UL 3703

STANDARD FOR SAFETY

Solar Trackers

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UL Standard for Safety for Solar Trackers, UL 3703

First Edition, Dated October 8, 2015

SUMMARY OF TOPICS

This revision of ANSI/UL 3703 dated April 22, 2025 includes the addition of references to UL 61010-1 for Controllers and Control Systems: Section 11A and Appendix A

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

The new requirements are substantially in accordance with Proposal(s) on this subject dated January 17, 2025 and March 14, 2025.

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OCTOBER 8, 2015
(Title Page Reprinted: April 22, 2025)

ANSI/UL 3703-2025

1

UL 3703

Standard for Solar Trackers

First Edition

October 8, 2015

This ANSI/UL Standard for Safety consists of the First Edition including revisions through April 22, 2025.

The most recent designation of ANSI/UL 3703 as an American National Standard (ANSI) occurred on April 22, 2025. 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 ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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CONTENTS

INTRODUCTION

CONSTRUCTION

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PROTECTION AGAINST RISKS OF INJURY TO PERSONS

PERFORMANCE

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INTRODUCTION

1 Scope

1.1 These requirements cover solar trackers intended for installation as fixed trackers which are not attached to buildings, in accordance with the National Electrical Code, NFPA 70. Trackers intended to be installed in an area where public access is anticipated shall be evaluated for all mechanical hazards as defined in this standard. Trackers intended to be installed in an area where public access is restricted by a fence, secured location, etc. should be evaluated with consideration given to the mechanical hazard requirements of this standard. These requirements also cover freestanding trackers, which are by design not required to be mechanically secured in position.

1.2 These requirements cover the attachment means of solar devices to the tracker platform, in both mechanical and electrical aspects, but do not cover the solar devices themselves. The solar devices shall have all suitable electrical and mechanical characteristics in order to be attached to the tracker evaluated in accordance with this standard. Any solar devices attached to the tracker shall be compliant with the solar devices standard for safety, and the specific mounting, bonding, and grounding means described in the tracker's installation manual. Alternatively, the combination of tracker and solar device can be evaluated in accordance with this standard and relevant solar device standards, such as, but not limited to, the Standard for Flat-Plate Photovoltaic Modules and Panels, UL 1703 for flat plate PV modules, and the Outline for Concentrator Photovoltaic Modules and Assemblies, UL 8703, for CPV modules.

1.3 The tracker and its functions are to be evaluated with respect to risk of electric shock, mechanical and fire hazards. Any part of the tracker that is utilized for mechanical support, bonding or grounding of the solar devices shall comply with the Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use With Flat-Plate Photovoltaic Modules and Panels, UL 2703, or as referenced to UL 2703 within the requirements of this standard.

1.4 These requirements cover solar trackers intended for use with solar devices with a maximum system voltage of 1500 V.

1.5 These requirements do not cover:

a) Equipment intended to accept the electrical or thermal output from the solar devices, such as inverters, converters, charge controllers, and batteries;

b) Trackers installed in hazardous locations;

c) Mechanical or structural integrity of the tracker under wind conditions, seismic conditions, and uplift conditions of the tracker base and base to platform connection;

d) Trackers installed in marine, offshore, and/or locations above standing water; and

e) Lightning striking the tracker.

2 Glossary

2.1 For the purpose of this standard, the definitions in 2.2 – 2.48 apply.

2.2 BARRIER – A part inside an enclosure that reduces access to a part that involves a risk of fire, electric shock, injury to persons, or electrical energy-high current levels.

2.3 BRANCH CIRCUIT – The portion of the building wiring system beyond the final overcurrent protective device in the power-distribution panel that protects the ac output of the field-wiring terminals in a permanently connected tracker.

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2.4 CHARGE CONTROLLER – A device intended to control the charging process of storage batteries used in photovoltaic power systems.

2.5 CLASS 2 TRANSFORMER – A step-down transformer complying with the applicable requirements in the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

2.6 CONTROL CIRCUIT – A circuit that carries low-voltage, limited-energy (LVLE) electric signals and not main power, voltage or current.

2.7 CONVERTER – A device that accepts ac or dc power input and converts it to another form of ac or dc power. For the purposes of this standard and unless otherwise specified, ac output converters intended to directly supply power to loads are to be subjected to all of the requirements for inverters.

2.8 DC GROUND FAULT DETECTOR/INTERRUPTER – A device that provides protection for photovoltaic arrays by detecting a ground fault and interrupting the fault path in the dc circuit.

2.9 DEAD METAL – An electrically conductive metal part of the tracker which is not electrically connected to, or is, a source of voltage, and has no electric potential difference with respect to earth ground during the intended operation.

2.10 DEGREE OF PROTECTION – The extent of protection provided by an enclosure against access to parts which involve a risk of injury to persons, ingress of foreign solid objects, and/or ingress of water as verified by standardized test methods.

2.11 DISCONNECT DEVICE – A device that disconnects the conductors of a circuit from a supply, source, utility, or load.

2.12 ELECTRIC POWER SYSTEM (EPS) – Equipment or facilities that deliver electric power to a load. The most common example of an EPS is an electric utility.

2.13 EMERGENCY STOP – A safety mechanism used to shut off the tracker in an emergency situation, which overrides all automatic controls and stops the moving of the tracker as quickly as possible, and the tracker needs a manual reset to return to an automatic control and moving.

2.14 ENCLOSURE – A surrounding case constructed to provide a degree of protection against:

a) The accessibility of a part that potentially involves a risk of fire, electric shock or injury to persons, or

b) The risk of propagation of flame, sparks, and molten metal initiated by an electrical disturbance occurring within.

2.15 FIELD-WIRING LEAD – A lead to which a supply, load, or other wire is intended to be connected by an installer.

2.16 FIELD-WIRING TERMINAL – A terminal to which a supply, load, or other wire is intended to be connected by an installer.

2.17 FIXED TRACKER – A tracker that is intended to be permanently connected mechanically and electrically and only able to be detached by the use of a tool.

2.18 FREESTANDING TRACKER – A tracker that is not intended to be permanently connected mechanically and electrically, such as, but not limited to portable (not fixed) floor units.

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2.19 GROUNDED CONDUCTOR – A system or circuit conductor that is intentionally grounded.

2.20 GUARD – A part outside of the enclosure that reduces access to a component involving a risk of injury to persons.

2.21 INTERCONNECTION SYSTEM EQUIPMENT (ISE) – A component or system of components that performs protective and control functions used to interconnect a distributed resource to an EPS.

2.22 INVERTER – An electronic device that changes dc power to ac power.

2.23 ISOLATED CIRCUIT – A circuit having an isolation transformer or isolating components such as optically or magnetically coupled devices.

2.24 ISOLATION TRANSFORMER – A transformer having its primary winding electrically isolated from its secondary winding and constructed so that there is no electrical connection – under normal and overload conditions – between the primary and secondary windings, between the primary winding and the core, or between separate adjacent secondary windings, where such connection results in a risk of fire or electric shock.

2.25 KNOCKOUT – A portion of the wall of an enclosure so fashioned that it is capable of being readily removed by a hammer, screwdriver, and pliers at the time of installation in order to provide an opening or hole for the attachment of an auxiliary device, raceway, cable, or fitting.

2.26 LIMITED-ENERGY (LE) CIRCUIT – An ac or dc circuit having a voltage not exceeding 1000 volts and the energy limited to 100 volt-amperes by:

a) The secondary winding of a transformer,

b) One or more resistors complying with 25.10, or

c) A regulating network complying with 25.11.

2.27 LIVE PART – An electrically conductive tracker part which is electrically connected to, or is, a source of voltage, and/or during intended use has an electric potential difference with respect to earth ground.

2.28 LOW-VOLTAGE, LIMITED-ENERGY (LVLE) CIRCUIT – A circuit involving an ac voltage of not more than 30 volts rms (42.4 volts peak) or a dc voltage of not more than 60 volts and supplied by:

a) An inherently limited Class 2 transformer or a not inherently limited Class 2 transformer and an overcurrent protective device that is:

1) Not of the automatic reclosing type,

2) Trip-free from the reclosing mechanism, and

3) Not readily interchangeable with a device of a different rating or the device is marked in accordance with 65.6.

b) A combination of an isolated transformer secondary winding and one or more resistors or a regulating network complying with 25.11 that complies with all the performance requirements for an inherently limited Class 2 transformer or power source; or

c) A battery that is isolated from the primary circuit or a combination of a battery, including the battery charging circuit of a tracker that is isolated from the primary circuit, and one or more resistors or a regulating network complying with 25.11.

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2.29 MACHINE SCREW – A threaded fastener which is utilized with a threaded nut or internal threads in a material, to provide a clamp load on the mechanical joint being fastened. See ANSI/ASME B18.6.3 for illustrations of the various types of machine screws.

2.30 MANUFACTURER-SPECIFIED EXTERNAL ISOLATION TRANSFORMER – A manufacturer-specified isolation transformer that is external to the product, but which is always required for proper operation of the product. For example, when an isolation transformer is required to prevent circulating ground current in installations that have a grounded conductor in the ac or dc input power circuit.

2.31 MAXIMUM SYSTEM VOLTAGE – The open-circuit voltage (Voc) of the photovoltaic module or panel multiplied by the temperature correction factor specified in Article 690.7 of the National Electrical Code, ANSI/NFPA 70 for crystalline and multi-crystalline silicon photovoltaic modules and panels. The maximum system voltage is equal to the Voc for amorphous silicate and thin film photovoltaic modules and panels.

2.32 OPEN-CIRCUIT VOLTAGE (Voc) – The maximum no load output voltage of a photovoltaic module or panel at standard test conditions (STC). See 2.45.

2.33 PERMANENTLY CONNECTED TRACKER – A tracker connected to the electrical supply by means other than a supply cord and an attachment plug.

2.34 PLATFORM – The portion of the tracker to which the solar devices are directly attached.

2.35 PRESSURE TERMINAL CONNECTOR – A terminal that accomplishes the connection of one or more conductors by means of pressure without the use of solder. Examples of pressure terminal connectors are:

a) Barrel and setscrew type,

b) Crimp-type barrel, or

c) Clamping plate and screw type.

2.36 PRIMARY CIRCUIT – Wiring and components that are conductively connected to a branch circuit.

2.37 RISK OF ELECTRICAL ENERGY- HIGH CURRENT LEVEL – The capability for damage to property or injury to persons, other than by electric shock, from available electrical energy existing between a live part and an adjacent dead metal part or between live parts of different polarity, where there is a potential of 2 volts or more and:

a) An available continuous power level of 240 volt-amperes or more, or

b) A reactive energy level of 20 joules or more.

For example, a tool, or other metal, short-circuiting a component that is able to result in a burn or a fire when enough energy is available at the component to vaporize, melt, or more than warm the metal.

2.38 SAFETY CIRCUIT – Any primary or secondary circuit that is used to reduce the risk of fire, electric shock, injury to persons, or electrical energy - high current levels. A safety interlock circuit, for example, is a safety circuit.

2.39 SAFETY INTERLOCK – A means relied upon to reduce the accessibility to an area that involves a risk of electric shock, electrical energy - high current levels, or injury to persons until the risk has been removed, or to automatically remove the risk when access is gained.

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2.40 SECONDARY CIRCUIT – A circuit supplied from a secondary winding of an isolation transformer.

2.41 SERIES CHARGE CONTROLLER – A control element for battery charging that is in series with a photovoltaic array and a battery. The control element usually operates in an on/off mode, a pulse-width modulated (PWM) mode, or a linear control mode. The control element is usually a solid state switching device or a mechanical relay.

2.42 SERVICE PERSONNEL – Trained persons having familiarity with the construction and operation of the equipment and the risks involved.

2.43 SOLAR TRACKER – A controlled moveable supporting system for solar devices, single or dual axis, which follows the sunlight to increase power output from solar devices mounted to the tracker's platform. For the purposes of this standard the solar tracker is an assembly, and will be referred to throughout this document as a "tracker".

2.44 STAND-ALONE INVERTER – An inverter intended to supply a load and does not provide power back to the electric utility.

2.45 STANDARD TEST CONDITIONS (STC) – Test conditions consisting of:

a) 1000 W/m^2 irradiance,

b) AM 1.5 solar spectrum, and

c) 25°C (77°F) cell temperature.

2.46 STOW – A position the tracker moves to when adverse weather conditions (e.g., high wind, heavy snow or hail) are present or expected so that the excessive loads that might damage the tracker or solar devices can be reduced. Not all trackers have a stow function, and the exact position may vary depending on the tracker design. It is possible that one tracker have multiple stow positions. For example, the front surface of the tracker could face up horizontally for high wind, or as vertical as possible for snow or hail.

2.47 TOOL – A screwdriver, coin, key, or any other object that is usable to operate a screw, latch, or similar fastening means.

2.48 UTILITY-INTERACTIVE INVERTER – An inverter intended for use in parallel with an electric utility to supply common loads and sometimes deliver power to the utility.

3 General

3.1 Components

3.1.1 Except as indicated in 3.1.2, a component of a tracker or product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components commonly used in the trackers or 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 tracker or 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.

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3.1.4 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.

3.2 Units of measurement

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

3.3 References

3.3.1 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.

CONSTRUCTION

4 Electrical Enclosure

4.1 General

4.1.1 System components shall be provided within an enclosure that houses all current-carrying parts. The enclosure shall protect the enclosure's internal electrical components against mechanical damage from forces external to the enclosure. The parts of the enclosure that are required to be in place to comply with the requirements to reduce the risk of fire, electric shock, injury to persons shall comply with the applicable enclosure requirements specified in this standard.

4.1.2 The chassis and/or supporting frame inside an enclosure shall not be relied upon to carry current during normal operation.

4.1.3 A part, such as a dial or nameplate that is a part of the enclosure shall comply with the enclosure requirements.

4.1.4 An enclosure shall comply with Environmental Rated Enclosures, Section 4.9, or the requirements for the respective Type in the Standard for Enclosures for Electrical Equipment, UL 50.

4.1.5 Sheet-metal screw thread form shall not be used. Machine screws, self-tapping machine screws, and thread forming machine screws are to be utilized in sheet-metal when there are at least two full threads of screw engagement.

4.2 Access covers

4.2.1 For an enclosure used as a load center, a cover that gives access to a fuse or other overload-protective device, the functioning of which requires renewal shall be hinged. A hinged cover is also required for an enclosure when it is required to open the cover in connection with normal operation of the tracker. The cover shall not depend solely upon screws or other similar means requiring the use of a tool to hold it closed; however, it shall be provided with a spring latch or catch, or a hand operable captive fastener. Live parts shall not be accessible when the cover is open.

Exception No. 1: A cover is not required to be provided with a hinge when the only overload-protective devices enclosed are:

a) Supplementary types in control circuits and the protective device and the circuit loads are within the same enclosure,

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b) Supplementary types rated 2 amperes or less for loads not exceeding 100 volt-amperes,

c) Extractor fuses having an integral enclosure, or

d) Protective devices connected in a low-voltage, limited-energy (LVLE) circuit.

Exception No. 2: A cover is not required to be provided with a hinge for an enclosure that contains no user-serviceable or -operable parts and which is provided with a marking in accordance with 65.5.

4.2.2 With reference to 4.2.1, a door or cover giving access to a fuse shall comply with the requirements for doors and covers, in the Standard for Industrial Control Equipment, UL 508.

4.3 Cast metal enclosures

4.3.1 The thickness of cast metal for an enclosure shall not be less than indicated in Table 4.1.

Exception: Cast metal of lesser thickness is usable where the enclosure complies with Compression Test, Section 48.

Table 4.1
Thickness of cast-metal enclosures

Use, or dimension of area involved	Minimum thickness, mm (inch)			
	Die-cast metal		Cast metal other than die-cast type	
Area of 154.8 cm^2 (24 in^2) or less and having no dimension greater than 152 mm (6 inches)	1.6[a]	(1/16)	3.2	(1/8)
Area greater than 154.8 cm^2 (24 in^2) or having any dimension greater than 152 mm (6 inches)	2.4	(3/32)	3.2	(1/8)
At a threaded conduit hole	6.4	(1/4)	6.4	(1/4)
At an unthreaded conduit hole	3.2	(1/8)	3.2	(1/8)

[a] The area limitations for metal 1.6 mm (1/16 inch) thick are attainable by the provision of reinforcing ribs subdividing a larger area.

4.4 Sheet metal enclosures

4.4.1 The thickness of a sheet-metal enclosure shall not be less than that specified in Table 4.2 and Table 4.3; however, uncoated steel shall not be less than 0.81 mm (0.032 inch) thick, zinc-coated steel shall not be less than 0.86 mm (0.034 inch) thick, and nonferrous metal shall not be less than 1.14 mm (0.045 inch) thick at points at which a wiring system is to be connected.

Exception: Sheet metal of lesser thickness is usable where the enclosure complies with Compression Test, Section 48.

4.4.2 With reference to Table 4.2 and Table 4.3, a supporting frame is a structure consisting of angles, channels, or folded rigid sections of sheet metal that is rigidly attached to and has similar outside dimensions as the enclosure surface and that has the torsional rigidity to resist the bending moments that result when the enclosure surface is deflected. A construction that has equivalent reinforcing is one that is as rigid as one built with a frame of angles or channels. Compliance of this requirement is to be determined by Compression Test, Section 48.

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Table 4.2
Thickness of sheet metal for enclosures, carbon steel or stainless steel

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness, mm (inch)			
Maximum width,[b]		Maximum length,[c]		Maximum width,[b]		Maximum length,[c]					
cm	(inch)	cm	(inch)	cm	(inch)	cm	(inch)	Uncoated		Coated	
10.2	(4.0)	Not limited		15.9	(6.25)	Not limited		0.51[d]	(0.020)	0.58[d]	(0.023)
12.1	(4.75)	14.6	(5.75)	17.1	(6.75)	21.0	(8.25)				
15.2	(6.0)	Not limited		24.1	(9.5)	Not limited		0.66[d]	(0.026)	0.74[d]	(0.029)
17.8	(7.0)	22.2	(8.75)	25.4	(10.0)	31.8	(12.5				
20.3	(8.0)	Not limited		30.5	(12.0)	Not limited		0.81	(0.032)	0.86	(0.034)
22.9	(9.0)	29.2	(11.5)	33.0	(13.0)	40.6	(16.0)				
31.8	(12.5	Not limited		49.5	(19.5)	Not limited		1.07	(0.042)	1.14	(0.045)
35.6	(14.0	45.7	(18.0)	53.3	(21.0)	63.5	(25.0)				
45.7	(18.0)	Not limited		68.6	(27.0)	Not limited		1.35	(0.053)	1.42	(0.056)
50.8	(20.0)	63.5	(25.0)	73.7	(29.0)	91.4	(36.0)				
55.9	(22.0)	Not limited		83.8	(33.0)	Not limited		1.52	(0.060)	1.60	(0.063)
63.5	(25.0)	78.7	(31.0)	88.9	(35.0)	109.2	(43.0)				
63.5	(25.0)	Not limited		99.1	(39.0)	Not limited		1.70	(0.067)	1.78	(0.070)
73.7	(29.0)	91.4	(36.0)	104.1	(41.0)	129.5	(51.0)				
83.8	(33.0)	Not limited		129.5	(51.0)	Not limited		2.03	(0.080)	2.13	(0.084)
103.4	(38.00	119.4	(47.0)	137.2	(54.0)	167.6	(66.0)				
106.7	(42.0)	Not limited		162.6	(64.0)	Not limited		2.36	(0.093)	2.46	(0.097)
119.4	(47.0)	149.9	(59.0)	172.7	(68.0)	213.4	(84.0)				
132.1	(52.0)	Not limited		203.2	(80.0)	Not limited		2.74	(0.108)	2.82	(0.111)
152.4	(60.0)	188.0	(74.0)	213.4	(84.0)	261.6	(103.0)				
160.0	(63.0)	Not limited		246.4	(97.0)	Not limited		3.12	(0.123)	3.20	(0.126)
185.4	(73.0)	228.6	(90.0)	261.6	(103.0)	322.6	(127.0)				

[a] See 4.4.2 and 4.4.3.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. In some cases, adjacent surfaces of an enclosure have supports in common and are made of a single sheet.

[c] "Not limited" applies only where the edge of the surface is flanged at least 12.7 mm (1/2 inch) or fastened to adjacent surfaces not normally removed in use.

[d] Sheet steel for an enclosure intended for outdoor use shall not be less than 0.86 mm (0.034 inch) thick for coated metal and not less than 0.81 mm (0.032 inch) thick for uncoated metal.

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Table 4.3
Thickness of sheet metal for enclosures, aluminum, copper, or brass

Without supporting frame[a]				With supporting frame or equivalent Reinforcing[a]				Minimum thickness,	
Maximum width[b],		Maximum length[c],		Maximum width[b],		Maximum length[c],			
cm	(inch)	cm	(inch)	cm	(inch)	cm	(inch)	mm	(inch)
7.6	(3.0)	Not limited		17.8	(7.0)	Not limited		0.58[d]	(0.023)
8.9	(3.5)	10.2	(4.0)	21.6	(8.5)	24.1	(9.5)		
10.2	(4.0)	Not limited		25.4	(10.0)	Not limited		0.74	(0.029)
12.7	(5.0)	15.2	(6.0)	26.7	(10.5)	34.3	(13.5)		
15.2	(6.0)	Not limited		35.6	(14.0)	Not limited		0.91	(0.036)
16.5	(6.5)	20.3	(8.0)	38.1	(15.0)	45.7	(18.0)		
20.3	(8.0)	Not limited		48.3	(19.0)	Not limited		1.14	(0.045)
24.1	(9.5)	29.2	(11.5)	53.3	(21.0)	63.5	(25.0)		
30.5	(12.0)	Not limited		71.1	(28.0)	Not limited		1.47	(0.058)
35.6	(14.0)	40.6	(16.0)	76.2	(30.0)	94.0	(37.0)		
45.7	(18.0)	Not limited		106.7	(42.0)	Not limited		1.91	(0.075)
50.8	(20.0)	63.5	(25.0)	114.3	(45.0)	139.7	(55.0)		
63.5	(25.0)	Not limited		152.4	(60.0)	Not limited		2.41	(0.095)
73.7	(29.0)	91.4	(36.0)	162.6	(64.0)	198.1	(78.0)		
94.0	(37.0)	Not limited		221.0	(87.0)	Not limited		3.10	(0.122)
106.7	(42.0)	134.6	(53.0)	236.2	(93.0)	289.6	(114.0)		
132.1	(52.0)	Not limited		312.4	(123.0)	Not limited		3.89	(0.152)
152.4	(60.0)	188.0	(74.0)	330.2	(130.0)	406.4	(160.0)		

[a] See 4.4.2 and 4.4.3.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. In some cases, adjacent surfaces of an enclosure have supports in common and are made of a single sheet.

[c] "Not limited" applies only where the edge of the surface is flanged at least 12.7 mm (1/2 inch) or fastened to adjacent surfaces not normally removed in use.

[d] Sheet copper, brass, or aluminum for an enclosure intended for outdoor use shall not be less than 0.74 mm (0.029 inch) thick.

4.4.3 With reference to 4.4.2 and Table 4.2 and Table 4.3, a construction does not have a supporting frame when it is:

a) An enclosure formed or fabricated from sheet metal,

b) A single sheet with single formed flanges or formed edges,

c) A single sheet that is corrugated or ribbed, or

d) An enclosure surface loosely attached to a frame, for example, by spring clips.

4.5 Nonmetallic enclosures

4.5.1 A polymeric enclosure or polymeric part of an enclosure shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. See 4.5.3.

Exception: A polymeric enclosure which complies with the Standard for Enclosures for Electrical Equipment, UL 50, is not required to be investigated for compliance with UL 746C.

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4.5.2 Where an electrical instrument, such as a meter, forms part of the enclosure, the face or the back of the instrument housing, or both together, shall comply with the requirements for an enclosure.

Exception: A meter complying with the Standard for Electrical Analog Instruments – Panel Board Types, UL 1437, complies with this requirement.

4.5.3 The requirement in 4.5.1 does not apply to a nonmetallic part that forms part of the enclosure under any one of the following conditions:

a) The part covers an opening that has no dimension greater than 25.4 mm (1 inch) and the part is made of a material Classed as V-0, V-1, V-2, or HB, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94,

b) The part is made of a material Classed V-0, V-1, V-2, or HB and covers an opening which does not give access to the user, when the part is removed, to live parts involving a risk of fire, electric shock, or electric energy-high current levels or moving parts.

c) The part covers an opening that has no dimension greater than 101.6 mm (4 inches) and the part is made of a material Classed as V-0, V-1, V-2, or HB, and there is no source of a risk of fire closer than 4 inches from the surface of the enclosure, or

d) The part is made of a material Classed V-0, V-1, V-2, or HB and there is a barrier or a device that forms a barrier made of a material Classed V-0 between the part and a source of a risk of fire.

Exception: A part of a component is not required to be Classed V-0, V-1, V-2, or HB when it complies with the flammability requirements applicable to the component. See Components, Section 3.1.

4.5.4 A nonmetallic enclosure intended for connection to a rigid conduit system shall comply with the Polymeric Enclosure Rigid Metallic Conduit Connection Tests in the Standard for Enclosures for Electrical Equipment, UL 50.

4.6 Openings covered by glass

4.6.1 Glass covering an opening shall comply with 4.6.2, shall be secured in place so that it is not readily displaced in service, and shall provide mechanical protection for the enclosed parts.

4.6.2 Glass for an opening:

a) Not more than 102 mm (4 inches) in any dimension shall not be less than 1.6 mm (1/16 inch) thick,

b) Glass for an opening other than described in (a) and not more than 929 cm^2 (144 square inches) in area and having no dimension greater than 305 mm (12 inches), shall not be less than 3.2 mm (1/8 inch) thick, and

c) Glass used to cover an area greater than described in (b) shall not be less than 3.2 mm thick and:

1) Shall be of a nonshattering or tempered type that, when broken, complies with the Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1-1984 (R1994), or

2) Shall withstand a 3.38 joules (2-1/2 ft-lbf) impact from a 50.8-mm (2-inch) diameter, 535 gram (1.18 pound) steel sphere without cracking or breaking to the extent that a piece is dislodged from its normal position.

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4.7 Openings for wiring system connections

4.7.1 Where threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or where an equivalent construction is employed, there shall not be less than three, or more than five threads in the metal; and the construction of the enclosure shall be such that a conduit bushing is attachable as intended. Where threads for the connection of conduit are not tapped all the way through a hole in an enclosure wall, conduit hub, or a similar component; there shall not be less than 3-1/2 threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors equivalent to that provided by a standard conduit bushing and the hole shall have an internal diameter that corresponds with the applicable trade size of rigid conduit.

4.7.2 Clamps and fasteners for the attachment of conduit, electrical metallic tubing, armored cable, nonmetallic flexible tubing, nonmetallic-sheathed cable, service cable, or equivalent, that are supplied as a part of an enclosure shall comply with the Standard for Conduit, Tubing, and Cable Fittings, UL 514B.

4.7.3 A knockout in a sheet-metal enclosure shall be secured and shall be removable without undue deformation of the enclosure.

4.7.4 A knockout shall be provided with a flat surrounding surface so a conduit bushing of the corresponding size seats as intended. A knockout intended to be used for installation purposes, shall be located so that installation of a bushing does not result in spacings between uninsulated live parts and the bushing of less than required in Spacings, Section 20.

4.7.5 In measuring a spacing between an uninsulated live part and a bushing installed in a knockout as specified in 4.7.4, it is to be assumed that a bushing having the dimensions specified in Table 4.4 is in place, in conjunction with a single locknut installed on the outside of the enclosure.

Table 4.4
Knockout or hole sizes and dimensions of bushings

Trade size of conduit,	Knockout or hole diameter		Bushing dimensions			
			Overall diameter		Height	
Inch	mm	(inch)	mm	(inch)	mm	(inch)
1/2	22.2	(7/8)	25.4	(1)	9.5	(3/8)
3/4	27.8	(1-3/32)	31.4	(1-15/64)	10.7	(27/64)
1	34.5	(1-23/64)	40.5	(1-19/32)	13.1	(33/64)
1-1/4	43.7	(1-23/32)	49.2	(1-15/16)	14.3	(9/16)
1-1/2	50.0	(1-31/32)	56.0	(2-13/64)	15.1	(19/32)
2	62.7	(2-15/32)	68.7	(2-45/64)	15.9	(5/8)
2-1/2	76.2	(3)	81.8	(3-7/32)	19.1	(3/4)
3	92.1	(3-5/8)	98.4	(3-7/8)	20.6	(13/16)
3-1/2	104.8	(4-1/8)	112.7	(4-7/16)	23.8	(15/16)
4	117.5	(4-5/8)	126.2	(4-31/32)	25.4	(1)
4-1/2	130.2	(5-1/8)	140.9	(5-35/64)	27.0	(1-1/16)
5	142.9	(5-5/8)	158.0	(6-7/32)	30.2	(1-3/16)
6	171.5	(6-3/4)	183.4	(7-7/32)	31.8	(1-1/4)

4.7.6 For an enclosure not provided from the factory with conduit openings or knockouts, spacings not less than the minimum required in this standard shall be provided between uninsulated live parts and a

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