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UL 1366

Outline of Investigation for Insulated Bus Pipe

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Summary of Topics

This First Issue of the Outline of Investigation for Insulated Bus Pipe, UL 1366, covers:

- a) Insulated Bus Pipe (IBP) having ac voltage ratings up to 46 kV;***
- b) Equipment intended for use only in ordinary locations in accordance with ANSI/NFPA 70, the National Electrical Code (locations other than those identified as “Hazardous” or “Classified Locations”); and***
- c) IBP for installation above ground for indoor use and outdoor use, in areas which are accessible to qualified persons only.***

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INTRODUCTION

1 Scope

1.1 These requirements cover Insulated Bus Pipe (IBP) having ac voltage ratings up to 46 kV.

1.2 These requirements cover equipment intended for use only in ordinary locations in accordance with ANSI/NFPA 70, the National Electrical Code (locations other than those identified as “Hazardous” or “Classified Locations”).

1.3 These requirements cover IBP for installation above ground for indoor use and outdoor use, in areas which are accessible to qualified persons only.

2 Components

2.1 A component of a product covered by this Outline shall comply with the requirements for that component and shall be used in accordance with its recognized rating and other limitations of use.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this Outline, or
- b) Is superseded by a requirement in this Outline.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this Outline shall be interpreted as referring to the latest edition of that code or standard.

5 Glossary

5.1 The following terms and definitions apply as related to this Outline.

5.1.1 **AMBIENT AIR TEMPERATURE** – The temperature of the surrounding air that comes in contact with equipment.

5.1.2 **INSULATED BUS PIPE (IBP)** – A bus system that consists of a solid or hollow conductor with insulation wound from untreated paper and subsequently impregnated with a curable resin.

5.1.3 **CAPACITIVE GRADING** – A method by which desired voltage grading is obtained by an arrangement of conducting or semiconducting layers incorporated into the insulating material.

5.1.4 **CLEARANCE** – The distance between two conductive parts along a string stretched the shortest way between these conductive parts.

5.1.5 **CONNECTION BOX** – An enclosure intended to surround the point where the IBP system is connected to other electrical equipment, such as switchgear, to provide protection against unintentional contact with live parts, and to provide some degree of protection against environmental contaminants when closely coupled with the connected equipment.

5.1.6 **COVERING** – A surrounding cover or housing used to protect the contained conductor and prevent accidental contact with live parts.

5.1.7 **CREEPAGE DISTANCE** – The shortest distance along the surface of an insulating material between two conductive parts.

5.1.8 **FIELD WIRING TERMINAL** – A portion of the IBP intended for connection to cable(s) at the installation site.

5.1.9 **INDOOR USE** – An installation of IBP where the entire IBP system is exposed only to indoor atmospheric conditions.

5.1.10 **MONTHLY NORMAL MAXIMUM TEMPERATURE** – A temperature computed by averaging the maximum temperature for each day of the month, and averaging this number over 30 years.

Note: The monthly normal maximum temperature for many locations in the United States can be obtained from National Centers for Environment Information. See IEEE C37.24, Guide for Evaluation the Effect of Solar Radiation on Outdoor Metal-Enclosed Switchgear for more information.

5.1.11 **OUTDOOR USE** – An installation of IBP where any portion of the system is exposed to outdoor atmospheric conditions.

5.1.12 **SUPPORT COMPONENTS** – The basic subassemblies of the IBP system that add strength, rigidity and support to the IBP system.

5.1.13 TAP BOX – An enclosure intended to surround a point in the IBP system where three or more sections of IBP are joined together, to provide protection against unintentional contact with live parts, and to provide some degree of protection against environmental contaminants.

5.1.14 TEMPERATURE RISE – The difference between the measured temperature and the ambient air temperature.

5.1.15 TERMINATION – A device that connects to the IBP and which contains all necessary mechanical and electrical items to complete the connections to other equipment.

5.2 The following ratings apply to IBP as covered by this Outline.

5.2.1 RATED CURRENT (I_r) – The maximum rms value of current which the IBP can carry continuously under the operating conditions of this Outline without exceeding its maximum conductor temperature.

5.2.2 RATED FREQUENCY (f_r) – The frequency at which the bus pipe system is designed to operate.

5.2.3 RATED MAXIMUM CONDUCTOR TEMPERATURE – The maximum temperature at which the conductor can operate as declared by the manufacturer.

5.2.4 RATED MAXIMUM VOLTAGE (U_m) – The highest rms value of the phase-to-phase voltage for which the IBP system is designed.

5.2.5 RATED PEAK WITHSTAND CURRENT (I_p) – The maximum peak current, equal to 2.6 times the rated short-time withstand current, the IBP can withstand without damage.

5.2.6 RATED PHASE TO GROUND VOLTAGE (U_0) – The highest rms value of the voltage between phase and ground for which the IBP system is designed.

5.2.7 RATED SHORT-TIME DURATION (t_k) – The period of time the IBP can withstand the rated short-time current.

5.2.8 RATED SHORT-TIME WITHSTAND CURRENT (I_k) – The maximum short-circuit current for which the IBP is designed to withstand for the specified rated short-time duration.

6 Service Conditions

6.1 Normal service conditions

6.1.1 IBP has been evaluated for use under the following conditions:

- a) Surrounding air temperature: -5°C to 40°C for indoor use IBP; -35°C to 40°C for outdoor use IBP, with the average temperature, measured over a period of 24 h, not exceeding 35°C ;
- b) Maximum altitude: 3300 ft (1000 m);
- c) Environmental conditions: Areas not polluted by dust, smoke, corrosive and/or flammable gases, vapors, or salt;
- d) Maximum relative humidity: 95% non-condensing, average value measured over a period of 24 h;
- e) Indoor IBP is located where the influence of solar radiation is not significant; and
- f) Outdoor IBP is subject to solar radiation, and as such, is subject to derating of the continuous current rating based on the monthly normal maximum temperature of the installation location.

6.2 Special service conditions

6.2.1 Altitude

6.2.1.1 Installation at altitudes above 3300 ft (1000 m) is also recognized in this Outline. Variations in the design will in some cases be required. For example, considerations should be made for temperature rise, insulation level, and mechanical parameters affected by lower ambient pressures. In such cases, the manufacturer shall supply de-rating factors to be applied to the normal service condition ratings.

6.2.2 Ambient temperature

6.2.2.1 Use of the equipment in temperatures above 40°C may require additional testing to establish the necessary de-rating factors to be applied to the equipment. Use at temperatures below -35°C may require additional considerations with respect to the mechanical properties of insulation and mechanical supports.

CONSTRUCTION

7 General

7.1 IBP systems are engineered for specific applications, and as such may have unique combinations of straight sections, curved sections, and the necessary interconnection sections and terminating ends. The entire system shall include all bus pipe, connectors, fittings, and mounting structures to enable proper installation of the complete system.

7.2 Current carrying parts of IBP shall be aluminum or copper. The bus pipe may be solid or hollow.

7.3 IBP systems may be provided in single or multiple phase configurations. The use of parallel runs of IBP to provide higher current ratings is not covered by this Outline.

7.4 IBP shall be provided with capacitive grading elements and a ground layer imbedded in the insulation that surrounds the main conductor, such that the IBP meets the requirements of the Dielectric Voltage-Withstand at Rated Frequency with Partial Discharge Measurement, Section 15.

7.5 When IBP is provided with a neutral conductor, it shall be of the same size and configuration as the phase conductors.

8 Grounding and Bonding

8.1 IBP shall have provision for permanently and effectively bonding all exposed non-current-carrying metal parts, including metallic connecting sleeves, as well as all mounting members, supports, and clamps. IBP provided with an overall metallic sleeve shall have provision for bonding each section of the sleeve. The means for bonding shall consist of a bonding stud or terminal suitable for connection of a bonding conductor no smaller than 12 AWG.

Note: This bonding connection is to prevent static charges and development of potential differences between exposed metal surfaces and ground, and is not intended to act as the equipment grounding conductor, or to carry currents associated with ground faults in equipment or systems supplied by the IBP.

8.2 At all points of connection between the bonding means or the bonding conductor and the assembly, any nonconductive coating, such as paint, shall be removed or penetrated to provide a good electrical connection. Bolts or screws engaging at least two full threads in the penetrated metal shall be considered to have provided adequate penetration.

8.3 IBP may be used for grounded or ungrounded systems. When intended for use in a grounded system, the IBP system shall be provided with an additional run of IBP, to be used as an equipment grounding conductor. This additional run shall be of similar configuration, and of no smaller size, than the IBP runs used for the phase conductors, unless the specific application is known to be provided with an appropriately sized equipment grounding conductor of different construction, such as a cable or bare bus.

9 Enclosures and Connecting Sleeves

9.1 IBP is not provided with an enclosure surrounding all phases. All connecting joints between sections of IBP shall be provided with connecting sleeves that prevent access to uninsulated live parts as demonstrated by compliance with the Rod Entry Test, Section 27.

9.2 The following requirements shall apply to IBP intended for outdoor use:

- a) Unless investigated for sunlight resistance in accordance with Sunlight Resistance, Section 24, the IBP shall be provided with a covering of stainless steel or aluminum over the entire length of the IBP. This outer covering shall comply with the requirements for corrosion protection for outdoor use equipment in accordance with the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E;
- b) The IBP shall be subjected to the rain tests described in Rain Tests, Section 26 in addition to any test requirements for any Type designation marked on the IBP in accordance with the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E;
- c) Connecting sleeves shall be provided with sealing rings that are resistant to weathering in accordance with the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E; and
- d) Connecting sleeves shall be provided with bellows to allow for expansion and contraction of the IBP system.

9.3 When provided with a tap box or connection box (enclosure) for connection of the IBP to other equipment, the box shall comply with the following:

- a) The box shall be constructed of metal no thinner than No. 11 gauge;
- b) The box, when mated to the equipment the IBP is connected to, shall comply with the Rod Entry Test, Section 27;
- c) All unhinged covers that provide access to the interior of the box shall be bolted closed with a minimum of 4 fasteners, one at each corner of the cover. Hinged covers shall be bolted closed with a minimum of two fasteners, one at each corner of the unhinged side. These fasteners shall be captive fasteners, and shall not be operable by hand without the use of a tool;
- d) If intended for outdoor use, the combination of the IBP and the box shall comply with the Rain Tests, Section 26, in addition to any test requirements for any Type designation marked on the box in accordance with the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E. Gaskets provided to meet the environmental conditions shall meet the requirements for such gaskets in accordance with UL 50E; and
- e) Where the individual runs of IBP pass through the box wall, the wall is of a material that does not have magnetic properties, to prevent eddy currents within the wall.

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