Standards Update Notice (SUN)

Issued: February 2, 2017

Standard Information

Standard Number: UL 2231-2
Standard Name: Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems
Standard Edition and Issue Date: 2nd Edition Dated September 7, 2012
Date of Revision: August 26, 2016
Date of Previous Revision to Standard: 2nd Edition Dated September 9, 2012

Effective Date of New/Revised Requirements

Effective Date: **July 30, 2018**

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requests in writing that current requirements be used along with their understanding that their listings will be withdrawn on Effective Date noted above, unless the product is found to comply with new/revised requirements.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: Clarification of Requirements Including New Section for Environmental Sequence Revision to Requirements Regarding Power Interruption, Revision to Specify the Minimum Delay for the Automatic Reset of an Operating, Mechanism in 14.3, Clarification of Requirements for Isolation Monitors for EV Charging Equipment, Revised Leakage Current Requirements, Revision of Requirements for a Ground Monitor/Interrupter (GM/I), Addition of Manufacturing and Production Line Tests, Clarification of Scope, Deletion of Cable Flexing Test, Section 37, Added Requirements for Periodic Testing of CCID Supervisory Test, Clarification of Requirements in 17.2 Regarding the Weld Monitor Self-Test, Revision of Requirements for the Exemption of the Dielectric Withstand after the Extra-Low-Resistance Ground Fault Test and Short Circuit Test, Revision of Requirements for EMC Exposure, Clarification of Requirements for Programmable Components and Reliability of Solid State Circuitry, Clarification of Requirements for Automatic Reset Function in 14.2.
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.

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Description of New/Revised Technical Requirements

Clause	Verdict	Comment
		Additions to existing requirements are underlined and deletions are shown ~~lined out~~ below.
2.16A		PROGRAMMABLE COMPONENT – Programmable components include monolithic, hybrid, or module circuits, where the internal circuit connections are not accessible exclusive of provided external connection pins or pads. The circuits are capable of functioning in the analogue mode, digital mode, or a combination of the two modes. This includes any microelectronic circuit such as a microprocessor, ASIC, ROM, RAM, PROM, EPROM, PAL, and PLD that can be programmed in the design center, the factory, or in the field. Here the term "programmable" is taken to be any manner in which one can alter the software or other logic wherein the behavior of the component can be altered.
6.1.4		~~When there is 150 to 300 Vrms single-phase or 150 to 260 Vrms three-phase between any two circuit conductors, a secondary protection mechanism is required in addition to basic insulation. The requirement shall be satisfied by complying with 6.1.3 and 6.1.4 when applicable, and by providing a centrally located ground such that the voltage to ground on any of the system conductors does not exceed 150 Vrms.~~
6.1.5		When there is 150 to 300 Vrms single-phase or 150 to 260 Vrms three-phase between any two circuit conductors, a secondary protection mechanism is required in addition to basic insulation. The requirement shall be satisfied by complying with 6.1.3 ~~and 6.1.4 when applicable,~~ and by providing a centrally located ground such that the voltage to ground on any of the system conductors does not exceed 150 Vrms.
6.1.7		~~The ground monitor/interrupter in 6.1.6(a) is not required when a special investigation of the grounding circuit proves it to be reliable. The special investigation involves:~~ ~~a) An evaluation of connections that are able to be subject to flexing, and~~ ~~b) The ability to conduct currents without damage to the grounding path.~~
6.1.8		When there is more than 300 Vrms to ground then the requirement shall be met by complying with the specifications in 6.1.6 ~~and 6.1.7 when applicable,~~ and providing a centrally located ground with impedance limitation.
14.3		A device with an automatic supervisory circuit that performs a self-test prior to each reclosure shall be permitted to have an automatic reset function which permits operation following an acceptable self-test. If the automatic supervisory circuit is used there shall be a minimum of 15 seconds between the tripping function with no maximum number of resets. The automatic supervisory test system shall comply with 17.7 and 17.8 as applicable.
14.4		A device shall be permitted to have an automatic reset function provided the automatic reset function complies with the following requirements: a) There shall be a minimum delay of 15 minutes between the activation of the tripping function and the automatic reset, b) The device shall not reset more than 4 times for any given charge sequence, c) A device having an automatic reset function utilizing solid state circuitry shall comply with the requirements in Annex A, Ref. No. 9, and d) A device having an automatic reset function utilizing programmable components shall comply with the requirements in 18A.1 and 18A.2. A manual intervention may override both the time delay to the automatic reset and the maximum number of resets. See 43.4.

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14.6.1		Compliance with the power output restoration requirement of 14.6 shall not be required for devices that incorporate a point of sale or user authentication feature. It shall be acceptable for such devices to return to a standby mode that requires a manual action to initiate resumption of power output.
14.6.2		Compliance with the power output restoration requirement of 14.6 shall not be required for devices that do not allow automatic resumption of power. It shall be acceptable for such devices to return to a standby mode that requires a manual action to initiate resumption of power output.
16.1.1		A device intended to monitor equipment grounding continuity in a charging system shall ~~either~~ prevent the charger circuitry from becoming energized under conditions where the grounding is not available ~~or~~ and shall interrupt the circuit under conditions where the grounding is lost during operation.
17.1		A device intended to be used on a grounded system shall be provided with a supervisory circuit that complies with at least one of the following: a) Allows for periodic manual, convenient testing of the ability of the device to trip by way of a simulated ground-fault, b) Automatically tests the system at least once for each use and at power up, or c) Automatically tests the system periodically. The automatic test shall be repeated at least every three hours.
17.2		The tests shall include the entire interrupting device including the interrupting contacts or: a) Employ a contactor position monitor that continuously verifies the contacts are open when operated to be open and closed when operated to be closed, or b) Employ an interrupting device that utilizes redundant components in the control path, including the interrupting contacts.
17.5		The results of the test shall be made known by means of an evident indication. If the device is an EVSE employing an electric vehicle communication signal and the supervisory circuit test conditions of 17.2 are not met, the device shall indicate that charging is not available.
17.7		An automatic supervisory test system utilizing solid state circuitry shall comply with the requirements in Annex A, Ref. No. 9, and there shall be a minimum delay of 15 seconds between the tripping function and the reset.
17.8		An automatic supervisory test system utilizing programmable components shall comply with the requirements in 18A.3 and 18A.4.
18A		Programmable Components
18A.1		If a programmable component is employed in a device with an automatic reset function as mentioned in 14.4, the device shall be evaluated to the requirements of Annex A, Ref. No. 10, as defined in 18A.2.
18A.2		The risks to be considered in the evaluation mentioned in 18A.1 shall include the following scenarios as applicable: a) Failure to trip under conditions where tripping should occur; b) Tripping at the wrong trip threshold value; c) Failure of a supervisory circuit to complete evaluation; and d) Unwanted tripping.
18A.3		If a programmable component is employed in a device employing an automatic supervisory test system, as mentioned in 14.3 and 17.8, the applicable portion of the device shall be evaluated in accordance with the requirements of Annex A, Ref. No. 10, as defined in 18A.4.

Clause	Verdict	Comment
18A.4		The risks to be considered in the evaluation mentioned in 18A.3 shall include the following scenarios as applicable: a) Failure of supervisory circuit to complete evaluation; and b) Failure of the supervisory circuit to indicate an unacceptable test result.
19.4		A device that meets the requirements of 17.2 a) or 17.2 b) and 17.5 shall not be required to comply with the Dielectric Voltage-Withstand Test between line and load terminals with the device open or tripped, Section 26, after the Extra-Low-Resistance Ground Fault Test, Section 32, or after the Short Circuit Test, Section 33, provided the device complies with all of the following: a) Line side and load side grounding monitor/interrupter (GM/I) is provided for both permanently connected and cord connected EVSE. b) Circuitry is provided that monitors the isolation between each input and output pole and verifies that the contacts are open when operated to be open and closed when operated to be closed prior to initiation of a charge in accordance with Section 17. c) In the event of a loss of isolation or incorrect operation of the interrupting contacts, the communication to the vehicle is disabled, including disabling of the pilot signal if provided. d) A visual or audible indication that the device is no longer functional, such as a fault light or alarm, shall be provided. The instructions provided with the device shall explain the meaning of the visual indication or alarm, noting that a device with such indications is no longer functional and should not be used. e) The reliability of solid state components used to implement the functions identified in (b – d) above shall be evaluated to Annex A, Ref. No. 9. Programmable components used to implement the functions identified in (b – d) above shall be investigated using Annex A, Ref. No. 10
21.1		Except as described in 21.2 or 21.3, the leakage current of a cord-connected device shall not be more than 0.5 MIU-RR when tested in accordance with 21.4 – 21.10.
21.2		The leakage current from any part to ground is permitted to exceed 0.5 MIU when the device complies with all of the following conditions: a) The leakage current from one accessible part to another accessible part shall not exceed 0.5 MIU, b) The leakage current shall not exceed 3.5 MIU when another leakage current measurement is made using the measurement instrument shown in Figure 5, c) An EMI filter is required in the product to meet FCC and Canadian regulations, d) The product is provided with a grounding type supply cord and plug, e) The parts of the product from which the high leakage current is available are not readily contacted by persons, f) Persons in the vicinity of the product are usually insulated from ground so that they do not conduct the high-leakage current when they touch a high-leakage part, and g) The consequences of touching a high-leakage part are not severe. For example, a person is not injured by involuntarily reacting to the current and contacting active machinery.

Clause	Verdict	Comment
21.9		A ~~permanently connected~~ representative device shall be tested for leakage current after the conditioning described in Humidity Conditioning, Section 20. When removed from the humidity chamber, the testing shall start within one minute after its removal. The grounding conductor of a cord-connected device shall be open at the supply receptacle. The supply voltage shall be adjusted to 110 percent of the rated voltage.
21.10		The test sequence, with reference to the measuring circuits in Figures 2 and 3, is as follows: a) With switch S1 open, the representative device shall be connected to the measurement circuit. The leakage current shall be measured using both positions of switch S2 and with the representative switching devices in all their positions. b) Switch S1 shall then be closed, energizing the representative device, and within a period of five seconds, the leakage current shall be measured using both positions of switch S2 and with the control settings varied throughout the operating range. c) Leakage current shall be monitored at intervals necessary to determine the maximum leakage current, with additional measurements being taken until such time as thermal equilibrium is attained. Both positions of switch S2 shall be used in determining this measurement. d) The leakage current shall also be monitored with switch S1 open while the product is at operating temperature and while cooling.
23.1.2		A charging circuit interrupting device (CCID) shall act to interrupt the circuit when the current, I, reaches or exceeds the threshold current specified in 23.2 within the time specified in 23.3. See 23.4 and 23.5.
23.3A		Environmental sequence
23.3A.1		A device shall comply with all of the applicable tests in 23.4 – 23.7, while operating in ambient air at 25°C (77°F). Except as indicated in 23.3A.2 – 23.3A.10, the device shall also be tested while in ambient air at 66°C (150.8°F), -35°C (-31°F), and 25°C (77°F) by following the sequence of steps shown in Table 8, and the requirements of this section. The ambient air temperature shall be changed to each value without intentional delay.
23.3A.2		When conducting the applicable tests described in 23.4 – 23.7, it shall be acceptable for only the assemblies providing the protective functions being tested to be subjected to the test sequence shown in Table 8. The assemblies shall include those providing power for the protective function to operate, as well as the interruption function.
23.3A.3		When conducting the test of Step 3 of Table 8 at 66°C (150.8°F), in the event a device is self-protecting such that it trips at this ambient temperature, lower values of load current shall be employed, until the device just continues to operate at this temperature. This value of load current shall also be used for step 4 if applicable for the most adverse operating condition.
23.3A.4		When the test of Step 3 of Table 8 is conducted at rated load current, the tests of Steps 5 and 6 shall not be performed.
23.3A.5		If a device is not intended to operate at a temperature greater than 40°C (104°F), it shall be tested in accordance with Steps 5 and 6 of Table 8 instead of Steps 3 and 4.
23.3A.6		If a device is intended to operate at a temperature greater than 66°C (150.8°F), the test of Steps 3 and 4 of Table 8 shall be conducted at the intended temperature.
23.3A.7		If a device employs a thermal limiting function that intentionally prevents operation above a specific ambient temperature, the test of Steps 3 and 4 of Table 8 shall be conducted at the maximum permissible temperature.

Clause	Verdict	Comment
23.3A.8		If a device is not intended to operate at a temperature lower than -5°C (23°F), it shall be tested in accordance with Steps 10 and 11 of Table 8 instead of Steps 8 and 9.
23.3A.9		If a device is intended to operate at a temperature lower than -35°C (-31°F), the test of Steps 8 and 9 of Table 8 shall be conducted at the intended temperature.
23.3A.10		If a device employs a thermal limiting function that intentionally prevents operation below a specific ambient temperature, the test of Steps 8 and 9 of Table 8 shall be conducted at the lowest allowable temperature.
23.4.1		Added reference to Section 23.3A
23.4.3,		Added reference to Section 23.3A
23.4.5,		Added reference to Section 23.3A
23.5.4		Added reference to Section 23.3A
23.6.2		Added reference to Section 23.3A
23.7.2		Added reference to Section 23.3A, 23.7.7 and 23.7.8
24.1.3		It shall be acceptable for a protective device including a CCID, ground monitor/interrupter or an isolation monitor/interrupter, to interrupt power to the load under any of the following conditions: a) Where permitted in the individual test conditions described in 24.2 – 24.10 b) For the Electrostatic Discharge Immunity Test of 24.3, and the Electrical Fast Transient Immunity Test of 24.6, power to the load may be interrupted once as a result of each exposure. However, except as indicated in (1) and (2) below, the protective device shall automatically restore power output following the exposure. 1) Compliance with the power output restoration requirement of 24.1.3 (b) shall not be required for devices that incorporate a point of sale or user authentication feature. It shall be acceptable for such devices to return to a standby mode that requires a manual action to initiate resumption of the power output. 2) Compliance with the power output restoration requirement of 24.1.3 (b) shall not be required for devices that do not allow automatic resumption of power. It shall be acceptable for such devices to return to a standby mode that requires a manual action to initiate resumption of the power output. c) If the device utilizes an automatic restart feature that complies with the Standard for Software in Programmable Components, UL 1998, provided the device employs a CCID selftest prior to restart.
24.7.2		The protective device is permitted to turn OFF during the disturbances specified in 24.7.1 as long as: a) This removes the power to the protected unit, and b) Except as indicated in (1) and (2) below, the power output is automatically restored when input power is restored to at least 85 percent of rated voltage. 1) Compliance with the power output restoration requirement of 24.7.2 (b) shall not be required for devices that incorporate a point of sale or user authentication feature. It shall be acceptable for such devices to return to a standby mode that requires a manual action to initiate resumption of the power output. 2) Compliance with the power output restoration requirement of 24.7.2 (b) shall not be required for devices that do not allow automatic resumption of power. It shall be acceptable for such devices to return to a standby mode that requires a manual action to initiate resumption of power output.
41A		**MANUFACTURING AND PRODUCTION LINE TESTS**
41A.1		Each device shall be subjected to the manufacturing and production-line tests described in Annex C.

Clause	Verdict	Comment
Annex C		**Manufacturing and Production Line Tests (Normative)**
C1		General
C1.1		Manufacturing and production line tests shall be performed on 100 percent of production based on the type of protection systems provided. Some tests are applicable to all systems. Others are applicable only to CCIDs, GM/Is, or IM/Is. In cases where multiple systems are provided, such as a CCID with a GM/I, tests applicable to both systems shall be conducted.
C1.2		Manufacturing and production line tests shall be conducted on 100 percent of production in accordance with Sections C2 – C7 as applicable
C1.3		The testing and measuring equipment used in the manufacturing and production line tests shall be established with the agreement of all concerned parties.
C1.4		The manufacturer shall maintain a program to assure that testing and measuring equipment used in manufacturing and production line tests is clean, is maintained in proper working order, and is in calibration.
C2		Visual Inspection (All Systems)
C2.1		Each finished product shall be visually inspected to assure that all internal components (relays, breakers, and similar components) have been properly installed into the final assembly, that all applicable markings have been properly applied, and that the device is properly identified.
C2.2		Where necessary, the visual inspection may be performed on subassemblies and printed wiring assemblies to avoid disassembly of the finished product.
C3		CCID Tests
C3.1		CCIDs can be complete CCIDs or special components that can only be tested in a limited manner.
C3.2		Complete CCIDs are those that do not need additional components to provide the CCID function. Such devices shall be subjected to the production line tests for complete CCIDs described in Section C4.
C3.3		Special components include printed wiring boards or other assemblies that need the addition of circuit components such as a power supply, interrupting relay, or EMC filter when integrated into an overall product. Special components shall be subjected to the Manufacturer's Proprietary Test Program for Special CCID Components described in C5
C4		Production Line Tests for Complete CCIDs
C4.1		CCID Trip - Rated Load - Low Leakage
C4.1.1		Each finished product shall comply with the trip level requirements in Table C1
C4.1.2		For devices rated 120 V, each unit shall be connected to the test circuit in Figure C1 with rated current in the load circuit. The test shall be performed with the fault circuit connected to points A and B as shown in Figure C1. Except as indicated in C4.1.6, the test voltage shall be set in turn to 85, 100, and 110 percent of the rated voltage of the device under test in accordance with Table C2.
C4.1.3		For each test voltage a simulated fault current shall be applied by gradually reducing the value of RB. The device shall trip within the specified time, and shall not trip below the specified "Minimum Allowable Trip Fault Currents."
C4.1.4		For devices rated 120/240 V or 120/208Y V, the test shall be conducted as described in C4.1.2 and C4.1.3, except each unit shall be connected to the test circuit shown in Figure C2 with the fault circuit connected between points A and B. The test shall be repeated with the fault circuit connected to points A and C of Figure C2.

Clause	Verdict	Comment
C4.1.5		For 3-phase devices, the test shall be conducted as described in C4.1.2 and C4.1.3, except each unit shall be connected to an appropriate 3-phase supply and an appropriate 3-phase load of rated current. The test shall be conducted with the fault connected between one ungrounded load conductor and the grounded supply conductor. The test shall be repeated with the fault moved to each of the other ungrounded load conductors.
C4.1.6		For devices where the results of the testing of Sections 23.2 – 23.5 of this Standard are considered to be unaffected by variations in supply voltage, testing may be conducted at rated voltage only.
C4.2		CCID Trip - Rated Load - High Leakage
C4.2.1		The test described in Section C4.1 shall be repeated on each device, except that RB shall be varied to obtain the test parameters detailed in Table C3.
C4.2.2		The test circuit of Figure C1 shall be used for units rated 120V.
C4.2.3		For devices rated 120/240 V or 120/208 V, each unit shall be connected to the test circuit shown in Figure C2. The test shall be repeated with the fault circuit connected to points A and C of Figure C2.
C4.2.4		For 3-phase devices, the unit shall be connected to an appropriate 3-phase supply and a 3-phase load of rate current. The test shall be conducted with the fault connected between one ungrounded load conductor and the grounded supply conductor. The test shall be repeated with the fault moved to each of the other ungrounded load conductors. Except as indicated in C4.2.5, the test currents are determined by taking the voltage to ground that occurs at 85 percent, 100 percent, and 110 percent of rated voltage and dividing by 500 ohms (RB). The required trip time for each test current is calculated from the formula specified in Table 6 of this Standard, except the trip time is not required to be less than 20 ms.
C4.2.5		For devices where the results of the testing of Sections 23.2 – 23.5 of this Standard are considered to be unaffected by variations in supply voltage, testing may be conducted at rated voltage only.
C5		Manufacturer's Proprietary Test Program for Special CCID Components
C5.1		CCIDs that are special components as mentioned in C3.3 shall be subjected to a manufacturer's proprietary test program as described in C5.2 – C5.4
C5.2		The Manufacturer's Proprietary Test Program for special component CCIDs shall include means to verify correct operation of the CCID functions of 100 percent of production of special component CCIDs. The testing shall verify the ability to sense a ground fault at the trip threshold (5 mA for a CCID5 or 20 mA for a CCID20) and provide an output signal to enable the end product to trip. Additional test conditions may be specified by the manufacturer.
C5.3		The Manufacturer's Proprietary Test Program for special component CCIDs shall identify the tests to be conducted and the test equipment employed by the manufacturer to conduct those tests.
C5.4		The Manufacturer's Proprietary Test Program for special component CCIDs shall be established with the agreement of all concerned parties.

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C6		Manufacturer's Proprietary Test Program for GM/I
C6.1		Systems that include a Ground Monitor/Interrupter (GM/I) shall be subjected to a Manufacturer's Proprietary Test Program for GM/I as described in C6.2 – C6.4.
C6.2		The Manufacturer's Proprietary Test Program for GM/I shall include means to verify correct operation of the GM/I functions of 100 percent of production of systems incorporating a GM/I. The testing shall verify that the GM/I inhibits the application of power to the load with a loss of grounding continuity in all protected grounding conductors. The testing shall also verify that the GM/I will interrupt the power to the load when the grounding continuity is lost during operation.
C6.3		The Manufacturer's Proprietary Test Program for GM/I shall identify the tests to be conducted and the test equipment employed by the manufacturer to conduct those tests.
C6.4		The Manufacturer's Proprietary Test Program for GM/I shall be established with the agreement of all concerned parties.
C7		Manufacturer's Proprietary Test Program for IM/I
C7.1		Systems that include an Isolation Monitor/Interrupter (IM/I) shall be subjected to a Manufacturer's Proprietary Test Program for IM/I as described in C7.2 – C7.4.
C7.2		The Manufacturer's Proprietary Test Program for IM/I shall include means to verify correct operation of the IM/I functions of 100 percent of production of systems incorporating an IM/I. The testing shall verify that the IM/I inhibits the application of power to the load when the resistance from any ungrounded conductor to ground is less than 100 ohms/volt based on the nominal system voltage. The testing shall also verify that the IM/I will interrupt the power to the load when the resistance from any ungrounded conductor to ground becomes less than 100 ohms/volt based on the nominal system voltage.
C7.3		The Manufacturer's Proprietary Test Program for IM/I shall identify the tests to be conducted and the test equipment employed by the manufacturer to conduct those tests.
C7.4		The Manufacturer's Proprietary Test Program for IM/I shall be established with the agreement of all concerned parties.
		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.