

STANDARD INFORMATION

Standard Number: CSA C22.2 No. 61010-2-032

Standard Name: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use — Part 2-032: Particular Requirements for Hand-Held and Hand-Manipulated Current Sensors for Electrical Test and Measurement

Standard Edition and Issue Date: 3rd Edition Dated December 1, 2014

Date of Revision: December 1, 2014

Date of Previous Revision of Standard: February 5, 2009

EFFECTIVE DATE OF NEW/REVISED REQUIREMENTS

Effective Date: **January 1, 2019**

IMPACT, OVERVIEW, AND ACTION REQUIRED

Impact Statement: A review of all Listing Reports is necessary to determine which products comply with new/revised requirements and which products will require re-evaluation. **NOTE:** Effective immediately, this revised standard will be exclusively used for evaluation of new products unless the Applicant requests in writing that current requirements be used along with their understanding that their listings will be withdrawn on Effective Date noted above, unless the product is found to comply with new/revised requirements.

Overview of Changes:

- Clearances and creepage distances have been added for unmated measuring circuit terminals
- Requirements have been added for specialized measuring circuit terminals
- Requirements have been added for low battery indication
- New annexes for measurement categories and hazards

Specific details of new/revised requirements are found in table below.

If the applicable requirements noted in the table are not described in your report(s), these requirements will need to be confirmed as met and added to your report(s) such as markings, instructions, test results, etc. (as required).

Client Action Required:

Information – To assist our Engineer with review of your Listing Reports, please submit technical information in response to the new/revised paragraphs noted in the attached or explain why these new/revised requirements do not apply to your product (s).

Current Listings Not Active? – Please immediately identify any current Listing Reports or products that are no longer active and should be removed from our records. We will do this at no charge as long as Intertek is notified in writing prior to the review of your reports.



STANDARD INFORMATION

CLAUSE	VERDICT	COMMENT
		<i>Additions to existing requirements are <u>underlined</u> and deletions are shown lined out below.</i>
5	Info	Marking and documentation
5.1.5	Info	TERMINALS, connections and operating devices
5.1.5.101		Measuring circuit TERMINALS
		<i>New clause added;</i>
		General
		Except as permitted in 5.1.5.101.4:
		a) the value of the RATED voltage to earth of measuring circuit TERMINALS shall be marked, and
		b) the value of the RATED voltage or the RATED current, as applicable, of each pair or set of measuring circuit TERMINALS that are intended to be used together shall be marked, and
		c) the pertinent MEASUREMENT CATEGORY for each individual, pair, or set of measuring circuit TERMINALS or symbol 14 of Table 1 shall be marked as specified in 5.1.5.101.2 and 5.1.5.101.3, if applicable.
5.1.5.101.1		Measuring circuit TERMINALS are usually arranged in pairs or sets. Each pair or set of TERMINALS may have a RATED voltage or a RATED current, or both, within that set, and each individual TERMINAL may have a RATED voltage to earth. For some equipment, the RATED voltage between TERMINALS may be different from the RATED voltage to earth. Markings shall be clear to avoid misunderstanding.
		Markings shall be placed adjacent to the TERMINALS. However, if there is insufficient space (as in multi-input equipment), the marking may be on the RATING plate or scale plate, or the TERMINAL may be marked with symbol 14 of Table 1.
		For any set of measuring circuit TERMINALS, symbol 14 of Table 1 does not need to be marked more than once, if it is close to the TERMINALS.
		Conformity is checked by inspection and, if applicable, as specified in 5.1.5.101.2 and 5.1.5.101.3, taking the exceptions in 5.1.5.101.4 into account.



CLAUSE	VERDICT	COMMENT
		<p><i>New clause added;</i></p> <p>Measuring circuit TERMINALS RATED for MEASUREMENT CATEGORIES II, III or IV</p> <p>The relevant MEASUREMENT CATEGORY shall be marked for measuring circuit TERMINALS RATED for measurements within MEASUREMENT CATEGORIES II, III or IV. The MEASUREMENT CATEGORY markings shall be “CAT II”, “CAT III” or “CAT IV” as applicable.</p> <p>Marking more than one type of MEASUREMENT CATEGORY and its RATED voltage to earth is permissible (see also 5.1.5.101.1).</p> <p>Conformity is checked by inspection.</p>
5.1.5.101.2		
		<p><i>New clause added</i></p> <p>Measuring circuit TERMINALS RATED for connection to voltages above the levels of 6.3.1</p> <p>Symbol 14 of Table 1 shall be marked for measuring circuit TERMINALS RATED for connection to voltages above the levels of 6.3.1, but that are not RATED for measurements within MEASUREMENT CATEGORIES II, III or IV (see also 5.4.2 bb)).</p> <p>Conformity is checked by inspection.</p>
5.1.5.101.3		
6	Info	Protection against electric shock
6.6	Info	Connections to external circuits
		<p><i>New clause added;</i></p> <p>Measuring circuit TERMINALS</p> <p>Conductive parts of each unmated measuring circuit TERMINAL which could become HAZARDOUS LIVE when the highest RATED voltage is applied to other measuring circuit TERMINALS on the equipment shall be separated by at least the applicable CLEARANCE and CREEPAGE DISTANCE of Table 101 from the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position (see Figure 1).</p> <p>Conformity is checked by inspection and measurement.</p>
6.6.101		



CLAUSE	VERDICT	COMMENT
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New table added;

CLEARANCES and CREEPAGE DISTANCES for measuring circuit TERMINALS with HAZARDOUS LIVE conductive parts

Table 1

Voltage on conductive parts of TERMINAL		CLEARANCE and CREEPAGE DISTANCE
V a.c. r.m.s.	V d.c.	mm
$\geq 33 \leq 300$	$\geq 70 \leq 414$	0,8
$> 300 \leq 600$	$> 414 \leq 848$	1,0
$> 600 \leq 1\ 000$	$> 848 \leq 1\ 414$	2,6
NOTE For WET LOCATIONS, there are no CLEARANCE and CREEPAGE DISTANCE requirements for voltages between 16 V a.c. r.m.s. and 33 V a.c. r.m.s., or between 35 V d.c. and 70 V d.c., but conductive parts of unmated measuring circuit TERMINALS shall not be ACCESSIBLE. The values in this table are not applicable to voltages below HAZARDOUS LIVE voltages (see 6.3.1 a)).		

New clause added;

Specialized measuring circuit TERMINALS

Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS shall not be both ACCESSIBLE and HAZARDOUS LIVE, in either NORMAL CONDITION or SINGLE-FAULT CONDITION, even when the highest RATED voltage is applied to any other measuring circuit TERMINAL.

6.6.102

Conformity is checked by inspection and measurement. Components, sensors, and devices intended to be connected to specialized measuring circuit TERMINALS are connected. The measurements of 6.3 are made to establish that the levels of 6.3.1 and 6.3.2 are not exceeded when each of the following voltages is applied to each other measuring circuit TERMINAL, if applicable:

- a) highest RATED a.c. voltage at any RATED MAINS frequency;
- b) highest RATED d.c. voltage;
- c) highest RATED a.c. voltage at the maximum RATED measurement frequency.

Pull test for endcaps of flexible current sensors

The endcaps of a flexible cord used for the JAW of the flexible current sensor shall be securely fixed, so that they withstand any forces likely to occur in NORMAL USE.

6.9.101.5

Conformity is checked by inspection and the following test on each endcap. ~~with the endcap clamped so that it cannot move, the cord is subjected to a steady axial pull force of 100 N, or four times the opening force of the JAW, whichever is greater, for 1 min. If the insulation of the cord moves more than 2 mm in the JAW end, then the test shall be repeated a maximum of 15 times, with a duration of 15 s each. The insulation shall not move more than 1 mm in addition to the displacement from the first test.~~



CLAUSE	VERDICT	COMMENT
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With the endcap clamped so that it cannot move, the flexible cord is subjected to a steady axial pull force according to Table 102 for 1 min.

After the pull the insulation shall not have moved more than 2 mm.

If the insulation has moved more than 2 mm, then the pull is repeated 15 more times with a duration of 15 s each.

After the last pull:

- a) the insulation shall not have moved more than 1 mm more than the displacement from the first pull if it is subjected to 16 pulls;
- b) CLEARANCES and CREEPAGE DISTANCES shall not have been reduced below the applicable values of K.101 for REINFORCED INSULATION; and
- c) the current sensor shall pass the tests of K.101.4 for REINFORCED INSULATION.

New table added;

Pull forces for endcaps of flexible current sensors

Table 102	Cross section area of the flexible cord	Pull force
	Mm ²	N
	≤ 25	50
	100	75
	≥500	100
Linear interpolation is allowed.		

10	Info	Equipment temperature limits and resistance to heat
10.5	Info	Resistance to heat

New clause added;

Resistance to heat of current sensors

Insulating material of JAWS surrounding a magnetic material which can overheat shall have adequate resistance to heat.

10.5.101 Conformity is checked by examination of material data. For rigid insulating materials, if the material data is not conclusive, one of the following tests is performed.

- a) A sample of the insulating material, at least 2,5 mm thick, is subjected to a ball-pressure test using the test apparatus Figure 14. The test is made in a heating cabinet at the temperature measured as specified in 10.101 ± 2 °C, or at 105 °C ± 2 °C, whichever is higher. The part to be tested is supported so that its upper surface is horizontal, and the spherical part of the apparatus is pressed against this surface



CLAUSE	VERDICT	COMMENT
		<p>with a force of 20 N. After 1 h the apparatus is removed and the sample is cooled within 10 s to approximately room temperature by immersion in cold water. The diameter of the impression caused by the ball shall not exceed 2 mm.</p> <p>b) The Vicat softening test of ISO 306, method A120. The Vicat softening temperature shall be at least 105 °C.</p> <p>Addition:</p> <p>Add the following new subclause:</p> <hr/> <p><i>New clause added;</i></p> <p>Other temperatures of current sensors</p> <p>Most current sensors depend on inductive connection to the circuit being measured. The behaviour of the measuring circuit will, in these cases, depend on the frequency of the signal being measured. When the current sensor is used to measure currents at high frequency, circulating currents could cause significant heating within the magnetic circuit of the current sensor.</p> <p>If a HAZARD could be caused by excessive temperature, easily touched surfaces shall not exceed the values of Table 19 and the temperature of the insulating material of windings shall not exceed the values of Table 20 when the current sensor measures the maximum current at the frequency which causes the highest temperature.</p> <p>Conformity is checked by measurement as specified in 10.4.</p>
10.101		
14	Info	<p>Components and subassemblies</p> <hr/> <p>Circuits or components used as TRANSIENT OVERVOLTAGE limiting devices in measuring circuits used to measure MAINS</p> <p>Signal and measuring leads and their accessories shall meet the requirements of IEC 61010-031.</p> <p><u>If TRANSIENT OVERVOLTAGE are limited in a measuring circuit used to measure MAINS, the overvoltage limiting device shall have adequate strength to limit likely TRANSIENT OVERVOLTAGES in NORMAL USE.</u></p> <p><u>Conformity is checked by applying five positive and five negative impulses with the applicable impulse voltage of Table 104, spaced up to 1 min apart, from a hybrid impulse generator (see IEC 61180-1). The generator produces an open-circuit voltage waveform of 1,2/50 μs, a shortcircuit current waveform of 8/20 μs, with an output impedance (peak open-circuit voltage divided by peak short-circuit current) of 2 Ω for MEASUREMENT CATEGORIES III and IV or 12 Ω for MEASUREMENT CATEGORY II. Resistance may be added in series if needed to raise the impedance. The test impulse is applied in combination with the MAINS voltage. The MAINS</u></p>
14.101		



CLAUSE	VERDICT	COMMENT
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voltage is the highest RATED voltage of the measuring circuit TERMINALS, but no more than 400 V a.c. r.m.s.

The test voltage is applied between each pair of TERMINALS used to measure MAINS where voltage-limiting devices are present.

No HAZARD shall arise in the event that the component ruptures or overheats during the test. If a rupture occurs, no part of the component shall bridge safety-relevant insulation. If the component overheats, it shall not heat other materials to their self-ignition points. Tripping the circuit breaker of the MAINS installation is an indication of failure. If the results of the test are questionable or inconclusive, the test is to be repeated two more times.

New table added;

Impulse voltages

Table 14

Nominal a.c. r.m.s line-to-neutral or d.c. voltage of MAINS being measured V	Impulse withstand voltage V		
	MEASUREMENT CATEGORY II	MEASUREMENT CATEGORY III	MEASUREMENT CATEGORY IV
≤ 50	500	800	1 500
> 50 ≤ 100	800	1 500	2 500
> 100 ≤ 150	1 250	2 500	4 000
> 150 ≤ 300	2 500	4 000	6 000
> 300 ≤ 600	4 000	6 000	8 000
> 600 ≤ 1 000	6 000	8 000	12 000

New clause added;

Low battery indication

16.101.2

When the battery of a current sensor which is powered by an internal battery, discharges, no HAZARD shall arise from an OPERATOR's reliance on a value displayed by the current sensor, at every battery voltage or energy level.

Conformity is checked by inspection and, in case of doubt, by provoking a battery discharge.

101	Info	Measuring circuits
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CLAUSE	VERDICT	COMMENT
		<p><i>New clause added;</i></p> <p>General</p> <p>The equipment shall provide protection against HAZARDS resulting from NORMAL USE and REASONABLY FORESEEABLE MISUSE of measuring circuits, as specified below.</p> <p>a) If a HAZARD could result, a current measuring circuit shall not interrupt the circuit being measured during range changing, or during the use of current sensors with an internal current transformer (see 101.2).</p> <p>b) An electrical quantity that is within specification for any TERMINAL shall not cause a HAZARD when it is applied to that TERMINAL or any other compatible TERMINAL, with the range and function settings set in any possible manner (see 101.3).</p> <p>c) Any interconnection between the equipment and other devices or accessories intended to be used with the equipment shall not cause a HAZARD even if the documentation or markings prohibit the interconnection while the equipment is used for measurement purposes (see 6.6).</p> <p>d) A TEMPORARY OVERVOLTAGE or a TRANSIENT OVERVOLTAGE applied on the measuring circuits TERMINALS in voltage measurement function shall not cause a HAZARD (see 101.4).</p> <p>e) Other HAZARDS that could result from REASONABLY FORESEEABLE MISUSE shall be addressed by RISK assessment (see Clauses 16 and 17).</p> <p>Conformity is checked as specified in 6.6, 101.2, 101.3, 101.4, Clause 16 and Clause 17 as applicable.</p>
		<p><i>New clause added;</i></p> <p>Protection against MAINS overvoltages</p> <p>MAINS voltage measuring circuits shall be so designed that, when a TEMPORARY OVERVOLTAGE or a TRANSIENT OVERVOLTAGE is applied on the measuring circuits TERMINALS in voltage measurement function in the proper range, no damage shall result which could cause a HAZARD.</p>
101.4		<p>MAINS voltage measuring circuits shall have a minimum of BASIC INSULATION between MAINS-connected conductive parts of opposite polarity.</p> <p>Conformity is checked by inspection, and by the following impulse withstand voltage test using the applicable test voltage of Table 104, or by the impulse withstand voltage test of 14.101 if an overvoltage limiting component or circuit is used to control the TRANSIENT OVERVOLTAGE.</p> <p>The test voltage is applied between each pair of TERMINALS used to measure MAINS voltage. The impulse withstand voltage test shall be conducted for five</p>



CLAUSE	VERDICT	COMMENT
		<p>impulses of each polarity with an interval of at least 1 s between impulses. The impulse voltage test is carried out with a 1,2/50 μs waveform (see Figure 1 of IEC 61180-1:1992). The wave shape of each impulse shall be observed (see Note 1 below).</p> <p>When verifying CLEARANCES within equipment by an impulse voltage test, it is necessary to ensure that the specified impulse voltage appears at the CLEARANCE.</p> <p>No flashover of CLEARANCES or breakdown of solid insulation shall occur during the test, but partial discharges are allowed. Partial discharge will be indicated by a step in the resulting wave shape which will occur earlier in successive impulses. Breakdown on the first impulse may either indicate a complete failure of the insulation system or the operation of overvoltage limiting devices in the equipment.</p>
102	Info	<p><i>New section added;</i></p> <p>Prevention of HAZARD from arc flash and short-circuits</p>
102.1		<p>General</p> <p>When a current sensor temporarily bridges two high-energy conductors, it may cause a shortcircuit, resulting in high current flow through the current sensor.</p> <p>The current sensor may become hot, or may melt. This may cause burns to an OPERATOR or a bystander near the current sensor.</p> <p>If contact is broken (by OPERATOR action, melting, or other event) while current is flowing through the current sensor, arcing may occur. The arcing will ionize the air in the vicinity of the arc, permitting continued current flow in the vicinity of the current sensor. If there is sufficient available energy, then the ionization of the air will continue to spread and the flow of current through the air continues to increase. The result is an arc flash, which is similar to an explosion, and can cause injury or death to an OPERATOR or a bystander.</p> <p>The current sensor shall be constructed to mitigate the RISK of arc flash and short-circuits.</p> <p>Conformity is checked as specified in 102.2 and 102.3. All measurements and tests in 102.2 and 102.3 are done after the pre-treatment of the JAW ENDS specified in 6.9.101.1, if applicable.</p>



CLAUSE	VERDICT	COMMENT
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102.2 **Protection against short-circuits during clamping**

Type A and Type B current sensors shall have additional protection against a short circuit caused by the JAWS during insertion and removal between conductors and busbars.

For the purpose of this standard, it is assumed that a single JAW END is not able to shortcircuit two separated conductors in an electric installation. The maximum voltage between two UNINSULATED conductors which could be short-circuited during clamping is considered to be the equal or lower than the line-to-line voltage of the distribution system for which the current sensor is RATED.

Conformity is checked by inspection, and if applicable, by the a.c. test of 6.8.3.1 with a duration of at least 1 min or for d.c. conductors the 1 min d.c. test of 6.8.3.2 using the test voltages from Table 105 applied between the test lead wires for each voltage of Table 105 up to and including the highest RATED voltage of the JAWS, while each specified test probe of Figure 106 and Table 105 for the considered voltage is inserted into the JAW opening as shown in Figure 107. If, for example, the RATED voltage of the JAWS is 450 V, then the tests will be performed with a 6 mm probe, a 10 mm probe, and a 15 mm probe.

New table added;

Thickness of the test probe of Figure 106 and test voltages

Table 105

RATED a.c. r.m.s. or d.c. voltage of the JAWS V	Thickness X of the test probe ^a mm	Test voltage ^b	
		1 min a.c. test	1 min d.c. test
		V r.m.s.	V d.c.
≤ 150	6	250	450
> 150 ≤ 300	10	6450	900
> 300 ≤ 600	15	1 300	1 850
> 600 ≤ 1 000	25	2 200	3 100

^a If the JAWS do not open to the appropriate dimension, the probe thickness will equal the maximum JAW opening.

^b The values for test voltage apply to tests performed at 2 000 m. For other test site altitudes, the corrections of Table 10 are applied.



CLAUSE	VERDICT	COMMENT
102.3		<p><i>New clause added;</i></p> <p>Protection against short-circuits in closed position</p> <p>In closed position, JAWS of Type A, Type B, and Type C current sensors shall have BASIC INSULATION between the outer surface of the ENCLOSURE of the JAWS and all conductive parts including small metal parts such as screws or rivets, except the JAW ENDS.</p> <p>Conductive parts of the JAW ENDS shall not be ACCESSIBLE in closed position.</p> <p>Conformity is checked by inspection, by the tests of K.101.4 for solid insulation and by the determination of whether the JAW ENDS are ACCESSIBLE in closed position in accordance with 6.2.</p>
Annex F		<p><i>New annex added;</i></p> <p>ROUTINE TESTS</p> <p>General</p> <p>Replacement: Replace the first sentence with the following text:</p> <p>F.1 The manufacturer shall perform the tests of F.2 to F.4 and F.101 on 100 % of equipment produced which has both HAZARDOUS LIVE parts and ACCESSIBLE conductive parts.</p> <p>Addition: Add the following new subclause:</p>



CLAUSE	VERDICT	COMMENT
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JAWS of current sensors

For Type A, Type B, and Type C current sensors, a test voltage is applied between:

- a) exposed conductive parts of the JAWS or JAW ENDS, and
- b) ACCESSIBLE conductive parts within the HAND-HELD or hand-manipulated area and input and output circuits connected together.

Type D current sensors and other current sensors whose JAWS and JAW ENDS do not have ACCESSIBLE conductive parts do not need to be subjected to this test.

F.101

The test voltage may be a.c., d.c., or impulse, and is selected from Table F.101 for the appropriate MEASUREMENT CATEGORY. For the a.c. and d.c. tests, the test voltage is raised to its specified value within 5 s, and maintained for at least 2 s. Impulse tests are the 1,2/50 μs test specified in IEC 61180 series, conducted for a minimum of three pulses of each polarity at 1 s minimum intervals. For current sensors with no RATED MEASUREMENT CATEGORY, the value of the test voltage is 1,5 times the RATED voltage to earth of the JAWS but not less than 350 V a.c. r.m.s. or 500 V d.c.

No flashover of CLEARANCES or breakdown of solid insulation shall occur during the test.

Test voltages for ROUTINE TESTS of JAWS of current sensors

Table F.101

RATED a.c. r.m.s. or d.c. voltage to earth of the JAWS V	MEASUREMENT CATEGORY II			MEASUREMENT CATEGORY III			MEASUREMENT CATEGORY IV		
	2 s a.c. test V r.m.s.	2 s d.c. test V d.c.	1,2/50 μs impulse V peak	2 s a.c. test V r.m.s.	2 s d.c. test V d.c.	1,2/50 μs impulse V peak	2 s a.c. test V r.m.s.	2 s d.c. test V d.c.	1,2/50 μs impulse V peak
≤ 150	840	1 200	1 200	1 400	2 000	2 000	2 200	3 100	3 100
> 150 ≤ 300	1 400	2 000	2 000	2 200	3 100	3 100	3 300	4 700	4 700
> 300 ≤ 600	2 200	3 100	3 100	3 300	4 700	4 700	4 300	6 000	6 000
> 600 ≤ 1 000	3 300	4 700	4 700	4 300	6 000	6 000	5 300	7 500	7 500

New annex added;

Annex AA

Added to describe the characteristic of MEASUREMENT CATEGORIES (see standard for details).

New annex added;

Annex BB

Added to describe HAZARDS that may be encountered when using measuring circuits (see standard for details).

CUSTOMERS PLEASE NOTE: This Table and column “Verdict” can be used in determining how your current or future production is or will be in compliance with new/revised requirements.