



**Single-Phase Mini Pad-Mounted Transformer**  
**Specification: Energy+ MPDL**

**Issued by:**        **Engineering Department**  
                         **Energy+ Inc.**  
                         **September 2016**

**Approved by:**    Shawn Jackson, P.Eng. Shawn Jackson  
                         Approval is given in accordance with Ontario Regulation 22/04

## **i. Scope**

This specification includes Energy+ Inc. (ENERGY+) requirements for distribution transformers purchased by ENERGY+ and by developers or contractors purchasing on behalf of ENERGY+. The requirements of CSA Specification C227.3-06 (Reaffirmed 2011) apply in addition to specific requirements in this document. Where conflicting information exists, this document shall supersede the CSA specification.

Clause numbering is identical to that used in C227.3-06. Additional or modifying statements to existing clauses contained in this specification shall govern and, where no reference is made, C227.3-06 shall apply as written. New clauses have been assigned new numbers based on the existing CSA numbering of the appropriate sections.

## **ii. Latest Revisions**

- a) Section 4.4 - Removed requirement for tap changer switch for 16kV transformers. The tap changer is still required for transformers specified with other primary voltages.
- b) Section 4.10 – Added a minimum impedance of 4.25% for 167 kVA transformers to reduce the available fault current at service entrance locations.
- c) Section 5.3 – Updated transformer fusing requirements.
- d) Section 6.3.1.1 – Added maximum secondary bushing thickness.
- e) Section 8.3.2.7 – Increased allowable load losses for 167 kVA transformers to allow for the higher impedance from Section 4.10.
- f) Section 11.1 h) – added requirement for bail tabs on both HV bushing wells.
- g) 03-Jun-16: Changed supplemented CEA document to CSA. Changed tank steel to stainless. Changed corporate name.
- h) Included stainless steel construction requirement.
- i) Updated CSA spec number. Updated fusing part numbers (Table 6).

## **4. Electrical Characteristics**

### **4.4.1 Off-Circuit Voltage Taps**

Voltage taps are not required for transformers with a primary voltage of 16 kV. For transformers with other primary voltages, off circuit voltage taps shall be included and shall meet Clauses 4.4.2 and 7.1. In addition, taps shall be hot stick operable and transformers shall be shipped with the tap switch in the 100% or neutral position.

### **4.10 Impedance**

Minimum impedances to limit the available short circuit current at service entrances shall be as follows:

- 50 kVA – 1.5%
- 75 kVA – 2.0%
- 100 kVA – 2.5%
- 167 kVA – 4.25%

## **5. Electrical Connection and Mechanical Features**

### **5.2.1 Dimensions - Minimum Transformer Width**

Transformers shall have a minimum width of 915mm and a maximum dimension of 965mm. Therefore the width dimension shown in Figure 2 shall be revised to 940mm  $\pm$  25 mm.

### **5.2.5 Drain / Filler Plugs**

Transformers shall not include a drain plug. A filler plug is required and shall consist of a 1" IPS pipe connection with a threaded brass plug.

## **5.3 Fusing**

Specific transformer fusing requirements have been updated to include the latest manufacturer's recommendations. See Table 6. Fusing other than that specified must be approved prior to transformer manufacture.

### **5.3.2 Fusing – Bayonet Assembly**

The fuse assembly shall be designed such that repeated fuse insertions and removals do not result in loosening or detachment of any contacts or other parts of the assembly. Copper press on contact clips shall be used for connection onto the fuse studs. Wire connections to the contact clips shall be made using appropriate nuts and bolts.

### **5.3.6 Fusing – Interrupting Current Ratings**

The fuse assemblies shall have an interrupting capability as shown below, and provide safe energization and de-energization within any load range of the transformer:

<u>HV Rating</u>	<u>Interrupting Capability (RMS Symmetrical)</u>
4160GrdY/2400	12000 A, asymmetrical factor 1.2
8320GrdY/4800	12000 A, asymmetrical factor 1.2
27600GrdY/16000	12000 A, asymmetrical factor 1.6

### **5.3.7 Fusing – Assembly Loadbreak Capability**

The load break device including leads, connectors, contacts, etc. shall be capable of carrying 200% of nominal transformer primary current both continuously and for load breaking at 40°C ambient.

### **5.4 Stainless Steel Construction**

Stainless steel shall meet the requirements of American Iron and steel Institute (AISI) Type 304L. The transformer tank, hood and sill shall be constructed from Stainless Steel Type 304L.

## **6. Bushings, Terminals, and Grounding**

### **6.2 High Voltage Bushings**

**6.2.4** The H2 ground spade terminal shall be located between 350 mm and 400 mm from the left side of the transformer when facing the front wall.

**6.2.5** The internal connection between the two bushings shall have a fault withstand rating according to clause 5.3.6.

### **6.3 Low Voltage Bushings**

**6.3.1** Low voltage bushings shall be as per Figure 9 a) for all transformer sizes including 167kVA.

**6.3.1.1** The thickness of the bushing spade shall not exceed 10mm.

### **6.4 Grounding**

**6.4.1** A grounding bracket to facilitate the attachment of temporary working grounds is not required and therefore shall not be provided.

## **7. Switch and Tap Changers**

### **7.2 Loadbreak Switch**

All transformers shall be supplied with a loadbreak transformer winding switch meeting the requirements of Section 7.2. The make and catalogue number of the switch shall be identified in transformer drawings for approval prior to manufacture.

## **8. Tests**

### **8.2 Routine Tests**

- h) The leak detection test shall be performed with a minimum internal pressure of 50kPa.

In addition to CSA C2.1-06 and C227.3-06, the following routine tests shall be performed for each transformer supplied:

- i) A RIV Test shall be performed for transformers having a high-voltage rating of 27600 GrdY/16000.
- j) An impulse test, modified from the ANSI C57.12.90 requirements to include only 2 full waves, shall be applied to transformers having a high-voltage rating of 27.6/16 kV.
- k) Resistance shall be measured on high-voltage and low-voltage windings at the transformer production rate of 1 per 25, or one per batch for quantities below 25.

### **8.3.2 Losses and Exciting Current**

#### **8.3.2.1 No Load Losses**

Transformer no-load loss and exciting current shall be quoted and measured at **100%** of rated voltage and corrected to 85°C.

#### **8.3.2.4 Assessment of Loss Penalty**

If the measured average No-Load loss or Load loss on a stock item of a given purchase order exceeds the guaranteed value, the evaluation formula from clause 8.3.2.1 shall be applied to obtain the actual cost of losses (a). The guaranteed cost of losses (b) shall then be calculated using the same formula. If (a) - (b) is a positive value, a penalty shall be assessed using ((a) - (b)) × the number of units on the stock item.

#### **8.3.2.5 Evaluation of Losses - Installation by ENERGY+**

Quoted No-Load (N) and Load (L) losses in Watts will be evaluated in accordance with the following formula:

$$\text{Present Value of Cost of Losses} = \$8.30N + \$4.10L.$$

For evaluating competitive bids on a tender, the evaluated losses will be added to the quoted no-tax price to produce the "Total Owning Cost" (TOC). Tender award will not necessarily depend on the lowest TOC, but will also include other considerations such as

first cost, delivery, manufacturing quality, and historical quality of contract performance.

### 8.3.2.6 Maximum Losses - Installation by ENERGY+

Losses shall be equal or less than those maximum values given in CSA Standard C802, "Maximum Losses for Distribution, Power, and Dry-Type Transformers."

### 8.3.2.7 Maximum Losses - Installation by Developers

Maximum values shall be as follows:

Rating, kVA	No Load Loss, W	Load Loss, W
50	105	300
75	145	440
100	210	525
167	255	1080

### 8.5.4 Impulse Tests

In addition, the chopped waves, as required by CSA Standard C2.1-06, shall be replaced by two negative full waves and must be performed in addition to the requirements of CSA Standard C227.3-06.

## 9. Workmanship and Finish

### 9.2 Colour

The standard exterior finish shall be equipment green, Munsell 9GY 1.5/2.6.

## 10. Markings

### 10.2.3 Information on Nameplate

- s) The purchase order number

### 10.5.1 Tank Markings

- h) The kVA rating and high voltage shall be clearly stencilled on the inside of the hood. These designations shall consist of the numbers without kVA or voltage wording, and shall be legible with the hood in an opened position. The numbers shall have a uniform minimum height of 60 mm.

### **10.5.3 Information on the exterior of the Transformer**

#### **10.5.3.1 Information Tag**

- c) The manufacturer's logo shall not appear on the exterior of the pad-mounted assembly
- d) The purchase order number

## **11. Accessories and Features**

### **11.1 Optional Items**

The following optional accessories shall be included for all purchases meeting this specification:

- b) Filler plug (Section 5.2.5).
- c) Loadbreak transformer winding switch (Section 7.2).
- h) Bail tabs on each HV bushing well to connect a bleeder wire between the well and the insert.
- k) HV taps – for transformers with primary voltages of other than 16 kV (Section 4.4).
- n) Impedance - Minimum impedances to limit the short circuit current at service entrance locations shall be as per Clause 4.10.
- s) Stainless Steel Construction – the transformer shall be constructed with stainless steel (Section 5.4).

## **13. Witnessing**

- 13.1 The manufacturer shall advise ENERGY+'s Engineering Department (or designated representative) a minimum of four production days in advance of scheduled testing. The notice will allow in-plant witnessing of the tests plus inspection of the transformers on order. Where the testing location is beyond 200 km from ENERGY+, a minimum of seven days' notice shall be required.
- 13.2 A sampling, or the full quantity, of transformers of each rating ordered may be test-witnessed at the discretion of ENERGY+'s inspectors.

## **14. Quotation Data**

In addition to price and delivery, tenders shall include the following information in duplicate:

- Guaranteed No-load and Load losses at 100% voltage and 85°C.
- Guaranteed impedance at 85°C. (Where a design has been changed or the specific rating is infrequent, an approximation will suffice. Doubtful cases should be discussed with the Purchaser).
- Acknowledgement of specified fuse ratings.
- Make and catalogue number of the loadbreak switch.
- Location of manufacturing plant.

### **15. Contract Drawings**

Nameplate and Outline drawings, specific to the rating ordered, shall be submitted in two copies for approval prior to the commencement of production. Any deviations from this specification shall be clearly noted on the drawings. Signature by ENERGY+ on the approval drawings shall not waive the manufacturer's responsibility to supply the transformer(s) to this specification.

Once the outline and nameplate drawings are approved by ENERGY+, new drawings are not required on future orders unless the manufacturer makes a change.

### **16. Certified Test Reports**

The manufacturer shall submit two copies of a Certified Test Report reflecting all Routine and Type Test results as outlined in this specification. The reporting of the Routine Tests should be similar to Figure 1 – Sample Test Report.

### **17. Failure to Comply**

If the manufactured equipment does not comply with all the requirements of this specification, ENERGY+ reserves the right to reject all, or part of, the equipment under this contract. Such right will apply whether the equipment is in the manufacturing plant or in ENERGY+'s stores.

### **18. Shipment**

Shipment shall be made only when authorization is given by CNHDI. At such time, the shipment will be FOB Utility Stores.

### **19. Late Delivery**



ENERGY+ has the right to cancel a given order without cost to ENERGY+ if a late delivery is deemed unacceptable.

## **20. Warranty**

Approval, by ENERGY+ or its appointed agent, of the factory tests shall not relieve the manufacturer from its responsibilities with respect to Warranty.

If a transformer is defective upon arrival or malfunctions in normal service, for causes other than an accident, misapplication, or abuse, during a period of one year after the unit is placed in service, or two years after delivery, whichever occurs first, the defective transformer will be returned to the manufacturer by common carrier at its own expense.

The manufacturer shall make good all defects or shall provide a new transformer to replace the defective one without cost to ENERGY+. If the manufacturer fails to repair or replace the returned transformer within a time period agreed upon, the manufacturer shall reimburse ENERGY+ for the purchase price of the transformer. Transformers returned under Warranty shall include a Certified Test Report and a report on the cause of the failure.

**Table 6 – Transformer Fusing (Section 5.3)**

kVA	PRIMARY V	%IZ	BAYONET FUSE	ELSP FUSE
50	4160 Grd Y/2400	1.5	4000358C12M	CBUC08180D100
	8320 Grd Y/4800	1.5	4000358C08M	CBUC08080C100
	27600 Grd Y/16000	1.5	4000358C05M	CBUC17030C100
75	4160 Grd Y/2400	2	4000358C14M	CBUC08150D100 (2/ph)
	8320 Grd Y/4800	2	4000358C10M	CBUC08125C100
	27600 Grd Y/16000	2	4000358C08M	CBUC15080C100
100	4160 Grd Y/2400	2.5	4000358C16M	CBUC08165D100 (2/ph)
	8320 Grd Y/4800	2.5	4000358C12M	CBUC08150D100
	27600 Grd Y/16000	2.5	4000358C08M	CBUC15080C100
167	4160 Grd Y/2400	4.25	4000358C18M	CBUC08180D100 (2/ph)
	8320 Grd Y/4800	4.25	4000358C14M	CBUC08250D100
	27600 Grd Y/16000	4.25	4000358C10M	CBUC15080C100

**Figure 1 – Sample Test Report (See Section 16)**  
**XYZ Company**  
**DISTRIBUTION TRANSFORMER TEST REPORT\***

Customer: Energy+  
 Customer Code: P.O. No.  
 Specification No.: MPDL – September 2016 Work Order Number:  
 Order Quantity: 5  
 Description: Low Profile Pad-Mounted Transformer  
 100kVA  
 27600GrdY/16000-240/120 V

Tested By: Witnessed By:  
 Date: 05-07-22 Certified By:  
 Signature: Title:

The following tests were successfully performed on each unit in accordance with the above specification:

Ratio:	Within 0.5%	Yes
Polarity:	Additive	Yes
Applied Potential:	HV to LV and Ground at:	n/a
	L V to HV and Ground at: 10 kV for 1 min.	Yes
Induced Potential:	40/ 180/40 kV, Hz, sec respectively	Yes
Routine Impulse:	On HV, 2-Full Waves at 125 kV	Yes
Radio Influence V:	100 $\mu$ V maximum	Yes
Oil Leak Test:	At 50kPa	Yes

The following performance values were obtained:

Resistance: Ser. No. 26219 HV: 6.130 ohms @ 85°C  
 LV: 0.001043 ohms @ 85°C

	No Load Loss, W	% Exciting Current		Load Loss @ 85°C, W	Impedance @85°C, %
		100% V	110% V		
Guarantee	210	1.8	3.5	525	2.5
Ave. of 5 units	208.6	0.9	3.2	520.5	2.55
Serial No. Tested					
26217	209.6	0.94	3.25	521.2	2.60
26218	208.3	0.92	3.14	518.7	2.52
26219	208.7	0.89	3.38	519.6	2.59
26220	207.6	0.80	3.15	520.8	2.51
26221	209.0	0.84	3.31	522.3	2.54

\* - EXAMPLE ONLY