UL 48

STANDARD FOR SAFETY

Electric Signs

UL Standard for Safety for Electric Signs, UL 48

Fifteenth Edition, Dated September 2, 2011

Summary of Topics

This revision to ANSI/UL 48 dated April 22, 2022 includes the following changes in requirements:

– Relaxation of section sign markings; 7.7.1

– Components for use in LED signs and changing message signs; 4.4.6.1, 4.3.8.1, 4.3.8.3, 4.3.8.4, 4.3.18.1, 4.3.19.3.1 – 4.3.19.3.3 and Appendix A

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 June 18, 2021 and April 6, 2022.

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SEPTEMBER 2, 2011
(Title Page Reprinted: April 22, 2022)

ANSI/UL 48-2022

UL 48

Standard for Electric Signs

First Edition – November, 1917
Second Edition – March, 1930
Third Edition – September, 1937
Fourth Edition – March, 1940
Fifth Edition – June, 1954
Sixth Edition – February, 1957
Seventh Edition – December, 1958
Eighth Edition – December, 1960
Ninth Edition – November, 1966
Tenth Edition – October, 1971
Eleventh Edition – June, 1976
Twelfth Edition – November, 1980
Thirteenth Edition – March, 1988
Fourteenth Edition – February, 1996

Fifteenth Edition

September 2, 2011

This ANSI/UL Standard for Safety consists of the Fifteenth Edition including revisions through April 22, 2022.

The most recent designation of ANSI/UL 48 as an American National Standard (ANSI) occurred on April 22, 2022. 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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1 Scope

1.1 These requirements cover all electric signs, art forms and outline lighting for use in accordance with the National Electrical Code, NFPA 70.

1.2 Electric signs include all signs (regardless of voltage) that are electrically operated and/or electrically illuminated, including but not limited to the following methods of illumination: incandescent, fluorescent, high intensity discharge (HID), electric discharge tubing including neon tubing, light-emitting diode (LED), skeleton neon tubing, cold-cathode lamps, and electroluminescence. Unless otherwise noted the term "sign" includes signs, outline lighting, art forms, and skeleton neon tubing.

1.3 Electric signs covered by these requirements also include, but are not limited to, awning signs, trailer-mounted signs, electrically or mechanically animated signs, signs supplied by photovoltaic systems and other independent power sources, changing message signs, including scrolling, flipper, tri-view, liquid crystal display (LCD), and light-emitting diode (LED) type and other electrically operated signs that are not necessarily illuminated.

1.4 These requirements do not cover the following:

a) Illuminated clocks operating at 600 V or less; refer to the Standard for Household Electric Clocks, UL 826 or for commercial use clocks to the Standard for Time-Indicating and -Recording Appliances, UL 863;

b) Exit signs; refer to the Standard for Emergency Lighting and Power Equipment, UL 924;

c) The trailer of a trailer mounted sign;

d) Luminaires mounted to function as outline lighting; refer to the Standard for Luminaires, UL 1598;

e) Luminaires mounted within an Awning Sign; refer to Standard for Luminaires, UL 1598;

f) Signs that do not use electricity;

g) Luminaires intended for billboard illumination; refer to Standard for Luminaires, UL 1598;

h) Fiber optics or Fiber optic Illuminators;

i) Signs for use in hazardous (classified) locations as defined in the National Electrical Code, NFPA 70.

2 Glossary

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

2.2 ACCESSIBILITY BARRIER – A material provided to limit access to the following in items (a) – (d) below. If all or part of the barrier also serves as an enclosure, see Enclosure, 2.21.

a) Uninsulated live parts,

b) Dead metal parts that are at a risk of being energized and are not grounded, and

c) Live parts insulated with materials not intended to be subject to user contact, or

d) Moving parts that present a risk of injury.

2.3 ACCESSIBLE PART – See Part, Accessible, 2.44.

2.4 ADHESIVE – Bonding material (i.e. epoxy, paste, cement) placed between parts to be fastened together that adheres to each part, and remains the securement medium between the parts.

2.5 AWNING SIGN – A fixed structure with flexible or rigid sign face material extending over a window, door, patio, walkway, etc. providing protection from the weather and integral illumination of the signage.

2.6 BARRIER – See Accessibility Barrier, 2.2, Heat Barrier 2.28, Insulating Barrier, 2.31, and Water Shield, 2.76.

2.7 BONDING – Permanent joining of metallic parts to form an electrical conductivity path that provides electrical continuity between dead metal parts and the capacity to conduct any fault current that may occur.

2.8 CANOPY – A device provided with a sign, or separately, that is used to cover an outlet box. A canopy is capable of being secured to an outlet box or to a ceiling.

2.9 CANOPY SIGN – A sign that is supported and suspended from an outlet box by a chain, stem, or cable.

2.10 CLASS 2 CIRCUIT – Wiring, conductors, and components connected only to a Class 2 supply source. See Class 2 Supply Source, 2.11.

2.11 CLASS 2 SUPPLY SOURCE – An electrical source such as a transformer, power supply, or battery having an open-circuit voltage that is less than 30 Vrms (42.4 Vpeak) or 60 Vdc and having limited energy available in the circuit under load conditions, including short circuit and extremely low resistance as specified by the current and VA limitations of the Article 725 of the National Electrical Code, NFPA 70.

2.12 COLD-CATHODE LAMP – An electric-discharge lamp that is characterized by an arc discharge, and in which the cathode drop is relatively high and the current density at the cathodes is relatively low.

2.13 DAMP LOCATION – See Location of Use Designation, 2.36.

2.14 DECORATIVE PART – A part which, if removed, does not result in the product no longer complying with the requirements.

2.15 DRY LOCATION – See Location of Use Designation, 2.36.

2.16 ELECTRIC DISCHARGE LIGHTING – System of illumination whereby current is passed through a gas medium. This includes neon tubing, cold cathode lamps, fluorescent, and high intensity discharge (HID) types of illumination.

2.17 ELECTRICAL EQUIPMENT – A general term including fittings, boxes, wireways, switches, receptacles, panelboards, appliances, luminaries (fixtures), and the like used as a part of an electric sign.

2.18 ELECTRODE RECEPTACLE – A contact device intended to accept electrodes of neon tubing. An individual receptacle may or may not be provided with an integral outer enclosure of metal or other material.

2.19 ELECTRODE SPLICE ENCLOSURE – Component specifically intended to enclose a splice between a GTO cable conductor and the leads of a neon tube electrode.

2.20 ELECTROLUMINESCENT – The emission of light from phosphor coatings excited by an electrostatic (capacitive) field.

2.21 ENCLOSURE – A part of the sign that encloses electrical and mechanical parts and components that involve the risk of electric shock, hazardous energy, fire, and moving parts capable of causing injury. All or part of the enclosure may also serve as a water shield, sign body, or sign face.

2.21.1 GLASS – The following are types of glass:

a) LAMINATED GLASS – Two or multi glass sheets bonded together, consisting of at least one glass sheet bonded to at least one other sheet of glass with an organic interlayer. When broken, cracks may appear, but the glass fragments tend to adhere to the applied organic material. See also the Standard Specification for Laminated Architectural Flat Glass, ASTM C1172.

b) ORGANIC-COATED GLASS – A sheet of glass covered with either an organic film or a coating. When broken, cracks may appear, but the glass fragments tend to adhere to the applied organic material.

c) SODA-LIME GLASS – Glass that is monolithic and based on soda-lime silicate. It can be annealed or tempered for strengthening. When broken, shards of various sizes and shapes will be released. See also the Standard Terminology of Glass and Glass Products, ASTM C162 for definition.

d) TEMPERED GLASS – Glass that has been treated so that when broken, it dices into fragments. See also the Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass, ASTM C1048.

2.22 GROUNDED CONDUCTOR – A system or circuit conductor intentionally connected to ground at the building supply source, also referred to as "common" or "neutral."

2.23 GROUNDING CONDUCTOR, EQUIPMENT – The conductor used to connect the non-current-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor, the grounding electrode conductor, or both at the service equipment or at the source of a separately derived system.

2.24 GFCI (GROUND-FAULT CIRCUIT-INTERRUPTER) – A device intended to reduce the risk of electric shock by de-energizing a circuit or portion thereof within a certain amount of time after a fault to ground has been detected.

2.25 GTO CABLE – Gas-Tube-Sign Cable (formerly known as Gas Tube Oil Ignition Cable). Rated 5 kV, 10 kV, or 15 kV for use between the secondary or output of a neon supply and neon tubing and between segments of neon tubing.

2.26 GTO SLEEVING – A component specifically identified for use over GTO cable.

2.27 GTO CABLE SPLICE ENCLOSURE – Containment device intended to enclose the splice of two lengths of GTO cable that complies with the enclosure requirements.

2.28 HEAT BARRIER – A barrier provided to reduce the required spacing, or in place of the required spacing, from a heat producing component.

2.29 HID (HIGH-INTENSITY DISCHARGE) LAMP – A lamp that produces light from an electric discharge between electrodes in a gas or vapor at normal or high pressure. Common types include mercury vapor, metal halide, and high-pressure sodium lamps.

2.30 ILLUMINATION – Capable of emitting light from one of the following light sources such as Incandescent, Fluorescent, Induction Lighting, HID, Halogen, Xenon, Neon Tubing, Cold Cathode Lamp, LED, and Electroluminescent.

2.31 INSULATING BARRIER – A barrier provided in place of a required electrical spacing.

2.32 INTEGRALLY SLEEVED GTO CABLE – GTO cable that complies with the requirements for Integrally Sleeved GTO Cable in the Standard for Electric Sign Components, UL 879, and is marked "Integrally Sleeved".

2.33 LAMPHOLDER – A wiring device intended for making connection to the electrical circuits of a lamp and, in some cases, providing support.

2.34 LED (Light Emitting Diode) – A solid-state component embodying a p-n junction, emitting optical radiation when excited by an electric current.

2.35 LIVE PART – An electrically insulated or uninsulated conductive part that has a potential difference during operation with respect to ground or any other conductive part.

2.36 LOCATION OF USE DESIGNATION

a) DRY – Designation for a sign or sign component that has been evaluated for use in an environment where the component is not normally subject to dampness or wetness. Examples include inside an indoor shopping mall, inside a retail store, and other similar places.

b) DAMP – Designation for a sign or sign component that has been evaluated for use in exterior locations where protected from weather and not subject to saturation with water or other liquids, or interior locations where subject to moderate degrees of moisture, primarily by humidity and condensation. Protection overhead is generally considered to be within an area formed by an imaginary line drawn from the outer edge of the eave, overhang or sign body inward at a 45°-angle from vertical. Additionally, the interior of a sign body provided with a sign face and installed in an outdoor exposed location is considered a damp location. Examples include protected areas such as under a canopy, marquee, or a roofed porch.

c) WET – Designation of a sign or sign component that has been evaluated for use in a location that is subject to saturation with water or other liquids, such as direct spray or splashing of water or other liquids, and in unprotected locations exposed to weather.

2.37 MOBILE SIGN – A cord-connected sign that is provided with means to facilitate movement, such as being trailer mounted and does not meet one or more criteria for portable signs (e.g. size and weight limits).

2.38 NEC – National Electrical Code, NFPA 70.

2.39 NEON SUPPLY – A neon transformer or neon power supply.

2.40 NEON TUBING – Electric-discharge tubing manufactured into shapes that form letters, parts of letters, skeleton tubing, outline lighting, other decorative elements, or art forms, and filled with various inert gases.

2.41 ORDINARY TOOLS – For the purposes of these requirements, ordinary tools are defined as flat blade and Phillips head screwdrivers, nut drivers, and pliers.

2.42 OUTLET BOX – A point on a wiring system in the form of a box at which current is taken from a wiring system. Splices are made within the box.

2.43 OUTLINE LIGHTING – An arrangement of Illuminated sources that outlines or calls attention to features such as the shape of a building or window.

2.44 PART, ACCESSIBLE – An electrical or moving part that is not guarded by its location or by other means and that is capable of being touched by a user during operation or user servicing.

2.45 PART, CURRENT CARRYING – An electrical part such as a wire or lampholder, that carries electrical and qualifies to be considered an insulated live part.

2.46 PART, EXPOSED LIVE – Electrical part that is accessible to a user during normal use.

2.47 PART, INSULATED LIVE – Electrical part that is energized and surrounded by insulation that is suitable for the voltage involved.

2.48 PENDANT SIGN – See Canopy Sign in 2.9.

2.48.1 PHOTOVOLTAIC SIGN – An off-grid/stand alone, on-grid/non-utility interactive, or utility interactive sign powered by solar energy. It may be constructed with photovoltaic modules, controls, and/or batteries integrated into a single sign cabinet or as a separate section(s) of the photovoltaic sign.

2.49 POLYMERIC MATERIAL – Materials that are thermoplastic, thermosetting, or elastomeric.

2.50 PORTABLE SIGN – A cord connected sign weighing 22.7 kg (50 lbs) or less, has a weight times length value that does not exceed 575 kg-mm (1500 lb-in) and if provided with mounting means is removable from its mounting without the use of tools.

2.51 PRESSURE WIRE CONNECTOR – A device that establishes a connection between two or more conductors or between one or more conductors and a terminal by means of mechanical pressure and without the use of solder.

2.52 QUALIFIED SERVICING – Any servicing performed by persons trained to repair and operate the equipment, and who are familiar with the risks involved. Some examples of qualified servicing include the replacing of components such as ballasts, lampholders, switches, and electric-discharge tubing. See also User Servicing, 2.75.

2.53 RACEWAY – An enclosed metal or nonmetallic channel, including conduit and tubing, designed for holding wires, cables, or electrical components.

2.54 RECEPTACLE – A contact device for the connection of an attachment plug.

2.55 RECESSED SIGN – A sign intended to be installed in a cavity in a wall or ceiling surface so that at least part of the sign is behind the surface.

2.56 RISK OF ELECTRIC SHOCK – A risk of electric shock exists between any two uninsulated conductive parts or between an uninsulated conductive part and earth ground, if the continuous current flow through a 1500-Ω resistor in parallel with a 0.015-mF capacitor connected between the two points exceeds 0.5 mArms (0.7 mApeak) and if the open circuit voltage exceeds 30 Vrms or 42.4 Vpeak for dry, damp locations and, 15 Vrms or 21.2 Vpeak for wet locations.

2.57 RISK OF FIRE – A risk of fire exists between two conductive parts if the maximum voltage, current, or VA exceeds Class 2 limits.

2.58 RISK OF INJURY – A risk of injury exists when moving parts, sharp parts, or other physically hazardous mechanical constructions are accessible.

2.59 SCREW, MACHINE – A constant diameter screw intended for threading into a nut or threaded metal material.

2.60 SCREW, SELF-DRILLING THREAD-CUTTING – A screw that drills its own hole and cuts its threads as it is installed. A common type is called a TEK screw.

2.61 SCREW, SELF-TAPPING – A screw that drills its own pilot hole and forms its own threads.

2.62 SCREW, THREAD-CUTTING – A screw that cuts its own threads in a hole into which it is screwed.

2.63 SCREW, THREAD-FORMING – A screw that forms its own threads by deforming the metal on the edges of a hole into which it is screwed.

2.64 SCREW, WIRE BINDING – A screw used as a post around which a wire is to be wrapped.

2.65 SECTION SIGN – A sign shipped as subassemblies that requires field-wiring between the subassemblies to complete the overall sign.

2.66 SIGN – An electrically operated product that through illumination or mechanical means uses words, symbols, numbers, art, or other advertisement intended to convey information, attracts attention, provides information, or serves as decoration.

2.67 SIGN BODY – Portion of a sign that provides protection from the weather but is not an electrical enclosure.

2.68 SKELETON NEON TUBING – Neon tubing that is itself the sign or outline lighting and not attached to an enclosure or sign body.

2.69 SPLICE – Any point where one wire is connected to another wire. A wire terminating at a pressure wiring terminal or wire binding screw is not considered a splice.

2.70 STATIONARY SIGN – A cord-connected sign that meets all of the following:

a) Intended to be fastened in place or located in a dedicated space;

b) If fastened in place may be removed from its intended mounting with the use of no more than ordinary tools;

c) Does not meet one or more criteria for portable signs (e.g. size and weight limitations); and

d) Does not meet one or more criteria for mobile signs (e.g. provision for movement such as wheels or a trailer).

2.71 STRAIN-RELIEF – Knot, bushing, or equivalent intended to prevent strain from being transmitted through that portion of a wire or cord outside a product to the termination point of the wire or cord inside the product.

2.72 SUBASSEMBLY – Part or segment of a sign or outline lighting system that when assembled with all subassemblies forms a complete unit or product. For example, a sign subassembly is one part of an overall sign that when mechanically and electrically are assembled together form a complete sign.

2.73 TEMPERED GLASS – Glass that has been treated so that when broken, it dices into fragments not larger than 6.5 cm^2 (1 in^2), without splintering or producing sharp edges on any piece.

2.74 TRAILER SIGN – A cord connected sign intended for permanent mounting to a trailer.

2.75 USER SERVICING – Any servicing that is performed by persons other than those trained to maintain a particular sign. Replacement of neon tubing is not user servicing. Some examples of user servicing are:

a) Attaching an accessory by means of separable connectors, or by means of an attachment plug to a dedicated receptacle.

b) Resetting or replacing a protective device in a sign or a receptacle circuit that is overloaded by the user.

c) Resetting a circuit breaker or replacing a fuse, automatic starter, or lamp, that is accessible without the use of a tool.

d) Changing of advertising material and routine cleaning.

2.76 WATER SHIELD – A material relied upon to reduce the entrance of water into a sign or prevent the entrance of water onto current-carrying parts within a sign.

2.77 WET LOCATION – See Location of Use Designation, 2.36.

3 General

3.1 Components

3.1.1 Except as indicated in 3.1.2, 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.

3.1.2 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.

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

3.2 Reference publications

3.2.1 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.

3.3 Units of measurement

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

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

4 Construction

4.1 Mechanical

4.1.1 General

4.1.1.1 A sign shall be constructed in accordance with the requirements of 4.1 to have the strength and rigidity required to resist the environment to which it is subjected.

4.1.1.2 Parts of a sign that are only decorative in nature and do not affect the integrity of the sign need not comply with 4.1.

4.1.1.3 All parts, subassemblies, and components shall be secured to prevent loosening, unintended rotation, or turning, etc.

4.1.1.4 Moving parts of a sign or associated equipment, accessible during intended operation or user maintenance, as determined by the articulate probe in Figure 4.3, and that present a risk of injury to persons must be adequately guarded or protected to prevent contact by user or operator. See 4.4.2 for accessibility requirements.

4.1.1.5 An edge subject to contact by wiring or other electrical components shall not be sufficiently sharp to abrade, cut, or otherwise damage electrical insulation.

4.1.1.6 An edge subject to contact by persons during normal operation or maintenance shall not be sufficiently sharp to constitute a risk of injury.

4.1.1.7 Signs not constructed in accordance with the minimum thermal spacing requirements of 4.2.3.2 shall comply with the Temperature Test Requirements in 5.2.

4.1.2 Materials

4.1.2.1 General

4.1.2.1.1 Materials used to construct signs shall comply with the appropriate requirements in 4.1.2.

4.1.2.2 Metal

4.1.2.2.1 Thickness

4.1.2.2.1.1 The minimum thickness of metal relied upon as an enclosure in accordance with 4.1.3 shall be as specified below:

a) Cast metal shall comply with Table 4.1,

b) Sheet and extruded metals shall comply with Table 4.2,

c) Aluminum, copper, or brass shall comply with Table 4.3.

Table 4.1
Thickness of cast-metal enclosures

Material or location	Minimum thickness of cast metal			
	Unreinforced		Reinforced	
	mm	(in)	mm	(in)
Cast metal	3.2	0.126	2.4	0.094
Cast malleable iron	2.4	0.094	1.6	0.063
At a threaded conduit hole	2.4	0.094	1.6	0.063
At an unthreaded conduit hole	2.0	0.079	1.2	0.047

1) Reinforced – When the material is provided with integrally cast angles, channels, ribs, flanges or ridges.

2) Threads and breakouts – Areas around threads, breakouts, or similar features, are permitted to be thinner, providing the strength of structure is not affected, but in no cast thinner than permitted for the same length of sheet metal.

Table 4.2
Minimum thickness of uncoated and zinc coated steel

Specific construction		Uncoated steel				Zinc coated or galvanized steel			
		Unreinforced		Reinforced		Unreinforced		Reinforced	
		mm	(in)	mm	(in)	mm	(in)	mm	(in)
At opening for conduit connection		0.66	0.026	0.66	0.026	0.74	0.029	0.74	0.029
Length not more than 38 cm (15 in)	No electrical component support	0.41	0.016	0.33	0.013	0.48	0.019	0.41	0.016
	Electrical component support	0.41	0.016	0.41	0.016	0.48	0.019	0.48	0.019
Length more than 38 cm (15 in) and less than 66 cm (26 in)	No electrical component support	0.41	0.016	0.33	0.013	0.48	0.019	0.48	0.019
	Electrical component support	0.51	0.020	0.41	0.016	0.58	0.023	0.48	0.019
Length 66 cm (26 in) and greater	No electrical component support	0.51	0.020	0.41	0.016	0.58	0.023	0.48	0.019
	Electrical component support	0.66	0.026	0.51	0.020	0.74	0.029	0.58	0.023

1) Length – the longest straight line that can be drawn on any unsupported section of an enclosure. The longest straight line is measured in any direction regardless of the shape of the enclosure section in any direction. The longest straight line for an enclosure section that is frame supported in accordance with 4.1.2.2.1.6 and 4.1.2.2.1.7 is measured in any direction on the enclosure panel between the frame supporting members.

2) Length and Frame supported – A section of an enclosure secured to framing members not integral to the enclosure panel in accordance with 4.1.2.2.1.6 and 4.1.2.2.1.7.

3) Unreinforced – A section of an enclosure as described in 4.1.2.2.1.3 or that does not comply with the requirements in 4.1.2.2.1.2 and 4.1.2.2.1.4 for being a reinforced enclosure section.

4) Reinforced – A section of an enclosure that is provided with curves, ribs, breaks or flanged surfaces in accordance with 4.1.2.2.1.2 and 4.1.2.2.1.4.

5) No electrical component support – the minimum thickness required when no electrically components are secured to and supported by the enclosure surface.

Table 4.3
Minimum thickness of aluminum, copper, or brass enclosures

Specific construction		Copper, brass, aluminum sheet and extruded aluminum			
		Unreinforced		Reinforced	
		mm	(in)	mm	(in)
At opening for conduit connection		0.81	0.032	0.81	0.032
Length not more than 38 cm (15 in)	No electrical component support	0.51	0.020	0.51	0.020
	Electrical component support	0.51	0.020	0.51	0.020
Length more than 38 cm (15 in) and less than 66 cm (26 in)	No electrical component support	0.51	0.020	0.51	0.020
	Electrical component support	0.64	0.025	0.51	0.020
Length 66 cm (26 in) and greater	No electrical component support	0.56	0.022	0.51	0.020
	Electrical component support	0.71	0.028	0.56	0.022

1) Length – the longest straight line that can be drawn on any unsupported section of an enclosure. The longest straight line is measured in any direction regardless of the shape of the enclosure section in any direction. The longest straight line for an enclosure section that is frame supported in accordance with 4.1.2.2.1.6 and 4.1.2.2.1.7 is measured in any direction on the enclosure panel between the frame supporting members.

2) Length and Frame supported – A section of an enclosure secured to framing members not integral to the enclosure panel in accordance with 4.1.2.2.1.6 and 4.1.2.2.1.7.

3) Unreinforced – A section of an enclosure as described in 4.1.2.2.1.3 or that does not comply with the requirements in 4.1.2.2.1.2 and 4.1.2.2.1.4 for being a reinforced enclosure section.

4) Reinforced – A section of an enclosure that is provided with curves, ribs, breaks or flanged surfaces in accordance with 4.1.2.2.1.2 and 4.1.2.2.1.4.

5) No electrical component support – the minimum thickness required when no electrically components are secured to and supported by the enclosure surface.

4.1.2.2.1.2 A reinforced construction as indicated in Table 4.1, Table 4.2, and Table 4.3, is an enclosure material provided with integral angles, channels, breaks, ribs, flanges or ridges, that provides a mechanical strength across the span of the material. The reinforcement feature shall divide the enclosure into sections such that the longest dimension of all of the resulting sections is one third or less than the longest dimension of the undivided enclosure:

a) Flanges, angles or breaks that are 45° to 120° to the plane of the panel,

b) Ribs and ridges that are at least 3.2-mm (0.126-in) high from the plane of the panel with an internal angle of 45° to 120°,

c) Curves running across the shortest dimension, or

d) Channels having two 90° angles or breaks running in any direction.

4.1.2.2.1.3 The following constructions are not considered to be reinforced:

a) A single sheet with a formed edge flange around its perimeter,

b) A single sheet that is ribbed not meeting the angle criteria in 4.1.2.2.1.2,

c) A single sheet that is corrugated with the curves running parallel to the long dimension, and

d) A single sheet of sheet metal with reinforcement features, but secured to a peripheral frame by a means that would allow the material to flex at its center. For example, securement by physical fit into a channel.

4.1.2.2.1.4 For a cast metal to be considered as reinforced as specified in Table 4.1, the material must be provided with integrally cast angles, channels, ribs, flanges or ridges.

4.1.2.2.1.5 The length dimensions specified in Table 4.1, Table 4.2 and Table 4.3 are measured as the longest straight line that can be drawn across any unsupported section of the material. The longest straight line for an enclosure section is measured in any direction regardless of the shape. The longest straight line for an enclosure section that has a supporting frame in accordance with 4.1.2.2.1.6, is measured in any direction on the enclosure panel between the supporting frame members.

4.1.2.2.1.6 A supporting frame is a structure of angle, channel or a rigid folded length of sheet metal that is not an integral part of the enclosure panel and complies with 4.1.2.2.1.7. The supporting frame must be rigidly attached to the enclosure material at regular intervals and to other materials to which the enclosure material is secured, and have essentially the same outside dimensions as the enclosure surface.

4.1.2.2.1.7 A supporting frame shall consist of:

a) Steel or aluminum angle having a cross sectional dimension of at least 13 by 13 mm (0.5 by 0.5 in) with a minimum material thickness of 3.2 mm (0.125 in);

b) Flat metal bars which are minimum 9.5-mm (0.375-in) wide and 3.2-mm (0.125-in) thick; or

c) An internal metal structure such as a chassis, that is rigidly secured together to form a 3 dimensional structure onto which the enclosure material is secured at regular intervals.

4.1.2.2.2 Metal corrosion protection

4.1.2.2.2.1 Except as noted in 4.1.2.2.2.2, all surfaces of ferrous metal parts including hinges, bolts and fasteners, other than parts specified in 4.1.2.2.2.2, shall be protected against corrosion by galvanizing, painting, plating, corrosion resistant coating or enamel.

4.1.2.2.2.2 The following ferrous metal parts need not be protected against corrosion:

a) Punched holes and cut edges of sheet metal;

b) Edges, punched holes, and spot welds of pre-finished steel;

c) Enclosed steel pipe and hanger locations for painting and plating;

d) Shafts, bearings, sliding surfaces of a hinge, hinge pins, and other parts whose intended operation are adversely affected by plating or coating, and all parts that, in their intended operation, will be oil or grease coated;

e) Corrosion resistant ferrous metals such as stainless steel; or

f) Where the two surfaces of an identical ferrous alloy are in permanent contact.

4.1.2.2.2.3 Ferrous metal surfaces shall be prepared prior to painting, coating, or plating. The manufacturer shall have a system in place to ensure the surface is clean and free of contaminates.

4.1.2.3 Polymeric material

4.1.2.3.1 A polymeric material that functions as an enclosure, an accessibility barrier to reduce the risk of electric shock or mechanical injury, or that portion of a sign body located above live parts that diverts water from contacting those live parts shall comply with the requirements in the Standard for Electric Sign Components, UL 879, applicable for its intended function and rating.

4.1.2.3.2 A polymeric material shall be spaced away from heat producing components in accordance with the thermal spacing requirements of 4.2.3.2.

4.1.2.4 Other materials

4.1.2.4.1 A material other than metal, glass, or polymeric, that is of an inorganic composition such as ceramic and porcelain, shall comply with the requirements in the Standard for Electric Sign Components, UL 879, the enclosure requirements in 4.1.3, and accessibility requirements of 4.2.2.

4.1.2.5 Gaskets

4.1.2.5.1 A gasket used to seal a joint so that a sign complies with the Exclusion of Water requirements in 5.9 shall be constructed of neoprene, rubber, neoprene-composition, rubber-composition, synthetic rubber, or similar material that complies with one of the following:

a) Investigated and found suitable for use as a weather seal in outdoor or wet location signs, luminaires, industrial control panels, or similar outdoor or wet location electrical equipment, or

b) Complies with the Gasket Aging Test in 5.7.

4.1.2.5.2 The gasket shall be secured so that it does not loosen from the mounting means.

4.1.2.5.3 The gasket of a gasketed joint that must be opened in order to relamp or change advertising material shall be secured in place by:

a) Rivets, screws, or similar mechanical means, or

b) Comply with the Gasket Adhesion Test described in 5.8.

4.1.2.5.4 The gasket and securement of the gasket shall not be damaged when the joint is opened.

4.1.3 Enclosures

4.1.3.1 General

4.1.3.1.1 An enclosure shall consist of one or more fabricated and/or prefabricated enclosures constructed in accordance with the requirements of 4.1.3.

4.1.3.1.2 Enclosure parts shall be secured by positive mechanical means, such as screws or welding.

4.1.3.1.3 The tolerance of fit between parts of wire ways or the sign enclosure shall not exceed 3.2 mm (0.127 in) in width. A 6.4-mm (0.25-in) tolerance is allowed in a raceway which circumferences the pole in a pole mounted sign.