STANDARDS UPDATE NOTICE (SUN)
ISSUED: March 19, 2026

STANDARD INFORMATION

Standard: ANSI/CAN/UL 3741
Standard ID: Photovoltaic Hazard Control [ANSI/CAN/UL 3741:2020 Ed.1+R:20Oct2025]
Previous Standard ID: Photovoltaic Hazard Control [ANSI/CAN/UL 3741:2020 Ed.1]

EFFECTIVE DATE OF NEW/REVISED REQUIREMENTS

Effective Date: **October 20, 2027**

IMPACT, OVERVIEW, AND ACTION REQUIRED

Impact Statement: Per our accreditation, Intertek is required to review reports against the standard revisions to confirm compliance. Once compliance is confirmed, the standard reference in the report is updated to show continued compliance to the technical requirements of the standard. Reports not updated to this version by the effective date above will be withdrawn.

This standard contains Functional Safety requirements.

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

- New requirements for barriers and wireways were enhanced to address the PVHC application
- Testing section was updated for critical construction details for the test equipment as well as the test method procedures
- Controlled Air Gap Testing

The above changes could affect previous test results and evaluations where the following conditions were observed, and previously listed systems should be reevaluated where:

- Passing leakage current test result occurred following a Damage from FF Tool impact test where the impact tool penetrated all layers of a PV module laminate. Tests involving Type 29 modules and other glass/glass construction should be reviewed
- Enhanced wire management was used to reduce hazard levels in the form of positioning devices used along grounded metal, rather than nonmetallic conduit

Specific details of new/revised 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 – Please immediately identify any current Listing Reports or products that are no longer active and should be removed from our records.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
		Additions to existing requirements are <u>underlined</u> and deletions are shown ~~lined out~~ below.
7	Info	**Array Component Requirements – PVHCS Requirements**
7.6		***New clause added;*** Physical barriers to limit access to live parts in 9.5 shall meet one or more of the following requirements. a) Metallic barriers shall meet the requirements of UL 1741, 7.8.6.3. b) Polymeric barriers shall meet the requirements of 9.6. c) Electronic and electrical equipment enclosures shall meet the enclosure construction and testing of UL 50, or UL 1741, or UL 62109-1. Nonmetallic enclosures shall additionally meet requirements for cold impact protection as outlined in UL 746C. Nonmetallic enclosures located where the Pe value for the enclosure as determined in Table 9 is greater than 1 shall additionally be subject to the FF tool damage test in 14.2.
7.7		***New clause added;*** Electrical barriers for enhanced protection in 9.4 shall meet the requirements in 9.6.
7.8		***New clause added;*** Where components are used as a barrier to provide a controlled air gap for enhanced protection or limited access to live parts in 9.4 or 9.5, the construction shall be unable to be readily deformed or displaced to defeat its purpose when installed with associated PV array components during applicable FF interactions in Fire Fighter (FF) PV Array Interactions, 12.3.
7.9		***New clause added;*** Where positioning devices are used to provide a controlled air gap for enhanced protection, the Controlled Air Gap Tests in 15.5 shall be conducted.
8	Info	**Protection Requirements**
8.2	Info	**Application of requirements**
8.2.1		Protection Requirements, Section 8, applies to equipment and components of the PV array that have a potential to pose a risk of electric shock to FF. A safety analysis as defined in Section 12 shall be performed to <u>assess</u> ~~select~~ the relevant PVHC components, foreseeable faults or failures, and anticipated FF interactions

CLAUSE	VERDICT	COMMENT
		for a system or set of components, as follows:, ~~and performance tests in Section 13 to be evaluated for a specific PVHCS or PVHCE protection. The evaluation of a PVHCS begins with an analysis of the relevant array equipment and components as required in Section 12 of this standard:~~ a) Identify and list energized array equipment that can be contacted by the FF during interactions. b) Analyze the identified equipment to determine if they pose a risk of electric shock as a result of FF interactions combined with array equipment and wiring fault conditions. c) Determine a list of components and equipment that will be relied upon to provide protection from the shock hazard. These components and equipment shall be identified as PVHCC or PVHCE of the PVHCS.
8.2.3		The extent of performance testing defined in Sections 13 – 15 that are required is dependent on the results of the safety analysis in Section 12. ~~construction features. PVHCE that meet a minimum level of protection and/or have operational limits below the thresholds specified in this standard to reduce shock hazards can reduce or eliminate testing requirements.~~
8.2.4		***New clause added;*** A PVHCS or collection of PVHCE may not require any of the testing in Sections 13 – 15 when the evaluation to Section 12 results in a Hazard Level of 0 or 1 when considering the following: a) Highest risk level for Pf1 and Pf2, b) Worst case FF interaction is assumed to result in contact with the highest circuit voltage, and c) Worst case fault resistance path is used that results in highest current flow.
8.2.5		***New clause added;*** A system or collection of PVHCE resulting in Hazard Levels of 0 or 1 as described in 8.2.4 but which assumes fault resistances other than the worst case as defined in Section 12 shall validate the assumed resistances with tests from Sections 14 – 15.
8.2.6		***New clause added;*** A system or collection of PVHCE resulting in Hazard Levels > 1 for any of the scenarios covered in Section 12 and which therefore relies on suitable risk levels to avoid further protective action shall validate assumed resistances and/or risk assumptions with applicable tests from Sections 14 – 15.

CLAUSE	VERDICT	COMMENT
9	Info	**Protective Elements**
9.1	Info	**General**
9.1.3		***New clause added;*** PVRSE and PVRSS may also perform ground fault and or arc fault monitoring and mitigation functions. Systems that perform multiple protective functions may make use of common equipment and components. Systems that include and or perform multiple protective functions shall not interfere with the proper operation of the other functions as required by UL 1741.
9.5	Info	**Limited access to live parts of different voltages**
9.5.4		Physical barriers restricting access to exposed conductive parts shall meet the requirements in 7.6. Where the physical barrier is exposed and conductive it shall be evaluated in Section 12 for the likelihood to become energized under foreseeable single point failure and system level fault conditions.
9.6		***New section added;*** **Polymeric materials** Polymeric materials used as PV wireway, wireway support or electrical barrier to protect conductors from damage or physical barrier to limit access shall comply with the following requirements. See standard for details.
9.7		***New section added;*** **PV wireways** PV wireways shall comply with the following requirements. See standard for details.
9.8		***New section added;*** **Wire management and wire securement** Wire management and wire securement devices shall comply with the following requirements. See Annex H for examples of wire management and securement. See standard for details.

CLAUSE	VERDICT	COMMENT
12	Info	**Safety Analysis**
12.1	Info	**General**
12.1.4		Steps necessary to perform a comprehensive safety analysis are detailed in Section 12.2. For systems or collections of equipment designed to achieve Hazard Levels of 0 or 1 for worst case fire fighter interactions, fault path resistances, and fault scenarios, the steps in Section 12.2 include exceptions to simplify the analysis and exempt performance testing.
14	Info	**PVHC System Conditioning**
14.1	Info	**Potential damage from FF operations**
14.1.5		***New clause added;*** If the tests in this section result in direct exposure of live parts as determined by use of the conductive accessibility probe in Annex G, the evaluation shall consider direct contact. The leakage current test is waived, and the current calculation shall be based upon direct contact with the live part(s). NOTE 1: Example is a FF tool test in 14.2 resulting in a complete puncture through the PV module. NOTE 2: See Safety Analysis, Section 12, for details on the lowest resistance path or test results.
14.2	Info	**Damage from FF tool**
14.2.2	Info	**Apparatus**
14.2.2.2		The impactor tool shown in Figure 3 shall have the following characteristics: circular bar stock weighing 2.72 kg (6 lbs) with a 51 mm (2 in) wide impactor blade (±3%), a symmetric impactor angle with a blade edge radius of 1 mm +0/-0.2 mm (0.039 in +0/-0.008). The impactor tool is to be dropped from a height of approximately 1 m (39.4 in) measured between the impactor tool blade edge and the EUT surface in order to achieve an impact energy of no less than 26.5 Joules. Variability in the weight and drop height is permitted as long as the required impact energy is maintained. The 17° angle in Figure 3 is approximate. The impactor material shall be of sufficient hardness to maintain the specified dimensions and tolerances during testing.
14.2.2.3		The impactor guide tube internal diameter shall be at least 0.5 mm (0.02 in) larger than the impactor outside diameter and not more than 3.0 mm (0.12 in) larger. The bottom of the impactor guide tube shall be located above the EUT at least 20% and not more than 50% of the impactor length. The impactor tool apparatus shown in Figure 4 shall be constructed such that the impactor tool is sufficiently guided by the tube to result in a consistent sharp edge impact on the EUT, without limiting the required impact energy through friction or air pressure The tool is permitted to impact the surface multiple times if it bounces off the test surface.

CLAUSE	VERDICT	COMMENT
14.2.3		***New section added;*** **Procedure** Assemble the EUTi sample as required per 14.1.2 using the method and parts described by the manufacturer, including: See standard for details.
14.2.3.2A		***New clause added;*** Select impact location or locations on the EUT that are most critical to the functions of the PVHCS. Selection of the location(s) should consider factors such as location of module busbars, junction boxes, electrical/electronic devices under modules, their electrical connections, exposed or semi-exposed wire management components, and proximity to other equipment or components where the lowest impedance paths for current exist. Secure the impactor assembly relative to the EUT such that the blade edge falls normal, ±3 degrees in both planes, to the planar surface. Lift the impactor to the nominal (subject to variation) drop height of 1 m (39.4 in) measured vertically to the EUT surface. Allow the impactor to stabilize and then release it to strike the EUT sample. The blade chisel point shall be rotated /oriented such that it is most likely to contact live parts.
14.2.3.4		***New clause added;*** After each impact the impact tool shall be inspected for damage. If significant deformation is identified the impactor chisel tool shall be reshaped or replaced to maintain compliance with the requirements in 14.2.2.2.
14.3	Info	**Damage from falling FF**
14.3.2	Info	**Apparatus**
14.3.2.1		The impactor shall be a circular, flexible but firm (canvas for example) bag made of a material capable of retaining the required fill weight (e.g. steel balls or pellets that do not have sharp points or irregular shapes) and maintain physical integrity throughout the test without loss of fill material. The bag shall not have hard protrusions such as metal hardware attachment points in the bottom impact area. When filled, the impactor bag shall have dimensions as described in Figure 5 and a weight of 125 ±0.5 kg (275 ±1 lb) (representing a large FF with FF equipment). The diameter of the bottom surface which impacts the EUT shall be between 0.28 m (11 in) and 0.36 m (14 in),~~no more than 0.3 m (1 ft),~~ resulting in a surface area of no more than 0.1 m2 (1.07 ft2). Variability in the weight and drop height is permitted as long as the required impact energy of 1225 Joules is maintained.
14.3.2.2		A rigid test frame, structure or apparatus similar to that shown in Figure 6 shall be provided to minimize movement and deflection during impact testing. A quick release or latching mechanism shall be utilized to prevent any unintentional movement of the impactor bag when testing. ~~The structure framing and bracing~~

CLAUSE	VERDICT	COMMENT
		~~shall be steel channel, approximately 100 mm (3.9 in) x 200 mm (7.9 in) or larger and shall have a minimum area moment of inertia of approximately 187 cm4. The frame shall be welded or securely bolted at the corners to minimize twisting during impact. It shall also be bolted to a rigid floor to prevent movement during impact testing.~~
14.3.3	Info	**Procedure**
14.3.3.1		***New clause added;*** Mount the EUT sample as defined in 14.1.2 so that it is centered on a horizontal rigid test surface using the method and parts described by the manufacturer. The test surface may alternatively be constructed to simulate the properties (other than rigid) of the roofing specific to the product application. The orientation and tilt angle shall be representative of the worst case (typically the lowest angle). If the EUT consists of modules in a racking assembly with an adjustable tilt angle, that racking assembly shall be tested at the minimum design tilt angle
14.3.32		***New clause added;*** Select the impact location or locations on the EUT that are most critical to the functions of the PVHCS. Figure 6 identifies three potential locations (A), (B), and (C). Selection of the location(s) requires evaluation of the specific design, but should consider the following: areas on modules least supported by framing (location C), edges of module frames or assembly rails susceptible to breakage and/or deformation from the dropped bag (location A), location of module busbars, junction boxes (location B), electrical/electronic devices under modules, their electrical connections, exposed or semi-exposed wire management components, and proximity to other equipment or components where the lowest impedance paths for current exist
14.4	Info	**Damage from FF step, walk or crawl**
14.4.2	Info	**Purpose**
14.4.2.1		The pressure foot shall be a static loading device capable of applying a 1225 N (275 lbf) force on surface of the EUT, as illustrated in Figure 7. The pressure foot shall utilize a 7.6 cm (3 in) diameter circular steel plate adhered with a flat rubber or polymer pad. The pad shall be between 9 mm and 11 mmi (i0.35 and 0.43 in) thick with a Shore A hardness ranging from 65 – 75 with beveled or chamfered edges <u>to remove sharp edges. The pressure foot shall allow for articulation, using an articulating joint part or steel sphere, with one or more degrees of freedom to provide even surface contact and pressure with the EUT.</u>

CLAUSE	VERDICT	COMMENT
14.4.3	Info	**Procedure**
14.4.3.1		***New clause added;*** Mount the EUT sample as defined in 14.1.2 so that it is centered on a horizontal rigid test surface using the method and parts described by the manufacturer. The orientation and tilt angle shall be representative of the worst case (typically the lowest angle). If the EUT consists of modules in a racking assembly with an adjustable tilt angle, that racking assembly shall be tested at the minimum design tilt angle. Exception: The test surface may alternatively be constructed to simulate the properties (other than rigid) of the roofing specific to the product application.
14.4.3.1A		***New clause added;*** Select the impact location or locations on the EUT that are most critical to the functions of the PVHCS. Selection of the location(s) requires evaluation of the specific design, but should consider areas on modules least supported by framing, edges of module frames or assembly rails susceptible to breakage and/or deformation from the pressure foot, location of module busbars, junction boxes, electrical/electronic devices under modules, their electrical connections, exposed or semi-exposed wire management components, and proximity to other equipment or components where the lowest impedance paths for current exist.
15	Info	**Hazard Exposure**
15.3	Info	**Leakage current tests**
15.3.1	Info	**EUT leakage current test**
15.3.1.1	Info	**Purpose**
15.3.1.1.1		The purpose of this test is to quantify the potential leakage current from a PV array assembly (EUT) that has been subjected to potential damage from the FF interaction impact tests in Section 14. Leakage current is measured across the EUT surface at a circuit voltage elevated to represent the PVHCS maximum circuit voltage provided by the intended hazard control system. The test foil is intended to cover a large area around the impact points to represent body contact areas larger than a single point, and to increase the potential cumulative flow of leakage current. Resistive circuits representing the combined FF body, PPE, fault, and source series resistances defined in 15.2.1 are shown as “Resistance network" in Figure 9.
15.3.1.2		The assembled test apparatus is shown in Figure 9. a) The test apparatus is to be applied to the EUT in its damaged state following each of the applicable impact tests from

CLAUSE	VERDICT	COMMENT
15.3.1.3	Info	**Procedure**
15.3.1.3.1		Inspect the test sample for damage that can permit direct access to uninsulated live parts. If the test probe in Annex G as defined in 14.1.5 can contact live parts the leakage current test is waived and the current calculation shall be based upon direct access to the live part(s). Where there is no direct access to uninsulated live parts as described above, the following sequence of steps 15.3.1.3.2 through 15.3.1.3.6 are intended to be performed without interruption and initiated within 5 minutes of saturating the cotton sheet as described in 15.3.1.2.1(C). For test samples without flat surfaces, refer to the test procedure in 15.3.2.
15.3.1.3.3		Apply a minimum force of 9.8 N to the board to provide uniform contact of the sponges to the glass around any damaged areas. The force should be applied across the area instead of a single point and the force may be increased above the minimum required (9.8 N) to ensure adequately broad electrical contact. Some means may be necessary to prevent the board from moving during the test.
15.4		***New section added;*** **Application of test results**
15.4.1		Determine the applicable Hazard Levels for each of the recorded leakage current values obtained in 15.3.1 and 15.3.2 for use in 12.2.3 of the Safety Analysis. If all tests of the fire fighter interaction points within the EUT array result in a Hazard Level of 1 or less, PV hazard control is achieved based on: a) Table 6, Pf1 risk score is zero, and b) Table 7, FO score is zero, and no action (additional protection measure) is required. NOTE: If any interaction test results in a Hazard Level of 2 or more, adequate PV hazard control as defined in the Safety Analysis will require measures with a low Pf2 risk level, or the reduction of the PVHCS maximum voltage.
15.5		***New section added;*** **Controlled Air Gap Tests** The controlled air gap shall be tested to ensure a suitable air gap is maintained between conductors and any metallic component within the array boundary. See standard for details.

CLAUSE	VERDICT	COMMENT
	Info	**INSTRUCTIONS**
18	Info	**General**
18.4		Instructions shall be provided as required by the individual PVHC system, equipment and components and as necessary for the proper installation of the PHVC equipment and components. Instructions shall include locations of PVRSE as required between PVHC arrays in accordance with National Electrical Code (NEC), NFPA 70.
18.10		If the routing or separation of conductors or cables is necessary to maintain the operational integrity of the hazard control function, the instructions shall provide details of how the conductors or cables are to be managed and protected. They shall include details on the inspection of critical system components (that perform critical PVHCS functions or properties such as, but not limited to, maintain securement, distance, isolation, etc.) which may degrade over time. Illustrations may also be provided for visual clarification. Service and maintenance instructions shall include visual inspection of the array as well as inspection intervals.
18.12		The operating instructions shall contain instructions on the periodic testing and service of the PVHC if such operations are required to maintain the operational integrity of the hazard control function.
18.15		***New clause added;*** PVHC instructions shall define if it provides protection for inside the array, outside the array or both and shall identify the method used to obtain PV hazard reduction, such as: a) Voltage reduction within the array to a specified voltage after activation of the rapid shutdown, b) Enhanced physical barriers to minimize risk of fire fighter contact with energized circuits, and/or c) Enhanced electrical barriers and wire management to reduce risks of dc PV circuits referencing to metal parts. NOTE: Local fire codes may require signage next to the rapid shutdown initiator with specific language and illustrations that indicate the voltage potential within the array after rapid shutdown activation.
Annex B		***New annex added;*** **COMMON CONSTRUCTION DETAILS INCLUDING ASSOCIATED RISK LEVELS** In accordance with 12.2.3(k)(2 and assigning a risk level for Pf2: Table B.1 shows common construction approaches for reducing wire management fault risk, including the associated risk levels for the likelihood of PV circuit conductors becoming electrically referenced to adjacent metal surfaces, structures or equipment. See standard for details.

CLAUSE	VERDICT	COMMENT
		New annex added;
Annex G		**CONDUCTIVE ACCESSIBILITY PROBE** See standard for details.
		New annex added;
Annex H		**WIRE MANAGEMENT AND SECUREMENT** See standard for details.