JOINT CANADA-UNITED STATES
NATIONAL STANDARD

ANSI/CAN/UL 8803:2023

STANDARD FOR SAFETY

Portable UV Germicidal Equipment With Uncontained UV Sources

Approved American National Standard

ANSI/UL 8803-2023

SCC FOREWORD

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UL Standard for Safety for Portable UV Germicidal Equipment With Uncontained UV Sources, ANSI/CAN/UL 8803

First Edition, Dated November 17, 2023

Summary of Topics

This is the First Edition of ANSI/CAN/UL 8803, Standard for Portable UV Germicidal Equipment With Uncontained UV Sources, dated November 17, 2023. These requirements apply to portable germicidal equipment intended to expose the air and surfaces within an unoccupied area with uncontained ultraviolet (UV) energy.

The new requirements are substantially in accordance with Proposal(s) on this subject dated November 25, 2022 and August 25, 2023.

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ANSI/UL 8803-2023

NOVEMBER 17, 2023

ANSI/CAN/UL 8803:2023

Standard for Portable UV Germicidal Equipment With Uncontained UV Sources

First Edition

November 17, 2023

This ANSI/CAN/UL Safety Standard consists of the First Edition.

The most recent designation of ANSI/UL 8803 as an American National Standard (ANSI) occurred on November 17, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on November 17, 2023.

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Preface

This is the First Edition of ANSI/CAN/UL 8803, Standard for Portable UV Germicidal Equipment With Uncontained UV Sources.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL 8803 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at http://csds.ul.com.

This Edition of the standard has been formally approved by the Technical Committee (TC) on Ultraviolet (UV) Germicidal Equipment And Systems, TC 8802.

This list represents the TC 8802 membership when the final text in this Standard was balloted. Since that time, changes in the membership may have occurred.

TC 8802 Membership

Name	Representing	Interest Category	Region
Carl Bloomfield	Intertek	Testing & Standards Org.	USA
Juan Caamano	UL Solutions	Testing & Standards Org.	USA
Thomas Carlson	R-Zero Xyxtems Inc.	Producer	USA
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This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE

INTRODUCTION

1 Scope

1.1 These requirements apply to portable germicidal equipment intended to expose the air and surfaces within an unoccupied area with uncontained ultraviolet (UV) energy. These requirements address equipment intended to remain stationary while in operation, and intended for use by ordinary persons. The equipment may also produce visible light.

1.2 In this Standard, the UV overexposure risk is addressed via the following integral safeguards:

a) Motion detection as a critical control function; and

b) Activation cycle requirements and operating time limits. Additional safeguards may optionally be included by the manufacturer.

1.3 These requirements do not cover:

a) Hand-held equipment;

b) Equipment that does not use a motion detection function as a safeguard;

c) Equipment that uses a wireless or remote control (i.e., a control not physically part of the same device) to initiate or extend an operating cycle; or

NOTE: Wireless/remote controls are still allowed to terminate an operating cycle.

d) Devices intended for sterilization of equipment covered by other standards, such as UL 8802, Standard for UV Germicidal Equipment and Systems.

1.4 In the United States, products generating ultraviolet radiation are intended for use in accordance with Title 21 Code of Federal Regulations (CFR) Parts 1000 through 1004, and section 1005.25.

NOTE: These regulations include reporting of Accidental Radiation Occurrences, notification to FDA and customers of a radiation safety defect and corresponding plan for corrective action for FDA approval, and designation of a U.S. agent for imported lamps.

1.5 This Standard does not apply to UV germicidal equipment covered by other standards. Products not covered by this Standard include:

a) Laboratory and health care equipment with UV emitters covered by UL 61010-1 and CSA C22.2 No. 61010-1;

b) UV germicidal equipment and systems covered by UL 8802, Standard for UV Germicidal Equipment and Systems.

1.6 These requirements address risk of personal injury due to overexposure to UV emissions. To address other safety considerations (e.g., risk of fire or electric shock, or personal injury risks besides UV) this Standard shall be used in conjunction with CSA C22.2 No. 250.4 / UL 153, Standard for Portable Luminaires. All construction, performance and marking requirements in those standards apply unless specifically exempted or superseded by a requirement in this Standard.

1.7 Equipment that emit electromagnetic energy with wavelengths outside of the 200 – 400 nm range are not fully addressed by this Standard, and may require an additional evaluation.

1.8 In this Standard, combined US and Canadian standard references are commonly separated by a slash (" / "). The CSA standard reference applies to products intended for use in Canada, and the UL standard reference applies to products intended for use in the United States.

1.9 Equipment features, functions or accessories not anticipated by this standard may require a separate evaluation.

2 Components

2.1 A component of a product covered by this Standard shall:

a) Comply with the requirements for that component as specified in this Standard;

b) Be used in accordance with its rating(s) established for the intended conditions of use; and

c) Be used within its established use limitations or conditions of acceptability.

2.2 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this Standard; or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

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

2.4 A component that is also intended to perform other functions such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable standard(s) that cover devices that provide those functions.

3 Units of Measurement

3.1 The values given in SI (metric) units shall be normative. Values in parentheses are explanatory or approximate information.

3.2 Unless indicated otherwise, all voltage and current values specified in this Standard are root-mean-square (rms).

4 Referenced Publications

4.1 Any undated reference to a code or standard appearing in the requirements in this Standard shall be interpreted as referring to the latest edition of that code or standard.

4.2 The following standards are referenced in this Standard, portions of these referenced standards may be essential for compliance.

CSA C22.2 No. 0.15, *Adhesive Labels*

CSA C22.2 No. 187, *Electrostatic Air Cleaners*

CSA C22.2 No. 250.4, *Portable luminaires*

CSA E60730-1, *Automatic Electrical Controls – Part 1: General Requirements*

CSA C22.2 No. 61010-1, *Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements*

CSA C22.2 No. 62471, *Photobiological Safety Of Lamps And Lamp Systems*

IEC 62471, *Photobiological Safety Of Lamps And Lamp Systems*

IEC 62471-6, *Photobiological safety of lamps and lamp systems – Part 6: Ultraviolet lamp products*

IES RP-27.1, *Recommended Practice for Photobiological Safety for Lamps & Lamp Systems – General Requirements*

IES RP-44, *Recommended Practice: Ultraviolet Germicidal Irradiation (UVGI)*

UL 153, *Portable Electric Luminaires*

UL 248-1, *Low-Voltage Fuses – Part 1: General Requirements* and the applicable Part 2 standard(s) from the UL 248 series

UL 867, *Electrostatic Air Cleaners*

UL 969 *Marking and Labeling Systems*

UL 4200A, *Products Incorporating Button or Coin Cell Batteries of Lithium Technologies*

UL 8802, *UV Germicidal Equipment and Systems*

UL 60730-1, *Automatic Electrical Controls – Part 1: General Requirements*

UL 60730-2-9 *Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls*

UL 61010-1, *Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements*

5 Glossary

5.1 For the purpose of this standard, the following definitions apply.

5.2 ACTIVATION CYCLE – The time interval between user initiation of the equipment and the start of the operating cycle. Alternatively, the activation cycle can end when a safe reset or shutdown is triggered by the user or the device itself.

5.3 EMITTER – The component that produces UV radiation. This may also produce visible light.

5.4 EQUIPMENT – A generic term for the portable UV devices covered by the scope of this document.

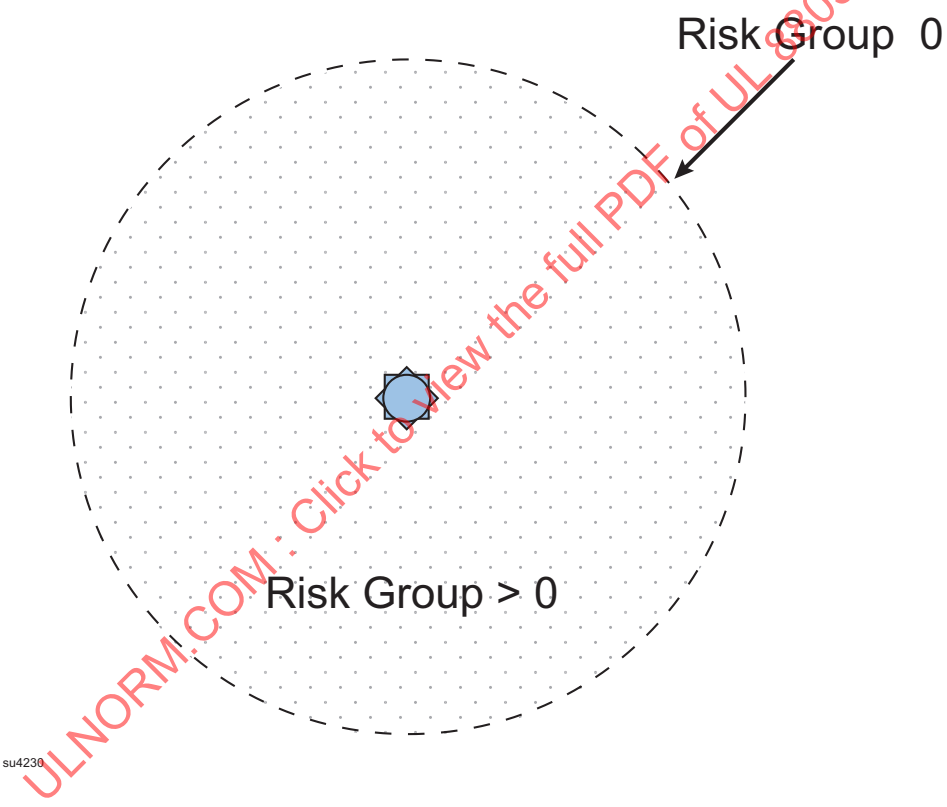
5.5 EXEMPT PERIMETER – The boundary around the equipment formed by the line-of-sight distance from its geometric center to points where UV emissions are considered Risk Group 0 (Exempt). These points are drawn on the horizontal plane formed by the floor. See Figure 5.1 for a graphical representation of this perimeter.

Note 1: This boundary is declared by the manufacturer and verified by test. By definition, persons standing at the edge of this boundary do not require additional safeguards against UV overexposure, as defined by IEC 62471, CSA C22.2 No. 62471, or IES RP-27.1, when the emitter is operating.

Note 2: Figure 5.1 is for reference purposes only. The perimeter's shape will depend on device design and may not be circular or symmetrical. In addition, when the line-of-sight distances for actinic and near UV are different, the larger of the two values are used to determine the exempt perimeter.

Figure 5.1

Graphical Representation of Exempt Perimeter



5.6 HAND-HELD EQUIPMENT – Cord-connected (or battery powered) electrically operated equipment intended to be supported by the hand in normal use. In this Standard this equipment type is considered attended in normal use. This type of equipment is not covered by this Standard; see 1.2.

5.7 INSTRUCTED PERSON – Person adequately advised or supervised by skilled persons to enable them to perceive risks and to avoid risks of injury associated with germicidal equipment.

5.8 MOTION DETECTION FUNCTION – The integral function that detects motion, and then initiates the safe reset mode. This function is implemented using one or more motion detectors, along with their associated control circuitry and software.

5.9 OCCUPANT – Individual(s) who are normally present in the treated space when the germicidal equipment is not in operation. It is assumed that occupants may not be aware of presence of the

germicidal equipment and cannot be expected to take any precautions against UV exposure while the equipment is operating.

5.10 OPERATING CYCLE – The interval after the activation cycle during which the emitter is in operation, and the air and surfaces in the vicinity of the equipment are exposed to UV energy.

5.11 ORDINARY PERSON - Person who is neither a skilled person nor an instructed person.

5.12 PORTABLE EQUIPMENT– Cord-connected or battery powered electrically operated equipment capable of being easily moved by hand from place to place. Portable equipment may be floor or counter supported in normal use. In this Standard, this equipment type is considered unattended and stationary while operating during normal use.

5.13 QUALIFIED SERVICE PERSON – A trained individual charged to repair the germicidal equipment.

5.14 SAFE RESET (MODE) – A safe state where the germicidal equipment ceases to operate, which requires the intervention of a user in order to reinitialize the device's starting sequence and restore normal equipment operation. A full shutdown is also considered a safe reset.

5.15 SAFEGUARDS – In the context of this Standard, integral equipment controls that function to prevent or reduce the likelihood of personal injury due to overexposure to UV or optical energy.

5.16 SKILLED PERSON – Person with relevant education and experience to enable him or her to perceive risks and to avoid hazards associated with germicidal equipment.

5.17 TREATED SPACE – The area that is exposed to UV energy from the emitter when the equipment is in operation.

5.18 ULTRAVIOLET (UV) RADIATION – Electromagnetic energy with a wavelength of 200 – 400 nm.

5.19 UNCONTAINED – When used to describe a UV source, this term refers to the electromagnetic energy that radiates from the emitter into spaces or surfaces that are external to the equipment while the equipment is in operation.

5.20 USER – The ordinary person that is operating the equipment.

Note: It should be assumed that users may not be fully aware of the potential UV overexposure risk posed by equipment use or misuse, and may not always follow the equipment's safety markings or instructions.

CONSTRUCTION

6 General

6.1 All equipment shall comply with the safety standards specified in 1.6 in addition to the requirements in this Standard.

6.2 The battery compartment of equipment or any accessory, such as a wireless remote control, incorporating one or more coin cell batteries of lithium technologies shall comply with UL 4200A, when the battery has a diameter of 32 mm (1.25 in) maximum with a diameter greater than its height.

7 Photobiological Hazards

7.1 Photobiological Assessment

7.1.1 The equipment shall be subjected to a photobiological assessment for actinic and near UV hazards from 200 nm through 400 nm in accordance with the requirements in CSA C22.2 No. 62471 (in Canada) or IEC 62471 (in the United States). At the manufacturer's request, the photobiological assessment may alternatively be conducted in accordance with IES RP-27.1.

7.1.2 This assessment shall be conducted at a distance from the radiation source equal to the emitter's exempt perimeter in the direction likely to produce the worst-case test result. The equipment shall be oriented and operated to produce the worst-case test result permitted by its construction.

Note: The entire exempt perimeter is required to be covered by the detection boundary of the integral motion detector. See 7.5.2.

7.1.3 Controls intended to interrupt equipment operation (e. g. motion detectors, etc.) shall be bypassed or disabled so that the equipment will operate continuously during the photobiological assessment, except for controls of the types of identified in 7.1.4.

7.1.4 When compliance with the photobiological assessment relies on controls or timing circuits to continuously operate the UV source on a duty cycle, or to vary the drive current or power to the emitter over time, then the control shall be additionally evaluated as a safety-related electronic circuit (SREC) in accordance with Annex C, Safety-Related Electronic Circuit (SREC) Requirements.

7.1.5 The result of the assessment in 7.1.1 – 7.1.4 is considered acceptable if the equipment achieves a classification of Risk Group 0 (Exempt) for actinic and near UV hazards at the exempt perimeter.

7.1.6 At the manufacturer's option, a second photobiological assessment may be conducted at a distance from the radiation source equal to 200 mm. The classification from this second assessment can be used to determine the maximum operating cycle time limits in 7.3.2.

7.2 Activation cycle

7.2.1 The equipment shall have an integral control that employs a delayed-start timer to permit users to leave the treated space before the operating cycle is initiated. A control that allows the equipment to begin an operating cycle immediately is not permitted.

7.2.2 The delayed-start function time duration shall be no less than 30 seconds and no more than 5 minutes. The time duration shall be marked or displayed on the equipment where evident to the user during equipment activation.

Note: A display that indicates the remaining time (countdown) to the operating cycle during the activation cycle is considered "evident to the user."

7.2.3 The control shall be designed to require a user to physically interact with the equipment to initiate the activation cycle.

7.2.4 A feature that permits a user to schedule the equipment to initiate an operating cycle automatically at a future time is not permitted.

7.2.5 A feature that allows for the user to physically interact with a remote device (e.g.: an app on a smart phone) to initiate the operating cycle is not permitted.

7.2.6 During the activation cycle, the equipment shall produce an audible or visual signal, or both, to alert the user of the impending operating cycle.

7.2.7 The control shall require at least two successive and deliberate operations to be performed within 4 seconds during the activation cycle in order to initiate the delayed-start function, otherwise the activation cycle shall cancel.

Note: Examples of a deliberate operation include but are not limited to pushing a button, holding a button, rotating a knob, or actuating a switch.

7.2.8 A control on the device shall permit the activation cycle to be interrupted or cancelled with one simple action (e.g., pressing a button, etc.).

7.2.9 The device shall check for motion within the exempt perimeter at the end of the activation cycle, before the operating cycle begins. If motion is detected, then the device shall enter a safe reset (mode).

7.3 Operating cycle

7.3.1 The equipment shall have a maximum operating cycle time of 60 minutes, unless otherwise permitted by 7.3.2.

7.3.2 As an alternative to 7.3.1, equipment evaluated in accordance with the photobiological assessment method in 7.1.6 may apply the limits in Table 7.1:

Table 7.1
Maximum Allowed Operating Cycle Time by Risk Group at 200 mm

Risk Group	Cycle Time
3	1 hour
2	3 hours
1	8 hours
0	Unlimited

7.3.3 If the equipment does not emit visible light, then it shall have an audible or visual indicator, or both, to signal to the user that the equipment is in its operating cycle. This indicator shall be a different tone or pattern than the activation cycle indicator specified in 7.2.6.

7.4 Wireless control

7.4.1 When a wireless remote controller or the capability of wireless operation is provided, this device or function shall comply with 7.4.2 – 7.4.4.

7.4.2 The control shall bring the equipment to safe reset (mode) with one simple action (e.g.: pressing a button, etc.).

7.4.3 The control shall only be capable of bringing the equipment to safe reset (mode). The control shall not be capable of:

a) Turning on the equipment;

b) Initiating or extending an operating cycle; or

c) Scheduling a future time for an activation or operating cycle.

7.4.4 The control shall not require a clear line of sight to the equipment in order to function. Compliance is verified using the test procedure in Annex B, Determination of Wireless Control Range.

7.4.5 The operating range of the control shall not be less than the shortest distance from the equipment to the exempt perimeter. The operating range shall be verified using the test procedure in Annex B, Determination of Wireless Control Range.

7.5 Motion detection

7.5.1 The equipment shall include an integral motion detector or detector system that forces the equipment into a safe reset (mode) when motion is detected within the exempt perimeter during an operating cycle.

7.5.2 The minimum detection range of this control shall cover the entirety of the equipment's exempt perimeter. This coverage shall be determined by combining the worse-case test results from both test procedures in Annex D, Motion Detectors – Determination of Coverage Area.

7.5.3 The motion detection function (i.e., motion detectors and all associated circuitry) within the equipment is considered a critical control function, and shall be additionally evaluated as a safety-related electronic circuit (SREC) in accordance with Annex C, Safety-Related Electronic Circuit (SREC) Requirements.

7.6 UV source replacement

7.6.1 When the equipment includes a user replaceable UV source (i.e., lamp), the replacement procedure shall not initiate an operating cycle.

8 Ozone Assessment

8.1 Devices that emit ultraviolet radiation at wavelengths less than 250 nm shall comply with the Ozone Test in CSA-C22.2 No. 187 / UL 867.

Note: Equipment with an ozone monitoring circuit or an interlock mechanism to control ozone production are not addressed by this document, and may require a separate evaluation.

MARKINGS AND INSTRUCTIONS

9 Safety Instructions

9.1 The safety instructions shall be a permanent part of the manual but separated in format and preceding all other instructions (such as installation, operation, and maintenance instructions).

9.2 The safety instructions shall include instructions or illustrations to identify important safety features, in addition to the important safeguards specified in 9.5.

9.3 The height of lettering in the text and illustrations of the safety instructions shall be as follows:

a) The phrases "IMPORTANT SAFEGUARDS", "READ AND FOLLOW ALL SAFETY INSTRUCTIONS", and "SAVE THESE INSTRUCTIONS" shall be in letters not less than 4.8 mm (3/16 inch) in height.

b) Other upper-case letters shall not be less than 2.1 mm (1/12 inch) in height.

c) Lower-case letters shall not be less than 1.6 mm (1/16 inch) in height.

9.4 The items may be numbered. The phrases "READ AND FOLLOW ALL SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS" shall be first and last, respectively, in a list of items. Other important safeguard items considered appropriate by the manufacturer may be inserted.

9.5 For all equipment, the safety instructions shall include the following safeguards verbatim or in equally definitive terminology. If a specific safeguard does not apply to a particular type of equipment, the safeguard may be modified or deleted as appropriate:

IMPORTANT SAFEGUARDS

When using electrical equipment, basic safety precautions should always be followed including the following:

a) READ AND FOLLOW ALL SAFETY INSTRUCTIONS.

b) This equipment uses an ultraviolet (UV) source and must be used in compliance with its markings and instructions to prevent the user's eye and bare skin from exposure to harmful UV or optical radiation. Follow the instructions for correct placement of the equipment and the precautions for securing the area before initiating equipment operation.

c) IT IS THE RESPONSIBILITY OF THE USER TO ENSURE THAT PERSONS WILL NOT BE EXPOSED TO EXCESSIVE UV RADIATION DURING EQUIPMENT OPERATION. THIS WILL REQUIRE THE USER TO ENSURE THAT THE SPACE BEING TREATED HAS BEEN VACATED PRIOR TO ENGAGING THE EQUIPMENT.

d) THIS DEVICE IS EQUIPPED WITH SAFEGUARDS TO DISENGAGE THE UV SOURCE WHEN MOTION IS DETECTED IN THE VICINITY OF THE DEVICE. DO NOT TAMPER WITH, MODIFY OR DISABLE ANY SAFEGUARD OR OPERATIONAL FEATURE OF THIS DEVICE. STOP USING THIS DEVICE AND CONTACT THE MANUFACTURER IF YOU SUSPECT THAT THE MOTION DETECTOR IS NOT FUNCTIONING PROPERLY.

e) IF USED IMPROPERLY THIS DEVICE MAY POSE A RISK OF PERSONAL INJURY FROM UV OVEREXPOSURE. IT IS THE RESPONSIBILITY OF THE USER TO READ AND FOLLOW ALL SAFETY INSTRUCTIONS.

f) To reduce the risk of injury, close supervision is necessary when this device is used near children.

g) When replacing lamps or UV sources, disconnect power and replace only with the lamps for which the equipment is marked and intended.

Note: Item (g) applies only to equipment with user-replaceable lamps.

h) Always disconnect this device from the power source immediately after use.

i) The use of accessory equipment not recommended by the manufacturer may cause an unsafe condition.

j) Do not use this equipment for other than its intended use.

SAVE THESE INSTRUCTIONS

10 Additional Markings and Instructions

10.1 The instruction manual shall include instructions for operation and maintenance recommended by the manufacturer. The instructions shall state that the device does not have any user-serviceable parts (except lamps) and that all servicing should be performed by qualified service personnel.

10.2 The instructions shall include the manufacturer's declarations for:

a) The dimensions of the treated space or UV radiation distribution;

b) The horizontal field of view of the integral motion detection system, in degrees;

c) The operating range of the wireless control, when provided;

d) The device's startup sequence;

e) UV source (lamp) replacement procedure, for equipment with user replaceable sources; and

f) Proper handling and disposal of UV sources containing mercury.

10.3 Equipment shall be permanently and legibly marked with the following product markings on an exterior surface that is normally visible, using a minimum letter height of 2.4 mm:

a) "This equipment produces potentially hazardous UV energy. Refer to the operating manual for important safety and operating instructions."

10.4 Permanent marking methods include paint-stenciling, indelible ink or die stamping, etching, engraving, embossing, molding, casting, or the use of a suitable marking and labeling system compliant with CSA No. 0.15 / UL 969.

ANNEX A – SAFETY MARKING TRANSLATIONS

(Normative for Canada and Informative for the U.S.)

This Annex includes the markings required to be translated and suggested French translations. For Canada, this Annex is a normative (mandatory) part of this Standard. For the US, this Annex is an informative (non-mandatory) part of the Standard.

Paragraph, Figure, Table	Marking – English	French Translation
9.3	"IMPORTANT SAFEGUARDS", "READ AND FOLLOW ALL SAFETY INSTRUCTIONS"	« MESURES DE PROTECTION IMPORTANTES », « LIRE ET SUIVRE TOUTES LES CONSIGNES DE SÉCURITÉ »
9.3	"SAVE THESE INSTRUCTIONS"	« CONSERVER CES INSTRUCTIONS »
9.4	"READ AND FOLLOW ALL SAFETY INSTRUCTIONS"	« LIRE ET SUIVRE TOUTES LES CONSIGNES DE SÉCURITÉ »
9.4	"SAVE THESE INSTRUCTIONS"	« CONSERVER CES INSTRUCTIONS »
10.3	"This equipment produces potentially hazardous UV energy. Refer to the operating manual for important safety and operating instructions."	« Cet équipement produit de l'énergie UV potentiellement dangereuse. Reportez-vous au manuel d'utilisation pour consulter les instructions en matière de sécurité et de fonctionnement. »

ANNEX B (Normative) – DETERMINATION OF WIRELESS CONTROL RANGE

B.1 The equipment shall be plugged in and energized as intended. A person shall stand and hold the wireless control such that the distance from the wireless control to the equipment is equal to the maximum operating range declared by the manufacturer. At this distance, the person shall operate the wireless control and attempt to trigger a safe reset (mode) of the equipment. When the equipment's integral receiver is directional, then the equipment shall be oriented to produce the worst-case test result permitted by its construction.

B.2 The setup and test in B.1 shall be repeated with the person holding the flattened palm of one hand against the front of the wireless control.

B.3 The test results are considered acceptable if, in both cases, the wireless control was able to trigger a safe reset (mode) of the equipment at the distance declared by the manufacturer.

ANNEX C (Normative) – SAFETY-RELATED ELECTRONIC CIRCUIT (SREC) REQUIREMENTS

C1 Scope

C1.1 These requirements apply to safety-related electronic circuits. Bold text in Section C3 identifies defined terms from Section C2.

C1.2 These requirements are not intended to serve as the sole basis for evaluating risk. End-product requirements may amend or supersede these requirements, as appropriate.

C2 Glossary

C2.1 The following definitions apply to terms used within this annex. Defined terms are shown as bolded text throughout the Annex.

C2.2 CRITICAL CONTROL FUNCTION – A function performed by a discrete component or a component network whose primary purpose is normal operation of the product, but whose failure could cause the device to exceed the electrical, thermal or exposure limits for normal operation as defined in this standard and the additional safety standard(s) that apply to the product; see 1.6.

NOTE: Examples include functions that:

a) Disconnect power in response to the opening of a service compartment access panel, analogous to the function of a mechanical interlock switch to prevent contact with a hot surface or high voltage circuit during maintenance;

b) Limit or reduce available voltage or current at accessible terminals during routine maintenance, such as at the pins of a lamp or lamp holder during lamp replacement; and

c) Control the ON-state or maintain the duty cycle of a UV source, where a fault can cause the equipment to unexpectedly energize or emit higher UV doses.

C2.3 CRITICAL FAILURE (MODE) – A software or hardware fault which can result in a risk. See C2.8.

C2.4 PRODUCT – The device into which the safety-related electronic circuit is integrated. This is a generic term used in this annex for the portable UV equipment covered by the scope of this Standard.

C2.5 PROGRAMMABLE COMPONENT – Any microelectronic hardware 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 wherein the behavior of the component can be altered." This includes discrete components (e.g., microcontrollers, memory storage ICs) that store or execute software instructions in response to thermal or electrical conditions.

C2.6 PROTECTIVE COMPONENT – A discrete component or component network that has been separately evaluated to reliably perform a protective function.

NOTE: Examples of such components include thermal cutouts evaluated to UL 60730-2-9 and fuses evaluated to the UL 248 series of standards.

C2.7 PROTECTIVE FUNCTION – A function performed by a discrete component or component network relied upon to reduce risk during abnormal operating conditions.

NOTE: Examples include functions that:

a) Limit or reduce power in response to elevated ambient conditions or discrete component failures, analogous to the function of a thermal protector in recessed luminaires; and

b) Maintain electrical outputs within limits defined as non-hazardous during abnormal operation, such as those defined for Class 2 or low-voltage limited-energy (LVLE) power sources.

C2.8 RISK – The unacceptable potential for fire, electric shock, or injury to persons as defined by the product standard of the device being evaluated.

C2.9 SAFETY-RELATED SOFTWARE – Computer programs, procedures, and data resident on the hardware or remotely interactive with the hardware pertaining to the operation of a programmable component that provides safety-related elementary functionality as follows:

a) Exercises direct control over the state of microelectronic or product hardware. When not performed, performed out of sequence, or performed incorrectly, such programs, procedures, and data are capable of resulting in a risk.

b) Monitors the state of microelectronic or product hardware. When not performed, performed out of sequence, or performed incorrectly, such programs, procedures, and data provide data that is capable of resulting in a risk.

c) Exercises direct control over the state of the microelectronic or product hardware. When not performed, performed out of sequence, or performed incorrectly, such programs, procedures, and data are capable of, in conjunction with other human actions, product hardware or environmental failure, resulting in a risk.

C2.10 SAFETY-RELATED ELECTRONIC CIRCUIT – An electronic circuit that implements one or more critical control functions or protective functions. These circuits may incorporate any combination of active, passive, programmable, and protective components or semiconductors.

C3 General

C3.1 To ensure an acceptable level of circuit redundancy or supervision, safety-related electronic circuits (SREC) shall be subject to the reliability evaluation in Section C4, Reliability Evaluation.

Exception: SRECs that comply with C3.2 and C3.3 are exempt from this requirement.

C3.2 A design review of the SREC shall be conducted to determine if all the conditions below are true.

a) All critical failure modes that can occur in the SREC hardware due to any discrete component or integrated circuit fault can be identified, simulated and applied via a suitable FMEA or other circuit analysis methods (complexity of the circuit);

b) All critical failure modes that can occur in the SREC due to a software fault or defect that affect the critical control function or protective function of the SREC can be identified, simulated and applied to determine if the software is relied upon for a critical control function or protective function to work properly. This assessment does not require an analysis of the software itself; rather this is an analysis of all critical failure modes of the SREC due to software faults (complexity of the circuit and software).

C3.3 If the design review in C3.2 indicates that all of the conditions are true, then all product tests shall be conducted using special samples with each of the critical failure modes identified in C3.2 applied, in turn, in the manner likely to result in the most adverse operating condition for each test.

a) The single component faults or simulated software faults (critical failure modes) applied to either a critical control function or protective function shall not lead to unacceptable test results (e.g. temperatures above permissible limits; voltage, current or power levels above permissible limits at a Class 2 output; etc.) or create a risk during any applicable test outlined in the end-product standard.

b) When the product test is an abnormal condition test, this SREC fault is in addition to the component faults or abnormal conditions required by the test.

c) The product under test is not required to function normally during these tests provided there is no risk.

d) Testing will require consideration for several critical failure modes and the fault type may differ from test to test. To manage the total number of test conditions, based on the design review, tests that will represent the most onerous conditions can be selected.

C4 Reliability Evaluation

C4.1 Safety-related electronic circuits shall be evaluated to the requirements of UL 60730-1; including Annex H: Requirements for Electronic Controls. Safety-related electronic circuits that do not rely on safety-related software are not required to comply with H.11.12 of Annex H.

C4.2 When a product contains a safety-related electronic circuit intended to provide the function of thermal protection in recessed equipment, it shall additionally comply with UL 60730-2-9.

C4.3 In reference to C4.1, and unless specifically superseded by a relevant Part 2 standard, the following parameters apply from Annex H in UL 60730-1:

a) Safety-related software shall be evaluated as Software Class B.

b) The Thermal Cycling test shall be performed using the ambient operating temperature range designated by the manufacturer or the temperature parameters below, whichever are more severe:

1) The lower parameter shall be -35 °C (-31 °F) for wet location products, 0 °C (32 °F) for damp location products, and 10 °C (50 °F) for all other products; and

2) The upper parameter shall be 40 °C (104 °F).

c) When evaluating for compliance with the EMC Requirements – Immunity:

1) Protective circuits are considered to be Protective Controls with Class B control functions; and

2) Critical control circuits are considered to be Operating Controls with Class B control functions.

d) The Influence of Voltage Unbalance Test is not applicable.

e) For the Ring Wave test, use Overvoltage Category III.

f) The Influence of Supply Frequency Variations Test is not applicable if the safety-related electronic circuit does not rely on the power line frequency for timing or control.

g) The Power Frequency Magnetic Field Immunity test is not applicable if the safety-related electronic circuit does not rely on Hall-effect devices, such as current-sensing transformers.

C4.4 With regard to the evaluation of compliance in Annex H:

a) The requirements in the product standard applicable to creepage, clearance and dielectric voltage withstand shall be used when they are more severe; and

b) As a result of each test, the product incorporating the safety-related electronic circuit shall not exhibit a risk and either:

1) Continue to function as intended with no degradation to the critical control or protective functions (i.e., normal performance with no loss of protective functions);

2) Cease to function, with normal function restored by an automatic, user-resettable or user-replaceable protective component or function such as an automatic or manual-reset protector, a fuse replacement, or cycling the power to the product (i.e., loss of protective function with safety shut down); or

3) Cease to function permanently.

ANNEX D (Normative) – MOTION DETECTORS

Determination of Coverage Area

D1 Scope

D1.1 The test procedures in this Annex determine the coverage area of an integral motion detector or system, when it is relied on as a safeguard to address the risk of UV overexposure.

D1.2 These requirements are predicated on the assumption that the space being treated was vacated prior to UV equipment operation, and that a person attempts to re-enter the space while the equipment is in the activation or operation cycles.

D1.3 Presence detection is outside the scope of this annex.

D2 Glossary

D2.1 The definitions below apply to terms used in this Annex. Defined terms are shown as bolded text throughout the Annex.

D2.2 CELL – A 0.91 m by 0.91 m (3 ft by 3 ft) section of the grid.

D2.3 COVERAGE AREA – The area in which the motion detector can detect motion, as determined by the test procedures in this annex.

D2.4 GRID – The floor area in which the motion detector is tested divided into cell sections.

D2.5 HORIZONTAL FIELD OF VIEW (HFOV) – The area of coverage in a horizontal plane to the motion detector.

D2.6 MICROWAVE – Type of occupancy motion detector that emits a low power microwave into the area being monitored. Changes in the reflection pattern caused by motion are received by the detector and converted into an electrical signal.

D2.7 MOTION DETECTOR – The integral control employed to detect motion. This control can be implemented using a single detector or with a system of multiple detectors. The detectors can consist of one or a combination of various sensing technologies (e.g. passive infrared, ultrasonic, microwave).

NOTE: In some standards, this device may be referred to as a "occupancy detector."

D2.8 PASSIVE INFRARED – Type of motion detector that uses thermal detectors to absorb the received energy focused on them. A change in energy received by a thermal detector results in a change in detector temperature which results in an electrical signal. When a person moves into or out of a field of view, the detector experiences a change in received energy, which is converted into an electrical signal.

D2.9 SENSITIVITY – The ability of the motion detector to detect the designated magnitude of motion for a given application.

D2.10 ULTRASONIC – Type of motion detector that emits a low power sound into the area being monitored. The sound wave is at a frequency above the range that a person can hear. Changes in the reflection pattern caused by motion are received by the detector and converted into an electrical signal.

D2.11 VERTICAL FIELD OF VIEW (VFOV) – The area of coverage in a vertical plane to the motion detector.

D3 Determination of Coverage Area

D3.1 Test environment

D3.1.1 The test room where the motion detector will be investigated shall have the following characteristics:

a) The room shall be larger than the manufacturer's specified coverage area in length and width by at least 5 %, and have a ceiling height of at least 2.75 m (9 feet), so that the test subject can walk into the field of view of the motion detector from outside of its coverage area during testing.

Alternatively, when the manufacturer's specified coverage area exceeds any of the dimensions (length, width or height) of the test room, one half of the field of view can be tested. Followed by re-positioning the motion detector, for the test to be performed on the other half of the field of view.

Note: The alternate test method is acceptable for:

a) Line of sight motion detectors; or

b) Ultrasonic motion detectors that have opposing transmit and receive ports, such that the FOV can be divided in half. Other types of motion detectors shall be tested with the standard method.

b) The floor shall be visibly divided into a square grid with cell dimensions of 0.91 by 0.91 m (3 by 3 feet).

c) During testing, the room's ambient temperature shall be maintained at 25 ±5 °C. The ambient shall be measured at a horizontal distance of 1 ±0.1 m (3.05 ±0.3 ft) from the motion detector, at the motion detector height.

d) During testing, the room's relative humidity shall be between 30 % and 70 %.

D3.2 Test setup

D3.2.1 Prior to testing, the test sample shall be maintained at the test room's ambient temperature and relative humidity for at least 1 hour.

D3.2.2 During testing, the sample shall be supported on stable and vibration free surface.

D3.2.3 The sample shall be set up and tested, in turn, as follows:

a) Resting on the floor in the center of the test room in its intended operating orientation (i.e., upright);

b) Resting on a horizontal platform in the center of the test room such that the top of the device is located 1 m (3.3 feet) above the floor below it; and

c) Resting on a horizontal platform in the center of the test room such that the top of the device is located 2 m (6.6 feet) above the floor below it.

D3.2.4 When the motion detectors have adjustable positioning, they shall be adjusted in the most adverse position or positions allowed by their construction for each test. Several iterations of the testing may be necessary to identify the most adverse position(s). For each test, the motion detector orientation and mounting angle shall be recorded.

D3.2.5 Motion detectors with adjustable sensitivity settings shall be operated in the most adverse setting for each measurement. Several iterations of the testing may be necessary to identify the most adverse position(s). For each test, the motion detector sensitivity settings shall be recorded.

D3.3 Test subject

D3.3.1 The test subject (e.g., person) for the testing shall meet the following criteria:

a) A height of 1.57 – 1.85 m (62 – 73 inches);

b) A mass of 77 ±9 kg (170 ±20 pounds); and

c) Dressed in a short-sleeved shirt, long pants, and shoes, with their head and hands exposed. The person shall not wear a coat or other insulated garments. Clothing shall fit the person with no hanging or swaying material.

NOTE: The manufacturer may consider additional testing at different statures.

D3.3.2 During each test the person shall walk at a velocity of 0.46 ±0.08 m/s (18 ±3 inches/second) with arms crossed over their chest.

D3.4 Test procedure

D3.4.1 General

D3.4.1.1 To normalize motion detectors that have different thresholds for on and off state, all motion detectors shall be tested in both the "ON" and "OFF" state, as long as there is a visible indication of motion detection

D3.4.1.2 For each test iteration, the sample shall be set up as required by D3.2.3. Each test height shall be tested in turn.

D3.4.1.3 A special sample may be prepared to power a non-UV load or indicator, and whose safe reset circuit is bypassed or inactivated to permit multiple detection indications in succession. These modifications shall not enhance or degrade the sample's ability to detect motion during the test.

D3.4.1.4 Compliance is determined by conducting both the Radial and Tangential Motion Test methods in turn.

D3.4.2 Method A – radial motion

D3.4.2.1 The sample shall be set up in the test room at the appropriate test height. The horizontal orientation of the sample relative to the test subject shall be marked on the sample and designated the 0° position. The sample shall then be energized and operated so that its motion detector is operating normally.

D3.4.2.2 Starting at a point in the test room outside of the sample's detection range, the test subject shall walk directly towards the sample in the manner specified in D3.3.2. Once the sample indicates that the test subject's motion has been detected, the test subject shall stop walking and note their location on the floor. The linear distance along the floor from this point to the center of the sample shall be measured and recorded. The sample shall then be horizontally rotated clockwise 30 ±3°.

D3.4.2.3 The test specified in D3.4.2.1 – D3.4.2.2 shall be repeated until the entire Horizontal FOV has been tested in 30° intervals. For the sake of data comparison, the initial radial position of the sample (i.e., the 0° position) shall be the same for each test height. See Figure D3.1 for an illustrated summary of this test method.