American National Standard

ANSI C82.4-1992

American National Standard For Ballasts - For High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

National Electrical
Manufacturers Association
2101 L Street, N.W.
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American National Standard

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C82.4-1992
Revision of C82.4-1985, including ANSI C82.4a-1988

AMERICAN NATIONAL STANDARD FOR BALLASTS FOR HIGH-INTENSITY-DISCHARGE AND LOW-PRESSURE SODIUM LAMPS (MULTIPLE-SUPPLY TYPE)

Secretariat

National Electrical Manufacturers Association

Approved September 15, 1992

American National Standards Institute, Inc.

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The members of ANS C82 dedicate C82.4-1992 to the memory of Mr. Robert A. Kulka. His years of dedication and service to the development of this and other standards during his career as an electrical engineer with Magnatek were well known. His involvement will be greatly missed.

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FOREWORD (This Foreword is not part of American National Standard C82.4-1992)

Suggestions for improvement of this standard will be welcome. They should be sent to the Secretariat, C82, National Electrical Manufacturers Association, 2101 L Street, N.W., Washington, D.C. 20037.

This standard was processed and approved for submittal to the American National Standards Institute (ANSI) by the Accredited Standards Committee C82 on Lamp Ballasts. The actual development of the standard was accomplished by the C82-2 Subcommittee on High-Intensity Discharge Lamp Ballasts. Committee approval of this standard does not necessarily imply that all committee members voted for its approval.

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AMERICAN NATIONAL STANDARD C82.4-1992

AMERICAN NATIONAL STANDARD FOR BALLASTS FOR HIGH-INTENSITY-DISCHARGE AND LOW-PRESSURE SODIUM LAMPS (MULTIPLE-SUPPLY TYPE)

1. SCOPE

This standard provides specifications for and operating characteristics of ballasts for mercury, metal-halide, high-pressure sodium (HPS), and low-pressure sodium (LPS) lamps. The ballasts operate from multiple-supply sources of 600 volts maximum at a frequency of 60 hertz. They may be designed for operation under either indoor or outdoor conditions.

The following types of ballasts are excluded from this standard:

(1) Ballasts consisting of resistance only
(2) Transformers for constant current (series) operation of mercury lamps (see American National Standard for Mercury Lamp Transformers - Constant Current (Series) Supply Type, ANSI C82.7-1983 (R1988)
(3) All ballasts that use semiconductors to control the lamp power.

2. NORMATIVE REFERENCES

2.1 Referenced American National Standards

This standard is intended for use in conjunction with the following American National Standards. When these standards are superseded by a revision approved by the American National Standards Institute, Inc., the revision shall apply:

ANSI C78.40-1985, *Specifications for Mercury Lamps*

ANSI C78.41-1987, *American National Standard for Electric Lamps -Low Pressure Sodium Lamps, 1987*

ANSI C78.1340-1990, *ANS for Electric Lamps - 450 Watt Self-Ballasted Mercury Lamps*

ANSI C78.1341-1990, *ANS for Electric Lamps - 750 Watt 120-Volt Self-Ballasted Mercury Lamps*

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ANSI C78.1342-1990,	*ANS for Electric Lamps - 160 Watt 120-Volt Self Ballasted Mercury Lamps*
ANSI C78.1350-1990,	*ANS for Electric Lamps - 250 Watt S50 HPS Lamps*
ANSI C78.1352-1990,	*ANS for Electric Lamps - 1000 Watt S52 HPS Lamps*
ANSI C78.1353-1990,	*ANS for Electric Lamps - 70 Watt S62 HPS Lamps*
ANSI C78.1354-1990,	*ANS for Electric Lamps - 100 Watt S54 HPS Lamps*
ANSI C78.1355-1989,	*ANS for Electric Lamps - 200 Watt S66 HPS Lamps*
ANSI C78.1358-1988,	*ANS for Electric Lamps - 35 Watt S76 HPS Lamps*
ANSI C78.1359-1988,	*ANS for Electric Lamps - 50 Watt S68 HPS Lamps*
ANSI C78.1360-1990,	*ANS for Electric Lamps - 310 Watt S67 HPS Lamps*
ANSI C78.1375-1990,	*ANS for Electric Lamps - 400 Watt M59 Metal-Halide Lamp*
ANSI C78.1376-1990,	*ANS for Electric Lamps - 1000 Watt M47 Metal-Halide Lamp*
ANSI C78.1377-1990,	*ANS for Electric Lamps - 175 Watt M57 Metal-Halide Lamp*
ANSI C78.1378-1990,	*ANS for Electric Lamps - 250 Watt M58 Metal-Halide Lamp*
ANSI C78.1379-1990,	*ANS for Electric Lamps - 1500 Watt M48 Metal-Halide Lamp*
ANSI C78.1380-1988,	*ANS for Electric Lamps - 250 Watt 120 Volt Self-Ballasted Mercury Lamp*
ANSI C78.1381-1989,	*ANS for Electric Lamps - 70 Watt M85 Metal-Halide Lamp*

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ANSI C82.6-1985,	*Methods of Measurement of High-Intensity-Discharge Lamp Ballasts*
ANSI C82.9-1988,	*Definitions for High-Intensity-Discharge Lamp Ballasts and Transformers*
ANSI C92.1-1982,	*Power Systems - Insulation Coordination*
ANSI/IEEE C62.1-1984,	*Surge Arresters for AC Power Circuits*
ANSI/IEEE 100-1984,	*Dictionary of Electrical and Electronics Terms*

2.2 Other Related Standards

ANSI C78.386-1983,	*Electric Lamps - Mercury Lamps - Methods of Measuring Characteristics*
ANSI C78.387-1987,	*Methods of Measurement of Metal-Halide Lamp Characteristics*
ANSI C78.388-1984,	*Electric Lamps - High Pressure Sodium Lamps - Methods of Measuring Characteristics*
ANSI C82.5-1983 and C82.5a-1984	*Reference Ballasts for High-Intensity-Discharge Lamps*
ANSI C84.1-1982,	*Electric Power Systems and Equipment - Voltage Ratings (60 Hz)*
ANSI C136.3-1984,	*Roadway Lighting Equipment - Luminaire Attachments*

3. DEFINITIONS

Definitions of terms that apply specifically to the subject treated in this American National Standard are given in ANSI C82.9-1988. For additional definitions, see ANSI/IEEE 100.

4. RATINGS

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4.1 Input Voltage

The design center input voltage ratings for ballasts covered by this standard are 120, 208, 240, 277, and 480 volts.

4.2 Input Voltage Range

The designated input voltage ranges specified in the various parts of Section 5, Ballast Performance, of this standard shall be made available by the manufacturer in ballast catalogs or other technical literature.

4.3 Load

The rated load of a ballast shall be specified in terms of the wattage and the lamp designations of the lamp it is intended to operate.

4.4 Lamp Starting Temperature

Ballasts are commonly designated to start and operate lamps over one of the following ambient lamp temperature ranges:

(1) 10°C(50°F) and above
(2) -15°C(5°F) and above
(3) -30°C(-22°F) and above
(4) -40°C(-40°F) and above

4.5 Ballast/Starter Capacitive Load Rating

The ballast/starter capacitive load rating shall be the maximum value of capacitance with which the ballast/starter may be loaded and still meet all minimum pulse requirements. The capacitive loading of the ballast/starter/lamp system varies widely with different wiring methods and materials. Recommendations should be sought from the starter or ballast manufacturer, or both.

5. BALLAST PERFORMANCE

5.1 General

All measurements necessary to determine compliance with the ballast performance requirements of this standard shall be made in accordance with ANSI C82.6-1985.

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5.2 Lamp Operating Position

Ballasts may be designed for the operation of lamps in either the vertical or horizontal position. The ballast shall be tested with a reference lamp that meets the electrical requirements for the designated position, when operated with a reference ballast specified for that designated position.

5.3 Starting Voltage

When operated with the designated input voltage range including 92% to 105%[2] of its rated supply voltage and at rated frequency, a ballast shall provide root-mean-square (rms) and peak voltages that equal or exceed the appropriate minimum values specified in applicable American National Standards for lamps. For lamps requiring starting pulses, a ballast shall provide pulse voltage, width, repetition, and position within limits specified in applicable American National Standards for lamps.

5.4 Starting Current

When operated within the designated input voltage range including 92% to 105%[2] of its rated supply voltage and at rated frequency, a ballast shall provide starting current in compliance with the appropriate requirements of ANSI C78.40-1985, ANSI C78.41-1987, or the ANSI C78.1340 through C78.1381 standards (not inclusive) as listed under Normative Standards of this document.

However, an exception is made for the lead circuits of ballasts of the lead-lag-type, which need not meet the starting current requirements at less than rated voltage.

5.5 Additional Starting and Sustaining Requirements

Ballasts for metal-halide and high-pressure sodium lamps shall also meet additional starting and sustaining requirements within the designated input voltage range including 92% to 105%[1] of their rated supply voltage and at rated frequency as specified in applicable lamp standards in the ANSI C78.1340 through C78.1381 standards (not inclusive) as listed under Normative Standards of this document.

5.6 Lamp Operating Power

When operated at its rated voltage and frequency, a ballast shall deliver to a reference lamp a

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[2] The voltage limits of 92% to 105% of rated supply voltage closely approximate the range of utilization voltages provided by public utility systems. For more detailed information refer to ANSI C84.1-1989.

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wattage within the specified percentage (given in the following table) of the wattage delivered to the same reference lamp by the appropriate reference ballast. Both the reference ballast and the ballast under test shall have the same rated frequency. In this test, both ballasts shall be operated at their rated voltage and frequency.

Lamp Type	Wattage Range
Mercury	±7-1/2%
Metal Halide[3]	±5%
High-Pressure Sodium	±7-1/2%
Low-Pressure Sodium	±7-1/2%

5.7 Regulation

5.7.1 Ballasts for Mercury Lamps

The power delivered to a reference lamp by a ballast operating at any primary voltage within its designated range (the range shall not be less than 95% to 105% of its rated voltage) and at its rated frequency shall be not less than 88% or more than 112% of the power delivered to the same reference lamp by the same ballast when operated at its rated voltage and frequency.

5.7.2 Ballasts for Metal-Halide Lamps

The power delivered to a reference lamp by a ballast operating at any primary voltage within its designated range (the range shall not be less than 95% to 105% of its rated voltage) and at its rated frequency shall be not less than 85% or more than 115% of the power delivered to the same reference lamp by the reference ballast when operated at its rated voltage and frequency.

5.7.3 Ballasts for High-Pressure Sodium Lamps

At any primary voltage within its designated range (the range shall not be less than 95% to 105% of its rated voltage), a ballast shall have a load characteristic (voltage-wattage curve) such that the characteristic curve of the ballast passes through the diagram of the lamp operating limits (trapezoidal) as given on the relevant data sheet of the lamp standards in the ANSI C78.1340 through C78.1381 standards (not inclusive) as listed under Normative Standards of this document. The ballast curve within its designated range of primary voltage shall intersect both of the lamp-voltage limit lines between the wattage limit lines and shall remain between the wattage limit lines throughout the full range of lamp voltage.

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[3] Wattage excursions greater than ±5% increase the risk of noticeable lamp-color variation.

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NOTE: Preferably, a ballast characteristic curve should be such that the lamp wattage attains a maximum at or below the maximum lamp-voltage line and then decreases substantially as the lamp voltage increases beyond this point. A relatively flat ballast characteristic curve located near the line of rated lamp wattage is also preferable to one that rises or falls relatively steeply.

5.7.4 Ballasts for Low-Pressure Sodium Lamps

The power delivered to a reference lamp by a ballast operating at any primary voltage within its designated range (the range shall not be less than 95% to 105% of its rated voltage) and at its rated frequency shall be not less than 88% or more than 112% of the power delivered to the same reference lamp by the same ballast when operated at its rated voltage and frequency.

5.8 Lamp Dropout Voltage (High-Pressure Sodium Lamps Only)

At any constant primary voltage within its designated range (the range shall not be less than 95% to 105% of its rated voltage), a ballast shall have a load characteristic (voltage-wattage curve) such that the dropout voltage shall not be less than the maximum voltage line of the diagram of the lamp operating limits (trapezoidal) as given in the applicable lamp standards in the ANSI C78.1340 through C78.1381 standards (not inclusive) as listed under Normative Standards of this document.

5.9 Operating Current

With rated input voltage and rated frequency applied to the ballast, the current delivered to a reference lamp operating in the specified position shall not exceed 110% of the current delivered by a reference ballast to the same lamp in the same position.

5.10 Current Waveshape

5.10.1 Ballasts for Mercury Lamps

When operated at its rated voltage and at rated frequency, a ballast shall provide to the reference lamp a current whose crest factor does not exceed the limit specified in ANSI C78.40-1985.

5.10.2 Ballasts for Metal-Halide or High-Pressure Sodium Lamps

When operated at any primary voltage within its designated range and at rated frequency, a ballast shall provide to the reference lamp a current whose crest factor does not exceed the limit specified in the applicable lamp standards in the ANSI C78.1340 through C78.1381 standards (not inclusive) as listed under Normative Standards of this document.

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5.10.3 Ballasts for Low-Pressure Sodium Lamps

When operated at its rated voltage and at rated frequency, a ballast shall provide to the reference lamp a current whose crest factor does not exceed the limit specified in the ANSI C78.41-1987.

5.11 Extinction Voltage

5.11.1 Ballasts for Mercury or Metal-Halide Lamps

When rated voltage is applied to a ballast operating an appropriate reference lamp in its intended operating position, the ballast shall withstand a dip in line voltage of at least 10% below its rated voltage without extinguishing the lamp.

5.11.2 Ballasts for High-Pressure Sodium and Low-Pressure Sodium Lamps

When rated voltage is applied to a ballast operating an appropriate reference lamp in its intended operating position at its nominal voltage, the ballast shall withstand a dip in line voltage of at least 20% below its rated voltage without extinguishing the lamp.

5.11.3 Testing

The extinction voltage test for all ballasts shall be made in accordance with ANSI C82.6-1985.

5.12 Leakage Current

The leakage current of ballasts for high intensity discharge lamps shall be measured in accordance with ANSI C82.6-1985 and shall not exceed 0.75 milliamperes.

6. BALLAST TEMPERATURE

6.1 Winding and Case

A ballast shall be operated at rated input voltage and frequency until it is thermally stabilized using a reference lamp of the proper rating and in its specific operating position as a load. The test shall be made under draft-free conditions with an ambient temperature of 25°C $\pm$ 5°C. (The variation from 25°C shall be subtracted from or added to the observed temperature readings.) The temperatures shall be measured by using the change in resistance method in accordance with ANSI C82.6-1985 and shall not exceed the limits shown in Table 1 of this standard.

CAUTION: The 1000-watt high pressure sodium lamp frequently fails in a short-circuit condition. Consult the ballast manufacturer for expected performance under prolonged short-circuit conditions.

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Table 1
Limits of Ballast Temperature

Insulation Class	Ballast Winding (Maximum ○ C)
105 (A)	95
130 (B)	120
155 (F)	140
180 (H)	165
200	185
220	200
250	230

6.2 Capacitors

Capacitors used as a component part of a ballast shall be capable of withstanding the temperature and voltage to which they are subjected during operation of the ballast. For methods of measuring capacitor temperature, see ANSI C82.6-1985.

6.3 Starter

A starter used as a component part of a ballast for high intensity discharge lamps shall be capable of withstanding the temperature and voltage to which it is subjected during normal operation of the ballast. For methods of measuring starter temperature, see ANSI C82.6-1985.

CAUTION: Failure of a high intensity discharge lamp using a starter frequently presents an open circuit to the ballast and starter, which may reduce starter and ballast life. Consult the ballast manufacturer for expected performance and life under prolonged open-circuit conditions.

7. DIELECTRIC REQUIREMENTS

7.1 Applied Potential Test

The ballast shall be capable of withstanding an alternating test voltage, that is essentially sinusoidal, of rated frequency without breakdown for a period of (one) 1 minute. The magnitude of the test voltage shall be 1000Vrms plus twice the highest rated rms voltage of either winding or group of windings. For ballasts designed for outdoor service, the test voltage shall not be less than 2500 Vrms.

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The test voltage is applied after the ballast has been operated and thermally stabilized from the Ballast and Temperature tests of Section 6.1. Within 30 seconds after removal of the ballast load and power, apply the test voltage across each winding or group of electrically connected windings. The case, core and those windings not being tested are to be at ground potential. This test shall be made in accordance with ANSI C82.6-1985.

7.2 Transient Insulation Level

Ballasts intended for roadway lighting service shall be designed to have a minimum transient insulation level (TIL), as follows:

Table 2

Maximum Nominal Input Circuit Voltage Ratings (Volts)	TIL (kV)
250	7 1/2
600	10

A standard positive full-impulse voltage wave as defined in ANSI C92.1-1982 shall be applied. The Transient Insulation Level test shall be made in accordance with ANSI C82.6-1985.

The following type of ballasts are conditionally excepted:

Encased Ballasts. When component interconnections are sealed within the ballast enclosure and leads are not available from the capacitor cases or the core or both, specially constructed prototypes of such ballasts may be required to determine compliance with these requirements.

8. AUDIBLE SOUND LEVEL

Ballast noise is primarily produced by the core at a fundamental frequency of twice the applied frequency. Noise of this nature is an inherent characteristic of the core and cannot be completely eliminated. Unintentional amplification of the ballast noise can be caused by reflections from surrounding objects, resonance of mechanical mounting and electrical connections. Since HID ballasts are not sound rated care should be exercised in the selection of the ballast location and the mounting method used to minimize noise. The ballast or luminaire

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manufacturer should be consulted for specific recommendations for a quiet installation.

9. BALLAST MARKING

9.1 Permanent Marking

Ballasts shall be permanently marked to give the following information. When the ballast is originally built into or integrated with the luminaire or enclosure, the marking may be appropriately located on or in the luminaire or enclosure except for items 1, 2, 3, and 4, which shall be on the ballast.

(1) Name or trademark of manufacturer or vendor responsible
(2) Catalog number
(3) Input voltage rating (see 4.1 and 9.3)
(4) Frequency, supply line rated frequency
(5) Input amperes or voltamperes
(6) Quantity, classification letters, characteristic numbers, and wattage of lamps (see 9.4)
(7) Wiring instructions and termination identifications (see 9.2)
(8) Autotransformer type if applicable
(9) Catalog number of starter to be used with the ballast
(10) Minimum lamp ambient temperature for which ballast provides specified starting voltage, expressed as: _____ °C (_____°F)

9.2 Termination Identification

If color coding is used for ballast termination identification, see Appendix C (supplement pending).

9.3 Input Voltage Designation

For ratings other than those listed in 4.1, the designation shall be specified as given in 9.3.1 through 9.3.3.

9.3.1 Tapped Windings

A virgule (/) shall be used to separate voltage ratings of successive taps. Ratings shall be given in ascending order. For example:

115/120/125 signifies an input winding with taps at nominal voltages of 115, 120, and 125 volts.

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9.3.2 Series or Parallel Windings

The letter (X) shall be used to separate the voltage ratings of windings designed for either series or parallel connection. The winding configurations shall be designated by:

(1) The parallel voltage rating.
(2) The letter (X).
(3) The series voltage rating.

For example:

120 X 240 signifies a winding suitable for parallel connection to a 120-volt source or for series connection to a 2-wire 240-volt source but not suitable for a 3-wire connection.

9.3.3 Voltage Range

A hyphen (-) shall be used to separate the minimum and maximum recommended input voltages that may be applied to a voltage range rated ballast. For example:

105-135 signifies a winding designed for continuous operation at any input voltage between 105 and 135 volts, inclusive.

9.4 Lamp Types

When ballasts are designed to be suitable for more than one type of lamp of the same or different wattage rating, the applicable lamp designations shall be shown separated by a virgule (/) with related wattages indicated as well and also separated by a virgule. For example:

H38/H44 100/100W
H37/H39 250/175W

9.5 Ballast Marking for Matching Ballast Capacitors

Ballasts may be color coded for designs requiring a specific tolerance range of capacitance to maintain lamp wattage as defined in 5.6.

9.5.1 Marking

The coding shall consist of a permanent 1/4 inch diameter color dot, located in a prominent

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place adjacent to all other ballast markings. The color dot shall be overlaid on a distinct background color if the color of the ballast in the location of the dot is similar to the dot color.

9.5.2 Color Identification

The following color codes shall be used on the core and coil assembly. These are the same colors that are used on the capacitors.

Red - to indicate that a +6% to +3% value of nominal capacitance is to be used

Yellow - to indicate that a +3% to 0% value of nominal capacitance is to be used

White - to indicate that a 0% to -3% value of nominal capacitance is to be used

Black - to indicate that a -3% to -6% value of nominal capacitance is to be used

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Appendix A

(The Appendix is not part of American National Standard C82.4-1992, but is included for information only.)

Electrical Operating Characteristics of Reference Ballasts

Table A1 gives the electrical operating characteristics of the reference ballasts that are described in ANSI C82.5-1990 and its supplement and used in ANSI C82.4-1985.

The values shown in Table A1 were taken from high-intensity-discharge and low-pressure sodium lamp standards developed by Subcommittee C78-4 that were available at the time this standard was approved. Users of the above values are cautioned to secure the latest editions of ANSI C78.40-1985, C78.41-1987, or the ANSI C78.1340 through C78.1381 standards (not inclusive) as listed under Normative Standards of this document.

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Table A1
Electrical Operating Characteristics of Reference Ballasts

Wattage	Lamp Type	Lamp Position	Rated Input Voltage (volts)	Reference Current (amperes)	Impedance (ohms)	Lamp Reference Source
MERCURY LAMPS						
40	H45	VBU	180	0.530	251.0	ANSI C78.40
		Hor	180	0.535	244.0	
50	H46	VBU	165	0.60	190.0	ANSI C78.40
		Hor	165	0.60	183.0	
75	H43	VBU	220	0.66	226.0	ANSI C78.40
		Hor	220	0.66	219.5	
100	H38	VBU	220	0.85	170.0	ANSI C78.40
		Hor	220	0.88	168.0	
100	H44	VBU	220	0.85	170.0	ANSI C78.40
		Hor	220	0.88	168.0	
175	H39	VBU	220	1.50	99.5	ANSI C78.40
		Hor	220	1.55	97.5	
250	H37	VBU	220	2.10	70.8	ANSI C78.40
		Hor	220	2.15	69.3	
400	H33	VBU	220	3.2	44.8	ANSI C78.40
		Hor	220	3.4	44.2	
700	H35	VBU	220	2.80	112.0	ANSI C78.40
		Hor	220	3.05	108.5	
1000	H34	VBU	220	8.0	18.2	ANSI C78.40
		Hor	220	8.1	18.2	
1000	H36	VBU	460	4.0	80.0	ANSI C78.40
		Hor	460	4.3	77.3	

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Table A1
Electrical Operating Characteristics of Reference Ballasts

Wattage	Lamp Type	Lamp Position	Rated Input Voltage (volts)	Reference Current (amperes)	Impedance (ohms)	Lamp Reference Source
METAL-HALIDE LAMPS						
70	M85	Hor	220	0.98	188	ANSI C78.1381
175	M57	V	220	1.5	102	ANSI C78.1377
250	M58	Any	220	2.1	74	ANSI C78.1378
400	M59	Any	220	3.25	45	ANSI C78.1375
1000	M47	Any	460	4.1	89	ANSI C78.1376
1500	M48	Any	460	6.2	50.5	ANSI C78.1379
HIGH-PRESSURE SODIUM LAMPS						
35	S76	Any	120	0.83	116.5	ANSI C78.1358
50	S68	Any	120	1.18	83.1	ANSI C78.1359
70	S62	Any	120	1.6	61.0	ANSI C78.1353
100	S54	Any	120	2.1	44.0	ANSI C78.1354
150 (55V)	S55	Any	120	3.2	30.0	ANSI C78.1355
150 (100V)	S56	Any	220	1.8	97.0	ANSI C78.1356
200 250	S66	Any	220	2.4	74.6	DRAFT C78.1357
310	S67	Any	220	3.6	55.4	DRAFT C78-4/905
400	S51	Any	220	4.6	38.6	ANSI C78.1350
1000	S52	Any	480	4.7	77.0	ANSI C78.1352
LOW-PRESSURE SODIUM LAMPS						
18	L69	Hor	300	0.35	820	ANSI C78.41
35(37)	L70	Hor	480	0.6	775	ANSI C78.41
55(56)	L71	Hor	480	0.6	775	ANSI C78.41
90(91)	L72	Hor	480	0.9	500	ANSI C78.41
135	L73	Hor	650	0.92	655	ANSI C78.41
180(185)	L74	Hor	650	0.92	655	ANSI C78.41

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