UL 753

STANDARD FOR SAFETY

Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service

UL Standard for Safety for Alarm Accessories for Automatic Water-Supply Control Valves for Fire Protection Service, UL 753

Eighth Edition, Dated October 25, 2013

Summary of Topics

This revision of ANSI/UL 753 dated August 12, 2020 includes a correction to Figure 34.1.

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 revised requirements are substantially in accordance with Proposal(s) on this subject dated August 16, 2019 and June 12, 2020.

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OCTOBER 25, 2013
(Title Page Reprinted: August 12, 2020)

UL 753

Standard for Alarm Accessories for Automatic Water-Supply Control Valves for Fire-Protection Service

First Edition – November, 1967
Second Edition – July, 1971
Third Edition – March, 1976
Fourth Edition – October, 1982
Fifth Edition – August, 1989
Sixth Edition – July, 1995
Seventh Edition – May, 2004

Eighth Edition

October 25, 2013

This ANSI/UL Standard for Safety consists of the Eighth Edition including revisions through August 12, 2020.

The most recent designation of ANSI/UL 753 as an American National Standard (ANSI) occurred on August 12, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 These requirements cover alarm accessories for automatic water-supply control valves for use in automatic sprinkler equipment for fire protection service. Accessories may include water motors and gongs, pressure-operated switches, and other electrical and nonelectrical attachments, components, or units commonly used with alarm, dry-pipe and pre-action valves.

1.2 Requirements for the installation and use of alarm accessories with automatic water-supply control valves are included in the Standard for Installation of Sprinkler Systems, NFPA 13.

1.3 The electrical alarm accessories for automatic water-supply control valves are intended for fire-protective signaling use in ordinary locations in accordance with the National Electrical Code, ANSI/NFPA 70.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.2 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.

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

2.4 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.

3 Units of Measurement

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

4 Undated References

4.1 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.

5 Glossary

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

5.2 HIGH-VOLTAGE ELECTRIC CIRCUIT– A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage (or Class 2) circuit (or power limited circuit).

5.3 LOW-VOLTAGE ELECTRIC CIRCUIT– A circuit involving a potential of not more than 30 volts rms alternating current (ac) [42.4 volts peak or direct current (dc)] and supplied by:

a) A Class 2 transformer; or by a battery, by a battery and fixed impedance, or by a transformer and fixed impedance, each of which, as a unit, complies with all the performance requirements for a Class 2 transformer; or

b) Is limited to a maximum of 100 volt-amperes (va).

A circuit derived from a source of supply classified as high-voltage circuit, using resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low-voltage or an isolated limited secondary circuit.

5.4 SET POINT – A predetermined value to which a control or interlock is adjusted and at which it performs its intended function.

CONSTRUCTION

6 Adjustment and Stops

6.1 The set point of a pressure actuated control shall be indicated on the control in a recognizable and legible manner.

6.2 If a control is nonadjustable following factory calibration, it may be marked with a single set point.

6.3 If a control is adjustable in the field, the set points over the range of allowable field adjustment shall be indicated on the control.

6.4 An adjustable stop employed for limiting a set point shall not be used for other adjustments. It shall be firmly secured by a means provided solely for that purpose and in a manner so that the maximum intended setting cannot be increased except by the use of tools or by deliberate bending or removal of some part. A nut, screw, or the like, used for this purpose shall be provided with an integral lock washer, or the equivalent. A part used for support of the adjustment means shall have strength sufficient to resist unintentional bending.

6.5 If it is evident that a set point will be altered by resetting or removing the stop, or if directions are included on the control for altering the set point, a statement shall appear on the dial, scale, or stop, or directly adjacent thereto, or on the outside (not inside) of the cover. This statement shall be to the effect that the setting is a safety stop and is not to be altered to permit a higher or less safe operating point, for example, SAFETY STOP – DO NOT ALTER.

7 Calibration Means

7.1 Means provided for factory calibration of pressure actuated controls shall be factory secured against disturbances. The means for calibration, if accessible or apparent, shall be modified, guarded, or sealed to effectively prevent manipulation by hand or by commonly available tools subsequent to the factory calibration as specified in 8.2.

7.2 Sealing means used shall not permit evidence of tampering to be destroyed by replacement with commonly available material.

7.3 A calibration means considered to be not accessible or apparent is one not exposed to manipulation by commonly available tools, as specified in 8.2, or one not readily displaced. The complete concealment of conventional tool engaging means in a screw, such as a slot or recessed head, by the use of solder or

brazing material is acceptable for preventing manipulation if the calibration means cannot be changed by gripping with commonly available tools, and if engagement or manipulation is prevented at all other locations.

8 Tampering Protection

8.1 A door, cover, panel, or mounting means of a pressure actuated device, that permits access to internal components that may be subject to tampering, shall be provided with means for supervision.

8.2 The cover of a pressure actuated device shall be provided with a tamper switch, unless the cover cannot be removed by using commonly available tools, such as hex-head wrenches, slotted or cross-recessed screwdrivers, or pliers.

9 Materials

9.1 A part requiring freedom of movement essential to the operation of the device or for metering water flow shall be made of bronze or other material having equivalent durability and resistance to corrosion.

9.2 Body castings and covers shall be made of cast iron or other material having equivalent strength and corrosion resistance.

10 Assembly

10.1 An alarm accessory assembly shall include all of the components necessary for its intended function and installation. The components shall be planned for assembly as a unit.

10.2 An alarm accessory shall be constructed so that it can be installed and connected without damage to the accessory, using tools normally employed by the trade.

10.3 Two or more subassemblies intended to be assembled in the field as a unit shall be capable of being joined together without misalignment and without requiring any of the subassemblies to be drilled, welded, or otherwise altered except for a part required to be cut to length or threaded.

10.4 For the purpose of these requirements, if two or more subassemblies are designed to be used together as one unit, the entire assembly shall be considered and tested as one unit.

10.5 The assembly shall be capable of being dismantled, without removing the device from supporting structures or piping or disconnecting the field wiring means to permit inspection, adjustment, or repairs. Any means for adjustment that could adversely affect the operation of the device shall be enclosed or shielded to discourage tampering.

10.6 A water motor and gong assembly shall be constructed to prevent loosening of the gong from its support as a result of operation of the assembly or setting of the supporting structure.

11 Threaded Openings

11.1 An opening threaded for pipe connection shall be threaded in accordance with the Standard for General Purpose Pipe Threads, ANSI/ASME B1.20.1. An assembly for attachment to pipe by threaded connection shall have a substantial section to serve as a wrench grip.

11.2 A ferrule, bushing, or other functional part of a device having a threaded connection for attachment to pipe shall not become loosened or dislodged as the result of the turning effect of assembling or dismantling pipe.

12 Operating Mechanisms

12.1 Shafts or bearings and materials in contact with bearings for movable parts shall be of corrosion resistant materials and shall be either self-lubricated or provided with other means to accomplish lubrications for an extended period of time. Any lubricants employed shall be practical for use over a temperature range of minus 40 to 120°F (minus 40 to 48.9°C).

12.2 Metal parts coming in contact with a diaphragm shall have no sharp edges, burrs, or projections that might chafe or abrade the diaphragm.

12.3 An operating spring shall be made of corrosion resistant materials, and shall be retained and arranged to prevent abrasion, binding, buckling, or other interference with its free movement.

13 Water Motors

13.1 A water motor body shall have a 3/4 inch (19.05 mm) nominal pipe size tapped opening for a water supply connection and a tapped opening for a water drain connection. The smallest cross-sectional area of the discharge or water drain system and connection shall be not less than 50 times the cross-sectional area of the combined nozzles or jets.

13.2 A water motor body, or the piping immediately adjacent to a water motor body, shall be provided with a sump or chamber to catch and retain foreign matter that might otherwise be carried to the nozzles or jets by flowing water. Such a sump or chamber shall be provided with a plugged opening for cleanout and drain purposes.

13.3 Shafts or shaft bearings employed in a water motor and gong assembly shall be self-aligning or otherwise arranged to provide for continuing operation of the gong when the parts of the assembly are installed on uneven supporting surfaces.

14 Gong and Gong Protection

14.1 An alarm shall be provided with a device that affords protection to the operating mechanism from the weather and that excludes nesting birds and vermin. This device shall be mounted with relation to the gong so that the sound of the gong will not be muffled due to misalignment of the device during mounting or settling of the structure supporting the gong assembly.

14.2 Ferrous material employed for gong protection devices shall be protected from corrosion to at least the extent afforded by a paint coating. If polymeric material is used, it shall be resistant to the effects of temperatures within the range of minus 40 to 150°F (minus 40 to 65.6°C) and to the effects of sunlight, excluding effects of color.

14.3 A gong striker, supporting head, and any pins or fasteners used in the striker assembly shall be of brass or other material having equivalent corrosion resistance. The arrangement shall be such that corrosion of adjacent parts or the effects of weather will not interfere with the operation of the mechanism.

15 Strainers

15.1 A strainer with nominal 3/4 inch (19.05 mm) pipe threaded connections shall be furnished with each water motor for installation in the pipe line serving a water motor, to protect the nozzles or water motor jets. Instructions shall be furnished with each water motor and shall direct that the strainer be located as close as practical to the outlet of the retarding chamber, or outlet from the alarm valve if no retarding chamber is used. The total cross-sectional area of the openings in the strainer screen shall be not less than 20 times the cross-sectional area of the combined nozzle orifices or jets, and the largest dimension of the screen

openings shall be 1/32 inch (0.8 mm) less than the diameter of the smallest nozzle orifice. The screen shall be made of brass or other material having equivalent corrosion resistance.

16 Enclosures

16.1 A part of the enclosure, such as a door or cover, shall be provided with means for securing it in place.

16.2 A door or cover giving access to a fuse or mercury switch shall shut closely against a 1/4 inch (6.4 mm) rabbet or the equivalent, or shall have a complete flange that fits closely with the outside wall of the box and is not less than 1/2 inch (12.7 mm) in depth. An equivalent combination of flange and rabbet is acceptable.

16.3 Cast metal for an enclosure shall be at least 1/8 inch (3.2 mm) thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4 inch (6.4 mm) thick at holes tapped for conduit; except that, other than at plain or threaded conduit holes, die-cast metal shall be not less than 3/32 inch (2.4 mm) thick for an area greater than 24 square inches (155 cm^2) or having any dimensions greater than 6 inches (152 mm), and shall be not less than 1/16 inch (1.6 mm) thick for an area of 24 square inches (155 cm^2) or less and having no dimensions greater than 6 inches (152 mm). The area limitations for metal 1/16 inch (1.6 mm) in thickness may be obtained by reinforcing ribs subdividing a larger area.

16.4 If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or if an equivalent construction is employed, there shall be not less than 3-1/2 (88.9 mm), or more than 5 full threads in the metal, and the construction shall permit a standard conduit bushing to be attached. A partially tapped hole having 5 full threads and provided with a conduit end stop having a diameter approximately the same as the internal diameter of a standard conduit bushing as specified in Table 19.1 is an acceptable equivalent method of hole construction.

16.5 A knockout in a sheet metal enclosure shall be secured but shall be capable of being removed without undue deformation of the enclosure.

16.6 A knockout shall be provided with a flat surrounding surface for a conduit bushing and shall be located so that installation of a bushing at any knockout used during installation will not result in spacings between uninsulated live parts and the bushing of less than those indicated under Spacings, Section 31.

16.7 The thickness of a sheet metal enclosure shall be as indicated in Table 16.1 and Table 16.2, except that the steel shall not be less than 0.032 inch (0.81 mm) thick, 0.034 inch (0.86 mm) thick if zinc coated, and nonferrous metal shall be not less than 00.45 inch (1.14 mm) thick at points where a wiring system is to be connected. Sheet metal of two smaller size categories may be employed if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size of the surface provides equivalent mechanical strength. At any point where conduit or metal-clad cable is to be attached, sheet metal shall be of such thickness or shall be formed or reinforced so that it will have stiffness at least equivalent to that of an uncoated flat sheet of steel having a minimum thickness of 0.053 inch (1.34 mm).

Table 16.1
Minimum thickness of sheet metal for electrical enclosures – carbon steel or stainless steel

Size category	Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness			
	Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		Uncoated		Metal coated	
	inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	inches (MSG)	(mm)	inches (GSG)	(mm)
24	4.0	(10.2)	Not limited		6.25	(15.9)	Not limited		0.020[d]	(0.51)	0.023[d]	(0.58)
	4.75	(12.1)	5.75	(14.6)	6.75	(17.1)	8.25	(21.0)	(24)		(24)	
22	6.0	(15.2)	Not limited		9.5	(24.1)	Not limited		0.026[d]	(0.66)	0.029[d]	(0.74)
	7.0	(17.8)	8.75	(22.2)	10.0	(25.4)	12.5	(31.8)	(22)		(22)	
20	8.0	(20.3)	Not limited		12.0	(30.5)	Not limited		0.032	(0.81)	0.034	(0.86)
	9.0	(22.9)	11.5	(29.2)	13.0	(33.0)	16.0	(40.6)	(20)		(20)	
18	12.5	(31.8)	Not limited		19.5	(49.5)	Not limited		0.042	(1.07)	0.045	(1.14)
	14.0	(35.6)	18.0	(45.7)	21.0	(53.3)	25.0	(63.5)	(18)		(18)	

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

1) Single sheet with single formed flanges (formed edges);

2) A single sheet that is corrugated or ribbed; and

3) An enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

[c] For panels that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

[d] Sheet steel for an enclosure intended for outdoor use (raintight) is required to be not less than 0.034 inch (0.86 mm) in thickness, if zinc coated, and not less than 0.032 inch (0.81 mm) in thickness, if uncoated.

Table 16.2
Minimum thickness of sheet metal for electrical enclosures aluminum, copper, or brass

Size category	Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness inch (mm)
	Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		
	inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	
22	3.0	(7.6)	Not limited		7.0	(17.8)	Not limited		0.023[d]
	3.5	(8.9)	4.0	(10.2)	8.5	(21.6)	9.5	(24.1)	(0.58)
20	4.0	(10.2)	Not limited		10.0	(25.4)	Not limited		0.029
	5.0	(12.7)	6.0	(15.2)	10.5	(26.7)	13.5	(34.3)	(0.74)
18	6.0	(15.2)	Not limited		14.0	(35.6)	Not limited		0.036
	6.5	(16.5)	8.0	(20.3)	15.0	(38.1)	18.0	(45.7)	(0.91)
16	8.0	(20.3)	Not limited		19.0	(48.3)	Not limited		0.045
	9.5	(24.1)	11.5	(29.2)	21.0	(53.3)	25.0	(63.5)	(1.14)
14	12.0	(30.5)	Not limited		28.0	(71.1)	Not limited		0.058

Table 16.2 Continued on Next Page

Table 16.2 Continued

Size category	Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness inch (mm)
	Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		
	inches	(cm)	inches	(cm)	inches	(cm)	inches	(cm)	
	14.0	(35.6)	16.0	(40.6)	30.0	(76.2)	37.0	(94.0)	(1.47)

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

1) Single sheet with single formed flanges (formed edges);

2) A single sheet that is corrugated or ribbed; and

3) An enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

[c] For panels that are not supported along one side, for example, side panels of boxes, the length of the unsupported side shall be limited to the dimensions specified unless the side in question is provided with a flange at least 1/2 inch (12.7 mm) wide.

[d] Sheet copper, brass, or aluminum for an enclosure intended for outdoor use (raintight) is required to be not less than 0.029 inch (0.74 mm) in thickness (20 AWG).

16.8 Glass covering an observation opening and forming a part of the enclosure shall be secured in place so that it cannot be displaced in service, and shall provide mechanical protection for the enclosed parts. Glass for an opening not more than 4 inches (102 mm) in any dimension shall be not less than 0.055 inch (1.40 mm) thick, nominal 1/16 inch (1.6 mm); and glass for an opening having no dimension greater than 12 inches (305 mm) shall not be less than 0.115 inch (2.92 mm) thick, nominal 1/8 inch (3.2 mm).

17 Corrosion Protection

17.1 Ferrous metal parts of electrical equipment and enclosures, except bearings, or the like, where such protection is impracticable, shall be protected against corrosion by enameling, galvanizing, sheradizing, plating, or other equivalent means.

17.2 The requirements in 17.1 apply to all enclosing cases, whether of sheet steel or cast iron, and to all springs and other parts upon which operation may depend. Parts made of stainless steel do not require additional protection against corrosion.

18 Mounting

18.1 Means shall be provided for mounting an alarm accessory to a supporting surface. A bolt, screw, or other part used to mount a component of the equipment shall not be used for securing the complete device to the supporting surface.

18.2 An alarm accessory intended to be supported only by rigid conduit shall be provided with a conduit hub or nipple.

19 Supply Connections

19.1 An alarm accessory shall have provision for connection of one of the wiring methods that, in accordance with the National Electrical Code, ANSI/NFPA , is acceptable for the alarm accessory, such as provision for the connection of metal-clad cable or conduit.

19.2 For an enclosure not provided with conduit openings or knockouts, spacings not less than the minimum specified in Spacings, Section 31, shall be provided between uninsulated live parts and a conduit bushing installed at any location likely to be used during installation. Permanent marking on the enclosure, a template, or a full-scale drawing furnished with the device may be used to limit such locations.

19.3 In measuring a spacing between an uninsulated live part and a bushing installed in the knock-out referred to in 19.2, it is to be assumed that a bushing having the dimensions specified in Table 19.1 is in place, in conjunction with a single locknut installed on the outside of the enclosure.

Table 19.1
Dimensions of bushings

Trade size of conduit		Bushing dimensions, inches (mm)			
inches	(mm OD)	Overall diameter		Height	
1/2	(21.3)	1	(25.4)	3/8	(9.5)
3/4	(26.7)	1-15/64	(31.4)	27/64	(10.7)
1	(33.4)	1-19/32	(40.5)	33/64	(13.1)
1-1/4	(42.2)	1-15/16	(49.2)	9/16	(14.3)
1-1/2	(48.3)	2-13/64	(56.0)	19/32	(15.1)
2	(60.3)	2-45/64	(68.7)	5/8	(15.9)
2-1/2	(73.0)	3-7/32	(81.8)	3/4	(19.1)
3	(88.9)	3-7/8	(98.4)	13/16	(20.6)
3-1/2	(101.6)	4-7/16	(112.7)	15/16	(23.8)
4	(114.3)	4-31/32	(126.2)	1	(25.4)
4-1/2	(127.0)	5-35/64	(140.9)	1-1/16	(27.0)
5	(141.3)	6-7/32	(158.0)	1-3/16	(30.2)
6	(168.3)	7-7/32	(183.4)	1-1/4	(31.8)

20 Field Wiring Connections

20.1 A product shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by Section 760-16 (a) of the National Electrical Code, ANSI/NFPA 70, corresponding to the electrical rating of the system.

20.2 A pressure actuated device or a device intended for connection to a protective signaling system shall be provided with:

a) Duplicate terminals or leads for each incoming and each outgoing alarm initiating circuit connection; or

b) Equivalent means to achieve electrical supervision.

A common terminal may be used for connection of both incoming and outgoing wires, provided that the construction of the terminal does not permit an uninsulated section of a single conductor to be looped around the terminal and serve as two separate connections, thereby precluding supervision of the connection in the event that the wire becomes dislodged from under the terminal. A notched clamping plate under a single securing screw, where separate conductors of an initiating circuit are intended to be inserted in each notch, is acceptable, but this arrangement shall be supplemented by additional marking in the wiring area or on the installation wiring diagram specifying the intended connections to the terminals.

21 Leads

21.1 A lead that is intended to be spliced in the field to a circuit conductor shall be not smaller than 18 AWG (0.82 mm^2), and the insulation, if of rubber or thermoplastic material, shall be not less than 1/32 inch (0.8 mm) thick.

22 Terminals

22.1 Nonferrous soldering lugs or solderless (pressure) wire connectors shall be used for 6 AWG (13.3 mm^2) and larger wires. If the connectors or lugs are secured to a plate, the plate shall be not less than 0.050 inch (1.3 mm) thick. Securing screws may be plated steel.

22.2 A wire binding screw intended for field wiring connections shall be not smaller than No. 8 (4.2 mm diameter), except that a No. 6 (3.5 mm diameter) screw may be used for the connection of a 14 AWG (2.1 mm^2) or smaller wire. The screw may be plated steel.

22.3 A terminal plate tapped for wire binding screws shall:

a) Have not less than two full threads in the metal (the terminal plate metal may be extruded to provide the two full threads) and shall have upturned lugs, clamps, or the equivalent, to hold the wires in position. Other constructions may be employed if they provide equivalent ruggedness of the terminal plate and thread security of the wire binding screw.

b) Be of a nonferrous metal not less than 0.050 inch (1.3 mm) thick if used with a No. 8 (4.2 mm diameter) or larger screw, and not less than 0.030 inch (0.76 mm) thick if used with a No. 6 (3.5 mm diameter) or smaller screw.

22.4 If two or more conductors are intended to be connected by wrapping under the same screw except as specified in 20.2, a nonferrous intervening metal washer shall be provided for each additional conductor. A separator washer is not required if two conductors are separated and intended to be secured under a common clamping plate. If the wires protrude above terminal barriers, the nonferrous separator shall include means, such as upturned tabs or sides, to retain the wire.

23 Wiring Space

23.1 Space shall be provided within the enclosure of an alarm accessory to provide room for the distribution and stowing of wires and cables required for the wiring of the accessory.

24 Interconnection of Units

24.1 Strain relief shall be provided so that a mechanical stress on a flexible cord or cable will not be transmitted to terminals, splices, or internal wiring, as specified in 41.1.1 and 41.1.2.

24.2 If a knot in a flexible cord serves as strain relief, a surface against which the knot may bear or with which it may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, that may cause abrasion of the insulation on the conductors.

24.3 Means shall be provided to prevent the flexible cord or lead from being pushed into the alarm accessory through the cord-entry hole when such displacement results in:

a) Stress being transmitted to terminals, splices, or other internal wiring;

b) Live uninsulated parts being contacted;

c) Reducing the spacings within the enclosure;

d) The cord being subjected to damage from moving parts or to temperatures greater than its temperature rating, when moved inward; or

e) Subjecting the supply cord, lead, or other internal connections or components to mechanical damage.

To determine compliance, the supply cord or lead shall be tested in accordance with Section 42, Push-Back Relief Test.

24.4 Strain relief shall be provided for the field supply leads, and all internally connected wires that are subject to movement in conjunction with the installation, operation, or servicing of an alarm accessory to reduce the likelihood of mechanical stress being transmitted to terminals and internal connections. Inward movement of the leads provided with a ring-type strain relief or equivalent means shall not damage internal connections or components, or result in a reduction of electrical spacings, as specified in 41.2.1.

25 Internal Wiring

25.1 Internal wiring of an alarm accessory shall consist of type or types of wire that are acceptable with respect to the temperature, voltage, and conditions of service to which the wiring is to be subjected.

25.2 The insulation on internal wiring shall be at least 1/32 inch (0.8 mm) thick or the equivalent, except that the insulation on a short pigtail or coil lead may be not less than 1/64 inch (0.4 mm) thick.

25.3 If the use of a short length of insulated conductor, that is, a short coil lead, or the like, is not feasible, electrical insulating tubing may be employed. The tubing shall not be subject to sharp ends, tension, compression, or repeated flexing, and shall not contact sharp edges, projections, or corners. The wall thickness shall comply with the requirements for such tubing, except that the thickness at any point for the smaller sizes of polyvinyl chloride tubing shall be not less than 0.017 inch (0.43 mm). For insulating tubing of other types, the thickness shall be not less than that providing mechanical strength, dielectric properties, heat- and moisture-resistant characteristics, and the like, at least equal to those of a 0.017 inch (0.43 mm) thick polyvinyl chloride tubing.

25.4 Internal wiring and connections between parts of an alarm accessory shall be protected or enclosed to reduce the likelihood of damage from moving parts and sharp edges.

25.5 A wireway shall be smooth and free from sharp edges, burrs, fins, and moving parts that may cause abrasion of the conductor insulation.

25.6 A hole in a sheet metal partition through which insulated wires pass shall be provided with a bushing if the wall is 0.042 inch (1.07 mm) or less thick. A hole in a wall thicker than 0.042 inch (1.07 mm) shall have a bushing or smooth rounded edges.

25.7 A bare conductor shall be supported to maintain the required spacings, unless the conductor is covered by insulating sleeving or tubing.

25.8 A joint or connection shall be mechanically secure and shall provide electrical contact without strain on the connection and terminal.

25.9 A splice shall be provided with insulation equivalent in material and thickness to that of the wires involved, if performance of required spacing between the splice and uninsulated metal parts is not provided.

25.10 Internal wiring of circuits operating at different potentials shall be separated by barriers or shall be segregated, unless the conductors of the circuits of lower voltage are provided with insulation equivalent to

that required for the highest voltage involved. Segregation of insulated conductors may be accomplished by clamping, routing, or equivalent means that provide permanent separation.

26 Switches

26.1 A switch provided as part of an alarm accessory shall have a current and voltage rating not less than that of the circuit it controls when the device is operated under any condition of intended service.

27 Mercury-Tube Switches

27.1 A mercury tube switch shall be appropriate for the application as determined by tests specified in the Performance Section of this standard. Wire leads shall be as short as possible and shall terminate at eyelets or the equivalent, or in soldered connections at terminal plates on the supporting base.

28 Insulating Material

28.1 Material for the mounting of current carrying parts shall be slate, porcelain, phenolic or cold-molded composition, or equivalent material.

28.2 Insulating material, including barriers between parts of opposite polarity and material that may be subject to the influence of the arc formed by the opening of a switch, shall be acceptable as determined by the tests in the Performance Section of this standard.

28.3 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not for the sole support for uninsulated current carrying parts of other than low-voltage circuits.

28.4 A live screwhead or nut on the underside of an insulating base shall be prevented from loosening and shall be insulated or spaced from the mounting surface. This may be accomplished by:

a) Countersinking such parts not less than 1/8 inch (3.2 mm) in the clear, and then covering them with a waterproof, insulating, sealing compound which will not melt at a temperature of 15°C (59°F) higher than its intended operating temperature in the device and not less than 65°C (149°F) in any case; or

b) Securing and insulating such parts from the mounting surface by means of a barrier or the equivalent or by means of through-air and over-surface spacings as required elsewhere in this standard.

29 Current Carrying Parts

29.1 A current carrying part shall be of metal such as silver, copper, copper alloy, or other equivalent material.

29.2 Uninsulated live parts, including terminals, shall be secured to their supporting surfaces by methods other than friction between surfaces so that they will be prevented from turning or shifting in position if such motion may result in reduction of spacings to less than those required. The security of a contact assembly shall maintain the continued alignment of contacts.

29.3 Bearings, hinges and the like, are not acceptable for carrying current between interrelated fixed and moving parts.

30 Grounding and Bonding

30.1 An alarm accessory shall have provision for grounding all exposed dead metal parts that may be touched by a person during the operation or adjustment of the accessory and that may become energized.

30.2 An acceptable means for grounding is the provision of a knockout or other acceptable opening in the enclosure intended for the connection of metal-clad cable, conduit, metal raceway, or the like.

30.3 An enclosure employing insulating material, either wholly or in part, shall have a bonding means to provide continuity of grounding between all conduit openings.

31 Spacings

31.1 The spacing between uninsulated live parts of opposite polarity and between uninsulated live parts and dead metal parts shall be not less than those indicated in 31.2 and 31.3.

31.2 The spacing shall be not less than 1/2 inch (12.7 mm) for sheet metal or 1/4 inch (6.4 mm) for cast metal between an uninsulated live part and:

a) A wall cover of a metal enclosure;

b) A fitting for conduit or metal-clad cable; or

c) A metal piece attached to a metal enclosure, where deformation of the enclosure reduces spacings.

31.3 Except as noted in 31.4, the spacing shall be not less than the applicable value specified in Table 31.1 between an uninsulated live part and:

a) An uninsulated live part of opposite polarity;

b) An uninsulated, grounded, dead metal part other than the enclosure; or

c) An exposed dead metal part that is isolated or insulated.

Table 31.1
Minimum spacings

Point of application	Voltage range, volts	Minimum spacings, inch (mm)			
		Through air		Over surface	
Field wiring terminals	0 – 150	1/4[a,b]	(6.4)	1/4[a]	(6.4)
	151– 300	1/4[a]	(6.4)	3/8[a]	(9.5)
At other parts	0 – 150	1/8[c]	(3.2)	1/4[c]	(6.4)
	151 – 300	1/4[c]	(6.4)	3/8[c]	(9.5)

[a] To be measured with wire having rated capacity for the applied load connected to each terminal as in actual service, but with wire not smaller than 14 AWG (2.1 mm^2), in any case.

[b] The through air spacing at installation wiring terminals may be less than 1/4 inch (6.4 mm) but not less than 1/8 inch (3.2 mm) if the terminals are recessed in insulating material or have insulating barriers that confine loose strands of conductors sufficiently to make it unlikely that the terminals will be grounded or short-circuited.

[c] At fixed parts of rigidly clamped assemblies of live parts and insulating separators, such as contact springs on relays, cam switches, and the like, that are factory wired, the through air and over surface spacings may be less than those indicated, but not less than 1/16 inch (1.6 mm) for 0 – 150 volts and not less than 3/32 inch (2.4 mm) for 151 – 300 volts, except as follows:

Table 31.1 Continued on Next Page

Table 31.1 Continued

Point of application	Voltage range, volts	Minimum spacings, inch (mm)	
		Through air	Over surface
a) Not less than 3/64 inch (1.2 mm) through air and over surface for 250 volts or less if the equipment that the component part controls amounts to a load of no more than 375 volt-amperes or more than 5 amperes. b) Not less than 1/32 inch (0.8 mm) through air and over surface for a circuit involving a potential of no more than 30 volts and supplied by a primary battery or by a standard Class 2 transformer or by an acceptable combination of transformer and fixed impedance having output characteristics in compliance with those required for a Class 2 transformer.			

31.4 The specifications in Table 31.1 do not apply to the spacings within a component, such as a snap switch, lampholder, or similar wiring device supplied as part of an alarm accessory, as specified in 2.2.

31.5 A barrier or liner of insulating material used to provide spacings shall be not less than 1/32 inch (0.8 mm) thick [minimum 0.028 inch (0.71 mm)]; except that, if a barrier or liner is used in conjunction with not less than half the required spacing through-air, the thickness may be less than 1/32 inch (0.8 mm) but not less than 0.013 inch (0.33 mm). Such a barrier or liner shall be:

a) Of an insulating material resistant to moisture;

b) Of acceptable mechanical strength if exposed or otherwise subject to mechanical damage;

c) Securely held in place; and

d) Located so that it is not adversely affected by operation of the alarm accessory in service, particularly by arcing.

31.6 Film-coated wire shall be considered an uninsulated current-carrying part in determining compliance of a device with the spacing requirements.

32 Servicing Protection

32.1 An insulated live part of a high-voltage circuit, a moving part that can cause injury to persons, a sharp corner, or a projection shall be formed, located, guarded, or enclosed to reduce the risk of contact by persons during servicing such as relamping, fuse or rod replacement, adjusting controls, and routine maintenance.

32.2 An alarm accessory having a component such as a lamp, fuse, or rod requiring servicing shall either:

a) Provide a minimum 6 inch (153 mm) separation between the component and all uninsulated current carrying parts of high voltage circuits;

b) Provide protection from contact with uninsulated current-carrying parts of high voltage circuits when servicing the component, by means of insulating tape, barriers, or the equivalent;

c) Include an interlock on the cover to de-energize all live parts inside the enclosure during servicing; or

d) Be marked in accordance with 46.1.

PERFORMANCE

33 General

33.1 Unless otherwise specified, an alarm accessory is to be tested at the appropriate potential indicated in Table 33.1 for each test as detailed in the paragraphs describing the test.

Table 33.1
Test voltage

Voltage rating of device[a]	Test potential, volts
110 – 120 ac	120 ac
220 – 240 ac	240 ac
440 – 480 ac	480 ac
550 – 600 ac	600 ac

[a] If the rating of the accessory does not fall within any of the indicated ranges, it is to be tested at its rated voltage.

33.2 An alternating current accessory having no frequency rating is to be tested on a circuit having a frequency of 60 hertz, except that a circuit having a lower frequency may be employed.

33.3 An alarm accessory that must be mounted in a definite position in order to function as intended is to be tested in that position, provided that directions for mounting in the correct position are given on the accessory or on an instruction sheet supplied with the accessory.

34 Water Operated Accessories Test

34.1 Response

34.1.1 A water operated alarm accessory, such as a water motor and gong assembly, shall operate when supplied with water under a pressure of 5 psig (35 kPa), measured at a point adjacent to the inlet opening of the device.

34.2 Endurance

34.2.1 A water operated alarm accessory, such as a water motor and gong assembly, shall show no evidence of breakage of any of its parts when operated continuously for a period of not less than 50 hours with water flowing at an average pressure of 55 psig (379 kPa) and without attention during the period, such as for lubrication or adjustment.

34.3 Intensity of alarm

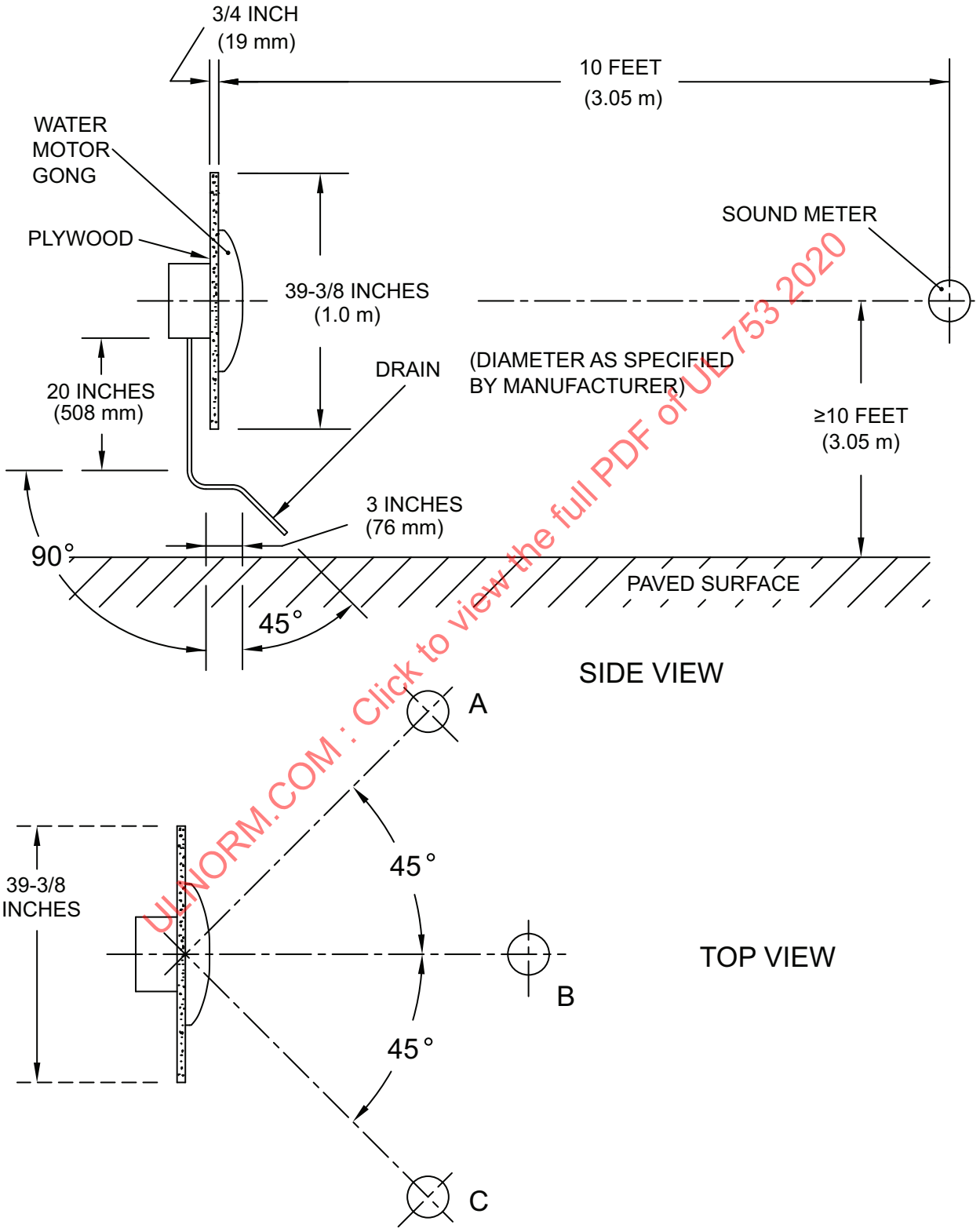
34.3.1 An alarm gong shall produce a distinctive sound at all pressures from 5 to 30 psig (35 – 206 kPa), and shall produce not less than 85 decibels at 30 psig (206 kPa), and not less than 90 decibels at pressures not greater than 50 psig (345 kPa).

34.3.2 The measurement is to be made with a sound level meter which meets the requirements of the Specification for Sound Level Meters, ANSI S1.4 – Plus Amendment S1.4A. The "C" weighting network and fast response characteristics are to be used. The alarm gong is to be mounted in a position of normal use and operated in increments of pressure of 5 psig (35 kPa), commencing with 5 psig (35 kPa), and ending at 50 psig (345 kPa). The microphone is to be located at a distance of 10 feet (3.05 m) from the gong and positioned to receive the maximum sound level produced by the device. See Figure 34.1. The measurement is to be made in a free field condition in order to minimize the effect of reflected sound

energy. The ambient noise level is to be at least 10 decibels below the measured level produced by the alarm gong.

Figure 34.1

Intensity of alarm test setup



34.3.3 Free field conditions may be simulated by mounting the gong not less than 10 feet (3.05 m) from the ground and with the microphone located 10 feet from the gong and conducting the test outdoors on a clear day with the wind velocity not more than 5 miles per hour (2.23 m/s) and at ambient temperature of 15 to 25°C (59 to 77°F). Alternatively, an anechoic chamber of not less than 1000 cubic feet (28.3 m^3), with no dimension less than 7 feet (2.13 m), and with an absorption factor of 0.99 or greater between 100 hertz and 10 kilohertz for all surfaces, may be used for this measurement.

35 Pressure Actuated Accessory Test

35.1 Sensitivity

35.1.1 A pressure actuated alarm accessory, such as a pressure operated switch, shall close circuits on a static pressure of 5 psig (35 kPa) and open circuits on a reduction in static pressure from 5 to 3 psig (35 to 21 kPa).

35.1.2 A pressure operated switch shall operate within ±5 percent of the nominal pressure rating indicated either in the product markings or the manufacturer's installation instructions. If the pressure switch has a range of settings, or has a different setting for an alarm condition than for the return to normal, the switch is to be tested at each setting.

35.1.3 After being tested in the as-received condition, the pressure operated switch is to be subjected to the Endurance Test, Section 38. The switch then is to be tested as specified in 35.1.2 and shall have a sensitivity within ±5 percent of the pressure value originally determined for the switch.

35.1.4 A control with an adjustable set point is to be calibrated at the maximum and minimum set points and at a set point approximately midway between the maximum and minimum.

35.1.5 A pressure operated control is to be connected to a source of aerostatic or hydrostatic pressure, whichever is consistent with its intended use. The source of pressure is to be accurately controlled and measured. Pressures are to be increased and decreased during the test at a rate of approximately 1 psig (7 kPa) per minute when approaching the set point.

35.2 Strength of parts

35.2.1 A part of an alarm accessory that is subjected to pressure during intended usage shall function as intended and remain within the limits for calibration after being subjected for 1 minute to a hydrostatic pressure of 150 percent of its maximum pressure rating and shall withstand, without rupture, a hydrostatic pressure of 875 psig (6033 kPa) applied for 1 minute.

35.2.2 Specimens of polymeric material used for gong protective devices are to be subjected to air-oven aging and compared with unaged specimens. The average tensile strength of five aged specimens shall be at least 80 percent of the average tensile strength of five unaged specimens. The average resistance to impact of five aged specimens shall be at least 80 percent of the average resistance to impact of five unaged specimens.

35.2.3 For tensile strength tests, specimens are to be prepared from the polymeric part and the tensile strength determined in accordance with the Standard Test Method for:

a) Tensile Properties of Plastics, ASTM D638; or

b) Tensile Properties of Plastics by Use of Microtensile Specimens, ASTM D1708.

The specimen dimensions will depend on the size and shape of the part, but are to be in accordance with one of the specified ASTM test methods.