



UL 2075

STANDARD FOR SAFETY

Gas and Vapor Detectors and Sensors

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UL Standard for Safety for Gas and Vapor Detectors and Sensors, UL 2075

Second Edition, Dated March 5, 2013

Summary of Topics

This revision to ANSI/UL 2075 dated January 23, 2023 was issued to incorporate the following changes:

- ***Unconditioned Areas; [1.1](#), [3.7](#), [3.16A](#), [45.2.1](#), and [50.1.1](#)***
- ***NFPA 720 Reference; [49.1.1](#)***

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated September 6, 2022 and October 21, 2022.

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UL 2075

Standard for Gas and Vapor Detectors and Sensors

First Edition – November, 2004

Second Edition

March 5, 2013

This ANSI/UL Standard for Safety consists of the Second edition including revisions through January 23, 2023.

The most recent designation of ANSI/UL 2075 as an American National Standard (ANSI) occurred on January 23, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page. Any other portions of this ANSI/UL standard that were not processed in accordance with ANSI/UL requirements are noted at the beginning of the impacted sections.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 This standard applies to fixed, portable and transportable toxic and combustible gas and vapor detectors and sensors intended for use in ordinary (non-hazardous) locations for use in indoor or unconditioned areas.

1.1A This standard covers gas and vapor detectors and sensors that are factory-calibrated and sealed with no means for recalibration or field maintenance by a qualified service personnel including:

- a) A toxic gas sensor and/or detector with detection and/or alarm limits within the applicable Time Weighted Average (TWA) concentration, as specified by the National Institute for Occupational Safety and Health, or
- b) A combustible gas detector with detection and/or alarm limits at or below 25% of the Lower of the Lower Explosive Limit (LEL),
- c) A combustible gas sensor up to and including the LEL.

1.1B A gas detector and/or sensor and/or vapor detector, as covered by these requirements, consists of an assembly of electrical components coupled with a sensing means inside a chamber or by separate components to detect toxic and/or combustible gases or vapors and in accordance with National Electrical Code, NFPA 70, the Fire Alarm and Signaling Code, NFPA 72, and Fuel Gases and Warning Equipment, NFPA 715. The detector includes provision for the connection to a source of power and signaling circuits.

1.2 These requirements cover the following types of detectors:

- a) Detectors intended for monitoring the environment and detectors intended for open area protection and for connection to a compatible power supply or control unit for operation as part of gas detection or emergency signaling systems;
- b) Detectors intended solely for control of ventilation or shut off devices such as fans or control valves;
- c) Detectors intended for both the above applications;
- d) Sensors and sensing circuits intended for use with or in gas detectors, alarms or gas detection circuits within fuel cell systems;
- e) Portable gas detectors;
- f) Multi-gas gas detectors;
- g) Multi-gas sensors.

1.3 These requirements also cover all remote accessories that are intended to be connected to a gas or vapor detector and/or sensor.

1.4 This standard does not cover the following:

- a) Control units to which the detectors are intended to be connected that are covered by the Standard for Control Units for Fire-Protective Signaling Systems, UL 864;
- b) Control units to which the detectors are intended to be connected that are covered by the Standard for General Purpose Signaling Devices and Systems, UL 2017;

- c) Self-contained single and multiple station carbon monoxide alarms or residential combustible gas detectors, not intended for connection to a system control unit, that are covered by the Standard for Single and Multiple Station Carbon Monoxide Alarms, UL 2034 or Residential Gas Detectors, UL 1484;
- d) Automatic flammable vapor sensor systems and components covered by the Standard for Automatic Flammable Vapor Sensor Systems and Components, Z21.94/CSA 6.3;
- e) Equipment intended for use in hazardous (classified) locations.

1.5 Users of these requirements will additionally need to ensure that influencing factors not addressed in this standard for the end product installation, such as mechanical movement, field placement of conductive material, and product damage, will not affect the system for insulation coordination or performance operation. Examples are the deformation of the enclosure, movement of the fittings for conduit or armored cable, or the improper installation of field wiring.

2 General

2.1 Components

2.1.1 Except as indicated in [2.1.2](#), a component of a product covered by this standard shall comply with the requirements for that component.

2.1.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.1.4 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.

2.2 Units of measurement

2.2.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.3 Undated references

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

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.2 ALARM SIGNAL – A signal intended to indicate an emergency condition.

3.3 ALARM VERIFICATION – The process that confirms the presence of an abnormal concentration of a gas vapor for a predetermined period before an alarm signal is indicated.

3.4 COMPONENT, LIMITED-LIFE – A component that is expected to fail and be periodically replaced and the failure of which is supervised, when failure of the component affects the intended operation, sensitivity, or both. Typical examples of such components include incandescent lamps, electronic tube heaters, and functional heating elements.

3.5 COMPONENT, RELIABLE – A component that is not expected to fail or be periodically replaced and is not supervised. A reliable component shall have a predicted failure rate of 2.5 or less failures per million hours as determined for "Ground Fixed" (GF) environment by MIL-HDBK 217F, or equivalent.

3.5.1 END-OF-LIFE SIGNAL – A trouble signal at the control panel or remote display and/or indication on the detector, identifying the specific trouble condition intended to annunciate the device or a component has reached the end of its useful life and should be replaced.

3.6 GAS OR VAPOR DETECTOR, TWO-WIRE TYPE – A detector that signals over, and obtains its power from, the initiating device circuit of an emergency system control unit. It is not prohibited to provide additional terminals or leads for annunciation or control of supplementary functions. This may be referred to as an alarm and/or detector throughout this Standard.

3.7 Deleted

3.8 LOWER EXPLOSIVE LIMIT (LEL) – Volume ratio of flammable gas or vapor in air below which an explosive gas atmosphere does not form, expressed as a percentage.

3.9 MANUFACTURER'S TEST PROGRAM – The tests described in Section 52 through Section 58, Manufacturing and Production Tests, of this standard are to be conducted by the manufacturer on a periodic or 100 percent basis.

3.10 OPEN PATH DETECTOR – An apparatus for the detection and measurement of combustible or toxic gases or vapors in ambient air by measuring the spectral absorption associated with the gases or vapors over extended optical paths, ranging typically from one meter to a few kilometers.

The apparatus can measure the integral concentration of the absorbing gas over the optical path in units such as LEL meter for combustible gases and ppm meter for toxic gases.

3.11 PPM – Gas concentration in parts per million. Ten thousand parts per million is equivalent to 1 percent gas by volume.

3.11A QUALIFIED SERVICE PERSONNEL – A person that has been trained by the manufacturer or representative of the manufacturer to perform field maintenance and/or service that would be considered acceptable to the authority having jurisdiction.

3.12 RISK OF ELECTRIC SHOCK – A risk of electric shock exists at any part when:

- a) The potential between the part and earth ground or any other accessible part is more than 42.4 volts peak, and
- b) The continuous current flow through a 1500-ohm resistor connected across the potential exceeds 0.5 milliamperes.

3.13 RISK OF FIRE – A risk of fire exists at any point in a circuit where:

a) The open circuit voltage is more than 42.4 volts peak and the energy available to the circuit under any condition of load, including short circuit, results in a current of 8 amperes or more after 1 minute of operation, or

b) A power of more than 15 watts shall only be delivered in an external resistor connected between the two points.

3.14 SENSITIVITY – Relative degree of response of a detector alarm or sensor. A high sensitivity denotes response to a lower concentration of gas or vapor than a low sensitivity under identical conditions.

3.15 SENSOR The component or combination of components of the detector/alarm that responds to and in turn provides a usable output signal in the presence of a combustible and/or toxic gas.

3.16 TROUBLE SIGNAL – A visible or audible signal intended to indicate a fault or trouble condition, such as an open or shorted condition of a component in the device or an open or ground condition in the connected wiring. The signal is indicated at the control unit to which the detector is connected.

3.16A UNCONDITIONED AREA – Partially or fully enclosed spaces without continuous climate controls where devices are not in direct contact with elements of weather and where an individual spends time (Examples include parking garages, attached garages, crawl spaces and attics associated with a family living unit, cottages and cabins, barns, etc.)

3.17 VOLTAGE CLASSIFICATION – Unless otherwise indicated, all voltage and current values specified in this standard are root-mean-square (rms).

a) Low-Voltage Circuit – A circuit classified as low-voltage is one involving a potential of not more than 30 volts alternating current (ac) [42.4 volts peak or direct-current (dc)], and supplied from a circuit whose power is limited to a maximum of 100 volt-amperes (VA).

b) High-Voltage Circuit – A circuit classified as high-voltage is one having circuit characteristics in excess of those of a low-voltage circuit.

4 Alarm, Sensor and/or Detector Reliability Prediction

4.1 The maximum failure rate for an alarm, detector assembly or circuit shall be 4.0 failures per million hours as calculated by a full part stress analysis prediction as described in Section 2.0 of MIL-HDBK 217F (December 2, 1991) or 3.5 failures per million hours as calculated by a simplified parts count reliability prediction as described in Appendix A of MIL-HDBK 217F, or equivalent. A "Ground Fixed" (GF) environment is to be used for all calculations. When actual equivalent data is available from the manufacturer it is not prohibited that it be used in lieu of the projected data for the purpose of determining reliability.

4.2 The maximum failure rate for a sensor or individual component is 2.5 failures per million hours as calculated by a full part stress analysis prediction as described in Section 3.4 of MIL-HDBK 217F (December 2, 1991) or equivalent. A "Ground Fixed" (GF) environment is to be used for all calculations. When actual equivalent data is available from the manufacturer it is not prohibited that it be used in lieu of the projected data for the purpose of determining reliability.

4.3 Any component whose failure:

a) Results in energization of an audible trouble signal, energization of a separate visual indication, or de-energization of a power-on light;

b) Does not effect the normal operation or sensitivity; or

c) Is evaluated by specific performance tests included in the standard; is not required to be included in the failure rate calculation. Examples include the audible signal appliance, non-compulsory thermostat, test switch, and battery contacts.

4.4 An integral or remote accessory, such as an integral transmitter or remote sounding appliance, is not required to be included in the reliability prediction except for those components whose failure affects the normal operation of the detector.

4.5 A custom integrated circuit (CHIP) employed in an alarm shall have a predicted failure rate of not greater than 2.5 failures per million hours. The failure rate is to be determined through an evaluation of data in a 3000-hour burn-in test, or equivalent. (See Supplement SA for information on evaluation methods.)

4.6 A sensor, or a sensing component supervision system, shall be provided with the following:

a) Reliability data developed using the Military Standardization Handbook, MIL 217-F or equivalent demonstrating a predicted failure rate of not more than 2.5 failures per million hours operation (see [4.4](#)); or

b) Supervision of the predicted failure modes other than for loss of electrical continuity. Documentation of the failure modes resulting from aging for the sensor or the sensing components and identification of failure modes addressed by the supervision system shall be provided. The manufacturer shall submit a test method to render the sensor unresponsive to the gas concentrations identified in Section [15](#) if the documentation submitted for the sensor or the sensing components indicates drift in the less sensitive direction. This method shall be used when conducting the Electrical Supervision Test, Section [17](#). All predicted failure modes shall result in a trouble signal; or

c) Supervision of the sensor drift beyond 5% of the predicted operating range.

5 Installation and Operating Instructions

5.1 A copy of the installation and operating instructions and related schematic wiring diagrams and installation drawings, shall be used as a reference in the examination and test of the detector.

5.2 The instructions and drawings shall include such directions and information as deemed by the manufacturer to be required for proper installation, testing, maintenance, operation, and use of the detector.

6 Compatibility

6.1 The interconnection of the product with other products shall be evaluated for the purpose of operating as a coordinated system relative to the intended alarm signaling and without risk of fire, shock, or injury to persons.

6.2 The requirements in [6.1](#) apply to:

a) Separate products connected to any circuit and by which the operating parts of the product are actuated for signaling and/or action and

b) Separate or incorporated appliances or units by which signals are indicated or actions carried out.

6.3 Power circuits interconnecting products shall have compatible voltage and current ratings.

6.4 All equipment directly connected to the product shall be evaluated for the application.

CONSTRUCTION

ASSEMBLY

7 General

7.1 Remote access

7.1.1 Unless specifically indicated otherwise the construction requirements specified for a gas or vapor detector shall also apply for any remote accessories with which it is to be employed.

7.2 Sensitivity indicating means

7.2.1 Each alarm or detector shall be provided with a means for measuring or indicating the nominal sensitivity or sensitivity range of the detector as described in [7.2.2](#), or a sensitivity test feature as described in [7.2.3](#), after it has been installed as intended. Removal of a snap-on cover to gain access to the sensitivity control is permissible only when no high-voltage parts are exposed or able to be contacted by the user.

7.2.2 The test feature is to verify that the sensitivity of the detector is within its marked range. Unless it is employed on a detector that has other means of measuring its sensitivity, the test feature shall consist of either an electrical means or a mechanical device which simulates a specified level of gas at the sensor.

7.2.3 A detector that incorporates a variable sensitivity setting intended to be field adjusted shall have a mechanical stop on the adjusting means for the maximum and minimum settings.

ALL PRODUCTS

8 General

8.1 A product shall use materials that have been determined to comply with the requirements for the particular use, as indicated by the performance requirements of this standard.

8.2 Metals shall not be used in such combination as to cause galvanic action that increases the risk of fire, electric shock, injury to persons, or impairs the operation of a product associated with the safety of life and/or the protection of property.

8.3 When breakage or deterioration of a part such as an enclosure, frame, or guard, results in a risk of injury to persons, then the part shall be constructed to meet the demand or expected loading conditions.

8.4 The requirement in [8.3](#) also applies to those positions of a part adjacent to a moving part identified to involve a risk of injury to persons.

9 Enclosure

9.1 General

9.1.1 All electrical parts of a product shall be enclosed to provide protection of internal components and prevent contact with uninsulated live parts.

9.1.2 Enclosures shall have the strength and rigidity to resist the abuses to which the product is likely to be subjected during intended use without increasing the risk of fire, electrical shock, or injury to persons.

9.2 Metallic material

9.2.1 An enclosure of metal shall have dimensions as specified in [Table 9.1](#), [Table 9.2](#), or [Table 9.3](#) or shall comply with the test requirements in Mechanical Strength Tests for Metal Enclosures and Guards, Section [43](#).

**Table 9.1
Cast-metal electrical enclosures**

Use or dimensions of area involved ^a	Minimum thickness			
	Die-cast metal,		Cast metal other than die-cast,	
	Inch	(mm)	Inch	(mm)
Area of 24 square inches (155 square cm) or less and having no two dimensions greater than 6 inches (152 mm)	1/16 ^a	1.6 ^a	1/8	3.2
Area greater than 24 square inches (155 square cm) or having any two dimensions greater than 6 inches (152 mm)	3/32	2.4	1/8	3.2
At threaded conduit hole	1/4	6.4	1/4	6.4
At unthreaded conduit hole	1/8	3.2	1/8	3.2

^a The area limitation for metal 1/16 inch (1.6 mm) in thickness shall be obtained by the provision of reinforcing ribs subdividing a larger area.

9.2.2 When threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or when a construction that is determined to be the equivalent is used, there shall not be less than 3-1/2 nor more than 5 threads in the metal, and the construction shall be such that a standard conduit bushing is capable of being attached.

9.2.3 When threads for the connection of conduit are tapped only part of the way through a hole in an enclosure wall, there shall not be less than five full threads in the metal. There shall be a smooth, rounded inlet hole for the conductors which shall provide protection to the conductors determined to be the equivalent to that provided by a standard conduit bushing.

9.2.4 At any point where conduit or metal-clad cable is attached to the enclosure the sheet metal shall be a minimum of 0.032 inch (0.81 mm) thick, or shall be formed or reinforced so that it shall have the minimum stiffness of an uncoated flat sheet of steel.

9.2.5 With reference to [Table 9.1](#) a supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes:

- a) Single sheet with single formed flanges (formed edges),
- b) A single sheet which is corrugated or ribbed, and
- c) An enclosure surface loosely attached to a frame, for example, with spring clips.

9.3 Polymeric materials

9.3.1 Polymeric materials used as an enclosure shall comply with the applicable portion of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and also with the additional requirements specified in this standard.

9.3.2 Polymeric material that is not used as an enclosure, but is attached to or exposed on the outside of a product, such as a viewing window, shall have flammability characteristics as shown in [Table 9.2](#).

Table 9.2
Flammability characteristics of polymeric material

Polymeric material area/dimensions	Flammability rating
0.24 inches ³ (4 cm ³) and 2.4 inches (61 mm) maximum length	None
Greater than 0.24 inches ³ (4 cm ³) and less than 2 square feet (0.19 m ²), 6 feet (1.83 m) maximum length	HB, V-2, V-1, V-0 or 5V
Greater than 2 square feet (0.19 m ²) and less than 10 square feet (0.93 m ²), 6 feet (1.83 m) maximum length	V-1, V-0 or 5V
Greater than 10 square feet (0.93 m ²), or longer than 6 feet (1.83 m)	Maximum flame spread rating of 200 as specified in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723 or radiant panel as specified in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

9.3.3 Conductive coatings applied to nonmetallic surfaces, such as the inside surface of an enclosure, shall comply with the appropriate requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, unless flaking or peeling of the coating does not result in the reduction of spacings or the bridging of live parts.

9.3.4 A polymeric enclosure intended for connection to a rigid metallic conduit system shall comply with the requirements for polymeric enclosure rigid metallic conduit connections in the Standard for Enclosures for Electrical Equipment, UL 50.

9.3.5 The continuity of a conduit system shall be provided by metal-to-metal contact and not rely on a polymeric material and shall comply with the requirements for polymeric enclosure bonding in the Standard for Enclosures for Electrical Equipment, UL 50.

9.4 Sensitivity adjustment

9.4.1 A field sensitivity adjustment, when provided, shall be accessible with the sensor detector or alarm installed as intended, marked to indicate the direction of sensitivity (high or low), and shall employ a mechanical stop at both extremes. Removal of a snap-on cover to gain access to the sensitivity control is permissible only when no hazardous voltage parts are able to be contacted by the user. Adjustment extremes shall not exceed the values specified by the manufacturers operating range for the unit.

9.5 Supplementary signaling feature

9.5.1 A supplementary signaling feature, such as a transmitter for remote signaling, included integrally with the device, shall be evaluated to the applicable requirements and determined suitable for its intended application.

9.6 Sharp edges

9.6.1 An edge, projection, or corner of an enclosure, opening, frame, guard, knob, handle, or similar part shall be rounded so as not to result in a cut-type injury when contacted during use or user maintenance.

9.7 Ventilating openings

9.7.1 Ventilating openings in an enclosure for hazardous-voltage circuits, including perforated holes, louvers, and openings protected by means of wire screening, expanded metal, or perforated covers, shall be of such size or shape that no opening will permit passage of a rod having a diameter of 9/64 inch (3.6 mm). An enclosure for a fuse(s) or other overload protective device provided with ventilating openings, shall afford protection against the emission of flame or molten metal. Openings provided to permit cleaning, or openings which may be used to clean internal parts, shall be constructed to reduce the risk of damage to functional internal components during such cleaning operations.

9.7.2 Except as noted in 9.7.3, perforated sheet metal employed for expanded metal mesh shall not be less than 0.042 inch (1.07 mm) in average thickness [0.046 inch (1.17 mm) when zinc coated].

9.7.3 Expanded metal mesh 0.021 inch (0.53 mm) thick, or zinc coated perforated sheet metal 0.024 inch (0.61 mm) thick, shall be used only when the following conditions are met:

- a) The indentation of the guard or enclosure does not alter the clearance between uninsulated live parts and grounded metal so as to reduce the spacings below the minimum values required; and either
- b) The exposed mesh on any one side or surface of the product has an area of not more than 72 square inches (465 cm²) with no dimension greater than 12 inches (305 mm) or
- c) The width of an opening so protected is not more than 3-1/2 inches (88.9 mm).

9.7.4 The wire forming a screen protecting hazardous-voltage parts shall not be smaller than 16 AWG (1.3 mm²) and the screen openings shall not be greater than 1/2 square inch (3.2 cm²).

9.8 Covers

9.8.1 An enclosure cover shall be hinged, sliding, pivoted, or similarly attached when:

- a) It provides ready access to fuses or any other overcurrent protective device requiring renewal or
- b) It is necessary to open the cover periodically in connection with the intended operation of the detector.

For the purpose of this requirement intended operation is considered to be operation of a switch for testing or operation of any other component of the device that requires such action in connection with its intended performance. This requirement does not apply to the battery replacement aspect of a device employing a battery as either the main or standby power supply.

9.8.2 A cover that is intended to be removed only for periodic maintenance shall be secured by any one of the following or equivalent means: positive snap catch, plug-in or twist action, snap tab with one screw, or two or more screws.

9.8.3 When a cover is not intended to be removed for cleaning or maintenance, and the device is intended to be returned to the factory for servicing, the cover shall be secured so that it is not readily removed. Exposed screw slots or nuts, other than a tamper-proof type, shall be sealed or covered.

Exception: These requirements do not apply if the alarm cover is intended to be removed for cleaning, maintenance, or both, even though the alarm is intended to be returned to the manufacturer for servicing.

9.8.4 A hinged cover is not required where the only fuse(s) enclosed is intended to provide protection to portions of internal circuits, such as may be employed on a separate printed-wiring board or circuit subassembly, to prevent circuit damage resulting from a fault. Such a fuse(s) shall only be used when the word "CAUTION" and the following, or equivalent marking is located on the cover of a device employing hazardous-voltage circuits: "Circuit Fuse(s) Inside – Disconnect Power Prior to Servicing".

9.8.5 A hinged cover shall be provided with a latch, screw, or catch to hold it closed. An unhinged cover shall be securely held in place by screws or a means determined to be equivalent.

9.9 Battery Removal Indicator

9.9.1 Removal of a battery from a battery-operated gas detector or alarm shall result in a readily apparent and prominent visual indication. The visual indication shall consist of:

- a) A warning flag that will be exposed with the battery removed and the cover closed,
- b) A hinged cover that cannot be closed with the battery removed, or
- c) An equivalent arrangement.

9.9.2 If a warning flag, or equivalent, is employed to comply with the requirement of [9.9.1](#), it shall be marked as required in [50.1.1](#) (k).

9.10 Transparent panels

9.10.1 Glass covering an enclosure opening shall be held securely in place so that it does not displace in service and shall provide mechanical protection of the enclosed parts. The thickness of a glass cover shall not be less than that indicated in [Table 9.3](#).

Table 9.3
Thickness of glass covers

Maximum size of opening				Minimum thickness,	
Length or width,		Area,			
inches	(mm)	inches	(cm ²)	inch	(mm)
4	102	16	103	1/16	1.6
12	305	144	929	1/8	3.2
Over 12	Over 305	Over 144	Over 929	See footnote ^a	

^a Minimum thickness shall be 1/8 inch (3.2 mm) or more, depending upon the size, shape, and mounting of the glass panel. A glass panel for an opening having an area of more than 144 square inches (929 cm²), or having any dimension greater than 12 inches (305 mm), shall be supported by a continuous groove not less than 3/16 inch (4.8 mm) deep along all four edges of the panel.

9.10.2 A transparent material other than glass employed as a cover over an opening in an enclosure shall:

- a) Be mechanically equivalent to glass,
- b) Not distort, and

c) Not become less transparent at the temperature to which it is subjected under normal service conditions.

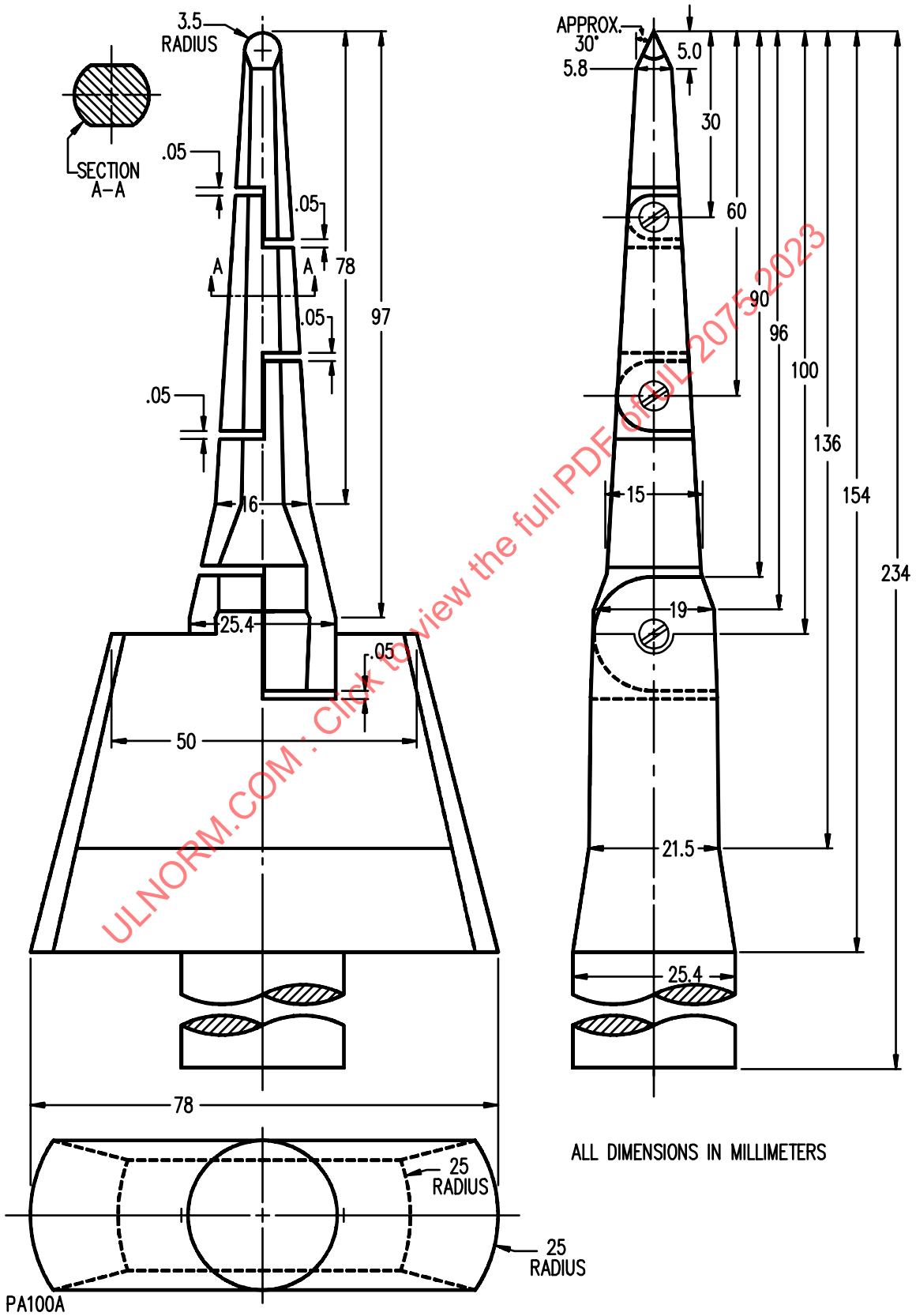
9.10.3 A lens, light filter, or similar part of a gas or vapor detector shall be constructed of a material whose transparency will not be diminished by the conditions to which it will be exposed in service, as represented by the performance tests of this Standard.

9.11 Accessibility of uninsulated live parts, film-coated wire, and moving parts

9.11.1 To reduce the risk of unintentional contact and risk of electric shock from an uninsulated live part or film-coated wire, and injury to persons from a moving part, an opening in an enclosure shall have a minor dimension less than 1 inch (25.4 mm), and such a part or wire shall not be contacted by the probe illustrated in [Figure 9.1](#).

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Figure 9.1
Articulated probe



9.11.2 The probe mentioned in 9.11.1 shall be applied to any depth that the opening will permit. The probe shall be rotated or angled before, during, and after insertion through the opening to any position that is required in order to examine the enclosure. The probe illustrated in Figure 9.1 shall be applied in any possible configuration and, when necessary, the configuration shall be changed after insertion through the opening.

9.11.3 The probe mentioned in 9.11.1 shall be used as a measuring instrument to evaluate the accessibility provided by an opening, and not as an instrument to evaluate the strength of a material. It shall be applied with the minimum force required to determine accessibility.

9.11.4 During the examination of a product to determine whether it complies with the requirement in 9.11.1, a part of the enclosure that is to be opened or removed by the operator without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) shall be opened or removed.

10 Spacings

10.1 A product shall provide maintained spacings between uninsulated live parts and the enclosure or dead metal parts, and between uninsulated live parts of opposite polarity. The spacings shall not be less than those indicated in Table 10.1.

**Table 10.1
Minimum spacings**

Point of application	Minimum spacings				
	Voltage range, volts	Through air,		Over surface,	
		inch	(mm)	inch	(mm)
To walls of enclosure					
Cast metal enclosures	0 – 300	1/4	6.4	1/4	6.4
Sheet metal enclosures	0 – 50	1/4	6.4	1/4	6.4
	51 – 300	1/2	12.7	1/2	12.7
Installation wiring terminals:					
(General application) ^{a,b}	0 – 30	3/16	4.8	3/16	4.8
	31 – 150	1/4	6.4	1/4	6.4
	151 – 300	1/4	6.4	3/8	9.5
Installation wiring, except solder-type terminals	0 – 30	1/8	3.2	1/8	3.2
	31 – 150	3/16	4.8	3/16	4.8
	151 – 300	1/4	6.4	1/4	6.4
Rigidly clamped assemblies ^c					
100 volt-amperes maximum	0 – 30	1/32 ^d	0.8 ^d	1/32 ^d	0.8 ^d
	0 – 30	3/64	1.2	3/64	1.2
	31 – 150	1/16	1.6	1/16	1.6
	151 – 300	3/32	2.4	3/32	2.4
Other parts	0 – 30	1/16	1.6	1/16	1.6
	31 – 150	1/8	3.2	1/4	6.4

Table 10.1 Continued on Next Page