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UL 2808

Outline of Investigation for Energy Monitoring Current Transformers

Issue Number: 2

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Summary of Topics

This is the second issue of the Outline of Investigation for Energy Monitoring Current Transformers, UL 2808. Updates include the following:

1. Revised spacing requirements in accordance with UL 61010-1 basic insulation requirements in lieu of requiring full reinforced levels
2. Addition of requirements for enclosed-type current transformers intended for outdoor use
3. Addition of requirements to address Rogowski coil type constructions
4. Addition of requirements for terminal blocks and industrial cable assemblies for alternative wiring methods
5. Addition of requirements for Signal Gathering/Multiplexer Accessories to allow multiple current transformers to be connected together within a panel to send the signal down one pair of conductors to the meter
6. Increasing the maximum primary voltage rating to include 1,000 Vac and 1,500 Vdc circuits

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INTRODUCTION

1 Scope

1.1 These requirements cover open-type current transformers and their associated signal level combiner and/or multiplexer board accessories thereto intended for field installation within distribution and control equipment such as panelboards, switchboards, industrial control equipment, and energy monitoring/management equipment, to measure current on a branch circuit. Installation is in accordance with the National Electrical Code, ANSI/NFPA 70. These requirements also cover "Service Entrance" enclosed-type current transformers intended for outdoor use.

1.2 These current transformers are rated to measure current in a maximum 250 Vac, 600 Vac, or 1000 Vac line-to-line circuits or in a maximum 1500 Vdc circuit. Transformers rated for use in an AC circuit may also be used in DC circuits that do not exceed the Vac rating.

1.3 Current transformer conductor leads under the scope of this Outline are considered a Class 1 circuit, as defined by the National Electrical Code, ANSI/NFPA 70, and are intended to be installed with NFPA 70 Chapter 3 wiring methods. Isolation for the user is provided at the termination.

1.4 This Outline does not include investigation of the function of the controlled equipment.

1.5 These current transformers have not been evaluated for accuracy or use with emergency control systems where the function of the control could affect safety.

1.6 These current transformers are intended for use in an ambient temperature of 0 – 40°C (32 – 104°F) unless specifically indicated for use in other conditions.

1.7 These current transformers are intended for use at altitudes up to 2000 meters (6562 ft) and in a humidity tolerance of 0 – 95 percent, unless indicated for use in other conditions.

1.8 Unless specifically evaluated and marked "Service Entrance", these current transformers are evaluated for installation within equipment on the load side of the service equipment overcurrent device.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this Outline of Investigation shall comply with the requirements for that component.

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.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

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 For the purposes of this Outline, the following definitions apply.

5.2 BURDEN COMPONENT – A resistor or other component that limits open circuit voltage of the current transformer.

5.3 CLASS 1 CIRCUIT – The portion of the wiring system between the load side of the overcurrent device or power-limited supply and the connected equipment.

5.4 CLASS 2 CIRCUIT – The portion of the wiring system between the load side of a Class 2 power source and the connected equipment.

5.5 OPEN-TYPE DEVICE – A device that is not provided with a complete enclosure and is intended to be placed in a suitable end-product enclosure.

5.6 SERVICE ENTRANCE – That portion of the installation between the service point and the line side of the service equipment.

Note: Service entrance correlates with Overvoltage Category IV, or CAT IV, as defined in IEC 60364 and IEC 60664-1.

5.7 CONTROLLED ENVIRONMENT – Also known as Pollution Degree 2. Indicates current transformers are intended for installation in an environment where only non-conductive POLLUTION occurs, except that occasionally a temporary conductivity caused by condensation is expected.

5.8 ENCLOSED-TYPE DEVICE – A device that is provided with a complete enclosure and may be installed outside of a separate end-product enclosure.

CONSTRUCTION

6 General

6.1 In order to reduce the likelihood of creating a risk of electric shock, all metallic parts shall be completely encased or otherwise recessed within an insulating material and comply with the spacing requirements within this Outline.

6.2 Unless otherwise noted, all insulating materials shall be rated with an Electrical Relative Thermal Index (RTI Elec) of 105°C, minimum.

6.3 These current transformers shall be evaluated for installation within equipment having a maximum line-to-line voltage of 250 Vac, 600 Vac, 1000 Vac, or 1500 Vdc.

6.4 These current transformers shall not contain any radio signal generators or other intentional signal emitters.

7 Case and Potting Materials

7.1 All metallic parts of the current transformer shall be insulated or otherwise recessed within the insulating case to reduce the likelihood of creating a risk of electric shock within the installation. Materials for a molded insulating case shall comply with Table 7.1.

Table 7.1
Material characteristics for current transformer case and exposed potting

Flame class	RTI elec ^a	Performance level category (PLC)		
		HWI ^{b,c}	HAI ^{d,e}	CTI ^{f,g}
V-2, VTM-2	Min. 105°C	0, 1 or 2	0, 1 or 2	0, 1, 2 or 3
V-1, VTM-1	Min. 105°C	0, 1, 2 or 3	0, 1, or 2	0, 1, 2 or 3
V-0, VTM-0 or 5V	Min. 105°C	0, 1, 2, 3 or 4	0, 1, 2 or 3	0, 1, 2 or 3
Relative Thermal Index (RTI)				
^a The Electrical Relative Thermal Index (RTI) value of a material is to be determined in accordance with the Standard for Polymeric Materials - Long Term Property Evaluations, UL 746B, by test or by use of the generic RTI table. This material characteristic is dependent upon the minimum thickness at which the material is being used. The RTI shall not be exceeded during the Temperature Test.				
Hot Wire Ignition (HWI)				
^b The Hot Wire Ignition (HWI) value of a material is to be determined by test in accordance with the Standard for Polymeric Materials - Short Term Property Evaluations, UL 746A. This material characteristic is dependent upon the minimum thickness at which the material is being used. When the thickness of an insulating material is less than the minimum specified thickness corresponding to a HWI value, the material is evaluated as in footnote c.				
^c A material without an HWI Performance Level Category (PLC) value or with a HWI PLC value greater (worse) than the value required by Table 7.1 shall be subjected to the Glow Wire End-Product Test specified in the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations, UL 746C.				
High Current Arc Resistance to Ignition (HAI)				
^d The HAI value of a material is to be determined by test in accordance the Standard for Polymeric Materials - Short Term Property Evaluations, UL 746A. This material characteristic is dependent upon the minimum thickness at which the material is being used. When the thickness of an insulating material is less than the minimum specified thickness corresponding to a HAI value, the material is evaluated as in footnote e.				
^e A material without an HAI PLC value or with an HAI PLC value greater (worse) than the value required by Table 7.1 shall be subjected to the end-product Arc Resistance Test specified in the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations, UL 746C.				
Comparative Tracking Index (CTI)				

Table 7.1 Continued

Flame class	RTI elec ^a	Performance level category (PLC)		
		HWI ^{b,c}	HAI ^{d,e}	CTI ^{f,g}
^f The Comparative Tracking Index (CTI) PLC value of a material is to be determined by test in accordance with the Standard for Polymeric Materials - Short Term Property Evaluations, UL 746A. This material characteristic is not dependent upon the minimum thickness at which the material is being used. When the thickness of an insulating material is less than the minimum specified thickness corresponding to a CTI value, the material is evaluated as having the same CTI value found for the greater thickness.				
^g A material without a CTI PLC value or with a CTI PLC value greater (worse) than the value required by Table 7.1 shall have a proof tracking index of 175 as determined by the end-product Proof Tracking Test specified in the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations UL 746C.				
Basic Insulated Transformers				
^h Current transformers marked in accordance with 19.5 do not require molded case materials with HAI or HWI ratings, and the case shall have a CTI rating of 0, 1, 2, 3 or 4.				

7.2 One side of the case may consist of a potting material complying with 7.3 or Table 7.1, if it can be demonstrated that a minimum of 0.8 mm of void and bubble free potting material is provided between the external surface and all internal metal parts.

7.3 Potting material shall be at least 0.8 mm thick and void and bubble free. Any generic potting material may be used whose Electrical RTI is a minimum 105° C, as determined by the Standard for Polymeric Materials - Long Term Property Evaluations, UL 746B. Examples of suitable generic material include: Epoxy, Melamine-Phenolic, Phenolic, Unfilled Nylon and Unfilled Polycarbonate.

7.4 Potting materials that are entirely encased shall comply with the requirements in Table 7.1, the generic material requirements in 7.3, or Table 7.2.

Table 7.2
Additional material characteristics allowed for internal potting

Flame class	RTI elec	Performance level category (PLC)		
		HWI ^a	HAI ^a	CTI ^a
HB	Min 90°C	0, 1 or 2	0 or 1	0, 1, 2 or 3
^a See Table 7.1.				

7.5 If provided in multiple pieces, except where it would interfere with the intended motion of a split-core bobbin, the case parts shall be reliably secured together by ultrasonic welding, solvent welding, snap-fit, glue, or other suitable means. If glue is used, it shall be rated minimum 105°C and evaluated for adhesion with the case material.

7.6 When mounted as intended, there shall be no ventilation or other openings in the case that would allow contaminants into areas with live parts.

7.7 Flexible case materials such as the Rogoski Coil shall meet the insulation requirements for field wiring leads described in 9.1 and 9.3, except the exterior-most insulating material shall be rated at least 105°C.

7.8 For enclosed-type current transformers, the case shall be molded of materials suitable for outdoor use (f1) with respect to exposure to Ultraviolet Light, Water Exposure and Immersion in accordance with the Standard for Polymeric Materials - Use in Electrical Equipment Evaluations, UL 746C. Potting material shall also be evaluated for exposure to Ultraviolet Light, Water Exposure and Immersion in accordance with UL 746C. Gasket materials shall comply with the Tensile Strength and Elongation Tests, and Compression Tests of the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E. The case shall restrict water access to interior parts. Exposed metal parts shall meet the outdoor and additional corrosion requirements for Type 6P of UL 50E.

8 Spacings

8.1 Electrical spacings for an uncontrolled environment from any external surface to any internal live part shall comply with Table 8.1. Over-surface distances depend on the Comparative Tracking Index (CTI) of the insulation material. If the CTI value is not known, a CTI PLC rating of 4 is assumed.

Table 8.1
"Uncontrolled environment" spacings to coil

From any external surface to coil, exposed conductor ends inside case or any other live part ^{a,b,c,d}				
Marked primary voltage	Through-air mm	Over-surface ^e mm		
		Comparative Tracking Index (CTI)		
		PLC 0	PLC 1	PLC 2 or 3 ^f
Non-service entrance				
250 Vac	5.9	6.4	7.2	8.0
600 Vac	10.5	15.2	17.1	19.0
1000 Vac	14.3	25.0	28.0	32.0
1500 Vdc	19.4	37.8	41.7	47.2
Service entrance				
250 Vac	10.5	10.5	10.5	10.5
600 Vac	14.3	15.2	17.1	19.0
1000 Vac	24.3	25.0	28.0	32.0
1500 Vdc	31.4	37.8	41.7	47.2
^a See 8.4 for possible increased spacings requirements due to potential tracking along dead metal parts or transformer core.				
^b For current transformers intended for altitudes above 2000 meters, see 8.10.				
^c For indoor-use current transformers marked in accordance with 19.5, above spacings may be reduced by 50 percent. Not applicable for outdoor-use.				
^d See 8.12 and Table 8.6 for alternative method to demonstrate spacings.				
^e If the distance across a groove is less than 1.5 mm, the over-surface distance is measured across the groove as if the groove did not exist.				
^f Current transformers marked in accordance with 19.5 that have a case material with a CTI rating of 4 use the CTI 2 or 3 column for over-surface spacings requirements.				

8.2 Ultrasonic or solvent welding shall be considered a cemented joint, thus no measurements through an ultrasonic or solvent weld need be made. Potting material that is at least 0.8 mm thick which is void and bubble free is also considered a cemented joint where it bonds to the case material or conductor insulation. A glued seam of the case material is not considered a cemented joint for purposes of spacings. Measurements shall be made through any glued seam, as if the glue were not provided.