

STANDARD INFORMATION

If the project requires a sample for evaluation and/or testing, then this SUN applies.

Standard: UL 61010-2-032

Standard ID: 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 [UL 61010-2-032:2020 Ed.2]

Previous Standard ID: 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 [UL 61010-2-032:2014 Ed.1]

EFFECTIVE DATE OF NEW/REVISED REQUIREMENTS

Effective Date: **January 1, 2023**

IMPACT, OVERVIEW, AND ACTION REQUIRED

Impact Statement: No action is required for currently certified products. If modifications to the product after the effective date require an evaluation and/or testing, then the product must undergo re-evaluation to the new requirements.

Overview of Changes:

- Fork-style current sensors have been added
- Addition of clamp multimeters that have a primary purpose of measuring voltage on live mains
- Requirements for input/output circuits of Type A, Type B and Type C current sensors have been added
- Requirements for output circuit leads have been modified

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

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 – Please immediately identify any current Listing Reports or products that are no longer active and should be removed from our records.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
		<p>Additions to existing requirements are <u>underlined</u> and deletions are shown lined-out below.</p>
4	Info	<p>Tests</p> <p><i>New clause added;</i></p> <p>Power supply</p> <p>The following requirements apply.</p> <p>4.3.2.5</p> <p>a) The MAINS supply voltage shall be between 90 % and 110 % of any RATED supply voltage for which the equipment can be set or, if the equipment is RATED for a greater fluctuation, at any supply voltage within the fluctuation range.</p> <p>b) The MAINS frequency shall be any RATED frequency.</p> <p>c) Equipment for both a.c. and d.c. shall be connected to an a.c. or d.c. supply.</p> <p>d) Equipment powered by single-phase a.c. MAINS supply shall be connected both with normal and reverse polarity.</p> <p>e) If the means of connection permit reversal, battery-operated and d. c. equipment shall be connected with both reverse and normal polarity.</p> <p><i>New clause added;</i></p> <p>4.3.2.6</p> <p>Input and output voltages or currents</p> <p>Input and output voltages or currents, including floating voltages but excluding the MAINS supply voltage, shall be set to any voltage or current within their RATED range, in normal and reverse polarity if possible.</p>
5	Info	<p>Marking and documentation</p> <p>General</p> <p>Add the following new items to the list and a new paragraph:</p> <p>5.4.1</p> <p>aa) information about each relevant MEASUREMENT CATEGORY if the measuring circuit is RATED for MEASUREMENT CATEGORIES (see 5.1.5.101.2);</p> <p>bb) for measuring circuits that are not RATED for MEASUREMENT CATEGORIES, but that could be misused by connection to such circuits, a warning not to use the current sensor for measurements on MAINS, and a detailed RATING including TRANSIENT OVERVOLTAGES (see AA.2.4 for more information).</p> <p><u>Some current sensors may have multiple MEASUREMENT CATEGORY RATINGS for the same measuring circuit. For such current sensors, the documentation shall clearly identify the MEASUREMENT CATEGORIES where the current sensor is intended to be used and where it shall not be used.</u></p>



CLAUSE	VERDICT	COMMENT
		Equipment RATINGS
		<u>Add the following two new items to the list and a new paragraph:</u>
5.4.2		<u>aa) information about each relevant MEASUREMENT CATEGORY if the measuring circuit is RATED for MEASUREMENT CATEGORIES (see 5.1.5.101.2 and 5.1.5.102);</u> <u>bb) for Type A, Type B and Type C current sensors that are not RATED for MEASUREMENT CATEGORIES, but that could be misused by connection to such circuits, a warning not to use the current sensor for measurements on MAINS, and a detailed RATING including TRANSIENT OVERVOLTAGES (see AA.2.4 for more information).</u>
		If the current sensor has multiple MEASUREMENT CATEGORY RATINGS for the same measuring circuit, the documentation shall clearly identify the MEASUREMENT CATEGORIES where the current sensor is intended to be used and where it shall not be used.
6	Info	Protection against electric shock
6.6	Info	Connections to external circuits

Measuring circuit TERMINALS

The 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 current sensor shall be separated by at least:

- 6.6.101
- a) for TERMINALS with voltage RATING up to 1 000 V a. c. or 1 500 V d. c., 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);
 - b) for TERMINALS with voltage RATING exceeding 1 000 V a.c. or 1 500 V d.c., 2,8 mm for the CLEARANCE and CREEPAGE DISTANCE from the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position. These TERMINALS shall also withstand the voltage test of 6.8 with a test voltage equal to the RATED voltage of the TERMINAL multiplied by 1,25 applied between the closest approach of the test finger touching the external parts of the TERMINAL in the least favourable position and the other measuring circuit TERMINALS.

EXAMPLE For a 4 000 V a. c. r. m. s. RATED voltage, the test voltage is 5 000 V a. c. r. m. s. (7 070 V peak). The calculated CLEARANCE is 13,1 mm according to D2 in Table K.15. For homogeneous fields, a lower CLEARANCE value can be achieved by testing (see IEC 60664-1 for more information about homogeneous fields).



CLAUSE	VERDICT	COMMENT
		<p><u>c) for WET LOCATIONS, there are no CLEARANCE and CREEPAGE DISTANCE requirements for voltages between 16 V a.c. r.m.s. and 30 V a.c. r.m.s., or between 35 V d.c. and 60 V d.c., but conductive parts of unmated measuring circuit TERMINALS shall not be ACCESSIBLE.</u></p> <p><u>Annex CC provides information regarding the recommended dimensions of 4 mm "banana" TERMINALS.</u></p> <p><u>Conformity is checked by inspection, by the determination of ACCESSIBLE parts, by measurement of the applicable CLEARANCES and CREEPAGE DISTANCES, and if applicable, by the voltage test of 6.8.</u></p> <hr/> <p><i>New clause added;</i></p> <p>CREEPAGE DISTANCES</p> <p>Add the following new paragraph after the third paragraph:</p> <p>6.7.1.3 For HAND-HELD EQUIPMENT not powered from the MAINS or the measuring circuit, CREEPAGE DISTANCES according to material group I are allowed to be used for other materials.</p> <p>For TERMINALS of HAND-HELD EQUIPMENT intended to be connected only to a HAND-HELD probe assembly complying with Part 031, CREEPAGE DISTANCES according to material group I are allowed to be used for the insulating material of the TERMINALS.</p> <hr/> <p><i>New clause added;</i></p> <p>Requirements for insulation according to type of circuit</p> <p>Replace the text with the following:</p> <p>Requirements for insulation in particular types of circuits are specified as follows:</p> <p>6.7.1.5 a) in 6.7.2 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II with a nominal supply voltage up to 300 V; NOTE 1 See Annex I for nominal voltages of MAINS supplies. b) in 6.7.3 for secondary circuits separated from the circuits in a) only by means of a transformer; c) in Clause K.1 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY III or IV or for OVERVOLTAGE CATEGORY II over 300 V; d) in Clause K.2 for secondary circuits separated from the circuits in c) only by means of a transformer; e) in Clause K.3 for circuits that have one or more of the following characteristics:</p> <hr/>



CLAUSE	VERDICT	COMMENT
		<p>1) the maximum possible TRANSIENT OVERVOLTAGE is limited by the supply source or within the current sensor to a known level below the level assumed for the MAINS CIRCUIT;</p> <p>2) the maximum possible TRANSIENT OVERVOLTAGE is above the level assumed for the MAINS CIRCUIT;</p> <p>3) the WORKING VOLTAGE is the sum of voltages from more than one circuit, or is a mixed voltage;</p> <p>4) the WORKING VOLTAGE includes a recurring peak voltage that may include a periodic nonsinusoidal waveform or a non-periodic waveform that occurs with some regularity;</p> <p>5) the WORKING VOLTAGE has a frequency above 30 kHz;</p> <p>6) the circuit is a measuring circuit where MEASUREMENT CATEGORIES do not apply.</p> <p>f) in Clause K.101 for measuring circuits RATED for MEASUREMENT CATEGORIES.</p> <p>NOTE 2 These requirements are illustrated in the flowchart of Annex DD, Figure DD.1.</p> <p>The TRANSIENT OVERVOLTAGE level for the MAINS corresponds to the "required RATED impulse voltage of equipment" value specified in Table 443.2 of IEC 60364-4-44:2007/AMD1:2015.</p>
6.9	Info	Constructional requirements for protection against electric shock
6.9.101	Info	Protection against the HAZARDOUS LIVE conductor
		HAND-HELD or hand-manipulated parts
		<p>HAND-HELD or hand-manipulated parts of Type A current sensors shall be separated by DOUBLE INSULATION or REINFORCED INSULATION from the parts of the JAWS which can be touched by an UNINSULATED CONDUCTOR, in open and in closed position. If any conductive part of the magnetic circuit can touch a conductor, it is considered to be held at the RATED voltage to earth of the JAWS.</p>
6.9.101.2		<p><u>JAW ENDS which have a wear indicator shall provide at least DOUBLE INSULATION or REINFORCED INSULATION when new, and at least BASIC INSULATION when the wear indicator becomes visible.</u></p> <p><u>Conformity is checked by inspection, by determination of the touchable parts of the JAWS in open and in closed position using the metal pin of 6.2.3 and determination of the ACCESSIBLE HAND-HELD or hand-manipulated parts, and,</u></p> <p><u>a) if the current sensor is RATED for MEASUREMENT CATEGORIES, by measurement of the applicable values for CLEARANCES and CREEPAGE DISTANCES of K.101.2 and K.101.3, and for solid insulation by the applicable tests of K.101.4;</u></p>



CLAUSE	VERDICT	COMMENT
		<p>b) if the current sensor is not RATED for MEASUREMENT CATEGORIES, by <u>measurement of the applicable values for CLEARANCES and CREEPAGE DISTANCES of K.3.2 or K.3.3 and K.3.4, and for solid insulation by the applicable tests of K.3.5.</u></p> <p><u>In addition to the metal pin, the outer surfaces of the ENCLOSURE of the JAWS are covered with metal foil in open and in closed position during the test.</u></p> <p><u>If the JAW ENDS of Type A current sensors RATED for MEASUREMENT CATEGORIES III and IV, include a wear indicator, measurement and tests are done both before and after the JAW ENDS abrasion test of 8.101 and the JAW impact test of 8.102, if applicable.</u></p> <p><u>If the JAW ENDS do not include a wear indicator, measurement and tests are done after the JAW ENDS abrasion test of 8.101 and the JAW impact test of 8.102, if applicable.</u></p>
6.101		<p><i>New section added;</i></p> <p>Output circuit leads</p> <p>This section contains requirements for output circuit leads. See Standard for details.</p>
8		<p><i>New section added;</i></p> <p>Resistance to mechanical stresses</p> <p>This section contains requirements for resistance to mechanical stresses. See standard for details.</p>
14	Info	<p>Components and subassemblies</p> <p>Circuits used to limit TRANSIENT OVERVOLTAGE in measuring circuits used to measure MAINS</p> <p>If control of TRANSIENT OVERVOLTAGES is employed in a measuring circuit used to measure MAINS, the overvoltage limiting component or circuit shall have adequate strength to limit likely TRANSIENT OVERVOLTAGES.</p>
14.101		<p>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). 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.</p>



CLAUSE	VERDICT	COMMENT
		<p>The test voltage is applied while the circuit is operating under conditions of NORMAL USE, in combination with the MAINS voltage between each pair of TERMINALS used to measure MAINS where voltage-limiting devices are present.</p> <p><u>The MAINS voltage is the maximum RATED line-to-neutral voltage of the MAINS being measured. For measuring circuits RATED for MAINS line-to-neutral voltages above 400 V a.c. r.m.s. or d.c., the test may be performed with an available voltage source that has a line-to-neutral voltage of at least 400 V a.c. r.m.s. or d. c. The voltage source does not, in this case, need to match the measuring circuit RATING, but circuits RATED for a. c. shall be tested with an a.c. source, and circuits RATED for d.c. shall be tested with a d.c. source.</u></p> <p>No HAZARD shall arise. The overvoltage limiting devices shall not rupture or overheat during the test. 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.</p>
101	Info	<p>Measuring circuits</p> <p>Protection against MAINS overvoltages</p> <p>To ensure protection against arc flash or fire, measuring circuits RATED for measuring MAINS voltages shall have minimum CLEARANCES and CREEPAGE DISTANCES equivalent to BASIC INSULATION between MAINS connected conductive parts of opposite polarity.</p> <p>Conformity is checked by inspection and measurement.</p> <p><u>In addition, the measuring circuit TERMINALS of a voltage measuring circuit that are RATED for MEASUREMENT CATEGORIES III or IV shall withstand the applicable TRANSIENT OVERVOLTAGE with the voltage measurement function selectors set for the proper function and range, without damage which could cause a HAZARD.</u></p> <p>101.4</p> <p>Conformity is checked by the following impulse voltage test using the applicable impulse voltage of Table 104.</p> <p>The impulse voltage is applied between each pair of TERMINALS RATED for MEASUREMENT CATEGORY III or IV. The impulse voltage test shall be conducted for five impulses of each polarity <u>spaced up to 1 min apart, from a hybrid impulse generator (see IEC 61180). The generator produces an open-circuit voltage waveform of 1,2/50 μs, a short-circuit 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. Resistance may be added in series if needed to raise the impedance.</u></p>



CLAUSE	VERDICT	COMMENT
		<p><u>The impulse voltage is applied while the circuit is working under conditions of NORMAL USE, in combination with the MAINS voltage.</u></p> <p><u>The MAINS voltage used for the test is the maximum RATED line-to-neutral voltage of the MAINS being measured. For measuring circuits RATED for MAINS line-to-neutral voltages above 400 V a.c. r.m.s. or d.c., the test may be performed with an available MAINS voltage source that has a line-to-neutral voltage of at least 400 V a. c. r. m. s. or d. c. The MAINS voltage source does not, in this case, need to match the measuring circuit RATING, but circuits RATED for a.c. or a.c. plus d.c. shall be tested with an a.c. source, and circuits RATED for d.c. only shall be tested with a d.c. source.</u></p> <p><u>When verifying CLEARANCES within the current sensor by an impulse voltage test, it is necessary to ensure that the specified impulse voltage appears at the CLEARANCE.</u></p> <p><u>The wave shape of each impulse shall be observed (see Note 3). Distortions of the impulse voltage which do not change from impulse to impulse may be caused by operation of an overvoltage limiting device and do not indicate a (partial) breakdown of solid insulation.</u></p> <p><u>No HAZARD shall arise. 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 current sensors. If overvoltage limiting devices are present, they shall not rupture or overheat during the test. 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.</u></p>
102	Info	<p>Prevention of HAZARD from arc flash and short-circuits</p> <p>Protection against short-circuits in closed position</p>
102.3		<p><u>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. This requirement is also applicable to Type A current sensors with fork-style JAWS, by assimilating the rigid ENCLOSURE of the JAWS without the JAW ENDS being in a closed position.</u></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</p>



CLAUSE	VERDICT	COMMENT
		in accordance with 6.2. <u>For the voltage tests, insulated outer surfaces of the ENCLOSURE of the JAWS are covered with metal foil everywhere except around the JAW ENDS. The distance from the foil to the JAW ENDS is the applicable CLEARANCE.</u>
Annex K	Info	Insulation requirements not covered by 6.7
K.3	Info	Insulation in circuits not addressed in 6.7, Clause K.1 or Clause K.2
		General
		Replace the text with the following:
		These circuits have one or more of the following characteristics:
		<u>a) the maximum possible TRANSIENT OVERVOLTAGE is limited by the supply source or within the current sensor (see Clause K.4.) to a known level below the level assumed for the MAINS CIRCUIT;</u>
		<u>b) the maximum possible TRANSIENT OVERVOLTAGE is above the level assumed for the MAINS CIRCUIT;</u>
		<u>c) the WORKING VOLTAGE is the sum of voltages from more than one circuit, or is a mixed voltage;</u>
K.3.1		<u>d) the WORKING VOLTAGE includes a recurring peak voltage that may include a periodic nonsinusoidal waveform or a non-periodic waveform that occurs with some regularity;</u>
		<u>e) the WORKING VOLTAGE has a frequency above 30 kHz;</u>
		<u>f) the circuit is a measuring circuit where MEASUREMENT CATEGORIES do not apply.</u>
		<u>In cases a) to c) and f), CLEARANCES for BASIC INSULATION and SUPPLEMENTARY INSULATION are determined according to K.3.2.</u>
		<u>In cases d) and e) CLEARANCES are determined according to K.3.3.</u>
		<u>In all cases, K.3.4 addresses CREEPAGE DISTANCE and K.3.5 solid insulation.</u>
K101	Info	Insulation requirements for measuring circuits RATED for MEASUREMENT categories
K101.4	Info	Solid insulation
		<i>New clause added;</i>
K101.4.2		Test voltage values for testing the long-term stress of solid insulation are determined as follows:
		The test voltage for BASIC INSULATION and SUPPLEMENTARY INSULATION is calculated with the following formula:



CLAUSE	VERDICT	COMMENT
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$$U_T = A \times U_N + B$$

where U_T is the test voltage, U_N is the nominal a. c. r. m. s. line-to-neutral or d. c. voltage of MAINS being measured and A and B are parameters determined as follows:

when $U_N \leq 1\,000\text{ V}$, $A = 1$ and $B = 1\,200\text{ V}$

when $U_N > 1\,000\text{ V}$, $A = 1,5$ and $B = 750\text{ V}$

The a.c. test voltage is equal to U_T and the d.c. test voltage is equal to $1,414 \times U_T$. For REINFORCED INSULATION, the test voltage value is twice the value for BASIC INSULATION.

New annex added;

CLAMP MULTIMETER

Annex EE

The primary purpose of CLAMP MULTIMETERS is to measure current and voltage on a live MAINS. The circuit of a CLAMP MULTIMETER to measure current is a Type A or a Type B current sensor. See standard for details.
