

UL 1561

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Dry-Type General Purpose and Power Transformers

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UL Standard for Safety for Dry-Type General Purpose and Power Transformers, UL 1561

Third Edition, Dated March 23, 1999

Revisions: This Standard contains revisions through and including September 15, 2005.

Summary of Topics

These revisions to UL 1561 are being issued to incorporate new and revised requirements from the proposals for Subject 1561 dated March 25, 2005 and July 22, 2005.

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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 new and revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated March 25, 2005 and July 22, 2005.

The revisions dated September 15, 2005 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net.ul.com/ulforeword.html>.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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 Recognition and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

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UL 1561

Standard for Dry-Type General Purpose and Power Transformers

Prior to the first edition, the requirements for the products covered by this standard were included in a supplement to the Standard for Specialty Transformers, UL 506.

Prior to March 27, 1987, the first edition was titled the Standard for Large General Purpose Transformers.

First Edition – January, 1986

Second Edition – April, 1994

Third Edition

March 23, 1999

The most recent designation of ANSI/UL 1561 as an American National Standard (ANSI) occurred on September 15, 2005.

This ANSI/UL Standard for Safety, which consists of the Third Edition with revisions through September 15, 2005 is under continuous maintenance, whereby each revision is ANSI approved upon publication. 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>.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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.

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INTRODUCTION

1 Scope

1.1 These requirements cover:

a) General purpose and power transformers of the air-cooled, dry, ventilated, and nonventilated types rated no more than 500 kVA single-phase or no more than 1500 kVA three-phase to be used in accordance with the National Electrical Code, NFPA 70. Constructions include step up, step down, insulating, and autotransformer type transformers as well as air-cooled and dry-type reactors or

b) General purpose and power transformers of the exposed core, air-cooled, dry, and compound-filled types rated more than 10 kVA but no more than 333 kVA single-phase or no more than 1000 kVA three-phase to be used in accordance with the National Electrical Code, NFPA 70. Constructions include step up, step down, insulating, and autotransformer type transformers as well as air-cooled, dry, and compound-filled type reactors.

1.2 These requirements do not cover ballasts for high intensity discharge (HID) lamps (metal halide, mercury vapor, and sodium types) or fluorescent lamps, exposed core transformers, compound-filled transformers, liquid-filled transformers, voltage regulators, general use or special types of transformers covered in requirements for other electrical equipment, autotransformers forming part of industrial control equipment, motor-starting autotransformers, variable voltage autotransformers, transformers having a nominal primary or secondary rating of more than 600 volts, or overvoltage taps rated greater than 660 volts.

1.3 These requirements do not cover transformers provided with waveshaping or rectifying circuitry. Waveshaping or rectifying circuits may include components such as diodes and transistors. Components such as capacitors, transient voltage surge suppressors, and surge arresters are not considered to be waveshaping or rectifying devices.

1.4 *Deleted September 15, 2005.*

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 used in the products covered by this standard.

2.1.1 revised April 2, 2001

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.

2.1.2 revised April 2, 2001

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

2.1.3 revised April 2, 2001

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.

2.1.4 revised April 2, 2001

2.2 Units of measurement

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

2.2.1 revised April 2, 2001

2.2.2 Unless otherwise indicated, all voltages and current values mentioned in this standard are root-mean-square (rms).

2.3 Undated references

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

3 Glossary

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

3.2 COMPOUND-FILLED TRANSFORMER – A transformer in which the windings are enclosed with an insulating fluid which becomes solid, or remains plastic, at intended operating temperatures.

3.3 ENCAPSULATED COIL – A coil that

- a) Is enclosed with an insulating fluid that becomes solid and
- b) Can be used in either a ventilated or nonventilated transformer.

3.4 EXPOSED CORE TRANSFORMER – A transformer with exposed core laminations.

3.5 K-FACTOR – A rating optionally applied to a transformer indicating its suitability for use with loads that draw nonsinusoidal currents. The K-factor equals:

$$\sum_{h=1}^{\infty} I_h (pu)^2 h^2$$

in which:

$I_h(pu)$ is the rms current at harmonic "h" (per unit of rated rms load current) and

h is the harmonic order.

K-factor rated transformers have not been evaluated for use with harmonic loads where the rms current of any singular harmonic greater than the tenth harmonic is greater than 1/h of the fundamental rms current.

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3.6 NONVENTILATED DRY-TYPE TRANSFORMER – A dry-type transformer other than of the compound-filled or exposed core type that is constructed so as to provide no intentional circulation of ambient air through the transformer and is intended to operate at normal ambient air pressure.

3.7 VENTILATED DRY-TYPE TRANSFORMER – A dry-type transformer that is constructed so that ambient air may circulate through the enclosure to cool the transformer core and windings.

CONSTRUCTION

4 Mechanical Assembly

4.1 A transformer shall be complete when it is shipped from the factory.

Exception No. 1: A transformer that is complete for indoor use may have provision for a field-added rainproof hood if the transformer is marked in accordance with 35.9.2 and 35.9.3.

Exception No. 2: A transformer that is complete for intended use may have provision for a field-added extension to the enclosure to provide for additional wiring space.

Exception No. 3: Wire connectors may be field supplied.

4.2 A transformer that weighs more than 100 pounds (45 kg) shall be provided with a means for lifting by a fork lift, a cable, a sling, or the equivalent. The lifting means may be provided on the transformer core or frame or the equivalent if the transformer has a removable top cover. The lifting means shall be subjected to the Lifting or Mounting Means Test, Section 25.

Exception: The lifting means test does not apply to a transformer that is intended to be lifted from underneath by a fork lift or other means.

4.3 A transformer shall be marked in accordance with 35.11.1. The weight of the transformer shall not exceed 110 percent of the weight marked on the transformer.

4.4 A solid rivet, screw, bolt, or similar fastener in a sheet metal enclosure shall have a diameter at least 50 percent greater than the sum total thickness of all the sheet metal items secured by the fastener. Screws securing covers shall comply with 5.5.2. Screws threaded directly into a metal component of the enclosure shall meet or exceed the torque requirements in 4.5(b).

Exception No. 1: A fastening device as described in 4.5 may be used.

Exception No. 2: A machine screw fully engaging two complete threads need not be tested.

4.5 With respect to 4.4, a different type of fastening device may be used if employed with a conventional screw. Other types of fastening devices may be used if investigated for the particular application. A single-threaded nut intended to slip over the edge of sheet metal to receive a retaining screw may be used to secure a cover to an enclosure if:

- a) The nut is protected against corrosion by painting, galvanizing, sherardizing, plating, or other equivalent means and
- b) The threads do not strip when a torque of 30 pound-force-inches (3.4 N·m) is applied.

5 Enclosure

5.1 General

5.1.1 A transformer shall have an enclosure of moisture-resistant material. An iron or steel enclosure shall be protected against corrosion as described in 5.8.1 – 5.8.3. The enclosure shall house all uninsulated live parts.

Exception: A bottom for the enclosure need not be provided for a transformer intended to be pad mounted if the walls will be flush or within 3/8 inch (9.5 mm) of the pad and if the transformer is marked in accordance with 35.10.3.

5.1.2 If a transformer is intended to be mounted on a concrete pad, aluminum parts of an enclosure shall be located at least 1/4 inch (6.4 mm) above the mounting pad.

Exception: Aluminum parts of an enclosure coated with a metallic or nonmetallic coating may be in contact with a concrete pad if the coating is protected against corrosion by one of the means described in 6.9 (a), (b), (c), (d), or (e).

5.1.3 An edge, projection, or corner of an enclosure, opening, frame, guard, knob, handle, or the like of a transformer shall be smooth and not sufficiently sharp to cause a cut-type injury when contacted during intended use or maintenance.

5.2 Sheet metal

5.2.1 The thickness of a sheet metal enclosure shall comply with:

- a) Table 5.1 for an enclosure without a supporting frame,
- b) 5.2.2 and Table 5.1 for an enclosure with a supporting frame, or
- c) 26.2.1 for an enclosure with equivalent reinforcement.

5.2.2 With reference to Table 5.1, a supporting frame is a structure of angle or channel or folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied by the enclosure surface when it is deflected. Constructions considered to be without supporting frame include:

- a) A single sheet with single formed flanges (formed edges);
- b) A single sheet that is corrugated or ribbed;
- c) An enclosure surface loosely attached to a frame, for example, with spring clips; and
- d) An enclosure surface having an unsupported edge.

5.2.3 The upper edge of a vertical sheet of an enclosure that is under the overhang of the hood and not secured to the hood shall comply with the deflection test in 26.1.1 and 26.1.2.

Table 5.1
Minimum thickness of sheet metal for enclosures

Maximum dimensions of enclosure				Minimum average thickness of sheet metal							
				Steel ^a				Copper, brass, or aluminum			
Length or width, inches (cm)		Area, inches ² (cm ²)		Without supporting frame, inch (mm)		With supporting ^b frame or equivalent reinforcement ^c , inch (mm)		Without supporting frame, inch (mm)		With supporting frame ^b or equivalent reinforcement ^c , inch (mm)	
3	7.6	6	38.7	0.020	0.51	0.020	0.51	0.023	0.58	0.023	0.58
8	20.3	30	194	0.026	0.66	0.020	0.51	0.036	0.91	0.029	0.74
12	30.5	90	581	0.032	0.81	0.020	0.51	0.045	1.14	0.045	0.74
18	45.7	135	871	0.042	1.07	0.032	0.81	0.058	1.47	0.058	1.14
24	61	360	2323	0.053	1.35	0.042	1.07	0.075	1.91	0.075	1.47
46	122	1200	7742	0.067	1.70	0.053	1.35	0.095	2.41	0.075	1.91
60	152	1500	9677	0.093	2.36	0.053	1.35	0.122	3.10	0.075	1.91
Over 60	Over 152	Over 1500	Over 9677	0.123	3.12	0.053	1.35	0.153	3.89	0.075	1.91
^a Other metals may be used if they are tested in accordance with 26.2.1. ^b A supporting frame is described in 5.2.2. ^c As referenced in 5.2.1, thinner metals may be used if they are tested in accordance with 26.2.1.											

5.3 Nonmetallic enclosures

5.3.1 Among the factors that shall be taken into consideration when judging the acceptability of a nonmetallic material are resistance to:

- a) Mechanical damage,
- b) Impact,
- c) Moisture absorption,
- d) Combustion, and
- e) Distortion at temperatures to which the material may be subjected under conditions of use.

Additional considerations are specified in 6.5.

5.3.2 A polymeric material shall comply with the applicable requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

5.4 Mounting

5.4.1 A transformer shall be provided with means of mounting or securing it to a surface.

5.4.2 For a transformer intended to be wall mounted, the construction shall be such that, if the enclosure is mounted on a plane surface, it will make contact at points of support only and shall maintain a clearance of not less than 1/4 inch (6.4 mm) at other points.

5.4.3 A means of securing a transformer to a wall shall be subjected to the Lifting or Mounting Means Test, Section 25.

5.5 Covers

5.5.1 A cover shall have means for securing it to the enclosure. A flat unflanged cover shall be secured within 6 inches (152 mm) of each corner.

5.5.2 Fastening screws shall be not less than 5/32 inch (4.0 mm) in major diameter for a cover 360 square inches (2323 cm²) or less in area, and not less than 3/16 inch (4.8 mm) in major diameter for a larger cover.

5.5.3 A cover intended to be removed for inspection purposes that exceeds either 12 square feet (1.1 m²) in area or 60 pounds (27.2 kg) in weight shall be equipped with a lifting means or with hinges.

5.5.4 A removable cover shall be constructed such that it will not fall onto or damage any live part inside the enclosure when all of the fastenings and supports of the cover are removed.

5.6 Ventilation

5.6.1 Any opening in an enclosure shall have such size or shape that a test rod having the diameter specified in 5.6.2 will be prevented from entering.

Exception: An opening is investigated and found acceptable if, by means of its size, location, baffling, or the like, it will prevent a straight rod 33/64 inch (13.1 mm) in diameter from passing within 4 inches (102 mm) of any uninsulated live part inside the enclosure.

5.6.2 The test rod specified in 5.6.1 shall be 33/64 inch (13.1 mm) in diameter if the plane of the opening is less than 4 inches (102 mm) from an uninsulated live part or 49/64 inch (19.4 mm) in diameter if the plane of the opening is 4 inches or more from such a part.

5.6.3 The wires of a screen of a ventilating opening shall have a minimum diameter of:

- a) 0.054 inch (1.37 mm) for a screen opening 1/2 square inch (3.2 cm²) or less in area or
- b) 0.080 inch (2.03 mm) for a screen opening larger than 1/2 square inch in area.

5.6.4 The minimum thickness of perforated sheet steel or sheet steel used for expanded metal mesh shall be in accordance with Table 5.2.

Exception: The thickness of expanded metal mesh may be less than as specified in Table 5.2 if the enclosure complies with 26.2.1.

Table 5.2
Minimum thickness of perforated sheet steel or sheet steel used for expanded metal mesh

Area of perforation or mesh openings, inch ² (cm ²)		Minimum thickness of metal			
		Uncoated,		Zinc coated,	
		inch	(mm)	inch	(mm)
1/2 or less	3.2 or less	0.042	1.07	0.045	1.14
More than 1/2	More than 3.2	0.080	2.03	0.084	2.13

5.6.5 The total area of enclosure material removed from a top or vertical wall for providing an opening or for the insertion of a panel or screen, together with the total area of openings as a result of forming the parent material, shall not exceed 25 percent of the area of the entire surface of any wall in which such openings are located.

Exception: The total area of enclosure material removed from a wall may exceed 25 percent of the area of the entire wall surface if the enclosure complies with 26.2.1.

5.6.6 The area of any opening in a top or vertical wall, as defined by the opening in the parent metal, shall not exceed 200 square inches (1.29 m²) if the closing panel is formed from material having a thickness less than that of the parent metal. A closing panel of maximum 0.053 inch (1.35 mm) thick sheet steel or 0.064 inch (1.63 mm) diameter or thinner screen wire shall not be used to close an opening of more than 80 square inches (516 cm²).

5.6.7 A ventilated closing panel of less than 0.06 inch (1.52 mm) thick uncoated steel; 0.063 inch (1.60 mm) thick zinc-coated steel; 0.075 inch (1.91 mm) thick aluminum, copper, or brass; or steel wire mesh less than 0.063 inch (1.6 mm) in diameter shall not be used to close an opening larger than 80 square inches (516 cm²).

5.7 Specific environmental conditions

5.7.1 An enclosure intended for a specific environmental condition and found acceptable by investigation for such use, as specified in Table 5.3, shall be marked in accordance with 35.9.1. An enclosure that complies with the requirements for more than one type of enclosure may be marked accordingly with multiple type designations.

5.7.2 An enclosure shall be subjected to the tests specified in Table 5.3, and shall comply with the construction requirements applicable to an enclosure of the type number or numbers with which it is marked.

5.7.3 A watertight connection at a conduit entrance shall be a conduit hub or the equivalent (such as a knockout or fitting) located so that when conduit is connected and the enclosure is mounted in the intended manner, the enclosure is found to be acceptable by investigation, as specified in Table 5.3.

5.7.4 An enclosure marked "Type 2" shall have provision for drainage. Provision for the entrance of conduit at the top or side walls shall be a conduit hub or the equivalent.

Table 5.3
Enclosure types

Table 5.3 revised September 15, 2005

Number	Environmental condition	Required tests	Openings
1	Indoor use primarily to provide protection against contact with the enclosed equipment and against a limited amount of falling dirt .	Rust Resistance Test ^a , Section 31	Rod Entry, 5.6.1
2	Indoor use to provide a degree of protection against limited amounts of falling water and dirt .	Drip Test, Section 29; Rust Resistance Test ^a , Section 31	Rod Entry, 5.6.1
3R	Outdoor use to provide a degree of protection against rain; undamaged by the formation of ice on the enclosure.	Water Spray Test, Section 28; Icing Test ^b , Section 30; and Metallic Coating Thickness Test ^c , Section 32	Rod Entry, 5.6.1
3RX	Outdoor use to provide a degree of protection against rain or corrosion; undamaged by the formation of ice on the enclosure.	Water Spray Test, Section 28; Icing Test ^b , Section 30; Metallic Coating Thickness Test ^c , Section 32; and Corrosion Resistance Test, Section 31A	Rod Entry, 5.6.1
^a The rust resistance test is not required if the enclosure is constructed as specified in 5.8.2 or Corrosion Resistance, Section 6.			
^b The transformer need not be subjected to the icing test if the enclosure has no external cavities that can trap water.			
^c The metallic coating thickness test is not required if the enclosure is constructed as specified in 6.1 – 6.8; 6.9(a) or (c); 6.10(a), (c), or (d); and 6.11 – 6.14.			

5.7.5 An enclosure marked "Type 3R or "Type 3RX" shall have:

- a) A conduit hub or the equivalent for a watertight connection when the conduit entrances are at a level higher than the lowest insulated live part in compliance with 5.7.3;
- b) Provision for drainage; and
- c) Provision for locking the door, if a door is provided.

5.7.5 revised February 6, 2004

5.7.6 An enclosure of a transformer that complies with the requirements for a rainproof Type 3R or Type 3RX enclosure, if used with a field-added rainproof hood, may be shipped without the hood if the transformer and hood are marked as described in 35.9.2 and 35.9.3

5.7.6 revised February 6, 2004

5.7.7 In an enclosure marked "Type 3R or "Type 3RX and intended for mounting on a horizontal supporting surface, any live part (including a winding) shall be located at least 4 inches (102 mm) above that surface.

5.7.7 revised February 6, 2004

5.8 Corrosion protection

5.8.1 An enclosure marked "Type 3R" or Type 3RX" (as described in 5.7.1 and 35.9.1) and fabricated of iron or sheet steel shall be protected against corrosion as specified in Corrosion Resistance, Section 6.

5.8.1 revised February 6, 2004

5.8.2 For other than a rainproof type, an enclosure of iron or steel shall be protected against corrosion by galvanizing, plating, painting, or the equivalent.

Exception: An interior surface that is covered by a compound need not be additionally protected against corrosion.

5.8.3 Iron or steel parts other than the enclosure shall be plated, painted, or otherwise protected against corrosion.

6 Corrosion Resistance

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

6.2 Hinges and other attachments shall be resistant to corrosion.

6.3 The requirements in 6.5 – 6.14 do not contemplate corrosion that might be caused by exposure to the earth or to other corrosive agents.

6.4 The requirements in 6.5 – 6.14 do not apply to a part that is not required to form a part of the enclosure.

6.5 A nonmetallic enclosure shall be judged on the basis of the effect of exposure to ultraviolet light and water. Additional considerations are specified in 5.3.1.

6.6 A metallic enclosure shall be protected against corrosion as specified in 6.7– 6.14.

6.7 Copper, bronze, brass containing not less than 80 percent copper, or stainless steel may be used without additional protection against corrosion. Sheet, extruded, or cast aluminum; die-cast zinc; and other metals shall be of a grade or alloy known to be resistant to atmospheric corrosion, shall be subjected to appropriate tests, or shall be additionally protected against corrosion.

6.8 An enclosure of cast iron or malleable iron shall be at least 1/8 inch (3.2 mm) thick and shall be protected against corrosion by:

- a) A 0.00015-inch (0.0038-mm) thick coating of zinc, cadmium, or the equivalent on the outside surface, and a visible coating of such metal on the inside surface or
- b) One coat of an organic finish of the epoxy or alkyd-resin type or other outdoor paint on each surface.

6.9 An enclosure of sheet steel less than 0.126 inch (3.20 mm) thick if zinc coated or 0.123 inch (3.12 mm) thick if uncoated shall be protected against corrosion by one of the following means or by other metallic or nonmetallic coatings that have been found to give equivalent protection as described in 6.12.

- a) Hot-dipped, mill-galvanized sheet steel conforming with the coating Designation G90 in Table I of the Standard Specifications for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirements in this ASTM specification. The weight of zinc coating may be determined by any acceptable method; however, in case of question, the weight of coating shall be established in accordance with the Standard Test Method for Weight [Mass] of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90-A90M.
- b) A zinc coating, other than that provided on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (0.015 mm) on each surface with a minimum thickness of 0.00054 inch (0.014 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 32. An annealed coating shall also comply with 6.14.
- c) A zinc coating conforming with 6.10 (a) or (b) with one coat of an organic finish of the epoxy or alkyd-resin type or other outdoor paint on each surface applied after forming.
- d) A cadmium coating not less than 0.001 inch (0.025 mm) thick on both surfaces. The thickness of coating shall be established in accordance with the Metallic Coating Thickness Test, Section 32.
- e) A cadmium coating not less than 0.00075 inch (0.019 mm) thick on both surfaces with one coat of outdoor paint on both surfaces, or not less than 0.00051 inch (0.013 mm) thick on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established in accordance with the Metallic Coating Thickness Test, Section 32, and the paint shall be as specified in (c).

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6.10 An enclosure of sheet steel 0.126 inch (3.20 mm) thick or thicker if zinc-coated or 0.123 inch (3.12 mm) thick or thicker if uncoated shall be protected against corrosion by one of the following means or by other metallic or nonmetallic coatings that have been found to give equivalent protection as described in 6.12.

- a) Hot-dipped, mill-galvanized sheet steel conforming with the coating Designation G60 or A60 in Table I of the Standard Specifications for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, ASTM A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in this ASTM specification. The weight of zinc coating may be determined by any acceptable method; however, in case of question, the weight of coating shall be established in accordance with the Standard Test Method for Weight [Mass] of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90-A90M.
- b) A zinc coating, other than that at provided on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00041 inch (0.010 mm) on each surface with a minimum thickness of 0.00034 inch (0.009 mm). The thickness of the coating shall be established by the Metallic Coating Thickness Test, Section 32.