



UL 1638

Underwriters Laboratories Inc. Standard for Safety

Visual Signaling Appliances –
Private Mode Emergency
and General Utility Signaling



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UL Standard for Safety for Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling, UL 1638

Fourth Edition, Dated April 11, 2001

Revisions: This Standard contains revisions through and including October 10, 2008

Summary of Topics

Revision to ratings information in installation literature

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The revisions dated October 10, 2008 are substantially in accordance with UL's Bulletin(s) on this subject dated May 30, 2008.

The following table lists the future effective dates with the corresponding item.

Future Effective Date	References
October 10, 2010	32.3

The revisions dated October 10, 2008 include a reprinted title page (page1) for this Standard.

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing, Recognition, and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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Prior to the December 22, 1993 revision pages for the second edition, the first and second editions were titled Visual Signaling Appliances.

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April 11, 2001

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This ANSI/UL Standard for Safety, which consists of the Fourth Edition with revisions through October 10, 2008, is under continuous maintenance, whereby each revision is ANSI approved upon publication.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc. and is not part of the ANSI standard.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements. 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 <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements cover electrically-operated visual signaling appliances, rated 300 volts or less, and intended for indoor locations, outdoor locations, or both, in accordance with the following Standards of the National Fire Protection Association:

- a) NFPA 70, National Electrical Code, and
- b) NFPA 72, National Fire Alarm Code.

1.2 These requirements cover visual signaling appliances intended for:

- a) Private mode fire or other emergency signaling where the appliance signals only those persons directly concerned with the implementation of emergency action. Refer to the National Fire Alarm Code, NFPA 72.
- b) Informative type visual signaling appliances connected to or controlled by fire alarm or other emergency signaling system equipment, or both.
- c) General non-emergency use. Requirements for light output, flash rate, and duration characteristics of such visual signaling appliances are not applicable.

1.2 revised November 7, 2003

1.3 When the appliance produces both a visual signal and an audible signal, the product shall also comply with the Standard for Audible Signal Appliances, UL 464; or the Standard for Speakers for Fire Protective Signaling Systems, UL 1480, as appropriate.

1.4 These requirements cover visual signaling appliances for use in ordinary locations. Visual signaling appliances for use in hazardous locations, as defined in the National Electrical Code, NFPA 70, are evaluated on the basis of their compliance with these requirements and further appropriate examination and tests to determine their acceptability for such use.

1.5 These requirements do not cover visual signaling appliances intended for the public operating mode as defined in the National Fire Alarm Code, NFPA 72. Public operating mode visual signaling appliances are covered under the Standard for Signaling Devices for the Hearing Impaired, UL 1971.

1.6 These requirements do not cover lamp or strobe-light assemblies intended for entertainment or room lighting.

1.7 These requirements do not cover annunciators that identify functions of a fire or emergency signaling system or relate information concerning portions thereof. Annunciators are covered under the Standard for Control Units for Fire-Protective Signaling Systems, UL 864.

1.8 Deleted May 7, 2003

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. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

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.

2.4 Electrical circuits terminology

2.4.1 For the purpose of these requirements, electrical circuit characteristics are defined as follows:

- a) High-Voltage – A circuit classified as high-voltage is one having circuit characteristics in excess of those of a low-voltage circuit.
- b) Low-Voltage – A circuit classified as low-voltage is one involving a potential of not more than 30 volts AC, 42.4 volts peak or DC.

2.4.2 The term "appliance" as used in these requirements refers to any equipment covered by this standard.

2.4.3 For purposes of this standard the terms "visual" and "visible" are interchangeable.

2.4.3 added May 7, 2003

CONSTRUCTION

3 Enclosure

3.1 General

3.1.1 The enclosure of an appliance shall be sufficiently strong and rigid to resist the abuses likely to be encountered during intended service. The degree of resistance inherent in the appliance shall preclude total or partial collapse and the attendant reduction of spacings, loosening or displacement of parts, and other serious defects which alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

3.1.2 Enclosures for individual electrical components, outer enclosures, and combinations of the two are to be considered in determining compliance with the requirement in 3.1.1.

3.1.3 Operating parts, such as gear mechanisms, light-duty relays, and similar devices, shall be protected against fouling by dust or other material that may impair their intended operation.

3.1.4 Electrical parts of an appliance shall be enclosed to provide protection against contact with uninsulated live parts.

3.1.5 An appliance intended to be installed on a flush-device box, cutout box, or the like, is to be evaluated with regard to compliance of the combination with the requirement in 3.1.4.

3.1.6 The enclosure of an appliance shall be provided with means for mounting in the intended manner. Any fittings, such as brackets, hangers, or the like, necessary for proper mounting shall be furnished with the appliance. The mounting means shall be accessible without disassembling any operating part of the appliance. The removal of a completely assembled panel, cover, or equivalent, to mount the appliance is not considered to be disassembly of an operating part.

3.1.7 An enclosure shall have provision for the connection of metal-clad cable, conduit, or non-metallic sheathed cable. An enclosure without such provision may be used when instructions are furnished with it indicating the sections of the enclosure that are intended to be drilled in the field for the connection of raceways, or when the appliance is intended for mounting on an outlet box.

3.1.8 A cover or other detachable part of the enclosure shall be provided with means, other than snap-catch fastenings only, for firmly securing it in place. The removal of the cover or detachable part shall require the use of a common hand tool, such as a screwdriver, wrench, or the like.

3.1.9 Except as noted in 3.1.10, an appliance intended for either flush or surface mounting in a back box shall be provided with a back box of thickness as specified in Table 3.1.

Table 3.1
Thickness of sheet metal

Group	Maximum dimensions of enclosure				Minimum thickness of sheet metal					
					Steel				Copper, brass or aluminum, inch (mm)	
	Length or width, inches (mm)		Area, inches ² (cm ²)		Zinc-coated, inch (mm)		Uncoated, inch (mm)			
A	3	76.2	6 ^a	39	0.025	0.64 ^b	0.021	0.53 ^b	0.023	0.58 ^c
B	8	203	36	232	0.030	0.76 ^{b,d}	0.027	0.69 ^{b,d}	0.036	0.91 ^d
C	12	305	90	581	0.034	0.86 ^d	0.032	0.81 ^d	0.045	1.14 ^d

^a Volume of enclosure not more than 12 cubic inches (197 cm³).

^b Sheet steel for an enclosure intended for outdoor use (rain-tight) is required to be not less than 0.036 inch (0.91 mm) thick when zinc coated and not less than 0.032 inch (0.81 mm) thick when uncoated.

^c Sheet copper, brass, or aluminum for an enclosure intended for outdoor use (rain-tight) is required to be not less than 0.029 inch (0.74 mm) thick.

^d For a cover in Group B or C having a supporting frame or equivalent reinforcing and not intended for outdoor use, the thickness of sheet steel may be less than that specified in the table but shall not be less than 0.021 inch (0.53 mm) [0.025 inch (0.64 mm) when zinc coated]; and the thickness of copper, brass, or aluminum may be less than that specified in the table, but shall not be less than 0.029 inch (0.74 mm).

3.1.10 An appliance need not be furnished with a back box if:

- a) Means are provided for attachment to a standard outlet box and
- b) The required spacings as specified in Spacings, Section 10, are maintained when the appliance is mounted on such a box.

3.1.11 There shall be space within a terminal or wiring compartment to permit the use of a standard conduit bushing on conduit connected to the compartment when a bushing is required for intended installation.

3.2 Cast metal enclosures

3.2.1 The thickness of cast metal used for an enclosure shall be as indicated in Table 3.2. Cast metal having a thickness 1/32 inch (0.8 mm) less than that indicated in the table may be used when the surface under consideration is curved, ribbed, or otherwise reinforced, or when the shape, size, or both, of the surface provides mechanical strength equivalent to the required thickness.

Table 3.2
Cast metal enclosures

Table 3.2 revised November 7, 2003

Use, or dimensions of area involved ^a	Minimum thickness			
	Die-cast metal,		Cast metal of other than the die-cast type,	
	inch	(mm)	inch	(mm)
Area of 24 square inches (155 cm ²) or less and not having any dimension greater than six inches (152 mm)	1/16	1.6	1/8	3.2
Area greater than 24 square inches (155 cm ²) or having any dimension greater than six inches (152 mm)	3/32	2.4	1/8	3.2
At a threaded conduit hole	1/4	6.4	1/4	6.4
At an unthreaded conduit hole	1/8	3.2	1/8	3.2
^a The area limitation for metal 1/16 inch (1.6 mm) thick may be obtained by the provision of reinforcing ribs subdividing a larger area.				

3.2.2 When threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, there shall not be less than 3-1/2 nor more than five threads in the metal, and the construction shall permit a standard conduit bushing to be attached.

3.2.3 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 3-1/2 full threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors that shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.

3.3 Sheet metal enclosure

3.3.1 The thickness of sheet metal used for the enclosure or mechanism cover of an appliance shall not be less than that indicated in Table 3.1.

3.3.2 At any point where conduit or metal-clad cable is to be attached, sheet metal shall be of such thickness or shall be so formed or reinforced that it will have a stiffness at least equivalent to that of an uncoated (No. 16 MSG) flat steel sheet having a minimum thickness of 0.053 inch (1.35 mm).

3.3.3 A ferrous plate or plug closure for an unused conduit opening or other hole in the enclosure shall have a thickness not less than 0.027 inch [not less than 0.032 inch (0.69 or 0.81 mm) when of nonferrous metal] for a hole having a 1-3/8 inch (34.9 mm) diameter maximum dimension.

3.3.4 A closure for a hole larger than 1-3/8 inch (34.9 mm) diameter shall have a thickness equal to that required for the enclosure of the appliance, or a standard knockout seal shall be used. Such closures shall be securely mounted.

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

3.3.6 A knockout shall be provided with a surrounding surface for seating of a conduit bushing, and shall be located so that a bushing used at any knockout likely to be used during installation will not result in spacings between uninsulated live parts and the bushing of less than those indicated under Spacings, Section 10.

3.3.7 An enclosure intended for recessed mounting, and whose panel is to be flush with the surface of the wall, shall not have nonfunctional openings.

3.3.8 An appliance intended to be supported by rigid conduit shall be provided with conduit hubs, or the equivalent, having not less than five full threads.

3.4 Nonmetallic enclosures

3.4.1 An enclosure or parts of an enclosure of nonmetallic material shall have the mechanical strength and durability and be so formed that the mechanical strength of the enclosure is at least equivalent to a sheet metal enclosure of the minimum thickness specified in Table 3.1.

3.4.2 Among the factors to be considered when evaluating the acceptability of a nonmetallic enclosure of parts are:

- a) Flammability;
- b) Mechanical strength;
- c) Resistance to impact;
- d) Moisture absorptive properties;
- e) Dielectric strength insulation resistance, and resistance to arc tracking; and
- f) Resistance to distortion at temperatures to which the material may be subjected under conditions of anticipated use.

All these factors are to be considered with regard to aging. See the Tests of Polymeric Materials, Section 26.

3.4.3 When a polymeric enclosure is intended for connection of conduit, the connection shall comply with the appropriate requirements for torque, bending, and pullout described in the Standard for Industrial Control Equipment, UL 508.

3.5 Ventilating and acoustical openings

3.5.1 An opening in an enclosure (including perforated holes, louvers, and openings protected by means of wire screening, expanded metal, or perforated covers) shall not permit passage of a 17/64-inch (6.7-mm) diameter rod.

3.5.2 The wires of a screen shall not be less than 16 AWG (1.3 mm²). Except as noted in 3.5.3, perforated sheet steel and sheet steel used for expanded-metal mesh shall not be less than 0.042 inch (1.07 mm) in average thickness [0.046 inch (1.17 mm) thick when zinc coated].

3.5.3 When the indentation of a guard or enclosure will not alter the clearance between uninsulated live parts, or between uninsulated movable live parts and grounded metal, or reduce spacings below the minimum values given in Spacings, Section 10, 0.021 inch (0.53 mm) expanded-metal mesh [0.024 inch (0.61 mm) when zinc coated] may be used, if:

- a) The mesh openings are not more than 1/4 square inch (1.6 cm²) in area and
- b) The maximum dimension of the overall opening so protected is not greater than 3 inches (76.2 mm).

4 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts

4.1 To reduce the risk of unintentional contact that may involve a risk of:

- a) Electric shock from an uninsulated live part or film-coated wire or
- b) 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 4.1.

4.2 The probe mentioned in 4.1 and illustrated in Figure 4.1 is to be applied to any depth that the opening will permit; and is to be rotated or angled before, during, and after insertion through the opening to any position that is necessary in order to examine the enclosure. The probe illustrated in Figure 4.1 is to be applied in any possible configuration; and, when necessary, the configuration is to be changed after insertion through the opening.

4.3 The probe mentioned in 4.1 is to 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 is to be applied with the minimum force necessary to determine accessibility.

4.4 During the examination of a product to determine whether it complies with the requirements in 4.1, a part of the enclosure that may be opened or removed by the operator without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

5 Corrosion Protection

5.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

5.2 The requirement in 5.1 applies to all enclosures whether of sheet steel or cast iron, and to all springs and other parts upon which intended mechanical operation may depend. The requirement does not apply to minor parts, such as washers screws, bolts, and similar parts, when the corrosion of such unprotected parts would not result in a risk of fire or electric shock; or would result in unintended operation of the appliance.

5.3 Metal shall be used in combinations that are galvanically compatible.

5.4 Hinges and other attachments shall be resistant to corrosion.

5.5 Nonferrous cabinets and enclosures may be used without special corrosion protection.

6 Field Wiring Connections

6 revised November 7, 2003

6.1 General

6.1.1 An appliance shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by the National Electrical Code, NFPA 70, corresponding to the rating of the appliance.

6.1.2 Duplicate terminals or leads, or equivalent means to achieve electrical supervision, shall be provided for each incoming and outgoing connection. A common terminal shall not be used for connection of both incoming and outgoing wires, unless 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, in which separate conductors of an initiating circuit are intended to be inserted in each notch, shall not be used unless this arrangement is supplemented by additional marking in the wiring area or on the installation wiring diagram specifying the intended connections to the terminals.

6.2 Field wiring compartment

6.2 revised November 7, 2003

6.2.1 The field wiring compartment area shall be of sufficient size for completing all wiring connections without damage to wire insulation or to internal components. There shall be sufficient space within the compartment to permit the use of a standard conduit bushing on conduit connected to the compartment when a bushing is required for intended installation.

6.2.1 revised November 7, 2003

6.2.2 Protection for the internal components and wire insulation from sharp edges shall be provided by insulating or metal barriers having smoothly rounded edges or by a marking as specified in 33.8.

6.2.3 The location of an outlet box or compartment in which field wiring connections are to be made shall permit the connections to be inspected after the appliance is installed as intended. The removal of not more than two mounting screws, or equivalent arrangement, to view the field wiring connections, is considered to comply with this requirement.

6.2.3 revised November 7, 2003

6.3 Field wiring terminals or leads

6.3 revised November 7, 2003

6.3.1 The terminals to which wiring connections are made are to consist of binding screws with terminal plates having upturned lugs or the equivalent to hold the wires in position. Other terminal connections may be provided when they are tested and are determined to be equivalent.

6.3.2 When a wire-binding screw is used at a field wiring terminal, the screw shall not be 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 mm²) or smaller conductor. The screw shall thread into metal and shall be of a nonferrous metal or plated steel.

6.3.2 revised November 7, 2003

6.3.3 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.27 mm) thick for a No. 8 (4.2 mm diameter) or larger screw, and not less than 0.030 inch (0.76 mm) thick for a No. 6 (3.5 mm diameter) screw and shall have not less than two full threads in the metal. A terminal plate may have the metal extruded at the tapped hole for the binding screw in order to provide two full threads.

6.3.4 Leads provided for field connections shall not be less than 6 inches (152 mm) long, and provided with strain relief, shall not be smaller than 18 AWG (0.82 mm²); and the insulation, when of rubber or thermoplastic, shall not be less than 1/64 inch (0.4 mm) thick. The leads may be less than 6 inches long when it is evident that the use of a longer lead may result in a risk of fire or electric shock.

6.3.5 For an appliance that is not intended for outlet-box mounting and is not provided with field wiring terminals or a field wiring compartment, the leads shall enter the enclosure:

- a) When of metal, through separate holes in insulating material which provide a spacing of not less than 1/4 inch (6.4 mm) between the conductors, and not less than 1/2 inch (12.7 mm) between the conductors and the plane of support of the appliance or

- b) The leads shall enter the enclosure through a nipple or other means for the attachment of conduit.

6.3.5 revised November 7, 2003

6.4 Grounding terminals and leads

6.4.1 When an appliance is intended for connection to a high-voltage source of supply only by means of other than a metal-enclosed wiring system, such as nonmetallic-sheathed cable:

- a) An equipment grounding terminal or lead shall be provided. The size shall be the same as the supply terminal or lead, but in any case not less than 18 AWG (0.82 mm²).
- b) A marking shall be provided to indicate that the wiring system or systems has been determined to be suitable.
- c) The grounding means shall be connected to all exposed dead-metal parts that are likely to become energized and to all dead-metal parts within the enclosure that are exposed to contact during servicing and maintenance.

6.4.2 The surface of an insulated lead intended solely for the connection of an equipment grounding conductor shall be green, with or without one or more yellow stripes, and no other leads visible to the installer, other than grounding conductors, shall be so identified.

6.4.3 A field wiring terminal intended for connection of an equipment grounding conductor shall be plainly identified, such as being marked "G," "GR," "Ground," "Grounding," or the equivalent; or by a marking on a wiring diagram provided on the appliance. The field wiring terminal shall be located so that it is unlikely to be removed during servicing of the appliance.

6.4.3 revised November 7, 2003

6.5 Grounded supply terminals and leads

6.5.1 A field wiring terminal for the connection of the grounded supply conductor of a high-voltage circuit shall be identified by means of a metallic plated coating substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of the terminal for the connection of the grounded conductor shall be clearly shown in some other manner, such as on an attached connection diagram.

6.5.1 revised November 7, 2003

6.5.2 A field wiring lead provided for connection of the grounded supply conductor of a high-voltage circuit shall be finished to show a white or gray color and shall be readily distinguishable from other leads and no other leads visible to the installer, other than grounded conductors, shall be so identified.

6.5.2 revised November 7, 2003

6.5.3 A terminal or lead identified for the connection of the grounded supply conductor shall not be electrically connected to a single-pole manual switching device which has an off position or to a single-pole overcurrent (not thermal) protective device.

7 Internal Wiring

7.1 General

7.1.1 The internal wiring of an appliance shall consist of conductors having insulation rated for the potential involved and the temperatures to which it may be subjected, and having mechanical strength and current carrying capacity that has been evaluated and determined to be acceptable for the service. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string, ties, or equivalent, unless of sufficient rigidity to retain a shaped form.

7.1.2 Leads or a cable assembly connected to parts mounted on a hinged cover shall be of sufficient length to permit the full opening of the cover without applying stress to the leads or their connections. The leads shall be secured or equivalently arranged to prevent abrasion of insulation and jamming between parts of the enclosure.

7.1.3 When the use of a short length of insulated conductor is not feasible, for example, in the case of a short coil lead or the like, electrical insulating tubing may be used. The tubing shall not be subjected to sharp bends, tension, compression, or repeated flexing, and shall not contact sharp edges, projections, or corners. The wall thickness of the tubing shall comply with the requirements for such tubing, except that the wall thickness at any point for polyvinyl chloride tubing of 3/8 inch (9.5 mm) diameter or less, shall not be less than 0.017 inch (0.43 mm). For insulating tubing of other types, the wall thickness shall not be less than that required to at least equal the mechanical strength, dielectric properties, heat and moisture resistant characteristic, and the like, of polyvinyl chloride tubing having a wall thickness of 0.017 inch (0.43 mm).

7.1.4 Internal wiring of circuits that operate at different potentials shall be separated by barriers or shall be segregated, unless the conductors in lower voltage circuits 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 to maintain separation.

7.1.5 A stranded conductor clamped under wire-binding screws or are similarly connected shall have the individual strands soldered together or be equivalently arranged.

7.2 Aluminum terminations

7.2.1 The continuity of any grounding system to which an appliance can be connected shall not rely on the dimensional integrity of nonmetallic material.

7.2.2 An aluminum conductor, insulated or uninsulated, used as internal wiring, such as for interconnection between current-carrying parts, shall be terminated at each end by a method that has been evaluated and determined to be acceptable for the combination of metals involved at the connection point.

7.2.3 With reference to 7.2.2, a wire-binding screw or a pressure terminal connector used as a terminating device shall be investigated and determined to be acceptable for use with aluminum under the conditions involved, for example, temperature, heat cycling, vibration, and the like.