



TECHNICAL SPECIFICATIONS FOR

METAL-ENCLOSED

NON-SEGREGATED PHASE BUS DUCT

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1.0 General:

- 1.1. This specification describes the electrical and mechanical requirements for metal-enclosed Non-Segregated Bus Duct for 600V through 38kV applications. The bus duct system described is to be suitable for indoor and outdoor installations with nominal current ratings operating in ambient temperatures to 40°C.
- 1.2. This specification covers only the general requirements of the bus duct assemblies. The specific requirements of each assembly (plan, arrangement, components, etc.) will be shown on drawings provided by the Purchaser. These drawings will be the basis for developing the drawings to manufacture and install.

2.0 Basic Construction:

- 2.1. The bus duct shall be of the Non-Segregated Phase type with adequate air space between each phase and from phase to ground.
- 2.2. Bus duct designed for outdoor installations shall be totally enclosed, non-ventilated, and weather resistant, with peaked top cover.
- 2.3. Bus duct designed for indoor installations shall be totally enclosed, non-ventilated and drip proof.

3.0 Standards and Codes:

- 3.1. The assemblies shall be constructed, wired and tested in accordance with all applicable sections of the following latest listed standards and codes.
 - 3.1.1. American National Standards Institute (IEEE-C37.23-2015)
 - 3.1.2. National Electric Code (NEC) (NFPA No. 70)
 - 3.1.3. National Electrical Manufacturers Association (NEMA)
 - 3.1.4. It shall be the manufacturer's responsibility to be knowledgeable of the requirements of the above Standards and Codes. Where standards or codes conflict, IEEE-C37.23-2015, shall be the governing document.
- 3.2. Site Conditions
 - 3.2.1. Ambient Air temperature limits (-30°C to +40°C)_____.
 - 3.2.2. Altitude above sea level _____ feet.

3.2.3. Maximum wind velocity ____ miles per hour.

3.2.4. Ice load ____ pounds per square foot.

3.2.5. Snow load ____ pounds per square foot.

3.2.6. Seismic Zone _____.

4.0 **Ratings (Current ratings based upon 40°C ambient):**

4.1. Maximum voltage ____ V/kV RMS

4.2. Basic impulse insulation level ____ kV

4.3. Rated frequency withstand ____ kV (1 min. dry) 60HZ

4.4. Rated continuous current ____ Amperes

4.5. Momentary withstand current ____ kA Asymmetrical

4.6. Conductor total temperature limit 105°C for silver-plated surfaces, or equivalent bolted bus joints.

4.7. Enclosure total temperature limit 80°C

5.0 **Conductors:**

5.1. Copper-ETP 110 ASTM Designation B187, or Aluminum 6101-T61 ASTM Designation 8236.

5.2. Conductors must not exceed specified temperature limit when operated at the rated current.

5.3. Conductor supports must be provided to withstand short circuit currents and remain functional after short circuit has been experienced.

6.0 **Bus Joints:**

6.1. Temperature rise of bus bar joint shall not exceed 65°C above a maximum 40°C ambient, or a total of 105°C operating temperature.

6.2. Hardware shall be high strength 304 stainless steel, including bolts, flat washers. Belleville spring washers are used for copper, aluminum bus bar and flexible link connections. Nuts shall be silicone bronze hardware.

6.3. Conductor splices to be an overlap single row bolted joint. Joints with splice plates and filler putty are not acceptable.

6.4. Contact surfaces of bolted copper joints shall be silver plated, to maintain low contact resistance without the use of joint compounds.

7.0 **Bus Bar Insulation:**

- 7.1. 600V systems will not require an insulation material applied to the conductors or joints. Adequate air space will be provided between phases, and phase to ground to operate without insulation. Conductors will be painted flat black.
- 7.2. 5kV to 38kV shall have fully insulated conductors and conductor joints. Insulating materials shall be fluidized bed epoxy coating. The materials shall be non-hygroscopic and flame retardant, rated for continuous operation at 105°C (Class 105). The insulation level of the combined system shall meet or exceed the requirements in Table 2 of IEEE Standard C37.23-2015.
- 7.3. Insulation at bus joints shall be molded vinyl boots.
- 7.4. All bolted joints to be taped shall be wrapped with a conductive mesh prior to insulation. This mesh serves as a corona suppressant.

8.0 **Grounding:**

- 8.1. The bus enclosure shall be designed to carry the system ground fault current without excessive temperature rise. As an option, a separate ground bus can be provided on the inside or outside of the bus enclosure. Separate ground bus may terminate to equipment, or a ground pad, for connection to the station ground.
- 8.2. Flexible jumpers shall be provided at all expansion joints to ensure ground continuity.
- 8.3. The housing ground continuity shall be maintained at the shipping splits by the use of housing ground splice plates.

9.0 **Conductor Support Systems:**

- 9.1. Bus conductors shall be rigidly supported and in a vertical position within the enclosure and shall be braced to withstand the short circuit currents specified.
- 9.2. Supports for 600V systems shall be non-hygroscopic, track resistant, flame retardant, glass-reinforced polyester blocks. Silicone rubber inserts will be supplied between the conductors and the support blocks to eliminate the air gap between them.
- 9.3. 5kV and 15kV systems shall be supported on insulators, which are non-hygroscopic, track resistant and flame retardant. Insulators will be molded Cycloaliphatic epoxy mounted on glass reinforced polyester blocks or wet process porcelain type insulators.

10.0 **Enclosures:**

- 10.1. Enclosures shall be constructed of one piece aluminum for the sides and bottoms to limit reduced current losses and circulating currents, which prevents magnetic heating.
- 10.2. All exposed surfaces are to be finished as described below:
 - 10.2.1. All surfaces shall be cleaned to prepare them for paint adhesion.
 - 10.2.2. All surfaces shall have a primer coat applied to 0.2 mil minimum dry film thickness
 - 10.2.3. Outside surfaces shall have a final finish coat of 1.5 mil minimum dry film thickness
- 10.3. Enclosure shall be designed for a maximum temperature rise of 40°C when carrying rated current in a 40°C ambient.
- 10.4. Removable covers shall be provided throughout the bus duct run, on the top, for access to bus joints and supports without the need for disassembling the bus duct. The bottom shall have removable parts at the splice joints only.

10.5. Outdoor weatherproof construction

- 10.5.1. Top covers shall be peaked and have drip lips to shed and prevent entry of wind blown rain.
- 10.5.2. Outdoor exposed enclosure assembly hardware shall be 304 stainless steel.
- 10.5.3. Top cover joints, and joints with end flanges, are to be flanged, gasketed, and protected with a metallic sealing strip.
- 10.5.4. Screened breather/drains are required along bottom covers and at all low points of the installation

10.6. Indoor non-ventilated drip-proof construction

- 10.6.1. Housing will include gasketed solid top and bottom splice covers, and solid sides to prevent entry of falling liquid or solid particles.
- 10.6.2. Enclosure assembly hardware shall be stainless steel.
- 10.6.3. Screened breather/drains are required along bottom covers and at all low points along the installation.

- 10.7. Enclosure joints will provide adjustment to accommodate site variances and linear expansion of up to ¼ inch per joint.
- 10.8. Manufacturer will include any necessary additional expansion joints required by lengths and configuration of each run or at building seismic joints. (Refer to 15)
- 10.9. Enclosures are to be shipped in longest practical lengths to minimize field assembly labor.

11.0 **Space Heaters**

- 11.1. Space heaters shall be completely factory wired inside the bus enclosure. Wiring shall be in a separate grounded metal shielding. Heaters shall be thermostatically controlled.
- 11.2. Space heaters shall be rated 240 volts/1000 watts.
- 11.3. Space heaters shall be operated at 120 volts/125 watts to maintain low heater surface temperature and prolong their life.

12.0 **Wall, Floor or Roof Entrances**

- 12.1. Bus duct will include an internal vapor/fire barrier for one half hour to three hour fire rating, where specified, at all wall, floor and roof penetrations when required.
- 12.2. A dress up plate shall be provided to seal between the outside of the bus enclosure, and the building opening. The fire rating material between the wall and outside of the bus duct enclosure to be supplied by the installing contractor.

13.0 **Testing**

- 13.1. All equipment will be subjected to IEEE-C37.23 standard production tests.
- 13.2. Manufacturer may be requested to submit test reports showing compliance with the following IEEE-C37.23 design tests, or may submit design tests performed on similar ratings along with technical data to substantiate compliance of the equipment being furnished:
 - Temperature Rise
 - Insulation Withstand
 - Impulse
 - Wet and Dry Withstand
 - Momentary
 - Insulation Flame Retardance
 - Water Tightness

14.0 **Equipment Connections**

- 14.1. All transition parts for connection to mating equipment terminals shall be provided by the bus manufacturer. The Purchaser will provide the Manufacturer with the necessary interfacing details from other equipment manufacturers, to allow the bus duct manufacturer to design the connections.
- 14.2. Equipment connections will include bolting hardware, bus adapters (where required), insulating materials and assembly drawings.
- 14.3. Where connection to porcelain bushing of transformers, generators, or reactors is required, flexible connectors having a continuous current rating equal to or greater than the main conductors will be furnished.

15.0 **Expansion Joints (For enclosures or conductors)**

- 15.1. Expansion joints are required for straight runs exceeding 60 feet on copper or aluminum conductors. This applies to indoor or outdoor bus duct construction.
- 15.2. Expansion joints may be factory or field assembled. Full assembly instructions shall be furnished when field installation is required.
- 15.3. Only outdoor expansion joints shall be used in seismic zones 3 or 4, or equivalent, as earthquake joints, indoors or outdoors, and when equipment being connected are on different pads.

16.0 **Documentation Required**

- 16.1. Dimensioned drawings with plan, elevation, and other views necessary for clarity
- 16.2. General bus duct description drawings with views of bus bar, supporting blocks, and the housing arrangements
- 16.3. Bus termination drawings showing details of the connecting equipment (transformers, switchgear, etc.)
- 16.4. Drawings giving location of space heaters, and diagrams indicating the Purchaser's other terminal locations
- 16.5. Installation and operating instructions on all of the equipment furnished