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American National Standard

ANSI C82.12-1999

American National Standard

for Lamp Ballasts—Fluorescent Adapters

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
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American National Standard

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For Lamp Ballasts—Fluorescent Adapters

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Foreword (This Foreword is not part of ANSI C82.12-1999.)

Suggestions for improvement of this standard should be submitted to the Secretariat C82, American National Lighting Group of the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.

This standard was processed and approved by Accredited Standards Committee on Electric Lamps, C82, and its Sub-Committee, C82-1. Committee approval of the standard does not necessarily imply that all committee members voted for that approval. At the time it approved this standard, the C82 Committee had the following members:

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Ken Denton, Technical Coordinator
Randolph N. Roy, Secretariat
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For Lamp Ballasts

1 Scope

This standard is intended to cover fluorescent lamp adapters rated for 120 and 127 volt, 60 hertz input and for use with Edison-screw lampholders. This comprises adapters for hot-cathode fluorescent lamps, with either preheat (switch)-start, rapid-start (continuously heated cathodes), modified rapid start or programmed start. The adapter and lamp combinations covered by this specification are normally intended for use in room ambient temperatures of 10°C to 40°C. At ambient temperatures outside this range, the performance may vary outside the values given in this document and certain special operating characteristics may be required.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI/NFPA No. 70-1993, National Electrical Code

ANSI/IEEE C62.41-1980 (R1985), Guide for Surge Voltages in Low-Voltage AC Power Circuits

ANSI C78.1-1991 (R1996) C78.2-1991 (R1996), C78.3-1991 (R1996), C78.4-1995, American National Standards for Dimensional and Electrical Characteristics of Fluorescent Lamps

ANSI C82.2-1984 (R1995), American National Standard Methods of Measurement of Fluorescent Lamp Ballasts

ANSI C82.3-1983 (R1995), American National Standard Specification for Fluorescent Lamp Reference Ballasts

ANSI C82.11-1993 (R1998), American National Standard for Lamp Ballasts—High Frequency Fluorescent Lamp Ballasts

US Code of Federal Regulations #47, Chapter 18. (Federal Communications Commission Requirements for RFI)

UL 1993, Underwriters Laboratories, Inc., Standard for Self-Ballasted Lamps and Lamp Adapters

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3 Definitions

3.1 Lamp types

3.1.1 Reference lamps

Seasoned lamps which, under stable operating conditions and in conjunction with the specified reference ballast, operate at values of lamp voltage, lamp wattage (for rapid-start lamps arc wattage is to be used and not total wattage), and lamp current, each within 2.5% of the values given in the normative referenced ANSI C78 standards. Reference lamps of the rapid-start type are operated in circuits in which their cathodes are continuously heated by appropriate low-voltage power sources.

3.1.2 Hot-cathode lamp

An electric discharge lamp in which the electrodes operate at incandescent temperatures and the cathode fall voltage is relatively low (less than 20 volts). The current density at the cathodes is relatively high, and lamps may be designed to carry any desired current up to several amperes. The energy to maintain the cathodes at a sufficient thermal emission may come either from the arc (arc heating), from circuit elements (voltage heating), or from both.

3.2 Ballasting system

3.2.1 Reference ballasts

Series impedance-type ballasts, which are designed, manufactured, and maintained for the purpose of providing comparison standards for use in testing ballasts or lamps. They are also used in selecting the reference lamps that are needed in the work of testing ballasts. Reference ballasts are characterized by constant impedance over a wide range of operating current and also by constant characteristics that are relatively uninfluenced by time, temperature, magnetic surroundings, etc. The general specifications for reference ballasts are in ANSI C82.3. The values of reference current, impedance, line voltage, and cathode conditioning for the reference ballasts to be used with each size and rating of lamp are given in the normative referenced C78 standard.

3.2.2 Rapid-start type systems

Those systems in which hot-cathode electric discharge lamps are operated under the following conditions: (1) the lamps are started with the cathodes heated to a temperature sufficient for adequate electron emission and without establishing local ionization across the cathodes; (2) such heating is accomplished either by means of low-voltage heater windings in the ballast itself, by separate low-voltage transformers, or by other means of heating the cathodes; (3)** sufficient voltage is applied across the lamp and between the lamp and the starting aid (usually the fixture itself) to initiate the discharge when the cathodes reach a temperature high enough for adequate emission; and (4) cathode heating is maintained even after the lamp is in full operation.

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NOTE: Several types of rapid-start systems have evolved: (1) those for lamps with nominal 3.6 volt cathodes (low resistance) and (2) those for lamps with nominal 8.0 volt cathodes (high resistance). In some cases the same lamp can be suitable for operation in either rapid-start or switch start (preheat-start) system. Other starting scenarios to follow.

3.2.3 Modified rapid-start type systems

Those systems in which hot-cathode electric discharge lamps are operated under the following conditions: (1) the lamps are started with the cathodes heated to a temperature sufficient for adequate electron emission and without establishing local ionization across the cathodes; (2) such heating is accomplished either by means of low-voltage heater windings in the ballast itself, by separate low-voltage transformers, or by other means of heating the cathodes; (3)** sufficient voltage is applied across the lamp and between the lamp and the starting aid (usually the fixture itself) to initiate the discharge when the cathodes reach a temperature high enough for adequate emission; and (4) cathode heating is reduced or removed after the lamp is in full operation.

3.2.4 Preheat (switch)-start systems

Systems in which hot-cathode electric discharge lamps are started with the cathodes preheated through the use of a starting switch, either manual or automatic in its operation. The starting switch, when closed, connects the two cathodes, in series, in the ballast circuit so that current flows to heat the cathodes to emission temperature. When the switch is opened, a voltage surge is produced which initiates the discharge. Only the arc current flows through the cathodes after the lamp is in operation.

3.2.5 Programmed start systems

Those systems in which hot-cathode electric discharge lamps are operated under the following conditions: (1) the lamps are started with the cathodes heated to a temperature sufficient for adequate electron emission and without establishing local ionization across the cathodes; (2) such heating is accomplished by supplying the required energy from a voltage or current source in the ballast, while during the heating period the voltage across the lamp is kept below a level to initiate any discharge; (3) after the heating period the voltage across the lamp is increased to a sufficient level to initiate the discharge; and (4) cathode heating may be reduce or removed after the lamp is in full operation.

** **NOTE:** In general, references to the starting aid (a grounded metal fixture) do not apply to ballasted adapters. Adapters are generally used in applications where the lamp is not close enough to a grounded metal surface to act as a starting aid.

3.2.6 High frequency adapter

A device which operates at a supply frequency of 50 or 60 Hz and operates the lamp at frequencies between 20kHz and 500kHz.

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3.3 Characteristics

3.3.1 Input power factor

Power Factor is dependent upon the current's wave shape as well as the phase relationship between the current and voltage. The power factor is to be calculated by determining the ration of the active power to the apparent power. The active power is to be measured with a wattmeter capable of indicating the active (or real, average) power in watts. The apparent power is to be the product of the true rms values of the input voltage and current.

$$\text{Power Factor} = \frac{\text{Active Power (watts)}}{\text{Apparent Power (volt amperes)}}$$

3.3.2 Current crest factor

Current Crest Factor is defined as the ratio of peak current to rms current. The High Frequency Current Crest Factor is equal to the peak current of the modulated or unmodulated envelope divided by the rms current.

3.3.3 Ballast factor

The output of a ballast delivered to a reference lamp(s) in terms of power or light divided by the output of the relevant reference ballast delivered to the same reference lamp(s).

3.3.4 Input current, harmonic distortion

The ratio of the rms value of all the harmonics to the rms value of the fundamental.

NOTE: Some instrumentation permits the user to define THD as the ratio of the harmonics to either the rms of the fundamental or the rms of the total. It is recommended that the term "THD(fund)" or "THD(rms)" be used in lighting standards and product labeling to identify the definition. Possible end-user confusion is avoided. The following relationships are useful for the conversion purposes.

$$\text{THD(rms)} = \frac{\text{THD(fund)}}{\sqrt{1+\text{THD(fund)}^2}} \quad \text{or} \quad \text{THD(fund)} = \frac{\text{THD(rms)}}{\sqrt{1-\text{THD(rms)}^2}}$$

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4 Marking

Fluorescent lamp adapter markings shall comply with UL 1993.

5 Requirements

5.1 General

Measurements necessary to determine adapter performance shall be made in accordance with ANSI C82.2 as applicable.

5.2 Starting conditions

5.2.1 Starting

For satisfactory lamp starting, when operated at any supply voltage between 90% and 110% of its rated supply voltage and frequency, an adapter shall follow the requirements of this standard or as specified otherwise in the normative paragraph of this standard.

5.2.2 Lamp starting time vs. starting current requirement

Adapters utilizing high frequency circuits shall meet the requirements of starting time and starting current as defined in C82.11.

5.3 Output

An adapter shall provide the operating characteristics given in 5.3.1 and 5.3.2 when connected to any specified complement of reference lamps.

5.3.1 System light output

With rated voltage applied to the input of the adapter, the minimum light output is the product of the ballast factor and the light output of the same reference lamp when operated on its reference ballast at its rated voltage.

5.3.1.1 Minimum ballast factor

With rated voltage applied to the input of the adapter, the minimum ballast factor shall be 0.925 or 92.5%. Adapters utilizing either continuous or step dimming should be tested at their full light output settings.

5.3.1.2 Dimmable systems

Refer to the appropriate lamp data sheets to determine proper lamp operation at lower light output levels. Limits are under consideration.

5.3.2 Lamp operating current ratio

Adapters shall deliver current to a reference lamp, as measured in percent of the current delivered to the same lamp by a reference ballast, within the limits 92.5% to 107.5%. Both the

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reference ballast and the adapter under test shall be operated at their rated voltage and frequency.

5.3.3 Lamp current operating frequency

To limit incompatibility with infrared remote controls, the lamp operating frequency for high frequency ballasted adapters should be greater than 40 kHz. These frequencies should be met under all stable normal operating conditions, including dimming.

5.4 Cathode preheating current

Adapters designed for operating of preheat (switch)-start lamps shall provide preheating current within the limits required by the appropriate ANSI C78 lamp standard.

5.5 Regulation

Lamp current of a reference lamp on an adapter at a supply voltage between 90% to 106% of rated shall be between 75-115% of current delivered by reference ballast.

5.6 Operation-current waveshape

At rated input voltage, the current waveshape supplied to a warmed-up reference lamp shall have a crest factor that does not exceed 1.70 unless otherwise specified on the specific lamp data sheet. Successive half cycles of lamp current shall show substantially the same shape.

5.7 Supplementary cathode heating

Cathode heating shall meet the requirements specified in the normative referenced lamp data sheets.

5.8 Electromagnetic interference suppression

Fluorescent lamp systems may be a source of electromagnetic radiation at radio frequencies. High-frequency adapters shall comply with FCC regulations, Title 47 of the US Code of Federal Regulations, Part 18, Consumer Limits.

5.9 Safety

Fluorescent lamp Adapters shall comply with UL 1993.

5.10 Input current, harmonic distortion and power factor

In installations where requirements exist for limiting the amount of input current harmonic distortion of lighting productions, ballasted adapters with High Power Factor and/or low THD should be used. In other installations the use of adapters with or without High Power Factor is acceptable.

1) Adapters with marking of low THD shall comply to the requirements as given in Table 1.

2) Adapters with marking High Power Factor shall have a PF > 90%.

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Table 1

Harmonic order N	Maximum permissible harmonic current expressed as a percentage of the input current at the fundamental frequency %
2	2
3	30•λ
5	10
7	7
9	5
11≤n≤39 (odd harmonics only)	3 λ is the circuit power factor

NOTE: For adapters with input power less than 25W the limits on THD are to be determined.

5.11 Line transient requirements

Electronic high-frequency circuits are more susceptible to line transients than line frequency magnetic circuits. Therefore, transient protection shall be included. The adapter shall meet the transient protection requirements as outlined in ANSI/IEEE C62.41, location category A1.

5.12 Inrush currents

There is a need to control inrush current transients caused by capacitor charging. The limits are to be determined.

5.13 Dimmable systems

Adapters utilizing either continuous or step dimming shall be tested at their full light output settings, unless otherwise stated in this standard. To determine the proper lamp operation at lower output levels, refer to the appropriate lamp data sheet appearing under the normative paragraph of this standard. Limits for dimming operation are under consideration.

5.14 End of lamp life

At the end of lamp life a broken or deactivated cathode can create an asymmetrical lamp operating condition with high local heating that, if allowed to continue, might crack the small lamps or overheat the lamp bases, sockets, or lighting fixtures. Specific end of life requirements are under consideration.

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6 Application requirements

See ANSI/NFPA 70, National Electrical Code, for maximum voltage-to-ground limitations.

6.1 Operating temperature limits

The service installation must be designed so that the temperature at the hottest spot of the lamp base shall not exceed the values as shown in the normative paragraph of this standard under normal operating conditions measured at nominal line voltage.

6.2 Average voltage for satisfactory operation

Ballasted adapters shall give satisfactory operation within ± 10% of the supply voltage rating.

6.3 Audible sound level

Noise is an inherent characteristic of all ballasts and cannot be completely eliminated. The ballast or luminaire manufacturer, or both, should be consulted for specific recommendations for a quiet installation.

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