

VIDEO IMAGE SMOKE DETECTION SYSTEM DEVICES



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FOREWORD

Certification organizations are periodically requested to promptly provide certification services for devices, constructions, materials and systems where Canadian recognized Standards do not currently exist or are not entirely applicable. Accordingly, the certification organization utilizes its experience, existing specifications and requirements in related areas, together with assistance from its advisory councils to develop and prepare Other Recognized Documents (ORDs) for use in conducting the necessary tests and evaluation investigation.

Underwriters Laboratories of Canada has prepared many ORDs in response to requests from, and in conjunction with, industry, code writing bodies, regulatory agencies and others prior to promulgating a certification program. In many instances such documents have become published ULC Standards and subsequently National Standards of Canada. It is the intention of Underwriters Laboratories of Canada to continue this practice, as appropriate.

Comments on the content of this ORD should be directed to the Head Office of Underwriters Laboratories of Canada, 7 Underwriters Road, Toronto, Ontario, CANADA, M1R 3A9.

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ULC/ORD-C529A-13

VIDEO IMAGE SMOKE DETECTION SYSTEM DEVICES

PREFACE

This is the First Edition of the Other Recognized Document ULC/ORD-C529A, Video Image Smoke Detection System Devices.

Only metric SI units of measurement are used in this ORD. If a value for measurement is followed by a value in other units in parentheses, the second value may be approximate. The first stated value is the requirement.

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.

Attention is drawn to the possibility that some of the elements of this ORD may be the subject of patent rights. ULC Standards shall not be held responsible for identifying any or all such patent rights.

Requests for interpretation of this ORD should be sent to the ULC Mark Program Owner of Underwriters Laboratories of Canada. The requests should be worded in such a manner as to permit a “yes” or “no” answer based on the literal text of the requirement concerned.

This ORD is intended to be used for conformity assessment.

1 SCOPE

1.1 The intent of this ORD is to utilize the existing applicable "in Canada" requirements in ULC-S529, Smoke Detectors for Fire Alarm Systems, and incorporate additional requirements necessary for the evaluation of video image smoke detection system devices. Although video image smoke detection system devices may include flame detection functions, this ORD does not include testing for flame detection functions or the combination of Video Image Smoke and Flame detection functions.

NOTE: As a BiNational Standard, ULC-S529 includes Clauses that apply in both Canadian and United States contexts, Clauses identified as applicable in Canada ("in Canada") only and Clauses that are identified as applicable in the United States only.

1.2 The Video Image Smoke Detection Systems Devices addressed by this ORD are to be investigated with the intent to detect the image of smoke from a fire in the field of view area defined by the limits of the camera. Installation/operating document(s) and/or product marking information provided with the product must describe the specific operating parameters of the product.

1.3 The video image smoke detection system devices are not intended to be a direct replacement for standard open area protection devices, but do offer detection capabilities not possible with conventional devices. Special consideration must be given to the video image smoke detection system devices regarding the overall system's sensitivity and special care taken to reduce the possibility of false alarms.

2 REFERENCE PUBLICATIONS

The documents shown below are referenced in the text of this ULC Other Recognized Document (ORD). Unless otherwise stated elsewhere in this ORD, such reference shall be considered to indicate the edition and/or revisions of the documents available at the date on which this ULC ORD is published.

Documents published by CSA Group
5060 Spectrum Way, Mississauga, ON L4W 5N6 Canada
Telephone: (416) 747-4000 or 1-800-469-6727
www.csa.ca

- CSA C22.1-12, Canadian Electrical Code, Part I, Safety Standard for Electrical Installations

Documents Published by the Department of Defense, available from:

Standardization Document Order Desk
700 Robind Avenue, Building 4, Section D, Philadelphia PA 19111-5094 U.S.A.
Telephone: (215) 697-2667

- MIL-HDBK-217F, Military Handbook – Reliability Prediction of Electronic Equipment

Documents Published by International Society of Automation
67 T. W. Alexander Drive, P.O. Box 12277, Research Triangle Park, NC 27709 U.S.A.
Telephone: (919) 549-8411; Fax (919) 549-8288
E-mail: info@isa.org
www.isa.org

- ISA-MC96.1-1982, Temperature Measurement Thermocouples

Documents Published by the National Research Council of Canada (NRC)
Canadian Commission on Building and Fire Codes
1200 Montreal Road, Building M-58, Ottawa, ON K1A 0R6 Canada
Telephone: (613) 993-9101 or 1-877-672-2672
www.nrc-cnrc.gc.ca

- National Building Code of Canada, 2010

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- ULC/ORD-C386-90, Flame Detectors
- CAN/ULC-S525-07, Audible Signal Devices for Fire Alarm Systems, Including Accessories
- ULC-S529-09, Smoke Detectors for Fire Alarm Systems

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- CAN/ULC-S559-13, Equipment for Fire Signal Receiving Centres and Systems

3 GLOSSARY

3.1 In addition to the definitions listed in ULC-S529, Smoke Detectors for Fire Alarm Systems, the following definitions apply.

NOTE: Terms used in this Standard that are in *italic* print are defined as follows:

APERTURE — the size of the lens *aperture* (hole or opening) determines how much light will enter the camera. A larger physical *aperture* results in more light entering the camera. *Aperture* sizes may be specified as dividers of the lens *focal length*, in which case the smaller the *aperture* value, the greater the amount of light entering the camera.

FIELD — the *field* of the detection area, as defined by the manufacturer, is the area within the camera view where smoke presence results in a fire alarm signal with 100 % probability.

FOCAL LENGTH — the lens *focal length* identifies the location at which plane waves arriving from an infinitely distant source are focused to a point behind the lens. For objects (sources) less than several *focal lengths* distant from the lens, the *focal length* determines the magnification of the image projected onto the image plane.

MINIMUM LUMINANCE — the *minimum luminance* value, defined by the manufacturer, at the point origin of a fire required to detect the presence of the smoke and initiate a fire alarm signal.

SENSITIVITY — the *sensitivity* of a *video image smoke detection system device* resulting from software processing of the video image that includes the following parameters as specified by the manufacturer:

- A Volume and size of the smoke and fire characteristics required for detection;
- B Fire sources;
- C *Field of view* of the *video image smoke detection system device* (at specified lens *focal length* and *aperture*);
- D Minimum and maximum detection range (distance between fire sources and *video image smoke detection system device*) at specified lens *focal length* and *aperture size*;
- F Boundary of the detection area within the video image viewing area;
- G Presence and influence of false alarm sources within the viewing area;
- H Designation of the system;
- I Response time for detection of the presence of smoke.

VIDEO IMAGE SMOKE DETECTION SYSTEM DEVICE — a device designed to detect the presence of smoke from a fire within the *field* of the detection area of a camera image.

4 CLASSIFICATION

4.1 The manufacturer shall declare a *sensitivity* class for each type of *video image smoke detection system device* as described in either Clause 4.1.1 or Clause 4.1.2.

4.1.1 Class A: minimum operational distance as defined by the manufacturer; maximum operational distance 10 m.

4.1.2 Class B: minimum operational distance as defined by the manufacturer; maximum operational distance greater than 10 m, but specified by the manufacturer.

5 RELIABILITY

5.1 The maximum failure rate for a *video image smoke detection system device* shall be 4.0 failures per million hours as calculated by a full part stress analysis prediction as described in MIL-HDBK-217, Military Handbook – Reliability Prediction of Electronic Equipment or 3.5 failures per million hours as calculated by a simplified parts count reliability prediction as described in MIL-HDBK-217, Military Handbook – Reliability Prediction of Electronic Equipment, or equivalent (see Annex D in ULC-S529, Smoke Detectors for Fire Alarm Systems). A "Ground Fixed" (GF) environment shall be used for all calculations.

5.2 Any component whose failure results in a trouble signal shall not be included in the failure rate calculation.

5.3 A video image sensor installed in a *video image smoke detection system device* shall have a predicted failure rate of not greater than 2.5 failures per million hours - refer to Subsections 18.1 and 18.2 of ULC-S529, Smoke Detectors for Fire Alarm Systems.

5.4 Any application specific integrated circuit (ASIC) employed in a *video image smoke detection system device* shall have a predicted failure rate of not greater than 2.5 failures per million hours. The failure rate shall be determined through evaluation of data from a 3000 hour burn-in test, or equivalent.

6 COMPONENTS - MONITORING FOR INTEGRITY

6.1 The fuses of a *video image smoke detection system device* shall be electrically supervised to indicate rupture of the fuse by an audible trouble signal when the fault prevents normal operation of the *video image smoke detection system device*.

Exception: Supplementary products where the fault in no way affects the normal operation of the system except for omission of supplementary features.

6.2 Opening or shorting of capacitors shall either have no adverse effect on normal operation or be indicated by a trouble or an audible alarm signal.

Exception: Where it is not practical to have a component failure indicated, a reliable component shall be used. The reliability of the component may be based on de-rating or on reliability data recorded for the particular component. Suitable sources are:

- A *The capacitor derating parameters specified in Table 1;*
- B *MIL-HDBK-338, Military Handbook, Electronic Reliability Design Handbook; and*
- C *Component reliability data based on actual performance in a similar application, such that the failure rate is equal to or less than 0.5 failures per million hours of operation.*

6.3 Failure of a cooling fan motor which would result in product temperatures exceeding those in Tables 2 and 3 shall be indicated by a trouble signal.

6.4 When the off-normal position of any normally preset mechanism or similar part of a *video image smoke detection system device* requires manual restoration in order to permit normal signaling performance of the system, such position shall be indicated by a trouble signal.

6.5 To determine if a switching part of a *video image smoke detection system device* complies with the requirements of Clause 6.4, the investigation shall start with the representative system combination in the normal supervisory condition; the system is then to be operated for signals with the manual-switching part in each position.

6.6 When a *video image smoke detection system device* is controlled and influenced by a software program, a trouble signal shall activate for the occurrence of any of the following malfunctions:

- A *The video image smoke detection system device or the alarm system does not execute its program cycle;*
- B *The memory function of the microprocessor does not function or is corrupted;*
- C *A power-supply output upon which the operation of the stored program relies (such as loss of power to a microprocessor, memory, disk supply, or the like) ceases to operate; or*
- D *Rotation ceases, or fails to start when required, in a video image smoke detection system device that incorporates permanent memory-storage devices having rotating elements.*

EXCEPTION: Supervision is not required when malfunction of the memory-storage device results only in loss of supplementary information or features, and when the system is still capable of indicating the nature and location of any status change.

7 INSTALLATION AND OPERATING INSTRUCTIONS

7.1 Installation and operating instructions shall conform to the "in Canada" requirements of Section 5 of ULC-S529, Smoke Detectors for Fire Alarm Systems.

CONSTRUCTION

8 CONSTRUCTION - GENERAL

8.1 *Video image smoke detection system devices* shall conform to the applicable requirements, as determined by the testing laboratory, of Sections 6 to 25 of ULC-S529, Smoke Detectors for Fire Alarm Systems.

9 CONSTRUCTION - SPACINGS

9.1 SPACINGS - GENERAL

9.1.1 In addition to the "in Canada" requirements in Subsections 26.1 to 26.6 of ULC-S529, Smoke Detectors for Fire Alarm Systems, the requirements of Subsection 9.2 shall apply.

9.2 SPACINGS - TESTS AND ANALYSIS

9.2.1 Samples shall be subjected to the analysis and tests specified in Table 4, but are not necessarily in the sequential order unless otherwise noted within the specified Clause.

9.2.2 The confirmation of the device valid normal operation shall be demonstrated as defined in Subsection 16.5, Smouldering Smoke Test, without the presence of disturbing events.

PERFORMANCE

10 PERFORMANCE - GENERAL

10.1 The video image smoke detection systems device shall conform to the "in Canada" requirements of Section 27 of ULC-S529, Smoke Detectors for Fire Alarm Systems.

10.2 Where *video image smoke detection system devices* include features for transmitting a fire alarm signal to other fire alarm systems and proprietary fire signal receiving centre equipment, the requirements of CAN/ULC-S559, Equipment for Fire Signal Receiving Centres and Systems shall also apply.

10.3 Where Flame detection functions are included, the requirements of ULC/ORD-C386, Flame Detectors shall also apply.

11 PERFORMANCE - NORMAL OPERATION TESTS

11.1 GENERAL

11.1.1 A *video image smoke detection system device* shall operate for all conditions of its intended performance, at all *sensitivity* levels, lens *focal lengths* and *aperture* size settings, at the lowest secured area luminance, as per manufacturer specifications when used in conjunction with any related power supply or control unit with which it is intended to be employed, and with indicating devices used to form the system combination covered both by the installation wiring diagram and by any supplementary information provided. The *field* of the detection area shall be verified at the three point fire source locations in the video image view shown in Figure 2 (central point, left bottom corner along vertical edge and right top corner along horizontal edge).

11.1.2 The lowest luminance shall be measured from the fire source toward the camera location, using a Foot Candle/Lux Meter Model 401025 made by Extech, or similar.

11.1.3 The fire point shall be located at the maximum distance from the device for each of the minimum and maximum settings of the lens *focal length* and *aperture* size limits.

EXCEPTION: For a device of Class A, a fire point distance may be reduced by up to half of the maximum distance.

11.1.4 The test voltage shall be in accordance with the requirements of Clause 27.2.1 of ULC-S529, Smoke Detectors for Fire Alarm Systems, and the *video image smoke detection system device* shall be in the standby condition and prepared for its intended signaling operation when it is connected to related devices and circuits.

11.1.5 When a heat detection device is provided integral with a *video image smoke detection system device*, actuation of the heat detection device shall result in the same type of alarm signal as when actuated by smoke, as is required for a smoke detection device in Clause 28.1.3 of ULC-S529, Smoke Detectors for Fire Alarm Systems.

11.1.6 Neither principle of operation of a combination smoke device shall be rendered inoperative by any of the Performance Tests (Sections 11 to 40) of this ORD and referenced standard(s). A circuit analysis shall be made, supplemented by electrical measurement when required by the testing laboratory, to determine that both principles of operation contribute to operation of the *video image smoke detection system device*. All integral, complimentary or supplemental detection and indicating capabilities shall be discretely isolated and individually tested as part of the testing outlined in Section 11, Performance - Normal Operation Tests and Section 16, Fire Tests.

NOTE: An example of such isolation would be the disabling of a complimentary flame device to verify the normal operation and *sensitivity* of the video smoke component.

11.1.7 When an audible alarm signaling appliance is provided integral with a *video image smoke detection system device*, the audible alarm signaling appliance shall conform to the requirements of CAN/ULC-S525, Audible Signal Devices for Fire Alarm Systems, Including Accessories.

11.2 STANDARDIZED ALARM SIGNAL

11.2.1 A *video image smoke detection system device* that produces an audible signal which is intended to initiate immediate evacuation from the protected area shall produce the signal in the form of the "three pulse" temporal pattern shown in Figure 1 of ULC-S529, Smoke Detectors for Fire Alarm Systems. Each ON phase shall last $0.5\text{ s} \pm 10\%$ followed by an OFF phase of $0.5\text{ s} \pm 10\%$. After the third of these ON phases, there shall be an OFF phase that lasts $1.5\text{ s} \pm 10\%$. Where the intended action is not immediate evacuation, the audible signal shall produce an alert signal distinctive from the "three pulse" temporal system.

11.3 SENSITIVITY SHIFT CRITERIA

11.3.1 During or immediately after performance tests, the *sensitivity* of the *video image smoke detection system device* is permitted to shift more than $\pm 0.014\text{ OD/m}$ (0.004 OD/ft or 1 %/ft) from the value recorded prior to the test, but in no circumstance shall the *sensitivity* exceed the limit of 6.0 %/304 mm obscuration in $15.0 \pm 3.0\text{ min}$ as specified in Subsection 16.5, Smouldering Smoke Test.

12 ELECTRICAL SUPERVISION TEST

12.1 GENERAL

12.1.1 The electrical circuits formed by conductors extending from the installation wiring connections of a *video image smoke detection system device* for interconnection to a power supply source or system control unit shall be electrically supervised so that a trouble signal indication is obtained at the connected control unit under any of the following fault conditions when the fault prevents operation of the *video image smoke detection system device* for fire alarm signals:

- A Single open or single ground fault of the connecting field wiring;
- B Failure of a limited-life component. See Glossary item 3.7 in ULC-S529, Smoke Detectors for Fire Alarm Systems;
- C De-energization of the *video image smoke detection system device* power supply circuit; and
- D Removal of a separable *video image smoke detection system device* head from its base, unless the head is secured to the base after installation by a means that requires a special tool to release.

12.1.2 The requirements of Clause 12.1.1 do not apply to the following:

- A Circuits of *video image smoke detection system devices* intended only for releasing device service only if it results in release;
- B Circuits for trouble-indicating devices;
- C The neutral of a 3-, 4-, or 5-wire alternating current or direct current light-and-power-supply circuit;
- D A circuit for a supplementary signal annunciator, signal-sounding appliance, motor controller, or similar appliance, only when a break, short circuit, or ground fault in no way affects the normal operation of the *video image smoke detection system device* other than to result in the omission of the supplementary feature;
- E A supplementary source of power used as an auxiliary means for maintaining normal operation of a *video image smoke detection system device* when the main supply source is interrupted;
- F The leads of a trickle-charged battery.

12.1.3 A motor included in a *video image smoke detection system device*, such as a blower motor that is required to operate continuously during operation, shall be supervised to indicate motor stalling or burnout. Motor stalling or burnout shall not result in a risk of fire.

12.1.4 Interruption and restoration of any source of electrical power connected to a *video image smoke detection system device* shall not result in an alarm signal.

12.1.5 The operation of any manual switching part of a *video image smoke detection system device* from its "normal" position while the *video image smoke detection system device* is in the standby condition shall be indicated by a trouble signal when the "off-normal" position of the switch interferes with the operation of the *video image smoke detection system device*.

12.1.6 To determine that a *video image smoke detection system device* complies with the requirements for electrical supervision, the *video image smoke detection system device* shall be tested with the representative system combination in the standby condition, and the type of fault to be detected shall then be introduced. Each fault shall be applied separately, the results noted and the fault removed. The system combination shall then to be restored to the standby condition prior to establishing the next fault.

12.1.7 When one leg of the power supply system to a *video image smoke detection system device* is intended to be connected to a grounded circuit, a ground fault in the other leg shall result in a trouble signal at either:

- A The *video image smoke detection system device*;
- B The control unit; or
- C The power supply to which the *video image smoke detection system device* is connected.

12.2 COMPONENT FAILURE

12.2.1 Failure of a limited life electronic component, such as opening or shorting of electrolytic capacitors, shall be indicated by a trouble signal or a reliable component shall be used. Failure of the component shall not result in a risk of fire or electric shock.

12.2.2 Internal shorts between any two elements of an electronic tube shall be indicated by either a trouble signal or an alarm signal when such failure prevents operation of the *video image smoke detection system device*. Such a failure shall not result in a risk of fire.

12.2.3 The heaters of all electronic tubes or other functional heating elements employed in a *video image smoke detection system device* shall be electrically monitored to indicate an open circuit fault by a trouble signal when the fault prevents operation of the *video image smoke detection system device* or results in loss of *sensitivity*.

12.2.4 In determining that a *video image smoke detection system device* complies with the requirement with respect to failure of a limited life component, the fault condition, open or short, shall be applied, in turn, with the *video image smoke detection system device* connected to a source of supply in accordance with the requirements of Clause 27.2.1 of ULC-S529, Smoke Detectors for Fire Alarm Systems.

12.2.5 The *video image smoke detection system device* shall also conform to the requirements of ULC-S529, Smoke Detectors for Fire Alarm Systems.

12.3 BATTERY-POWERED UNITS

12.3.1 General

12.3.1.1 A video image smoke detection system device that uses a battery as the main source of supply shall be capable of producing an alarm signal for at least 4 min, at the battery voltage at which a trouble signal is obtained, followed by 7 d of trouble signal indication.

12.3.1.2 To determine compliance with the requirements of Clause 12.3.1.1, 3 samples shall be equipped with batteries that have been depleted to the trouble signal level. The samples shall then be placed in alarm condition for 4 min. Following the 4 min of alarm, the trouble signal shall persist for at least seven consecutive days.