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# LOW PROFILE, SINGLE PHASE, PAD-MOUNTED DISTRIBUTION TRANSFORMERS WITH SEPARABLE INSULATED HIGH-VOLTAGE CONNECTORS

# REVISION SHEET

| Revision | Description of Change | Date | Initial |
|---|---|---|---|
| 0 | Original Document | 2001-02-01 | c.m. / n.d.f. |
| 1 | Revise Title and Update Document | 2002-07-29 | g.m. / b.d. |
| 2 | Reformat, major revision | 2016-10-24 | mw/csm |

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# 1.0 Introduction

This specification covers low-profile, single phase, pad-mounted distribution transformers with separable insulated high-voltage connectors manufactured for Hydro Ottawa Limited and for use in Hydro Ottawa's service territory. This specification is an amendment to CSA standard C227.3-06 "Low-profile, single phase, pad-mounted distribution transformers with separable insulated high-voltage connectors."

# 2.0 References

| | |
|---|---|
| CSA C227.3-06 | Low-profile, single phase, pad-mounted distribution transformers with separable insulated high-voltage connectors |
| Hydro Ottawa UTS0006 | Transformer Signage 1 Phase Padmount - Identification Detail |
| Hydro Ottawa EMS0001 | Transformer Financial Operating Loss Formula |
| IEEE C57.12.35 | IEEE Standard for Bar Coding for Distribution Transformers |

# 3.0 Scope

The numbering of Section 4 and higher of this specification is identical to that used in C227.3-06 "Low-profile, single phase, pad-mounted distribution transformers with separable insulated high-voltage connectors." Where no reference is made, the CSA Specification shall apply. Additional or modifying statements, as given in this specification, shall govern.

It is not intended that this specification restrict bidder's ideas, inventions, advances in the state of the art, or technological improvement, and therefore all bids will be given careful consideration. It must be noted, however, that Hydro Ottawa requires sufficient explanations and descriptions to be able to make a good value judgement. Any variation from the requirements of this specification shall be quoted as additional bids.

See Schedule A for a list of information to be provided to Hydro Ottawa at the time of tender.

# 4.0 Electrical Characteristics

## 4.4 Off – Circuit Voltage Taps

Provide off-circuit voltage taps per Table 4.4.1 below.

Table 4.4.1

| **Transformer Primary Voltage (V)** | **Off Circuit Voltage Taps** | | **Off Circuit Voltage Tap Location – Dual Primary Voltage Units** | |
|---|---|---|---|---|
| | **Yes** | **No** | **High Tap** | **Low Tap** |
| 8320GrdY/4800 | | √ | n/a | n/a |
| 12800GrdY/7400 | √ | | √ | n/a |
| 27600GrdY/16000 | | √ | n/a | n/a |
| 4160GrdY/2400 x 12800GrdY/7400 | √ | | √ | n/a |
| 12470GrdY/7200 x 27600GrdY/16000 | | √ | n/a | n/a |
| 8320GrdY/4800 x 27600GrdY/16000 | | √ | n/a | n/a |

Taps shall be designated either numerically or alphabetically on the nameplate as per Table 4.4.2 below:

Table 4.4.2

| NUMERICAL | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Alphabetical | A | B | C | D | E |
| % of High Voltage Winding | 105.0 | 102.5 | 100.0 | 97.5 | 95.0 |

Transformers with 7400V primary shall be shipped with the tap changer switch in position 2 or B.

## 4.5 Insulation Class and Preferred Voltages

Revise Table 1 of CSA C227.3-06 to show;
Rated High Voltage 12800GrdY/7400V for the 15kV HV Insulation Class.

Dual primary voltage shall be:
12800GrdY/7400V X 4160 GrdY/2400V or
27600GrdY/16000V X 8320 GrdY/4800V or
27600GrdY/16000 VX 12470 GrdY/7200V

## 4.10 Impedance

Minimum impedances are required to limit the short circuit current at the service entrance equipment as follows:

- 50 kVA 1.5%
- 75 kVA 2.0%
- 100 kVA 2.5%
- 167 kVA 4.0%

Hydro Ottawa will not allow averages or tolerances on impedance.

# 5.0 Electrical Connection and Mechanical Features

## 5.2 Mechanical Features

5.2.2 Cable Entrance Compartment

5.2.2.2

The locking provisions shall accommodate a padlock with a [5/16"] diameter shackle.

5.2.2.3

Provision for lifting the hood shall extend the full width of the hood.

5.2.2.5

A 6mm thick and 25 mm wide gasket made of nitrile rubber shall be provided under the transformer sill and tank to compensate for minor irregularities of the concrete pad. This gasket is to extend under the tank and cable entrance compartment (complete mini-pad) such that the transformer is isolated from the concrete to reduce vibration noise and seal any openings between the transformer and the concrete slab.

## 5.3 Fusing

5.3.1 General

Dual voltage transformers are to be delivered with a replaceable higher voltage bayonet fuse only. Hydro Ottawa will purchase the lower voltage fuse separately.

For dual voltage transformers the manufacturer shall provide, at the time of drawing approval, evidence that the current limiting back up fuse will coordinate with the bayonet fuse at both voltages and protect against catastrophic failure of the transformer tank.

# 6.0 Bushings, Terminals, and Grounding

## 6.2 High Voltage Bushings

H.V. Bushings shall be equipped with Hydro Ottawa approved double-vented bushing inserts. Dual voltage transformers shall be equipped with bushing inserts rated for the highest voltage.

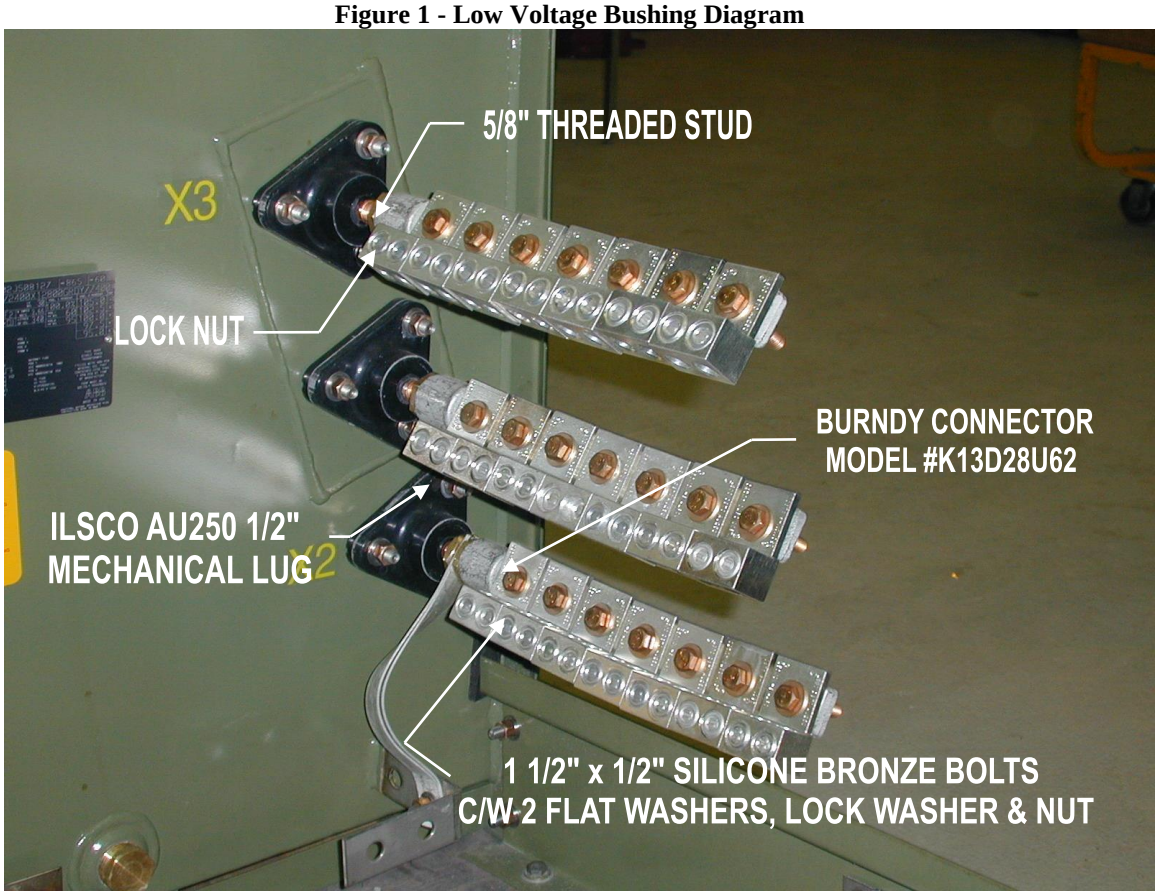
## 6.3 Low-Voltage Bushings

The low voltage bushings (X1, X2 and X3) must be a [5/8”-11] threaded stud complete with 2 locking nuts. Stud length shall be a minimum of 50mm [1-15/16”]. The stud material shall be compatible for use with a Burndy aluminum connector #K13D28U62.

Attached to each Burndy Connector, as a means of connection for secondary service cables, will be 7 Ilsco AU250 mechanical terminations, fastened with [11/2” x 1/2”] Silicon bronze bolts, nuts, and washers; see Figure 1, Low Voltage Bushing Diagram below.

All surfaces including cable will be prepared with a wire brush and treated with an oxide inhibitor.

**Figure 1 - Low Voltage Bushing Diagram**




# 7.0 Switches and Tap Changers

## 7.1 Off-Circuit Tap Changer and Voltage Selector Switches

The off-circuit tap changer and dual voltage selector switches shall be hot-stick operable.

## 7.2 Load break Switches

All transformers shall be constructed with two primary voltage switches under oil. The load break switches must be clearly identified in the cable compartment by a suitable method such that the identification marks cannot be removed under any operating conditions.

# 8.0 Tests

## 8.2 Routine Tests

Hydro Ottawa reserves the right to have a representative on hand to witness all tests. The Hydro Ottawa representative also reserves the right to request the manufacturer to verify the calibration of the test instruments. A minimum of 72 hours notice will be required to enable a Hydro Ottawa representative to witness these tests.

A certified transformer test report shall be submitted to Hydro Ottawa for acceptance before shipping transformers.

The following are modifications to the routine tests in C227.3-06 Clause 8.2

(c) No-load losses at 100% rated voltage and corrected to 85˚C;
(d) Exciting current at 100% rated voltage;

## 8.3 Tolerances for Routine Tests

8.3.2 Losses and Exciting Current

8.3.2.2 Individual Transformers

Transformers will be compared against the loss equation shown in Schedule 1 of this specification. Contact HOL for the latest equation.

8.3.2.3 Average for Two or more Transformers

If the actual losses exceed those quoted then a penalty will be assessed using the Loss evaluation formula from Schedule 1, which will be published annually.

8.3.3 Tolerance for Impedance

8.3.3.1 Guarantee

The impedance as stated in clause 4.10 of this specification is an absolute minimum. Hydro Ottawa will not allow averages or tolerances on impedance.

## 8.4 Type Tests

8.4.2 Standard Type Tests

(h) Drop Test. A 300mm drop test shall be performed for single phase pad-mounted transformers which have an internal back-up current limiting fuse. This "type test" may be performed on a simulated unit (instead of a production unit), but it must have an actual mounting of the fuse. This test is intended to provide assurance that the fuse, when mounted in the transformer will survive relatively rough handling.

# 9.0 Quality of Work and Finish

The finished product must be clean and free of paint chips, salt spray and dirt or salt.

## 9.2 Colour

The standard exterior finish shall be equipment green Munsell 9GY 1.5/2.6. The manufacturer must state the finishing process.

# 10.0 Markings

The manufacturer shall attach a permanent bar code label in accordance with IEEE Standard C57.12.35 – 1996 "IEEE Standard for bar coding for distribution transformers." The bar code shall contain the manufacturer ID number and the transformer serial number. The attachment location shall be as per IEEE C57.12.35.

## 10.5 Transformer Markings

10.5.2 Warning Labels

10.5.2.3 Electrical Hazard Warning Signs

Warning signs are to be affixed to the outside of the transformer as per Hydro Ottawa specification (UTS0006). Hydro Ottawa will provide the decals to the manufacturer so that they can be installed prior to delivery.

10.5.3 Information on Exterior of the Transformer

10.5.3.1 Information Tag

The self-adhesive tag shall be engraved aluminium indicating:

(d) kVA
(e) HV/LV

# 11. Optional Accessories and Features

The following items shall be included as part of the transformer.

(a) an anticorrosion skirt for high contaminated areas; (manufacturer to describe in tender)

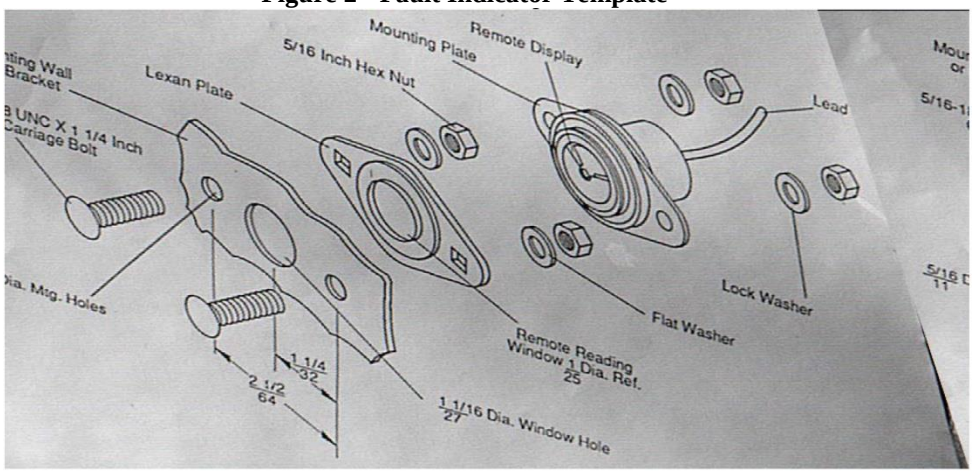
(b) drain plug and filler plug;

(c) load-break switches;

(e) Threaded stud-type low-voltage bushings;

(i) A 25 mm diameter hole, covered with a removable stainless steel plate, located as per Fig 10 of CSA C227.3-06, to be used for remote fault indicator light, as per figure 2.0 below;

**Figure 2 - Fault Indicator Template**




(k) high voltage taps (see clause 4.4 of this specification);

(m) permanent bar coding label as shown in ANSI/IEEE C57.12.35;

(n) minimum impedance to limit the short circuit current at the service equipment as noted in clause 4.10 of this specification

(o) oil level sight gauge located so as to ensure safe operation of the load break switches

(s) spade option c/w nuts, washers et al as stated in section 6.3 of this specification

# Schedule 1 – Transformer Loss Evaluation Formula

Transformers will be evaluated against the following loss formula from EMS0001:

Formula Effective Date: 2015-05-08

$$PV = 14.5NLL + 3.33LL$$

Where

PV = Present value of Distribution Transformer Losses ($)
NLL = No-Load Losses (W)
LL = Load Losses (W)