UL 935

STANDARD FOR SAFETY

Fluorescent-Lamp Ballasts

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UL Standard for Safety for Fluorescent-Lamp Ballasts, UL 935

Tenth Edition, Dated May 21, 2001

Summary of Topics

This revision to ANSI/UL 935 dated February 23, 2024 includes the following changes:

– Updating the references to UL and non-UL standards: 10.3.1, 20.12, 23.10, Table 25.1, 44.2, SB1.2, SB2.3, SB2.4, SB3.4, SB9.1, and SB9.2

– Editorial corrections: 2.3, Table 19.1, 34.4, Figure 34.2, Table 43.1, and SD2.1.4

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 and revised requirements are substantially in accordance with Proposal(s) on this subject dated September 29, 2023 and December 15, 2023.

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The Department of Defense (DoD) has adopted UL 935 on February 17, 1983. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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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PART 1 – ALL PRODUCTS

INTRODUCTION

1 Scope

1.1 These requirements cover ballasts of the resistance, reactance, and electronic (high frequency) types for use with fluorescent lamps involving a potential of 2500 volts or less in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 A fluorescent-lamp ballast may be determined by investigation to be acceptable for use, in a fixture or other device, with electric-discharge lamps of other than the fluorescent type.

1.3 Fluorescent self ballasted lamps and ballast adaptors are evaluated using the Standard for Self-Ballasted Lamps and Lamp Adapters, UL 1993. The component ballast is evaluated to requirements in this Standard.

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 Glossary

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

2.2 BALLAST – A device that by means of reactance or resistance, singly or in combination, limits the current of a lamp to the required value for proper operation and, where necessary, provides adequate starting voltage; and in the case of rapid start circuits, provides for low-voltage lamp filament heating.

2.3 CHEESECLOTH – Used in abnormal condition tests as an indicator of a fire hazard. Bleached cheesecloth is to be running 14 – 15 square yards per pound (26 – 28 m^2/kg), and have what is known to the trade as a count of 32 X 28; that is, for any square inch, 32 threads in one direction and 28 threads in the other direction (for any square centimeter, 13 threads in one direction and 11 threads in the other direction).

2.4 CLASS P PROTECTED BALLAST – A ballast that is integrally protected from overheating, where the ballast and protection combination comply with the requirements in this standard.

2.5 COMPACT FLUORESCENT LAMP – A fluorescent lamp of a small compact shape (such as a folded construction) with all contacts terminating in a single base that performs the entire mechanical support function.

2.6 CONDITIONED LAMP – A new lamp that has been operated for a minimum of 100 hours.

2.7 CONVENTIONAL MAGNETIC BALLAST – A ballast that consists of a coil of wire wound on a core and operates at the supply line frequency. A conventional magnetic ballast is either a transformer type or simple reactance type. A power capacitor is able to be provided with the magnetic ballast.

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2.8 DEACTIVATED LAMP – A lamp end-of-life failure mode, that is caused by the depletion of the filament emission material so that the lamp cannot be ionized.

2.9 ELECTRONIC BALLAST – A ballast involving high frequency switching that is controlled by active components (transistors, thyristors, and the like), and with the lamp ballasting impedance provided by a series capacitive or inductive reactance appropriate for the high switching frequency. The lamps and ballasting impedance may be connected either directly or by means of an isolating transformer to the switching transistors.

2.10 FIXED BALLAST – A ballast intended to be permanently connected electrically.

2.11 INSTANT-START CIRCUIT – A circuit that employs a high open-circuit voltage to start lamps that usually have a single contact at each end.

2.12 LEAD-LAG CIRCUIT – A two-lamp circuit that has one lamp in series with an inductor and the other lamp in series with a capacitor to attain a high power factor. Generally, it may be part of either an instant-start or preheat circuit.

2.13 LIVE PARTS – Metallic parts intended to carry voltage or current. A part that is connected to a grounded (neutral) supply conductor is determined to be a live part.

2.14 MEASUREMENT INDICATION UNIT (MIU) – The output voltage across the meter, in millivolts RMS, in the measurement instrument in Figure 23.2, divided by 500 ohms. The instrument indication is equal to the RMS value in milliamperes when the frequency is 60 Hz (sinusoidal current). The reading is not always a direct indication of the RMS or other common amplitude quantifier of leakage current when the leakage current is of complex waveform or frequency other than 50 or 60 Hz.

2.15 POWER CAPACITOR – A capacitor that is connected:

a) In series with a lamp or lamps and provides the ballast impedance for the lamp current; or

b) Across the input leads of the ballast or across an extension of the primary winding for power-factor correction.

2.16 PREHEAT CIRCUIT – A circuit with a ballast connected in series with a lamp, and having a manual or automatic starter that functions to cause an initial heating of the lamp filaments prior to ionizing the lamp. The starter, when closed, connects the two lamp filaments in series in the ballast circuit.

2.17 RAPID-START CIRCUIT – A circuit employing continuously heated lamp filaments, along with an open-circuit voltage for the ballast to start a lamp without a starter. The lamps usually have miniature or medium bi-pin contacts or specific sockets (for example, circular lamps) for sizes smaller than 40 watts or recessed contacts for the larger 800 and 1500 milliampere sizes. A metal reflector connected to ground is needed near the lamps to ensure starting.

2.18 REACTANCE BALLAST – A ballast, the impedance of which is provided by:

a) Inductive reactance;

b) Capacitive reactance; or

c) Both inductive and capacitive reactance.

2.19 REACTOR (SIMPLE REACTANCE) BALLAST – A reactance type ballast in which the lamp ballasting impedance is provided by a single coil inductor – not a transformer or inductor with additional components.

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2.20 RESISTANCE BALLAST – A ballast in which the impedance is provided by a resistor or resistance wire.

2.21 TWO-WINDING TRANSFORMER (ISOLATING TYPE) BALLAST – A ballast having independent, insulated primary and secondary windings with no common connection between them, except that a minimum resistor of 470,000 ohm may be connected between the windings to aid in lamp starting.

3 Components

3.1 Except as indicated in 3.2, 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.

3.2 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.

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

3.4 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.

4 Units of Measurement

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

4.2 All values of voltage and current are true rms values unless otherwise indicated.

5 Undated References

5.1 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

6 General

6.1 A fluorescent-lamp ballast is categorized according to the use for which it is intended. A ballast in one category is acceptable, with respect to protection against corrosion, for use as a ballast in the category that precedes it in the following list:

a) An indoor ballast is only intended for use indoor, dry location.

b) A Type 1 outdoor ballast is acceptable for use in:

1) Outdoor equipment;

2) A fixture intended for use in wet or damp locations; or

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3) An outdoor sign if the ballast is within an overall electrical enclosure.

c) A Type 2 outdoor ballast is intended for use in:

1) Outdoor equipment;

2) A fixture intended for use in wet or damp locations; or

3) An outdoor sign if the ballast, in addition to its own enclosure, is within an overall enclosure.

d) A weatherproof ballast is intended for exposure to the weather without an additional enclosure.

6.2 Materials employed in a ballast shall not be adversely affected by the temperatures to which they are subjected during normal operation. See 11.2, 13.2.4, and 13.2.5.

7 Mechanical Assembly

7.1 A ballast shall be formed and assembled so that it will have the necessary strength and rigidity to resist the abuses to which it is likely to be subjected, without increasing the risk of fire, electric shock, or injury to persons due to total or partial collapse resulting in a reduction of spacings, loosening or displacement of parts, or other defects.

8 Enclosure

8.1 General

8.1.1 A ballast shall be provided with an enclosure of metal or of a polymeric material that has been investigated and found to be evaluated for the intended use. See Polymeric Materials, Section 20, for requirements for a polymeric material used as an enclosure.

Exception: A reactor ballast intended for use within the enclosure of other equipment may be an open core-and-coil ballast.

8.1.2 A ballast is determined to be enclosed when:

a) All seams are overlapped, except that a total length of not more than 3 inches (76.2 mm) of butt seam meets the intent of this requirement when no opening in such seam is more than 0.005 square inch (3.23 mm^2) in area and the total area of such openings is no more than 0.250 square inch (161.29 mm^2); and

b) The perimeter of each opening for a lead wire fits closely around the wire that it encircles. An opening of 1/8 inch (3.2 mm) diameter or less complies with this requirement.

Exception No. 1: Laminated core sections are not required to be enclosed.

Exception No. 2: A Class P ballast without potting is not required to have lapped seams where parts of the enclosure are joined.

8.1.3 A Class P electronic ballast is able to have openings for ventilation when:

a) The ballast is provided with an overcurrent protective device rated 5 A or less or is provided with a foil trace that meets the requirements of this standard;

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b) Circular openings have a diameter not exceeding 3 mm (0.12 inch) and minimum spacing between circular openings is 3 mm (0.12 inch);

c) Rectangular (or square) openings have dimensions not exceeding 3 mm (0.12 inch) across and 30 mm (1.18 inch) in length; and

d) The pattern of openings for metal enclosures is such that the through air spacings (clearance) between live parts and the dead metal enclosure is not reduced below the values specified in Spacings, Section 19, when the enclosure is subjected to the Rod Pressure Loading Test, Section 41. (The pattern of openings for plastic enclosures is not specified).

A Class P electronic ballast shall be marked in accordance with 45.5.10.

8.1.4 The thickness of a cast- or sheet-metal enclosure shall be in accordance with Table 8.1.

Table 8.1
Thickness of metal enclosures

Metal	Minimum thickness, inch (mm)	
	At small, flat, non-reinforced surfaces and at surfaces that are reinforced by curving, ribbing, or the like	At relatively large non-reinforced flat surfaces
Die-cast metal	3/64 (1.2)	5/64 (2.0)
Cast malleable iron	1/16 (1.6)	3/32 (2.4)
Other cast metal	3/32 (2.4)	1/8 (3.2)
Uncoated sheet steel	0.026 (0.66)[a,b]	0.026 (0.66)[a,b]
Galvanized sheet steel	0.029 (0.74)[a]	0.029 (0.74)[a]
Nonferrous sheet metal (including extruded)	0.032 (0.81)[b]	0.032 (0.81)[b]

NOTE – These are minimum dimensions based on nominal metal gauge thicknesses, for example, 22 Manufacturer's Sheet Gauge, is 0.030 inch, nominal, 0.026 inch minimum. Because of the tolerance in metal gauge sizes, metal thickness is to be increased so it is never less than the specified minimum.

[a] See 8.1.5.

[b] Uncoated sheet steel or nonferrous sheet metal with a minimum thickness of 0.020 inch (0.51 mm) meets the intent of the requirement when:

1) The ballast is intended to be used indoors only or marked for Type 1 outdoor use;

2) The overall weight is less than 8.8 pounds (4.0 kg); and

3) The ballast is completely compound filled, or the ballast complies with the Crushing Resistance and Resistance to Impact tests described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Note that the metal is uncoated when measured, however, it shall have an additional metallic or organic coating when the ballast is marked "Type 1 outdoor use."

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8.1.5 A sheet-steel enclosure of a weatherproof ballast shall not be less than 0.056 inch (1.42 mm) thick if galvanized steel, and not less than 0.053 inch (1.35 mm) thick if uncoated steel.

8.1.6 A closure for a hole no larger than 1/2 square inch (323.0 mm^2) in area in the base of a metal enclosure complies with this requirement if:

a) The closure is not less than 0.014 inch (0.36 mm) thick;

b) The surrounding metal is reinforced by forming; and

c) The closure is secured in place so that it cannot be removed without the use of a tool.

8.1.7 Fiber or phenolic-composition sheet material used for an end piece of the enclosure of a reactance ballast shall not be less than 1/16 inch (1.6 mm) thick, and shall be:

a) Secured in place so that all seams are closed; and

b) Rigidly supported to prevent displacement or removal.

Exception: An end piece of insulating material of small area that serves principally as a bushing for a lead may be not less than 1/32 inch (0.8 mm) thick if the exposed area of the piece is not more than 1/4 square inch (161.0 mm^2), and if the insulating material is supported in a complete frame or rests on the metal enclosure around the entire perimeter. See 13.4.

8.1.8 Fiber shall not be employed for any part of the enclosure or for lead bushings of a ballast intended for outdoor use, and fibrous material shall not be used for any internal part of an outdoor ballast unless it is covered completely with a material that will prevent the absorption of moisture by the fibrous material.

8.2 Raintightness

8.2.1 A weatherproof or Outdoor Type 2 ballast shall be constructed so that it excludes a beating rain when tested in accordance with the Water-Spray Test, Section 37.

Exception: The Water-Spray Test is not required when a ballast is fully potted.

8.2.2 Means for drainage shall be provided in the enclosure of a weatherproof ballast that has a knockout or unthreaded conduit opening.

9 Means for Mounting

9.1 A ballast intended for permanent installation shall have at least two mounting feet or ears, or shall be otherwise arranged for support at not less than two points to reduce the likelihood of turning.

9.2 A ballast intended for permanent installation and provided with a single, threaded nipple meets the intent of the requirements when the nipple is a standard trade size long enough for two locknuts for assembly to a fixture enclosure. The ballast enclosure shall be evaluated for a construction with a ballast located outside a fixture enclosure.

9.3 A ballast connected in the power-supply cord, as specified in 46.3.1, shall not have screw holes or other means that may be used to mount the ballast permanently.

10 Protection Against Corrosion

10.1 General

10.1.1 An enclosure constructed of iron or steel shall be protected against corrosion by plating, painting, or the equivalent. Both inside and outside surfaces of an enclosure shall be protected against corrosion.

Exception: A protective coating need not be applied to:

a) The interior of a ballast enclosure that is completely filled with potting compound; or

b) Flat metal surfaces that are tightly clamped together.

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10.1.2 Exposed surfaces of the iron from which a core is assembled shall be protected against corrosion.

10.2 Outdoor ballasts

10.2.1 A ferrous-metal enclosure of a ballast marked for Type 1 outdoor use shall be protected against corrosion in accordance with 10.1.1 and 10.1.2.

10.2.2 A ferrous-metal enclosure of a ballast marked for Type 2 outdoor use shall be protected against corrosion as specified in Table 10.1.

Exception No. 1: The interior of a compound filled section of a ballast need not be so protected.

Exception No. 2: A steel enclosure provided with an organic coating complies with this requirement if comparative tests with galvanized-sheet steel (without annealing, wiping or other surface treatment) conforming with ASTM coating Designation G60 indicate the coating provides equivalent protection. Among the factors that are to be taken into consideration when judging the acceptability of such a coating system are exposure to salt spray, and moist carbon dioxide-sulphur dioxide-air mixtures.

Table 10.1
Sheet-steel coatings

Type of coating		Coating designation or thickness in inches (mm)
(A)	Hot-dipped mill-galvanized steel	G60 or A60[a]
(B)	Zinc coating other than Type (A)	0.00041 (0.0104)[b]

[a] Conforming with the coating Designation G60 (galvanized) or A60 (alloy) in Table 1 of the ASTM Designation A653/A653M, with no less than 40 percent of the zinc on any side, based on the minimum single-spot-test requirement in the ASTM designation.

[b] Average thickness with a spot minus tolerance of 0.00007 inch (0.00178 mm).

10.2.3 Cut edges and punched holes of a steel enclosure for a ballast need not be treated to reduce the likelihood of corrosion if the ballast is:

a) Marked for Type 1 outdoor use, and the steel enclosure is prepainted; or

b) Marked for Type 1 or Type 2 outdoor use and provided with a metallic ASTM coating Designation of G60 or G90.

10.2.4 A nonferrous enclosure for a ballast marked either Type 1 or Type 2 outdoor use may be employed without corrosion protection.

10.3 Weatherproof ballasts

10.3.1 A ferrous metal enclosure of a weatherproof ballast shall be protected against corrosion with a coating of zinc that complies with one of the following:

a) Hot-dipped mill-galvanized sheet steel conforming with the coating Designation G90 in Table 1 of the Specification for Steel Sheet, 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 the 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 and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90/A90M.

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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 36. An annealed coating shall also comply with the requirement in 10.3.5.

10.3.2 Ordinary painting or ordinary baked enamel is not considered to provide the necessary degree of protection for a cast-iron enclosure or exposed parts of a ballast core of a weatherproof ballast.

10.3.3 Hinges and other attachments of a weatherproof ballast shall be resistant to corrosion.

10.3.4 Metals shall be used in combinations that are galvanically compatible.

10.3.5 An annealed zinc coating that is bent or similarly formed after annealing shall also be painted in the bent or formed area if the bending or forming process damages the zinc coating. The zinc coating is considered damaged if flaking or cracking of the zinc coating at the outside radius of the bent or formed section is visible at 25 power magnification. Simple sheared or cut edges and punched holes are not considered to be formed but extruded and rolled edges and holes shall comply with this requirement.

11 Compound

11.1 An enclosed Type 1 outdoor, Type 2 outdoor, or weatherproof ballast shall be completely filled with potting compound. See 10.2.2.

Exception No. 1: A ballast enclosure need not be completely filled with potting compound if the interior surfaces are in accordance with the requirements for Protection Against Corrosion in Section 10 and spacings for any uninsulated live parts are in accordance with the requirements in Section 19, Spacing of Electrical Parts.

Exception No. 2: An electronic-ballast enclosure need not be provided with potting or may be partially filled with compound if:

a) The interior surfaces are protected against corrosion in accordance with the requirements in Protection Against Corrosion, Section 10; and

b) Spacings with or without a conformal coating that complies with Section 17, are maintained for adjacent uninsulated live parts and any uninsulated live part and accessible dead metal parts.

11.2 Compound shall not soften to the extent that it does not perform its intended function at the temperature to which it is likely to be subjected during normal and abnormal operation. See 6.2, 14.4, 27.5, and footnote (b) of Table 25.1.

11.3 For a resistance ballast, a heat-resistant compound shall comply with the requirement in 11.2; but another material may be used if, upon investigation, the material is found to have heat-resistant properties intended for the application.

12 Insulating Materials

12.1 A coil shall be provided with insulation between the windings and the core and the enclosure, and between windings that operate at a different potential or that are not electrically conductively connected to each other. Insulation, unless inherently moisture resistant, shall be treated so as to be resistant to moisture. Film coated wire does not require additional treatment to resist moisture absorption. See also 20.11.

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Exception: Bifilar wound coils, such as on an EMI filter, shall not be used with additional sheet insulating materials between the coils, unless the coils are in a metal enclosure and are protected by a supply fuse of 5 amp or less.

12.2 For other than coil forms, a material used as the mounting of uninsulated live parts shall be porcelain, phenolic, or cold-molded composition, or other thermoplastic or thermosetting material that complies with the appropriate requirements for Polymeric Materials, Section 20.

12.3 Insulating materials of a coil device shall be rated for the temperatures involved in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, as determined during both the Normal Temperature Test, Section 25, and the Abnormal Temperature Test, Section 26 of this standard. Also see 20.11.

12.4 A coil device that operates above Class 105 temperature limits as indicated in both the Normal Temperature Test, Section 25, and the Abnormal Temperature Test, Section 26, shall incorporate an insulation system that complies with the Standard for Systems of Insulating Materials – General, UL 1446.

Exception: The insulation system is not required to comply with UL 1446 when the coil device is located in an electronic ballast and:

a) Involves a potential less than 30 V rms (42.4 V peak), and has power less than 50 watts available when determined in accordance with 29.6;

b) Is an electromagnetic interference filter component:

1) Connected on the load side of an overcurrent protective device rated 5 A or less;

2) Incorporating a single winding; or

3) Incorporating rigid, fixed insulation between coils connected to opposite polarity (such as a bobbin or spacer);

c) Is a winding consisting only of film coated magnet wire wound on an insulating bobbin with a magnetic core isolated from ground or accessible dead metal; or

d) Does not provide electrical isolation between primary and output or primary and accessible low voltage circuits.

12.5 An insulating pad made of silicone rubber and having a minimum thickness of 0.005 inch (0.13 mm), or mica and having a minimum thickness of 0.004 inch (0.10 mm) is acceptable for the insulating of a semiconductor device to accessible dead metal provided the voltage is 120 volts (170 volts, peak) or less between the device's metal part and its mounting. Another insulating material can be considered acceptable provided the material has a Relative Temperature index as determined by the Standard for Polymeric Materials– Long Term Property Evaluations, UL 746B exceeds the temperature found in the Normal Temperature Test, Section 25, and the material acceptably withstands the Dielectric-Voltage Withstand Test, Section 32.

12.6 An insulating material having a minimum thickness of 0.010 inch (0.25 mm) is acceptable for insulation between the soldered side of a printed wiring board and the ballast enclosure provided the material is prevented from bearing against sharp points, although random contact is acceptable. Potting compound surrounding the liner is considered to provide adequate protection of the insulating liner. For other applications, such as insulation between a wound coil and the ballast enclosure, a sheet insulating material other than paper or polyester, shall have puncture resistance equal to or greater than the average puncture force of 0.005 inch (0.13 mm) polyester.

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12.7 A Type 1 outdoor ballast that is not provided with an enclosure, such as in an open-core-and-coil type, shall:

a) Be impregnated to reduce the risk of absorption of moisture.

Exception: A bobbin of nylon or other molded plastic meets the intent of the requirement without further impregnation.

b) Have lead wire insulation that complies with 13.2.2.

c) Comply with the Humidity-Conditioning Test, Section 38.

d) Have rated output of 300 volts or less.

12.8 An outdoor rated ballast that is not potted into an enclosure or have conformally coated printed wiring board shall be subjected to the Humidity Conditioning Test, Section 38.

13 Supply and Load Connections

13.1 Terminal and lead wire compartments

13.1.1 A terminal compartment or splice compartment for the connection of the source of supply and lamp lead wires shall provide field wiring space for the incoming wires and splices to the ballast lead wires. Field wire size is expected to be 12 AWG (3.3 mm^2). See 13.1.3.

Exception: A ballast marked for use only in signs, in accordance with 45.5.1, is expected to have 14 AWG (2.1 mm^2) field wires.

13.1.2 The field wiring compartment volume shall be at least the sum of the number of the specific wire volume allowances from Table 13.1, multiplied by the number of specific wire sizes. See Section 42, Volume Method of Measurement, for the procedure to determine the field wiring compartment volume.

Table 13.1
Conductor size for determination of the minimum terminal or splice compartment volume

Size of conductor, AWG (mm^2)		Conductor volume	
		in^3	(cm^3)
18	(0.82)	0.5	(8.2)
16	(1.3)	0.6	(9.8)
14	(2.1)	0.75	(12.3)
12	(3.3)	1.0	(16.4)
10	(5.3)	1.7	(27.9)
Example: An autotransformer ballast has a 120 volt input and operates two F32TB lamps in a rapid start design. All ballast wires (2 supply and 6 lamp) are 18 AWG. There are two incoming 12 AWG supply wires and six incoming 18 AWG wires from the lampholders. Required Volume = 14 x 0.5 + 2 x 1.0 = 9 in^3 = 147.8 cm^3			

13.1.3 The wire count shall include:

a) Branch circuit wires entering a terminal or wire compartment (for the purposes of calculating compartment volume, incoming supply wires are assumed to be 12 AWG (3.3 mm^2) or 14 AWG (2.1 mm^2) per the exception to 13.1.1, and the lamp circuit wires are assumed to be 18 AWG (0.82 mm^2);

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b) Lamp wires entering a terminal or wire compartment;

c) Grounding wires provided with the ballast;

d) Ballast wires for the supply and alternate taps;

e) Ballast wires for the lamp;

f) Ballast wires for a capacitor, when the capacitor is externally connected; and

g) Any accessory control wires.

13.1.4 There shall be no openings in a terminal or splice compartment other than those provided for drainage, and those required for mounting the ballast.

13.1.5 A hole for conduit in a weatherproof ballast, shall be threaded unless it is located wholly below the lowest live part of the device. Insulated wire leads are not considered to be live parts.

13.1.6 A bushed hole for open wiring shall not be located in the top or back of a weatherproof ballast unless a hood fitting is provided. If a bushed hole is located in a side above live parts, it shall provide for a downward direction of the wires leaving the enclosure. See 45.5.7.

13.1.7 A nipple provided with a weatherproof ballast for field connection to a splice box:

a) Shall provide a smooth, rounded opening for the leads; and

b) Shall be located in the bottom of the enclosure unless the leads are sealed within a nipple.

See 45.5.7.

13.1.8 The words below, lowest, top, back, side, above, downward, and bottom in 13.1.5– 13.1.7 denote relative positions while the ballast is oriented as it is intended to be when mounted.

13.1.9 If threads for the connection of conduit are tapped all the way through a hole in a box wall, or if an equivalent construction is employed, there shall not be less than 3-1/2 or more than 5 threads in the metal. The construction of the device shall be such that a conduit bushing can be properly attached.

13.1.10 If threads for the connection of conduit are not tapped all the way through a hole in a box wall, conduit hub, or the like, there shall not be less than five full threads in the metal. An inlet hole for the conductors shall be smooth, rounded, and afford protection to the conductors equivalent to that provided by a standard conduit bushing. The inlet hole shall have an internal diameter approximately equal to that of the corresponding trade size of rigid conduit.

13.1.11 A terminal or splice compartment shall have provision for grounding when the incoming supply is other than metallic conduit. The ground connection means shall be either a pig-tail lead wire or a wiring terminal. A pig-tail lead wire shall be green in color, at least 6 inches (152.4 mm) in length, and equal in gauge to the ballast primary lead wires. A wiring terminal shall comply with the requirements in 13.6. A sheet metal screw shall not be used.

13.2 Lead wires

13.2.1 A ballast lead wire provided for the field supply connection or output connection shall be 18 AWG (0.82 mm^2) or larger and be a solid or stranded, copper conductor with or without tinning. Ballasts with a factory-attached lampholder of a type that involves handling by the user during relamping (lamp connector) shall employ stranded conductors in lead wires to the lampholder.

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