taps above and two(2) 2-1/2% taps below stated primary voltage. All taps shall be rated for full transformer KVA and shall be set on stated primary voltage when shipped. The tap changer shall be operable from the primary compartment.

2.3. The low voltage shall be:

a. 480 Y/277 volts or

b. 208 Y/120 volts or

a. 240 volts Delta with one winding center tapped for 240/120 volts.

3. INSULATION LEVEL

3.1. The high voltage insulation shall be 15kV class and shall have a minimum Basic Impulse Level (BIL) of 95kV.

3.2. The low voltage insulation shall be 1.2kV class and have a minimum BIL of 30kV.

4. IMPEDANCE VOLTAGE

4.1. The percent impedance voltage, as measured on the rated voltage connection, shall be as follows:

KVA RATING	IMPEDANCE RANGE	
	Minimum	Maximum
75-300	1.28%	4.00%
500	2.00%	5.00%
750-2500	5.32%	6.18%
3000	5.78%	6.72%

5. TESTING

5.1. Routine tests on all transformers shall be made as specified in ANSI/IEEE Standards C57.12.00 latest revision. ANSI/IEEE Standard Test code C57.12.90 shall be followed for all testing procedures.

5.2. A certified test report shall be provided via Email or mail, to the T&D Engineering Supervisor of Energy Delivery System Engineering (EDEN) of Lakeland Electric at 501 East Lemon Street, Lakeland, Florida 33801, on each unit prior to payment to vendor. This report shall include the following test data:

a. Percent impedance at 85 degrees C

b. Percent excitation current

c. Excitation loss at 85 degrees C and 100% rated voltage expressed in watts

d. Load loss at 85 degrees C and rated load expressed in watts

6. CONSTRUCTION

6.1. The pad-mounted transformers shall meet the requirements for tamper resistance as set forth in ANSI/IEEE Standard C57.12.28, latest revision.

6.2. The construction of the tank shall conform to ANSI/IEEE Standard C57.12.26, latest revision, with the following exceptions:

a. The high voltage and low voltage doors shall be designed for removal by lift off and provided with a hold open device made captive on one end. Each hinge shall be made of 300 series stainless steel welded or bolted on and have a 300 series grade stainless steel hinge. The gauge of the hinges shall be the same or greater than the gauge of the tank. If the hinges are bolted on, the bolts shall not be exposed or accessible with the doors closed.

b. The low voltage door shall have a three-point latch. The handle shall have a minimum gripping length of 5 inches, and be pad lockable.

c. A one half inch (½") captive, spring loaded, penta head bolt of silicon bronze material with NC class 2 threads, shall be installed on the door handle. The nut shall be made captive in a metal cup that is permanently attached. A minimum sized hole of one half inch (1/2") shall be provided in the cup for a padlock. The bolt shall be installed such that it is accessible only after the lock is removed and it must be tightened before the lock can be installed. The nut shall be made of stainless steel with NC class 2 threads and shall be installed in a manner that will allow it to be replaced. The method of containing the nut must be designed so that it shall not be possible to insert a wire through or around the nub into the cable compartment when the bolt is not in place. This locking device shall be suitable for locking with a Sterling junior rotary ring lock with 1/4" shank.

d. The high voltage door shall be secured with two (2)1/2 inch penta head bolts. The bolts shall be silicon bronze, and the nuts shall be stainless steel. The nuts shall be contained in a manner that allows them to be replaced and prevents them from dropping when loosened. These penta bolts shall be accessible only after the low voltage door has been opened.

e. The low voltage compartment on 1500 KVA units and larger shall have a minimum depth of thirty (30) inches between the door of the cabinet and the tank wall.

f. Lifting provisions shall be in accordance with ANSI/IEEE Standard C57.12.26, latest revision.

g. All external and internal hardware (i.e. clamps, bolts, nuts, bails, etc...) shall be made of 300 series stainless steel. Silicon bronze nuts and bolts are also acceptable.

h. All transformers shall have a bolted removable top cover to allow complete access to the tank interior for inspection or repair of the core and coil, or a bolted handhole not less than 15" x 24". This cover shall be a sealed tamper proof design with no exposed main access bolts or nuts.

i. The sill shall be a removable design and be constructed of grade 300 series stainless steel.

6.3. All transformers shall be provided with an approved pressure relief device, (35 SCFM @ 15 PSIG Min.). This device shall be located in the upper right hand corner of the secondary voltage compartment.

6.4. Units shall be filled with the proper quantity of new insulating oil with a non-detectable PCB content, as per latest EPA definition, containing a minimum of 0.2% inhibitor. At the time of installation, the oil shall have a minimum dielectric strength of 26,000 volts. Insulating oil tests shall conform to ANSI/IEEE Standard C57.106, latest revision.

6.5 Material safety data sheets (MSDS) shall be provided to the City of Lakeland - Electrical Apparatus Shop at 1140 E. Parker Street, Lakeland, Florida 33801 on all oil contained in transformer. A single MSDS will suffice for each entire order provided no changes are made to the oil referred to on the MSDS.

6.6. The high voltage compartment shall have three RTE Flapper Bay-O-Net fuse assemblies, or approved equivalent, with externally removable oil fuses on all transformers smaller than 3000 kVA. These fuse assemblies shall have silver plated contacts for high current applications, for transformers 1500kVA thru 2500kVA. All of these fuse assemblies shall be equipped with the fuses shown in the Fusing Schedule (Section 17).

6.7. Inside each unit, RTE ELSP, Hi-Tech or approved equivalent oil submersible back-up current limiting fuses links shall be installed as shown on the Fusing Schedule (Section 17). They shall be connected before and in series with the Bay-O-Net fuses (if present).

6.8. An oil drip shield or cup shall be provided beneath the Bay-O-Net fuse(s) to prevent oil from dripping on primary bushings or terminators and shall be located such that they do not interfere with the switching operations of the unit.

a. Oil drip shields shall be at least 4 inches wide along its complete length and shall be slightly angled down to the left and designed to drain away any transformer oil that may drip from the Bay-O-Net Fuses.

b. Oil drip cups shall be constructed such that they are easily positioned and fastened to the exposed end of the Bay-O-Net holder without removal of the fuse holder.

6.9. Amorphous Core Transformers may be accepted as an alternative to silicon steel transformers.

6.10. Two 3/8 inch holes shall be provided for faulted circuit indicator lights. The holes will be above the primary door and located 6 inches from either side of the primary door.

7. ACCESSORY EQUIPMENT

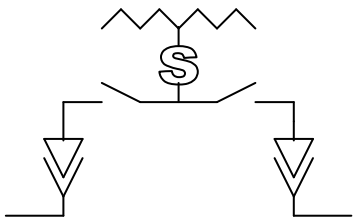
7.1. On 500 KVA units and smaller, an oil sampling plug (Ohio Brass #51292 or equivalent) shall be provided on all transformers in the high voltage compartment. On 750 KVA through 3000 KVA units, a one inch drain valve with built-in oil sampling device (Ohio Brass #51441 or equivalent) shall be provided in the high voltage compartment.

7.2. On 500 KVA through 3000 KVA units, a liquid level gauge shall be mounted to the front plate of the transformer inside the low voltage compartment.

7.3. All transformers shall have a dial type thermometer direct stem mounted in a closed well in the low voltage compartment shall be provided to indicate top liquid temperature. The thermometer shall be removable without breaking the tank seal and shall have a resetable drag hand to indicate maximum temperature.

7.4. Tank grounding provision on 500 KVA and below shall consist of two unpainted, copper faced or stainless steel pads with a 1/2"-13 NC tapped hole, 7/16" deep. Minimum thickness of copper facing to be .015 inch. Above 500 KVA shall be in accordance with ANSI/IEEE C57.12.26 latest revision.

7.5. The 3000kVA units shall include two (2) under-oil, three phase, 2-position, gang-operated, 15kV – 95kV BIL, load-break, line switches, connected as shown in the schematic below. These two (2) independent (on-off) switches shall be of the same type, with minimum Continuous and Loadbreak / Loadmake ratings (per ANSI/IEEE C37.71) of 300 amps, plus Momentary (10cyc.), 2 sec., and 3-Shot Make and Latch (fault current) ratings of 10,000 amps symmetrical and 15,000 amps asymmetrical. V or T blade switches are not acceptable, since service interruptions – no matter how short – are not acceptable. Switch handles must be readily accessible and operable by a standard hook stick. The locations of these handles shall not be over 60” high or in any area below the primary bushings or parking stands.



8. BUSHINGS AND TERMINALS

8.1. The bushings, terminals and parking stands shall be arranged according to Figure 6A in ANSI/IEEE C57.12.26, latest revision: Specific Dimensions for 8.3/14.4kV Transformers for Loop Feed Systems.

8.2. For 75 KVA through 2500 KVA units, the high voltage terminations shall be 8.3/14.4 kV – 125 kV BIL dead front, externally clamped, universal type Central Moloney, Cooper Power Systems, or approved equivalent bushing wells with removable copper stud. The minimum current carrying capabilities of components for the looped primary cable system shall be 200 amps (continuous) and 10,000 amps symmetrical (momentary).

8.3. For 3000 KVA units, the high voltage terminations shall be 600 amp 15 kV – 125 kV BIL dead front, externally clamped, universal type Central Moloney, Cooper Power Systems or approved equivalent bushings with removable tinned copper stud. The

minimum current carrying capabilities of components for the looped primary cable system shall be 300 amps (continuous) and 10,000 amps symmetrical (momentary).

8.4. The high voltage bushing wells shall be externally replaceable.

8.5. For transformers with 240 volt Delta secondary the high voltage neutral shall be brought out into the high voltage compartment with an integral primary neutral bushing. This is to allow transformer operation with the neutral either floating or solidly grounded.

8.6. The low voltage line and neutral bushings shall be of one piece construction, tinned copper with or without a threaded stud for a screw-on spade attachment. Spades are to be provided, in accordance with National Electrical Manufacturers Association (NEMA) with sized and spaced holes as specified below:

KVA	240 DELTA, 208Y/120	480Y/277
75	4 hole	N/A
112 1/2	4 hole	N/A
150	4 hole	N/A
225	4 hole	N/A
300	4 hole	4 hole
500	6 hole	4 hole
750	8 hole	6 hole
1000	8 hole	6 hole
1500	N/A	8 hole
2000	N/A	8 hole
2500	N/A	10 hole
3000	N/A	10 hole

All holes shall be 9/16 inch. The 8 and 10 hole low voltage spade terminals shall be supported on the outer end with insulated mechanical supports that shall not interfere with the NEMA spaced holes. These supports shall be mounted at the top of the low voltage compartment walls. The purchaser intends to use connectors similar to Utilco type USG2 for these spade terminals.

8.7. The low voltage terminals shall be staggered and spaced according to Figure 8 (a) in ANSI/IEEE Standard C57.12.26, latest revision. The minimum horizontal spacing between the faces of the spades shall be 5 inches for transformers 150 KVA and smaller and 6 inches for transformers 225 KVA and larger. The minimum vertical separation between the vertical centers of the spades shall be 6 inches for transformers 150 KVA and smaller between the vertical centers of the spades shall be 6 inches for transformers 150 KVA and smaller and 8 inches for transformers 225 KVA and larger.

8.8. The low voltage terminals shall be compatible with the continuous rating of the transformer at maximum KVA and suitable for operation with overload capabilities per ANSI/IEEE C57.92, latest revision.

8.9. The low voltage neutral bushing shall be fully insulated with a removable copper ground strap or cable connected between the neutral bushing and a ground pad on the outer surface of the tank. This strap shall be sized for the rating of the transformer.

8.10. The low voltage terminals shall be designed to accommodate bushing mounted current transformers, such as General Electric type JAB-O.

8.11 The high voltage bushings shall have an external clamp with 3 or 4 protruding tabs (one on each corner) that are sufficient in length and hole size to tie down a super close feed through insert or an approved alternative.

9. LABELS AND MARKINGS

9.1. The high voltage bushings and low voltage terminals shall be labeled with the appropriate letters and numbers as indicated in ANSI/IEEE Standard C57.12.38 and C57.12.28, latest revision. These labels shall be clearly shown adjacent to each bushing in positions, which will be visible with cables installed, and doors open.

9.2. All tap changers shall be permanently labeled with a "De-Energize before Operating" label.

9.3. The transformers shall be provided with the National Electrical Manufacturer's Association (NEMA) transformer markings. A "WARNING" label shall be installed on the outside of each door (2) and a "DANGER" label shall be installed inside the primary and secondary compartments to be visible when facing into the transformer. The labels shall be made of a tamper resistant and durable highly reflective UV resistant film.

9.4. No recommended fuse sizes or schedules shall be stenciled, stamped or otherwise marked on or attached to the unit, except current limiting fusing as described in this specification.

10. NAMEPLATE

10.1. The nameplate and information thereon shall meet all the requirements as specified in ANSI/IEEE C57.12.00, latest revision. The month and year of the date of manufacture shall be stamped on the nameplate uncoded.

10.2. When used, current limiting fuse type and rating information shall be shown on the nameplate.

11. TANK

11.1. The coating system shall meet ANSI/IEEE Standard C57.12.28, latest revision.

11.2. The top coat shall be olive green Munsell 7GY3.29/1.5 in color. The paint finish shall be smooth, even, and free of any grainy appearance. The quality of the paint finish shall meet the following American Society for Testing and Materials (ASTM) environmental and physical tests:

a. Salt fog cabinet test (ASTM B-117, latest revision)

b. Accelerated weathering test (ASTM G-53 & D-523, latest revision)

c. Mandrel flexibility test (ASTM D-2794, latest revision)

11.3. A tar base pitch or zinc rich (85% minimum) or an approved epoxy coating, 1.5 mil minimum thickness, shall be applied to the tank bottom and all surfaces that are in contact with the mounting pad for a minimum height of TWO (2) inches. A stainless steel bottom may be accepted as an alternative to coating.

12. SHIPPING AND ACCEPTANCE

12.1. All units shall be single stacked and shipped in such a manner so as to prevent no chafing or shifting. Each unit shall be securely attached to a single weather resistant pallet by bands or bolts.

12.2. Receipt of the order by the City of Lakeland Purchasing Department shall not constitute acceptance. Acceptance is contingent upon satisfactory inspection of the units and review of test reports by Lakeland Electric T&D Engineering (EDEN) will be at their option.

13. EVALUATION

13.1 The annual cost evaluation will be based on the formula A + B + C = Total ownership costs (TOC), where TOC = A x (Core Loss) + B x (Winding Loss) + Initial Cost

13.2. The economic evaluation will be based on the following evaluation factors for losses.

a. $ 3.07 /watt for excitation (core) loss at 100% rated voltage and 85 degrees C.

b. $ 1.66 /watt for load (winding) loss at 85 degrees C and rated load.

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14. EXCEPTIONS TO THESE SPECIFICATIONS

14.1. Should the manufacturer wish to make exceptions to these specifications, they shall provide complete written specifications and any supporting drawings. Written approval on any exceptions must be obtained from Lakeland Electric T&D Engineering (EDEN).

14.2. After initial approval of a specific design, any design changes shall be approved by Lakeland Electric T&D Engineering (EDEN), prior to manufacture.

15. LOSS ADJUSTMENT PROCEDURES

15.1. Each manufacturer is expected to supply distribution transformers which do not exceed the quoted values for excitation loss or load loss as described in paragraph 16.5 and as submitted in the bid proposal. Any unit(s) delivered by a manufacturer to Lakeland Electric that possesses any parameter outside the quoted values as specified shall, at the option of Lakeland Electric:

a. Be returned to the manufacturer, freight collect, for replacement with unit(s) meeting quoted values or delivery may be refused.

b. Be retained by Lakeland Electric subject to a loss adjustment charged to the manufacturer on an invoice basis. The adjustment shall be equal to the present levelized value of the difference in loss costs (using actual parameter versus quoted parameter) evaluated at the present cost of money for Lakeland Electric over a 20 year period but not to exceed the current price of the unit(s). The adjustment will be based only on losses over the quoted values. Credit will not be given for losses under quoted values. The loss adjustment amount will be deducted from the total invoice and payment made on the balance. For annual/multi-year awards, the loss adjustment amount will be calculated quarterly based on the average of all certified losses provided by the manufacturer for that quarter and will be deducted from the next processed total invoice with payment made on the balance.

15.2. Any manufacturer, who continually or willingly delivers distribution transformer shipments to Lakeland Electric which fails to meet the manufacturer's quoted losses, may be deleted as an approved supplier of distribution transformers.

16. INFORMATION REQUIRED WITH PROPOSAL

16.1. Unit price FOB Lakeland for each size unit.

16.3. Delivery schedule.

16.3. Dimensional data on each size unit.

16.4. Weight of each size unit.

16.5. Guaranteed losses as specified in “a” and “b” below at 85 degrees C. The average of the losses of the total transformers for each KVA design shall not exceed the quoted values for excitation loss or load loss. The tested loss values of an individual unit in the shipment may not exceed the tolerances specified in ANSI/IEEE Standard C57.12.00, latest revision.

a. Excitation Loss: The no load power loss of the transformer at 100% rated voltage, expressed in watts at 85 degrees C.

b. Load Loss: The I^2 R winding loss of the transformer at rated load, expressed in watts at 85 degrees C.

16.6. Percent impedance at 85 degrees C.

17. FUSING SCHEDULE THREE PHASE PAD-MOUNT DISTRIBUTION TRANSFORMERS

3 PHASE	12470 VOLT		
KVA	BAY-O-NET[1]	ELSP	HI - TECH
45	C03	3544030M61M	HTSS240030
75	C05	3544030M61M	HTSS240030
112.5	C08	3544065M61M	HTSS242065
150	C08	3544080M71M	HTSS242080
225	C10	3544125M71M	HTDS242100
300	C10	3544150M71M	HTDS242100
500	C12[3]	3544125M71M	HTDS242100
750	C14[3]	3544125M71M	HTSS242150
1000	C16[3]	3543165M71M	HTDS342200
1500	C05CB[5]	3544125M71M[2]	HTSS242165
2000	C05CB[5]	3544125M71M[2]	HTDS342200
2500	C05CB[5]	3544125M71M[2]	HTDS342200
3000[4]	NA	NA	N/A

1. All BON Fuses are Dual Sensing RTE 4000358xxx unless otherwise noted.
2. Parallel Fuses
3. BON Fuses are Current-Sensing RTE 4000353xxx or approved equal.
4. GE Internal Fuse 9F54WLD36 or approved equal.
5. 125A High Ampere Overload Bay-O-Net Fuse Link, Cooper Power Systems 4038361C05CB.