

1.0 **GENERAL**

1.1 **Coordination Requirements**

- .1 UBC [Facilities Electrical](#) (Vancouver)
- .2 UBC Facility Management (Okanagan)

1.2 **Description**

- .1 The Low-Voltage Transformer technical guideline outlines the requirements for dry type distribution transformers utilized at UBC facilities with primary/secondary voltages between the ranges of 120 to 600 volts.

2.0 **MATERIAL AND DESIGN REQUIREMENTS**

2.1 **Design**

The following variables must be evaluated when specifying a transformer:

- .1 Primary and Secondary voltage/phase/frequency requirements.
- .2 Total loading on the transformer.
- .3 Future capacity required.
- .4 Type of loads.
- .5 % of linear and non-linear loads.
- .6 Environmental requirements (Water/dirt egress, sound).
- .7 Spacing and weight requirements for proposed location.
- .8 Adequate ventilation in proposed location.
- .9 Mounting type.
- .10 Mechanical protection.
- .11 Tamper resistance in areas accessible to the public.
- .12 Ease of access for inspection, maintenance, removal and replacement.

2.2 **Transformer Types**

The following dry type transformers may be specified based on the following requirements:

- .1 **General Purpose:**
 - .1 General purpose transformers shall be specified when there are less than 15% non-linear loads.
- .2 **K-Factor Rated:**
 - .1 K-Factor Rated transformers shall be utilized in applications where 15% or greater non-linear loads are present:
 - 15-35% non-linear loads → K-4 rated transformer.
 - 36-75% non-linear loads → K-13 rated transformer.
 - 76-100% non-linear loads → K-20 rated transformer.
- .3 **Harmonic Mitigating:**
 - .1 Harmonic Mitigating transformers can be specified for the following applications:
 - Mitigation of potential nuisance tripping of overcurrent protection upstream in the distribution due to harmonics.
 - Mitigation of harmonics to sensitive equipment that are highly susceptible to voltage distortion.

- Improving the effects of decreased Power Factor due to harmonics.
- .4 Autotransformer:
- .1 Autotransformers shall only be specified for single load applications.
 - .2 Autotransformers may only be used in lieu of general purpose transformers in applications where isolation is not required and the latter cannot be utilized due to space and weight restrictions.
- .5 Encapsulated:
- .1 Encapsulated transformers can be specified for the following applications:
 - Harsh environment locations (i.e.: Laboratories, Street Lighting).
 - Hazardous locations requiring Class 1, Division/Zone 2 rated equipment.

2.3 Material Specifications

- .1 Capacity: The allowable range of capacities shall be from 3kVA minimum to 300kVA maximum.
- .2 Frequency: 60Hz shall be the default frequency.
- .3 Cooling: ANN Air Natural Convection Cooling shall be utilized for all transformers.
- .4 Winding Configuration: The transformer shall be delta connected primary with wye connected secondary unless another winding configuration is explicitly stated and required.
- .5 Conductors: Core conductors shall be copper windings, with terminations brazed, welded or bolted. Aluminum windings are only acceptable for transformers sized at 30kVA or less that service normal distribution equipment (emergency, essential, stand-by and life safety do not qualify).
- .6 Insulation: Insulation class shall be 220°C with 150°C temperature rise for all open wound transformers. Encapsulated transformers insulation class shall be 180°C with 135°C temperature rise.
- .7 Impregnation: All open wound transformers shall be immersed and baked in a CSA/UL recognized 220C varnish. Encapsulated transformers shall be completely encased in an approved resin or epoxy.
- .8 Efficiency: The transformer shall be meet the following Energy Efficiency Standards: Canada - (NRCAN 2019) SOR/2018-201, Amd. 14 & ON Reg. 404/12
- .9 Basic Impulse Level: Transformers shall have a minimum 10kV BIL unless otherwise stated.
- .10 Impedance: Shall not be greater than 6%.
- .11 Grounding:
 - .1 A ground terminal for all grounding and bonding conductor connections shall be secured inside the transformer enclosure and not installed on or over any vented portion of the enclosure.
 - .2 Ground core & coil assembly to enclosure with a flexible copper grounding strap or equivalent.

- .3 Transformer secondary neutral shall be solidly grounded to the ground bus.
 - .1 *The neutral is always required to be tied back to the building main ground bus. The only exception is the following:*
 - .1 *Transformer is equal to or less than 75kVA and*
 - .2 *Only serves a single piece of equipment. Panelboards and distributions do not qualify.*
- .12 Neutral: Wye connected secondaries shall have the neutral brought out to a separate fully rated neutral bus.
- .13 Sound Level: The transformer shall at minimum shall meet the sound requirements outlined in NEMA Standard ST-20 Table 3.9.

kVA	NEMA Standard ST-20
3-9	40dB
10-50	45dB
51-150	50dB
151-300	55dB

Lower dB ratings shall be specified for sensitive locations that require minimal sound disturbance.

- .14 Enclosure Type:
 - .1 General purpose areas: NEMA 1
 - .2 Locations where water ingress will occur: NEMA 3R
 - .3 Locations where pressurized water ingress will occur: NEMA 4
 - .4 Wood processing locations and locations subjected to circulating dusts/lints/fibers: NEMA 12
- .15 Enclosure Finish: ANSI/ASA 61 grey finish.
- .16 Seismic Rating: International Building Code (IBC), SDS=2.00g ; z/h = 1.00 ; Ip = 1.5 rated transformers shall specified by the designer as required for critical applications.
- .17 Installation Hardware: Where applicable, lifting lugs shall be adequately strengthened, sized and arranged on the transformer to provide a suitable lift for the completely assembled unit. Provision on the transformer base for skidding and jacking shall be provided as required.
- .18 Windows: Infrared windows shall be required for transformers 112.5kVA and larger.
- .19 Nameplate: The nameplate shall meet or exceed the requirements of the Canadian Electrical Code and CSA/cUL.
- .20 Certifications: All transformers shall bear a CSA or cUL certification label. Alternatively, ensure the equipment has any Nationally Recognized Testing Laboratory (NRTL) member organization's certification label, certifying the equipment for installation in Canada.
- .21 Standards: All transformers shall be constructed and tested to CSA C9, C22.2-47, IEEE C57.12.01, IEEE C57.12.91 and NEMA ST-20. In addition to the standards listed prior, K-Factor Rated and Harmonic Mitigating transformers must incorporate IEEE C57.110 and IEEE Std 519 standards.
- .22 Warranty: Minimum of 1 year of warranty required.
- .23 Approved Manufacturers are:
 - .1 Schneider Electric / Square D.
 - .2 Eaton.

- .3 Hammond.
 - .4 Delta.
 - .5 Rex Power Magnetics.
 - .6 Marcus
- .24 Provide design data and shop drawings for all transformer characteristics for approval by the consultant before proceeding with manufacture.

2.4 Installation Requirements

- .1 Location:
 - .1 Location shall comply with all applicable codes and standards. This includes requirements set out by the CEC, Technical Safety BC and the BC Building Code.
 - .2 Location shall consider the entire life cycle of the transformer. The transformer must be installed in a location that can be easily accessed by maintenance personnel. Access for removal and replacement of the transformer must be considered and any location that will require modification to building infrastructure for removal will not be deemed acceptable.
 - .3 The impact of the sound and vibration of the transformer must be considered when finalizing the location. Sensitive business and research operations must be considered.
 - .4 If applicable, mechanical protection shall be added in locations that are exposed to an increase risk of damage.
 - .5 Any equipment installed above or below the transformer shall not affect access or performance of either piece of equipment, such as:
 - .1 Pull Boxes.
 - .2 Junction Boxes.
 - .3 Cable Tray.
 - .4 Mechanical Equipment - Smoke, Heat, CO2 detectors.
- .2 Clearance:
 - .1 A minimum of 1m (3.28 feet) of clearance is required in front of the transformer as per the Canadian Electric Code.
 - .2 The following clearances are required on the sides, back, and top at a minimum:
 - .1 Transformers up to and including 150kVA: 152mm (6 Inches).
 - .2 Transformers over 150kVA to 300kVA: 305mm (12 inches).
- .3 Mounting:
 - .1 Floor:
 - .1 All floor mounted transformers must be on a concrete pad. Mounting directly on the floor is not allowed.
 - .2 Concrete pad dimensional requirements:
 - .1 Minimum 4 inch height.
 - .2 Minimum of 6 inches of extension past transformer sides.
 - .2 Wall:
 - .1 The largest size allowed or wall mount is 75kVA.
 - .2 Where applicable utilize manufacturer approved wall mounting kits.
 - .3 Ceiling:
 - .1 The largest size allowed is 30kVA.
 - .2 Where applicable utilize manufacturer approved ceiling mounting kits.
 - .4 Stacked: Stacking of transformers is only allowed if all other options have been exhausted due to lack of space. Stacking is only applicable to floor mount applications

and is not allowed for ceiling or wall mount configurations. Stacking shall comply with the following requirements:

- .1 The transformer stacked on top is the same size or smaller than the transformer below.
 - .2 The conditions outlined in 2.4.2 have been satisfied.
 - .3 The ambient temperature must not exceed 30°C.
- .4 Connections:
- .1 Flexible metal conduit shall be utilized for final connections to the primary and secondary sides of the transformer to reduce vibration and sound transmission. Teck cable is an acceptable alternative.
- .5 Grounding:
- .1 The ground terminal shall be connected back to the main building ground bus.
 - .2 The minimum size grounding conductor shall be #6AWG.
- .6 Vibration Isolation:
- .1 All transformers shall have vibration isolation pads between the core and coil assembly and the enclosure.
 - .2 Spring based vibration isolation mounts are required to be installed between the transformer and mounting surface. Where possible utilize mounts offered by the same manufacturer as the transformer.

*****END OF SECTION*****