American National Standard



ANSI C78.901-2001

American National Standard

For Electric Lamps

Single Base Fluorescent Lamps - Dimensional and Electrical Characteristics

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ANSI C78.901-2001

Consolidation/Revision of ANSI C78.1-1991, ANSI C78.2-1991, ANSI C78.3-1991, ANSI C78.4-1995 and all supplements

American National Standard

Approved: February 16, 2001 Secretariat: ANSLG-- National Electrical Manufacturers Association

For Electric Lamps

Single Base Fluorescent Lamps- Dimensional and Electrical Characteristics

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FOREWORD (This Foreword is not part of ANSI C78.901-2001)

Suggestions for improvement of this standard will be welcome. They should be sent to the Secretariat, C78 Committee, National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209. This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Electric lamps, C78, and it's subcommittee, C78-2. Approval of the standard does not necessarily imply that all committee members voted for its approval.

This standard is a consolidation and revision of ANSI C78.1-1991, ANSI C78.2-1991, ANSI C78.3-1991, and ANSI C78.4-1995 and supercedes all of the aforementioned standards and their supplements. Information concerning the approval of this standard is based on the documents listed in the table below:

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At the time of publications, the committee consisted of the following members:

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Al Rousseau, Technical Coordinator
Randolph N. Roy, Secretariat
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Table of Contents

FOREWORD iii

PART I – General Information and Requirements 1

1 Scope 1

2 General 1

3 Normative References 2

4 Definitions 3

5 Lamp Abbreviations 5

6 Methods of Measurement 5

7 Reference Ballasts 5

8 Product Drawings 5

9 Applications of Lamps on More than One Type of Circuit 6

10 Lamp Physical and Dimensional Requirements 6

11 Lamp Electrical Characteristics 7

12 Thermal Conditions 8

13 Requirements for Ballast Design 9

14 Information for Luminaire Design 11

PART II – Dimensioning Principles and Lamp Outline Drawings 13

15 Lamp Drawings and Dimensioning Principles 13

PART III – Annexes 21

Bibliography 21

Guidelines for Establishing Fluorescent Lamp Abbreviations 23

Generic Designation System for Compact Fluorescent andT5 Twin Fluorescent Lamps 27

Guidelines for the Establishment of Wattage Ratings on Fluorescent Lamp Data Sheets 29

PART IV – Lamp Specification Data Sheets 31

1 General Principles for Numbering of Data Sheets 31

2 Data Sheet List and Sequence 31

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AMERICAN NATIONAL STANDARD

For Electric Lamps-
Single Base fluorescent lamps-
Dimensional and Electrical Characteristics

PART I – General Information and Requirements

1 Scope

This standard sets forth the physical and electrical characteristics required to assure the interchangeability and to assist in the proper application of single-based fluorescent lamps. Single-based compact fluorescent lamps, both self-supporting and those requiring auxiliary support, including circular, square and U-shaped lamps are specified. Specifications for both the lamp itself and the interactive features of the lamp with the ballast are given. Information for luminaire design is given for certain lamp types.

The lamps covered in this standard are intended for use with external ballasts as described. These lamps are designed for 60Hz and/or high frequency operation. Specifications for the performance of self-ballasted compact fluorescent lamps are found in ANSI C78.5.

Many of the lamp types covered in this standard are closely comparable to those specified in IEC 60901.

2 General

There are four parts to this standard.

Part I Contains requirements and general information. Detailed descriptions, references, and explanations of the terms used in the lamp data sheets are given in this part. It also defines the principles of dimensioning lamps, both as finished lamps and for maximum outline purposes.

Part II Contains dimensioning principles and lamp outline drawings.

Part III Contains the annexes.

Part IV Contains all of the lamp data sheets for the lamp classes covered in this standard.

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3 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 editions of the standards indicated below.

ANSI C78.30-1997, *Procedure for Use in Preparation of Lamp Space Drawings*

ANSI C78.81-2001, *Double-based Fluorescent Lamps - Dimensional and Electrical Characteristics*

ANSI C78.375-1997, *Guide for Electrical Measurements.*

ANSI/IEC C78.1195-2001, *Double-Capped Fluorescent Lamps – Safety Specifications (for 2G13 based lamps only*

ANSI/IEC C78.1199-2001, *Single-Capped Fluorescent Lamps – Safety Specifications*

ANSI C79.1-1994, *Nomenclature for Glass Bulbs Intended for Use with Electric Lamps*

ANSI C81.61-1990 (R1996), *Electric Lamp Bases*

ANSI C81.63-1991(1996), *Gauges for Electric Bases and Lampholders*

ANSI C82.1-1997, *Line Frequency Fluorescent Lamp Ballast*

ANSI C82.11-1993, *High Frequency Lamp Ballasts in Normative Reference*

ANSI C82.12-1999, *Fluorescent Adapters*

ANSI C82.3-1983(R1995), *Reference Ballasts for Fluorescent Lamps*

IEEE 100-1992, *ANS/IEEE Dictionary of Electrical and Electronic Terms*

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4 Definitions

The definitions in this section relate to specific terms used in this standard. For additional definitions, see C78.81 and the ballast standards ANSI C82.1 and ANSI C82.11 and the electrical dictionary IEEE 100.

4.1 Lamps

Fluorescent lamp: A low-pressure mercury electric-discharge lamp in which a fluorescing coating (phosphor) transforms some of the ultraviolet energy, generated by the discharge, into light.

Self-supporting, single-based compact fluorescent lamp: A fluorescent lamp of a small, compact shape with a single base that performs the entire mechanical support function.

Preheat-start fluorescent lamp: A fluorescent lamp intended for operation on a preheat (switch)-start circuit. Some preheat lamps may contain an internal starting device.

Rapid-start fluorescent lamp: A fluorescent lamp designed to operate in a rapid-start circuit.

Deactivated lamp: A lamp which lacks sufficient emissive material on one or both of its cathodes or lacks circuitry to properly heat the cathode in order to obtain normal operation.

Lamp class: A grouping of lamps with common physical, dimensional, and electrical characteristics.

Lamp type: A grouping of lamps within a lamp class having common photometric characteristics.

Twin shape: The shape of a single-based lamp in which the bulb of the finished lamp is formed essentially into two parallel legs.

Quad shape: The shape of a single-based lamp in which the bulb of the finished lamp is formed essentially into four parallel legs, two each in planes parallel to each other.

Square shape: The shape of a single-based lamp in which the tube is formed into a nominally square shaped lamp.

Multiple shape: The shape designation for a single-based lamp using a combination of tubes (multiple) which is not covered by any other shape designation.

Nominal wattage: The wattage marked on the lamp, expressed in watts.

Nominal value: A suitable approximate quantity value used to designate or identify a component, device or equipment.

Rated value: A quantity value for specified operating conditions of a component, device or equipment. The value and conditions are specified in the relevant standard or assigned by the manufacturer or responsible vendor.

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4.2 Lamp Components

Low resistance cathode: A lamp cathode that exhibits a resistance in the range 2 to 15 ohms, when heated to nominal emission temperature by applying 3.6 volts/cathode.

High resistance cathode: A lamp cathode that exhibits a resistance in the range above 15 ohms, when heated to nominal emission temperature by applying 8.0 volts/cathode.

Radio frequency interference suppression capacitor: A capacitor, usually located in the base of certain lamps or in an external starter, which is connected in parallel to the lamp in order to suppress radio frequency interference. Such a capacitor will be specified on a lamp data sheet.

4.3 Lamp Operation

Lamp starting time: The time between application of circuit power and the time of establishment of full, or nearly full, operational current in the lamp.

Crest factor: The ratio of the peak value of lamp current (or voltage) to the root-mean square (rms) value of lamp current (or voltage).

High frequency current crest factor. The high frequency current crest factor is equal to the peak current of the modulated or unmodulated envelope divided by the effective rms current.

4.4 Ballasts and circuit characteristics

Fluorescent lamp ballast: A device that, by means of resistance, inductance, capacitance or electronic elements, singly or in combination, controls the current, voltage, and waveform to the proper values for starting and operation of fluorescent lamps.

Rapid-start circuit: A circuit in which hot-cathode electric discharge lamps are operated under the following conditions:

a) The lamps are started with the cathodes heated to a temperature sufficient for adequate electron emission and without establishing local ionization across the cathodes;

b) such heating is accomplished either by means of low-voltage heater windings in the ballast itself or by separate low-voltage transformers;

c) sufficient voltage is applied across the lamp and between the lamp and the starting aid (usually the luminaire itself) to initiate the discharge when the cathodes reach a temperature high enough for adequate emission; and

d) cathode heating voltage is maintained even after the lamp is in full operation.

Two types of rapid start circuits have evolved:

a) those for lamps with nominal 3.6 volt cathodes (low resistance); and

b) 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 preheat (switch) start circuits.

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A modified rapid start circuit may be used in some applications wherein, after lamp starting: (a) the cathode heating voltage is reduced or (b) the heating voltage is turned off.

Preheat (switch)-start circuit: A circuit 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 in conjunction with an inductive ballast which initiates the discharge. Only the arc current flows through the cathodes after the lamp is in operation.

External electronic preheat-start circuit: A circuit in which the cathode preheating function is provided as part of an external electronic ballast.

Note: Requires the use of lamps with 4-pin base.

Instant-start circuit: A circuit in which an electric discharge lamp is started by the application of a voltage sufficiently high to eject electrons from the electrodes by field emission, initiate electron flow through the lamp, ionize the gases, and start a discharge through the lamp without previous heating of the electrodes.

5 Lamp Abbreviations

Lamp abbreviations for fluorescent lamps are not officially assigned through any administered designation system. Those used on the data sheets in Part IV are assigned in accordance with the guideline of Annex B. There is no requirement for the use of these abbreviations for lamp marking.

6 Methods of Measurement

Electrical measurements necessary to determine the performance of lamps defined in this standard shall be made in accordance with the lamp measurements standard, ANSI C78.375.

7 Reference Ballasts

Reference ballasts used for measurements of fluorescent lamps shall meet the general requirements set forth in the reference ballast standard, ANSI C82.3. It should be noted that the reference ballast standard requires a power factor of 0.075 +/- 0.005 for all fluorescent reference ballasts, unless otherwise specified on a lamp data sheet. A rapid-start reference ballast when called for in this standard includes 3.6 volts cathode heating, unless otherwise specified on the relevant lamp data sheets.

8 Product Drawings

The drawings included in Part II are product drawings that show the applications of the various coded dimensions that appear on the data sheets. Drawings are only needed to depict families of lamps. The particular values vary with a family in accordance with the values on the relevant lamp data sheet.

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For self-supporting compact lamps, the general shape and size of a lamp's maximum outline is specified in relation to the same drawings and the "Max. Lamp Outline" dimensions on a lamp data sheet. For the types of lamps covered in this standard, it has been industry practice to overlook minor bulb shape and construction differences in a maximum outline and to merely apply expanded values to the finished lamp dimension to specify the outline.

9 Applications of Lamps on More than One Type of Circuit

Lamp data sheets in Part IV specify the intended circuit application. In some cases, a lamp may be used on more than one type of circuit. In such cases, the lamp data sheet will show the information for all of the appropriate circuits. If a particular lamp class has been authorized by the lamp manufacturers for operation at high frequency conditions, the appropriate information will be supplied on the relevant lamp data sheet.

10 Lamp Physical and Dimensional Requirements

10.1 Bulb Specifications

Each lamp data sheet in Part IV specifies the necessary bulb shape, tube diameter, and final lamp shape. Bulb shapes are defined in the bulb nomenclature standard, ANSI C79.1. Due to the long established practice of referring to the diameter of fluorescent lamp bulbs in eighths-of-an-inch units, this standard maintains that practice. For example, a ½" diameter bulb is called a T4 bulb. Metric diameters, in millimeters, are shown in parentheses immediately following the customary designation.

The basic bulb shape of some single-based fluorescent lamps may be additionally formed in the lamp assembly process to acquire a final "lamp shape". For example, some final shapes of lamps in this standard are referred to as twin or quad designs. There are not any requirements on finished lamp shape other than the specified lamp dimensions.

10.2 Base Specifications

The required standardized base type is specified on each lamp data sheet. Bases on finished lamps shall comply with the base standard, ANSI C81.61. Gauges for checking bases are included in ANSI C81.63.

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10.3 Marking

The following information shall be distinctly and durably marked on a lamp:

- Mark of origin. This may take the form of a trademark, the manufacturer's mark, or the name of the responsible vendor.
- Nominal wattage, identified by a suffix "W."

10.4 Lamp Dimensions

Finished lamps shall comply with the "Finished Lamp" dimensions specified on the relevant data sheet. Graphical definitions of the dimensional letter codes used on the data sheets are given in Part II.

Where maximum lamp outline dimensions are specified, such outlines are the maximum limits of the space that may be occupied by any part of the bulb of a lamp. They are referenced to the base in a fixed position. Base-to-bulb misalignment is taken into consideration.

Base alignment of U-shaped lamps with 2G13 bases. All four pins (excluding flanges) of an assembled lamp shall pass simultaneously, without binding, through a single slot 0.120 inch (3.05mm) in width.

Base rotation of circular lamps with G10q bases. The base on a finished lamp shall be capable of being rotated, without difficulty, over at least an arc of ± 5° about the normal angle α to the plane through the lamp tube. The lead wires shall not short-circuit during maximum rotation of the base.

10.5 Bulb-Base Strength

The requirements of Annex A of ANSI/IEC C78.1199 and ANSI/IEC C78.1195 (for 2G13 based lamps) apply.

10.6 Color

Lamp colors are not specified in this standard. Lamp chromaticity is considered to be a variable within each particular lamp class.

11 Lamp Electrical Characteristics

11.1 Lamp Operating Characteristics

The values of lamp voltage, current, and wattage shown on the individual lamp data sheets in Part IV are rated values that apply after the lamps have been aged for 100 hours. These values were chosen by consensus to represent the industry average at the time of publication. No manufacturer's average wattage shall exceed the rated value by more than 5% plus 0.5 watts.

Fluorescent lamp operating characteristics are based on operation with a reference ballast (with cathode heating for rapid-start characteristics) having the characteristics shown on the appropriate lamp data sheet and at an ambient temperature of 25°C, unless otherwise specified. Electrical characteristics and light output vary with ambient temperature.

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Twin, quad, and multi shaped lamps shall be tested in the vertical base-up position unless otherwise specified on the lamp data sheet. U, circular, and square shaped lamps shall be tested in a horizontal plane unless otherwise specified on the lamp data sheet.

Electrical measurements shall be made in accordance with the measurement standard ANSI C78.375. Test circuits are given therein.

11.2 Lamp Starting Requirements

Lamps shall start at the minimum starting voltages, within the waveshape limitation, as specified on each lamp data sheet under Information for Ballast Design. Separate values apply for rapid or preheat (switch)-start operation. For preheat starting, a minimum Preheat Time is defined. This value is used for testing starters in accordance with ANSI C78.180.

Those starting voltage values are intended to provide reliable starting at the minimum ambient temperatures specified and above, up to a defined upper limit. Upper temperature limits depend upon ballast design and operating current as follows, unless otherwise specified on the lamp data sheets:

At temperatures near the top of the range, however, initial starting will be secured but not necessarily immediate restarting.

Table 1 – Lamp Starting Requirements

Lamp operating current	Ballast Design	Upper Temperature Limit
<0.5A	All	110°F (43.3°C)
>0.5A	Single lamp	110°F (43.3°C)
>0.5A	2 or 3 lamp series	150°F (65.5°C)

11.3 Radio Interference Suppression Capacitors

In order to assist in the suppression of radio interference, lamps with internal starter systems shall employ a capacitor of the size specified on the relevant lamp data sheet. This capacitor shall be connected internally in such a manner as to be effectively in parallel with the lamp.

12 Thermal Conditions

12.1 Maximum Base Temperature Rise Values and Method of Measurement

The requirements of Annex B of ANSI/IEC C78.1199 and ANSI/IEC C78.1195 (for 2G13 based lamps) apply.

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13 Requirements for Ballast Design

13.1 General

Ballasts for use with the lamps in this standard shall meet the general requirements for fluorescent lamp ballasts as stated in the ballast standard, ANSI C82.1, ANSI C82.11, and ANSI C82.12.

Note: The values provided in this standard are generally for 60Hz operation. A radio interference suppression capacitor, if present in a lamp, may affect starting or operating parameters in a high frequency mode of operation.

A ballast intended for use with a particular lamp class shall provide the lamp starting, cathode heating if appropriate, and operating values as specified on the relevant lamp data sheet in Part II as defined in sections 13.2, 13.3, and 13.4. Other special requirements may be specified on the lamp data sheet.

13.2 Lamp Starting

A commercial ballast intended to be used on a particular lamp class shall provide, (a) the voltage between lamp terminals, (b) voltage from lamp terminal to a starting aid where necessary, within (c) the specified waveshape limitations, and (d) cathode heating requirements where applicable. The specified voltage limits shall be provided at any supply voltage between 90% and 110% of the ballast's rated input voltage unless otherwise specified on the lamp data sheet.

13.2.1 Voltage Between Lamp Terminals

The limits shown on the appropriate lamp data sheets apply to the voltage across the lamp to be supplied between those two ballast terminals that deliver the highest voltage. For series ballasts, the voltage is for two (or three) lamps in series.

13.2.2 Voltage From Lamp Terminal to Starting Aid

The limits, when provided on a lamp data sheet, apply to the voltage to be supplied between a terminal (the one delivering the highest voltage) of each lamp and that part of the ballast that will be at ground potential.

13.2.3 Waveshapes of Starting Voltage

The maximum starting voltage crest factor value for all lamps in this standard is 2.0, unless otherwise specified on the lamp data sheet. This applies both to the voltage across the lamp and to the starting aid voltage if specified, at 90-110% of the rated ballast input voltage.

13.3 Cathode Heating

For preheat (switch)-start circuits, requirements for cathode heating during the preheating phase and for the preheat time are given on the relevant lamp data sheet. In addition, an appropriate value of a dummy resistor is specified as an aid to ballast design. When the lamp has an internal means of starting, the dummy load should be

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used to assure that the cathode preheating current falls within the range specified on the lamp data sheet over the full range of supply voltage specified.

For rapid-start circuits, the required cathode heating voltage is specified on each lamp data sheet. Both starting (dummy load) and during operation limits are given. The specified voltage limits shall be provided at the ballast's rated input voltage, unless otherwise specified on the lamp data sheet.

In addition, the appropriate value of the dummy load resistor is specified as an aid to ballast design. Where one ballast winding operates two cathodes in parallel, the dummy load value shall be half the given value.

For high frequency electronic circuits, the requirements for cathode heating are provided on the lamp data sheets, if specified.

13.4 Operating Current Waveshape

The waveshape of the lamp operating current supplied to a single-based fluorescent lamp shall have a crest factor that does not exceed 1.70, unless otherwise specified on a lamp data sheet.

13.5 Lamp Operating Current Ratio

The lamp current in a reference lamp, delivered by a ballast at its rated supply voltage, shall not exceed 107.5% of the current delivered to the same lamp by a reference ballast at its rated input voltage, unless otherwise specified on the relevant lamp data sheet. For preheat operation, this ratio will also not be less than 92.5%.

13.6 Application Information

Lamps covered in this standard may rectify at end of life when operated with a series reactor ballast on a 277 volt line. This must be taken into account in the ballast design and means to prevent ballast damage from overheating shall be incorporated. Reactor ballasts for electrical systems that provide greater than 440-volt peak at the lamp shall not be allowed, e.g., 347 volt system.

13.7 Frequency to be used for high frequency operated lamps

For lamps designed for operation on high frequency, the lamp data sheets prescribe a frequency range for the reference ballast and for the testing of lamps (starting, electrical and photometric characteristics). This frequency range has been chosen for ease of reproducing test results and is not intended to restrict the design of high frequency ballasts where, for practical reasons, a higher frequency may be appropriate.

13.8 Lamp end temperature under abnormal operating conditions

The following applies to all high frequency electronic ballasts for lamps in this standard with a bulb diameter of T5 or less. In the case where a lamp does not start, any continuation of cathode heating shall not lead to overheating of the lamp ends. In the case where one of the electrodes is depleted or broken, while the lamp continues to operate (partial rectification) overheating of the lamp ends should be prevented by suitable measures in the circuit.

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13.9 Cathode resistance – high frequency operation

For lamps having preheated cathodes and designed for operation on high frequency or additionally operating on high frequency, the initial reading of the resistance of each cathode, when heated with the specified test current, shall comply with the values specified on the relevant lamp data sheet.

In addition, the average value of the resistance ratio R_h/R_c of the coils of 10 cathodes shall be in the range 4.75 ± 0.5. R_h is the resistance of the cathode when heated with the test current specified on the relevant lamp data sheet and R_c is the resistance of the cathode when cold, both excluding possible lead wire resistance.

14 Information for Luminaire Design

14.1 General

A luminaire intended for use with a particular lamp class shall provide the appropriate starting aid per 14.2 if necessary, and any specialized requirement, such as lamp operating position limitations, that may appear on the relevant lamp data sheet in Part IV. In addition, provisions shall be made to comply with the mechanical strength requirements and maximum base temperature requirements of 14.3, 14.4, and 14.5.

14.2 Starting Aid

Operation of fluorescent lamps on a rapid start circuit requires the presence of a grounded, conductive starting aid. This can be a conventional part of the luminaire. The starting aid shall be connected to electrical ground.

Unless otherwise specified on a lamp data sheet, distance from the lamp's bulb wall to the starting aid, as measured in a direction perpendicular to the surface of the starting aid, shall not be greater than the following:

Table 2 – Maximum Starting Aid Distance

Type of Fluorescent Lamp	Maximum distance	
	Inch	mm
T8 & T12 U-shaped lamps	½	13
Circular lamps, T5, 2G11 based	½	13
T6 Square		
Note – Size and spacing distance requirements for starting aids for use with self-supporting, single-based compact fluorescent lamps are under consideration.		

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14.3 Mechanical Strength

14.3.1 Auxiliary Supports

Certain lamp types are not intended to be held in place in a luminaire by the lamp base alone and auxiliary support is necessary. Such auxiliary support may take the form of a clip that holds the lamp's bulb. Location of the clip and its material may be critical for proper lamp operation. For circular-shaped and U-shaped lamps, location of auxiliary bulb supports is not critical. For 2G11-based lamps, location is critical (see the lamp data sheets).

The legs of U-shaped lamps may be connected with a brace. If present, this brace shall not be used to support the lamp in the luminaire.

Auxiliary supports or clips shall not restrict entry of the lamp into the luminaire nor cause damage to a lamp.

14.3.2 Attachments to Lamps

The lamp manufacturer may impose limitations in regards to attachment of any devices to its lamp. Contact the lamp manufacturer.

14.4 Maximum Guide Post Temperature, Normal Operation

Under normal operating conditions, with the lamp installed in a luminaire, the temperature of the lamp base measured at the bottom of the guidepost shall not exceed the value specified in the relevant lamp data sheet.

Notes:

(1) The temperature limitation under normal test conditions is necessary due to the presence of a radio interference suppression capacitor and glow-starter built into the bases of some classes of lamps, for example G23, GX23, G24d, or GX32d based lamps.

(2) Following are the test conditions:

- test lamps are production lamps with their lamp power within 2.5% of the standardized objective values
- the ambient temperature of the test room shall be 25±1°C
- with the lamp operating within its operating position limitation in a luminaire
- the test voltage of the luminaire shall be 106% of rated voltage

14.5 Maximum Base Temperature, Abnormal Operation

The requirements of ANNEX C of ANSI/IEC C78.1199 and ANSI/IEC C78.1195 (for 2G13 based lamps) apply.

14.6 Maximum Lamp Dimensions

The maximum space required to contain many of the lamps specified in this standard is found in Part II.

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PART II – Dimensioning Principles and Lamp Outline Drawings

15 Lamp Drawings and Dimensioning Principles

Theoretically, two sets of drawings are needed to describe the dimensions of concern for a single-based lamp. These are (a) a finished product drawing and (b) a maximum outline drawing. The main contrast being that the maximum outline drawing includes certain allowances beyond the finished product dimensions and to acknowledge bulb-to-base misalignment.

15.1 Lamps requiring maximum outline drawings

Basically, the same dimensional codes are used for the drawings of finished lamps and for maximum outline drawings of those lamps. In particular, the codes "C", "G", and "H" have essentially the same meanings in both cases. Only the values are different. The values are given on the lamp data sheets under the appropriate subtitles "Finished Lamp" and "Maximum Outline".

For G23 and GX23 based lamps, a wider allowance is given in the upper-base, lower-bulb area to accommodate the use of materials other than metal base shells. That area is defined by the 34.0mm width, 19.5mm depth and 30mm height above the reference plane dimensions.

For single-based fluorescent lamps, maximum outline drawings are based on certain principles and simplified assumptions. These are:

- Straight lines are used as much as possible to simplify the outline. All compromises with the actual space are in excess of the actual space.
- All excursions of a lamp bulb are considered relative to a fixed-position base.
- The base shown is merely a typical form. The relevant base contact-making gauge controls essential base dimensions.
- All dimensions are in millimeters unless otherwise specified.

Note: As a further simplification, there has been no attempt to strictly follow the procedures of ANSI C78.30, procedures for the use in preparation of incandescent lamp space drawings.

Figures 1 – 6, 9, 11 depict these principles.

15.2 Lamps not requiring maximum outline drawings.

Historically it has been unnecessary for circular lamps with G10q bases and U-shape lamps with 2G13 bases to have maximum outline drawings. Graphical definitions of the dimensional code letters used on the individual lamp data sheets are depicted in Figures 7 and 8.

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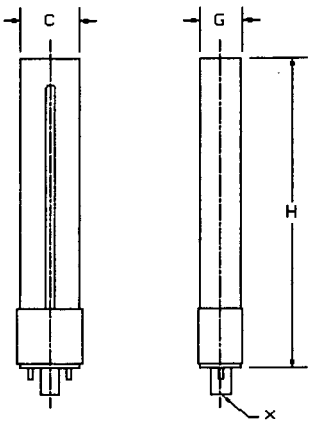


Figure 1- Twin Finished Product Drawing

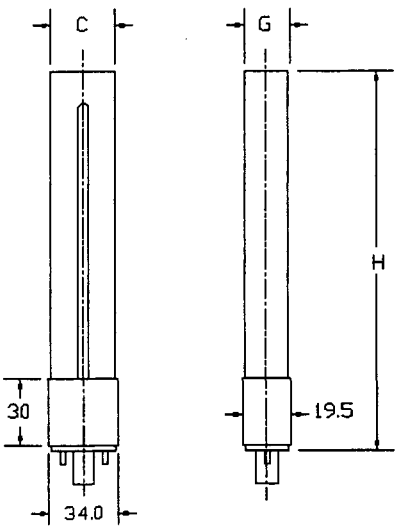


Figure 2 - Twin Maximum Outline Drawing

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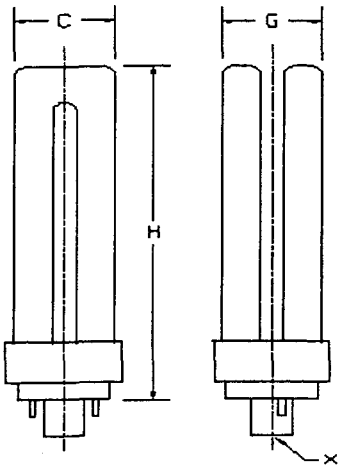


Figure 3 - Quad Finished Product Drawing

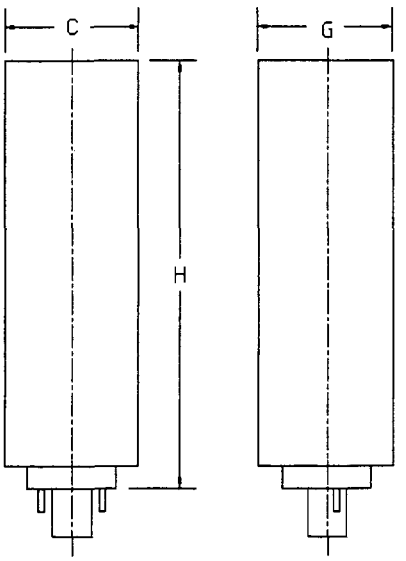


Figure 4 - Quad Maximum Outline Drawing

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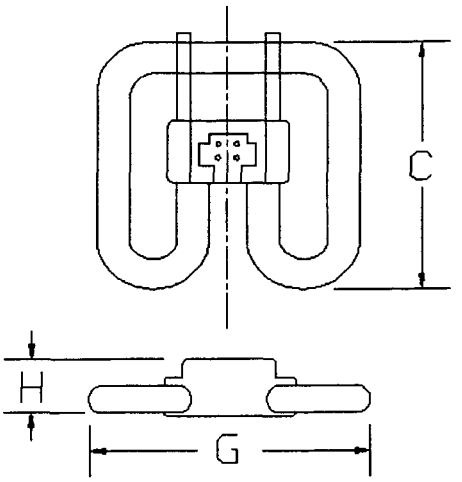


Figure 5 - Square-Shaped Fluorescent Lamp Finished Lamp Dimensions

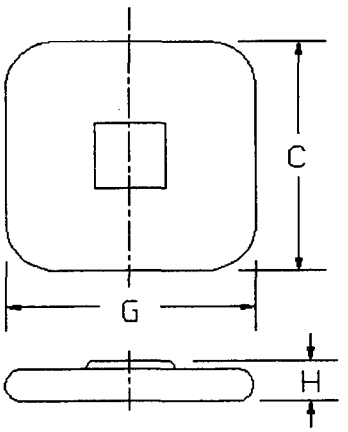


Figure 6 - Square-Shaped Fluorescent Lamp- Maximum Lamp Outline

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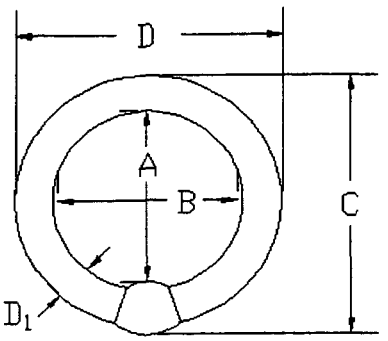


Figure 7 - Circular Lamps (G10q base)

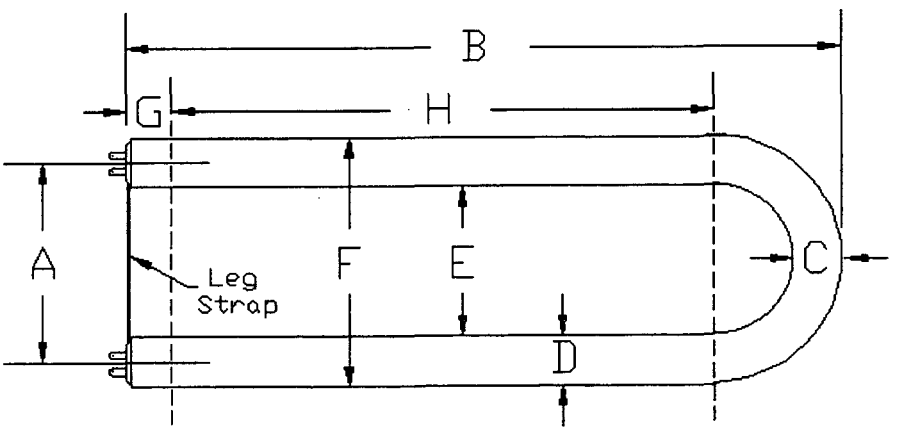


Figure 8 - U-shaped lamps (2G13 base)

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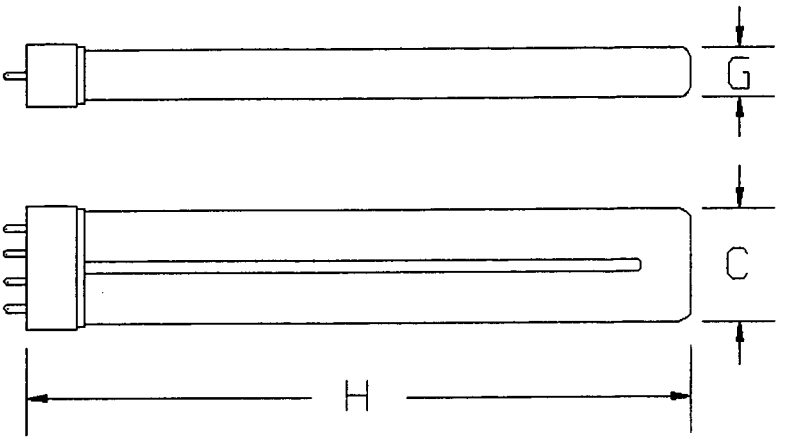


Figure 9 - 2G11 Based Lamps

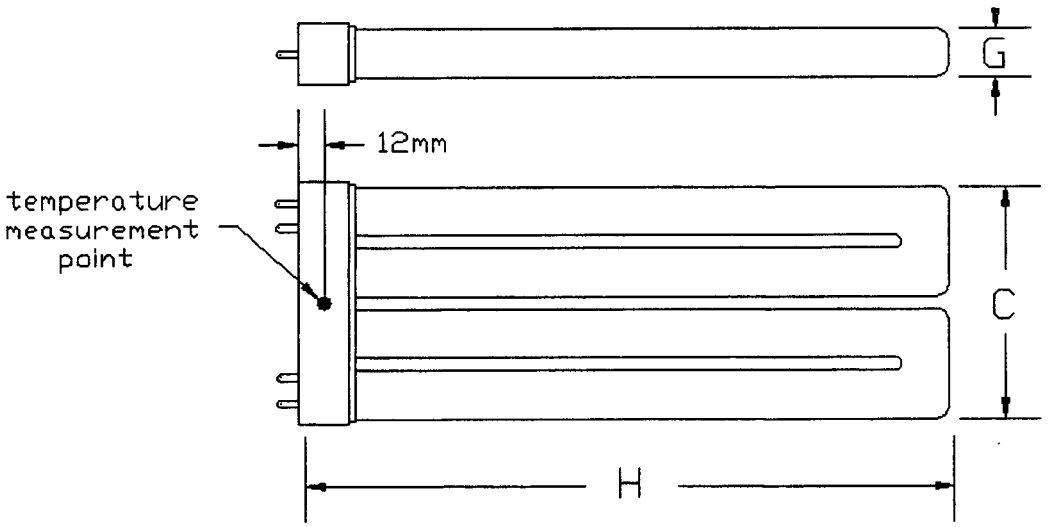


Figure 10 – Multi – 2G10 Based Fluorescent Lamp Finished Lamp Dimensions

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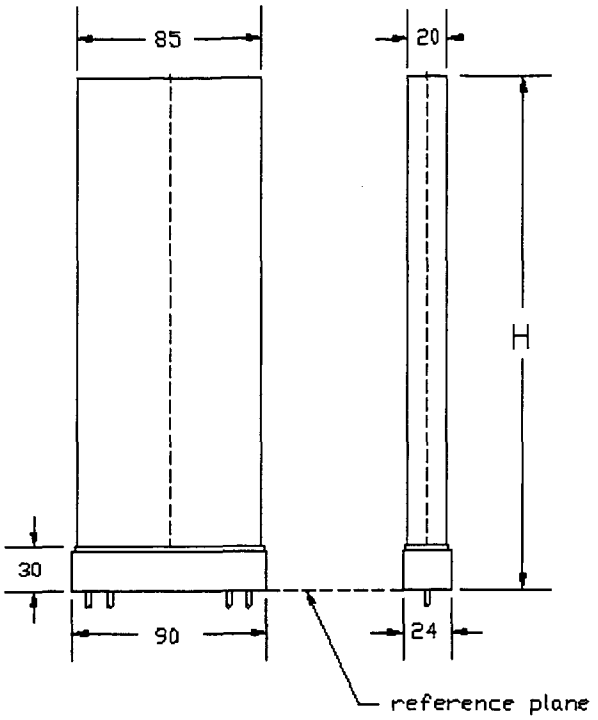


Figure 11 – Multi – 2G10 Based Fluorescent Lamp Finished Lamp Dimensions

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PART III – Annexes

Annex A (Informative)

Bibliography

A.1 Other related standards

Other classes of fluorescent lamps intended for use on other kinds of circuits are described in the following standards:

ANSI C78.180-1972 (R1994), *Specifications for Fluorescent Lamp Starters*

ANSI C78.376-1996, *Specifications for Chromaticity of Fluorescent Lamps*

ANSI/IES RP16-1996, *Recommended Practices for Illuminating Engineering, Nomenclature and Definitions*

A.2 Informative References

ANSI C78.5-1997, *Guide for the Performance of Self-Ballasted Lamps*

IEC 60901-1996, *Single-Capped Fluorescent Lamps - Specifications*

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Annex B (Informative)

Guidelines for Establishing Fluorescent Lamp Abbreviations

B.1 General

There is a need to identify lamp abbreviations for the lamps in this standard. These abbreviations will benefit users of the fluorescent lamp data sheets. A lamp, in this designation system, is identified by wattage, length or shape, bulb size, base and circuit application.

This guide is intended to provide a set of rules for reference in deriving abbreviations for lamp data sheets, in a consistent manner. There is no implication that abbreviations derived from this system are to be used or required for commercial literature applications.

B.2 Designation System

Only one abbreviation, under this system, is to be applied to a lamp data sheet. No attempt is made to identify lamp colors.

An abbreviation is comprised of six parts:

a. Lamp nominal wattage;

b. Lamp nominal length;

c. Bulb diameter;

d. Lamp shape, as required;

e. Lamp base, as required;

f. Circuit and/or special description.

The parts of the abbreviation are joined directly together in the above sequence and slashes are used as separators after wattage, bulb diameter, and the lamp shape or lamp base if used. A hyphen may be used if two properties are identified under item 6 above. Otherwise there are no spaces or other separator marks used.

B.2.1 Wattage

All lamps shall be identified by wattage, even though they may not be marketed by wattage. The wattage values shown shall be the nominal wattage of the lamp.

The numerical value of wattage in watts shall be followed directly by the letter "W".

B.2.2 Length

The length of a linear lamp shall be expressed in the designation by a number representing the nominal length of the lamp, in inches. Only the numerical value is entered. This length code is based upon a first order assumption that fluorescent lamps are linear lamps. For twin or quad shaped lamps the length (in inches) is part of the abbreviation.

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For those special cases where it is necessary to identify lamp length in metric units, the abbreviations shall contain the letters "mm" immediately following the length value in millimeters.

B.2.3 Bulb Diameter

Bulb diameter shall be entered directly following the above length without any separator. The bulb diameter information comprises two sub-parts. The first is a letter to indicate bulb's cross-sectional shape and the other part is the cross-sectional major diameter. The bulb shape is identified by a letter symbol as follows:

T Round cross-sectional tubular bulb

Bulb diameter values shall be entered in the conventional eighths-of-an-inch system.

For those special cases where it is necessary to identify bulb diameter in metric units, the abbreviation shall contain the letters "mm" immediately following the diameter value in millimeters.

B.2.4 Lamp Shape

Exceptions to the linear assumption, such as circular, U-Shape, and compact single-based lamps are called out with a special code in this length section of the abbreviation. Special descriptions are defined as follows:

U1 U-Shaped lamp, 1-5/8 inch leg centers

U3 U-Shaped lamp, 3-5/8 inch leg centers

U6 U-Shaped lamp, 6-inch leg centers

C8 Circular shaped lamp, 8-inch diameter of circle

C12 Circular shaped lamp, 12-inch diameter of circle

C16 Circular shaped lamp, 16-inch diameter of circle

T Twin, Two parallel legs with a common base

Q Quad, Four parallel legs, square, with a common base

S Square shaped lamp

M Multi, multiple legs (more than four) with a common base

As new lamps of similar design to the above are standardized, additional numerical values may be used within the established pattern. Radically new lamp shapes will necessitate the establishment of new letter codes and definitions in this clause.

B.2.5 Lamp Base

The lamp's base code may be used as part of the designation in certain cases. Those are the cases where the application of the lamp to the correct auxiliary circuit is controlled by means of the base on the lamp. The compact, single-based family of lamps, for example, employs a variety of bases for use in particular circuits. Proper base codes are noted in the base standard, ANSI C81.61.

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B.2.6 Circuit and/or Special Description

This part of the abbreviation shall follow the slashed separator which follows the bulb diameter or the optional shape and base information when they are provided. It is intended to help the user associate the lamp with the correct auxiliary circuit.

This abbreviation system does not necessarily identify all circuits that a lamp manufacturer may have authorized for use with a particular lamp.

Lamps that are specified for operation at two separate wattage or current levels, on the same type of circuit, are identified in the abbreviation by the lower level only.

Typical circuit identifiers are:

RS Rapid-start

PH Preheat-start (starter)

IS Instant-start

HF High frequency

Special descriptions may be necessary in certain cases to separate lamps of similar design. These special identifiers may be used in addition to the above circuit identifications, separated by a hyphen.

B.3 Sample Abbreviations

Following are several sample abbreviations with explanations.

40W/22T12/U6/RS	40 Watt, 22 Inch T12, U-Shaped – 6 inch Leg, Center Spacing, Rapid-Start
4W/6T5/PH	4 Watt, 6 Inch T5, Preheat-Start
5W/4T4/T/G23/PH	5 Watt, 4 Inch T4, Twin, G23 Base, Preheat-Start
13W/5T4/Q/G23-2/PH	13 Watt, 5 Inch T4, Quad, G23-2 Base, Preheat-Start
36-39W/16T5/T/2G11/PH-RS	36-39 Watt, 16 Inch T5, Twin, 2G11 Base, Preheat or Rapid-Start
20W/T9/C6/RS	20 Watt, 6 Inch Circular T9, Rapid-Start
10W/T4/S3/GR10q/PH	10 Watt, T4 Square-Shape Single-base Preheat Fluorescent Lamp with External Means of Starting
10W/T4/S5/GR8/PH	16 Watt, T4 Square-Shape, Single-base Preheat Fluorescent Lamp with Internal Means of Starting

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Annex C (Informative)

Generic Designation System for Compact Fluorescent andT5 Twin Fluorescent Lamps

The National Electrical Manufacturers Association (NEMA) lamp companies have developed a short generic designation to identify pin-based and T5 twin fluorescent lamps. This system is intended to simplify specification and re-ordering of lamps. It is not applicable to screw-based compact fluorescent lamps.

NEMA lamp manufacturers have adopted this terminology in lamp publications. It has also been adopted, for example, in the IESNA (Illuminating Engineering Society of North America) Handbook, in the Advanced Lighting Guidelines, by Lighting Research Center publications, and in federal government specifications. Luminaire and ballast manufacturers are encouraged to use this generic terminology in catalogs, on products and on re-lamping labels. Specifiers are encouraged to use the generic designations in bid documents.

Non-NEMA manufacturers are invited to adopt the same designation principles since the system is intuitive, and requires no central administering organization.

Additional information and details of the system can be obtained by contacting NEMA.

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Annex D (Informative)

Guidelines for the Establishment of Wattage Ratings on Fluorescent Lamp Data Sheets

D.1 Introduction

A typical ANSI lamp data sheet for a fluorescent lamp type shows values for both a wattage identification rating and a lamp operating characteristic wattage. While "rated wattage" is assigned for identification purposes, the "characteristic wattage" is a value used for the evaluation of results under specific measurement conditions. Since each has a separate purpose, there is no need for them to agree absolutely. However, wide disagreement could provoke questions and might be misleading to readers.

These guidelines should be applied to new lamp types being standardized. They are not to be applied retroactively.

D.2 Purpose

The purpose of this appendix is to provide guidelines for the establishment of rated wattage identification of a fluorescent lamp data sheet, relative to its associated characteristic wattage value.

D.3 Various Factors Affecting Rated Wattage

D.3.1 Application Circuit

Early in the history of the development of fluorescent lamps, preheat, switch-start circuits were used exclusively. Later, rapid-start and instant-start circuits became important also. Presently, additional circuits such as modified rapid-start, high frequency switch-start, high frequency rapid-start, etceteras are coming into use.

Although a type of fluorescent lamp may be designed for operation on one specific circuit, that lamp may be later applied on another circuit(s). Therefore, one particular type of fluorescent lamp might be utilized on one of several different auxiliary circuits. The operating power dissipation of a lamp can be expected to vary depending on the circuit in which it is used.

An overly complicated situation would occur if a lamp's wattage rating reflected the operational results of several different circuits. The more straightforward, simplified approach is the assignment of one rated wattage value, regardless of various applications.

D.3.2 Measurements of Lamp Characteristics on Reference Ballast

Measurements of fluorescent lamps have always been made on reference ballast circuits. Lamp characteristics, including characteristic wattage, are then specified on the lamp data sheet relative to the measurements on the specified reference ballast.

Switch-start reference circuits or rapid-start reference circuits are specified in various ANSI standards. The difference between them is that the latter incorporates continuous cathode heating. Numerically, for the same lamp type, this would amount to a wattage difference of less then 5%. Reference circuits for high frequency operation have not been fully developed yet. Where rapid-start lamp operating characteristics are given,

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both switch-start and rapid-start characteristics in reality are present. The terms used are arc wattage, which is analogous to operation on a switch-start reference ballast, and total wattage, which includes cathode wattage, and thus represent operation on a rapid-start reference ballast.

With the above two sets of lamp characteristics available, it is not always clear whether "arc wattage" or "total wattage" should be the basis for the "rated wattage".

D.3.3 Hierarchy of Lamp Characteristics

When switch-start was the first application for a lamp, the rated wattage value would have been established in relation to that original switch-start data. Once established, no change would be made when new applications and additional reference ballast conditions were added. Any change in rating of a specific lamp would be confusing to consumers. Conversely, a lamp originally developed for use on rapid-start circuits would be assigned a rated wattage relative to lamp characteristics on the rapid-start reference ballast. A dilemma occurs, however, when both applications for the same lamp type have commercial importance.

In one sense, basing a lamp's rated wattage on switch-start specification can be misleading to customers who operate the lamp on a rapid-start circuit. The rating based on switch-start specifications is further removed from the actual power consumption for the rapid-start application. The reverse is true, also. Therefore, it will be beneficial to all if a fixed procedure for assignment rated wattage is established so that uncertainties are eliminated.

D.4 Procedure for Establishing Rated Wattage

For lamp types intended only for application on rapid-start circuits, or where rapid-start is the only known application when the lamp data is first approved, the rated wattage shall be based on the rapid-start characteristic wattage (total wattage, including cathode heating wattage).

For lamp types intended for use on more than one type of circuit, the rated wattage shall be based on the most commonly used commercial circuits.

A rated wattage value may be rounded the nearest appropriate value.

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PART IV – Lamp Specification Data Sheets

1 General Principles for Numbering of Data Sheets

The first number represents the number of this standard "78901" followed by the letters "ANSI". For data sheets adopted from IEC, the IEC number will be retained and would start with "60901-IEC" or the like.

The second number is the data sheet number.

The third number represents the edition of the page of the data sheet. In cases where the data sheet has more than one page, it is possible for the pages to have different edition numbers, with the data sheet number remaining the same.

2 Data Sheet List and Sequence

The following page presents a list of all the data sheets. The list is sorted in the order of Shape, then bulb diameter, and then wattage. Use this list to identify the data sheet number of the lamp. The data sheets follow in order of the wattage.

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Data Sheet Number 78901-ANSI-	Nominal Wattage (W)	Shape	Bulb	Base	Reference Frequency (Hz)	Circuit
4001-1	5	twin	T4	G23	60	PH - internal
4002-1	7	twin	T4	G23	60	PH - internal
4003-1	9	twin	T4	G23	60	PH - internal
4006-1	13	twin	T4	GX23	60	PH - internal
4014-1	18	twin	T5	2G11	60	PH
4015-1	18	twin	T5	2G11	60	RS
4018-1	24-27	twin	T5	2G11	60	RS or PH
4020-1	36-39	twin	T5	2G11	60	RS or PH
4022-1	40	twin	T5	2G11	60	RS
4023-1	50	twin	T5	2G11	60	RS
*6255-1	55	twin	T5	2G11	25K	HF
4004-1	9	quad	T4	G23-2	60	PH - internal
4005-1	10	quad	T4	G24d-1	60	PH - internal
4007-1	13	quad	T4	GX23-2	60	PH - internal
4008-1	13	quad	T4	G24d-1	60	PH - internal
4009-1	18	quad	T4	G24d-2	60	PH - internal
4010-1	26	quad	T4	G24d-3	60	PH - internal
4011-1	15	quad	T5	GX32d-1	60	PH - internal
4012-1	20	quad	T5	GX32d-2	60	PH - internal
4013-1	27	quad	T5	GX32d-3	60	PH - internal
4016-1	18	multi	T5	2G10-3	60	PH or HF
4017-1	24	multi	T5	2G10-3	60	PH or HF
4019-1	36	multi	T5	2G10-3	60	PH or HF
4036-1	10	square	T4	GR10q	60	PH
4037-1	16	square	T4	GR8	60	PH – internal
4038-1	16	square	T4	GR10q	60	PH
4039-1	21	square	T4	GR10q	60	PH
4040-1	28	square	T6	GR8	60	PH – internal
4041-1	28	square	T6	GR10q	60	RS or PH
4021-1	38	square	T6	GR10q	60	RS or PH
4024-1	16	U 1-5/8	T8	2G13	60	RS
4025-1	24	U 1-5/8	T8	2G13	60	RS
4026-1	31	U 1-5/8	T8	2G13	60	RS
4027-1	32	U 6	T8	2G13	60	RS
4028-1	40	U 3-5/8	T12	2G13	60	RS
4029-1	40	U 6	T12	2G13	60	RS
4030-1	20	circular	T9	G10q	60	RS or PH
4031-1	22	circular	T9	G10q	60	RS or PH
4032-1	32	circular	T9	G10q	60	RS or PH
4033-1	32	circular	T10	G10q	60	RS or PH
4034-1	40	circular	T9	G10q	60	RS
4035-1	40	circular	T10	G10q	60	RS

*adopted from IEC 60901. The prefix for this sheet is 60901-IEC-

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5-Watt, T4 Twin Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	5W/5T4/T/G23/PH		
Nominal wattage	5 Watts		
Nominal dimension	OAL	Width	Depth
	105 mm	30 mm	15 mm
Bulb designation	T4 (T13)		
Base	G23		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	85	85
C (Width of lamp) max	28 (Note 1)	32.5
G (Depth of lamp) max	13 (Note 1)	18.1

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position: Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	5.5
Voltage (V)	35
Current (A)	0.180

Cathode characteristics

Type: High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.180
Impedance (ohms)	605

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	108
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.153
max at 106% of rated line voltage (A)	0.240

Cathode heat requirements

Dummy load resistor, for both cathodes in series	160 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Max temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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7-Watt, T4 Twin Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	7W/5T4/T/G23/PH		
Nominal wattage	7 Watts		
Nominal dimension	OAL	Width	Depth
	135 mm	30 mm	15 mm
Bulb designation	T4 (T13)		
Base	G23		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp dim (mm)	Max lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	115	115
C (Width of lamp) max.	28 (Note 1)	32.5
G (Depth of lamp) max.	13 (Note 1)	18.1

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	7
Voltage (V)	47
Current (A)	0.180

Cathode characteristics

Type	High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.180
Impedance (ohms)	570

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F(-18°C) and above, (Vrms) min	108
at 0°F(-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.153
max at 106% of rated line voltage (A)	0.240

Cathode heat requirements

Dummy load resistor, for both cathodes in series	160 ohms

Note - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Max temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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9-Watt, T4 Twin Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	9W/6T4/T/G23/PH		
Nominal wattage	9 Watts		
Nominal dimension	OAL	Width	Depth
	165 mm	30 mm	15 mm
Bulb designation	T4 (T13)		
Base	G23		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp dim (mm)	Max lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	145	145
C (Width of lamp) max.	28 (Note 1)	32.5
G (Depth of lamp) max	13 (Note 1)	18.1

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	9
Voltage (V)	59
Current (A)	0.180

Cathode characteristics

Type	High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.180
Impedance (ohms)	515

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 25°F(-4°C) and above, (Vrms) min	108
at 25°F(-4°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.153
max at 106% of rated line voltage (A)	0.240

Cathode heat requirements

Dummy load resistor, for both cathodes in series	160 ohms

Note - A radio interference suppression capacitor is located internal to the lamp base. See Sections 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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9-Watt, T4 Quad Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

Lamp description

Lamp abbreviation	9W/4T4/Q/G23-2/PH		
Nominal wattage	9 Watts		
Nominal dimension	OAL	Width	Depth
	112 mm	30 mm	30 mm
Bulb designation	T4 (T13)		
Base	G23-2		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	88	88
C (Width of lamp) max	28 (Note 1)	35
G (Depth of lamp) max	28 (Note 1)	35

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)	
Wattage (W)	9
Voltage (V)	59
Current (A)	0.180

Cathode characteristics
Type High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (uF) (at 60Hz)	0.0008
max (uF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.180
Impedance (ohms)	515

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals;	
at 25°F(-4°C) and above, (Vrms) min	108
at 25°F(-4°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.153
max at 106% of rated line voltage (A)	0.240

Cathode heat requirements

Dummy load resistor, for both cathodes in series	160 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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10-Watt, T4 Quad Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	10W/5T4/Q/G24/PH		
Nominal wattage	10 Watts		
Nominal dimension	OAL	Width	Depth
	120 mm	30 mm	30 mm
Bulb designation	T4 (T13)		
Base	G24d-1		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	95	95
C (Width of lamp) max	28 (Note 1)	35
G (Depth of lamp) max	28 (Note 1)	35

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position: Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	10
Voltage (V)	64
Current (A)	0.190

Cathode characteristics

Type: High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.190
Impedance (ohms)	1080

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F(-18°C) and above, (Vrms) min	198
at 0°F(-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.153
max at 106% of rated line voltage (A)	0.275

Cathode heat requirements

Dummy load resistor, for both cathodes in series	100 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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10-Watt, T4 Square-Shape Single-Based Preheat-Start Fluorescent Lamp with external means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	10W/T4/S3/GR10q/PH		
Nominal wattage	10 Watts		
Nominal dimension	OAL	Width	Depth
	91 mm	91 mm	34 mm
Bulb designation	T4 (T13)		
Base	GR10q		
Circuit application	Preheat (switch) start, external starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	34.5	35
C (Length of lamp) max	92 (Note 1)	98
G (Width of lamp) max	92 (Note 1)	98

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	10.5
Voltage (V)	72
Current (A)	0.180

Cathode characteristics

Type	High resistance
Resistance (at 8V/cathode)	
Both cathodes in series, objective (ohms)	110

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Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.165
Impedance (ohms)	1200

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	TBD
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.162
max at 110% of rated line voltage (A)	0.378

Cathode heat requirements

Dummy load resistor, for both cathodes in series	110 ohms

Information for starter design

Radio interference suppression capacitor (conditions of clause 13.1 apply)

Min (µF) (at 60Hz)	0.005
Max µF) (at 60Hz)	0.008

Information for luminaire design (conditions of clause 14 apply)

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13-Watt, T4 Twin Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	13W/7T4/T/GX23/PH		
Nominal wattage	13 watts		
Nominal dimension	OAL	Width	Depth
	190 mm	30 mm	15 mm
Bulb designation	T4 (T13)		
Base	GX23		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2
H (Base face to top of lamp) max	170	170
C (Width of lamp) max	28 (Note 1)	32.5
G (Depth of lamp) max	13 (Note 1)	18.1

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position: Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	13.4
Voltage (V)	59
Current (A)	0.285

Cathode characteristics

Type: Low resistance

Radio interference suppression capacitor (condtions of clause 13.1 apply)

min (µF) (at 60Hz)	0.0008
max (µF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.285
Impedance (ohms)	325

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 32°F(0°C) and above, (Vrms) min	108
at 32°F(0°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.270
max at 106% of rated line voltage (A)	0.525

Cathode heat requirements

Dummy load resistor, for both cathodes in series	25 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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13-Watt, T4 Quad Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

Lamp description

Lamp abbreviation	13W/5T4/Q/GX23-2/PH		
Nominal wattage	13 watts		
Nominal dimension	OAL	Width	Depth
	123 mm	30 mm	30 mm
Bulb designation	T4 (T13)		
Base	GX23-2		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	99	99
C (Width of lamp) max	28 (Note 1)	35
G (Depth of lamp) max	28 (Note 1)	35

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	13
Voltage (V)	59
Current (A)	0.285

Cathode characteristics

Type	Low resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.285
Impedance (ohms)	325

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 32°F(0°C) and above, (Vrms) min.	108
at 32°F(0°C) and above, (Vpeak) max.	440
Preheat current	
min at 90% of rated line voltage (A)	0.270
max at 106% of rated line voltage (A)	0.525

Cathode heat requirements

Dummy load resistor, for both cathodes in series	25 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See Sections 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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13-Watt, T4 Quad Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	13W/6T4/Q/G24/PH		
Nominal wattage	13 watts		
Nominal dimension	OAL	Width	Depth
	155 mm	30 mm	30 mm
Bulb designation	T4 (T13)		
Base	G24d-1		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	130	130
C (Width of lamp) max	28 (Note 1)	35
G (Depth of lamp) max	28 (Note 1)	35

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	13
Voltage (V)	91
Current (A)	0.175

Cathode characteristics

Type	High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (µF) (at 60Hz)	0.0008
max (µF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.170
Impedance (ohms)	1080

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F(-18°C) and above, (Vrms) min	198
at 0°F(-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.153
max at 106% of rated line voltage (A)	0.275

Cathode heat requirements

Dummy load resistor, for both cathodes in series	100 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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15-Watt, Single-Based, Quad Tube Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	15W/6T5/Q/GX32/PH		
Nominal wattage	15		
Nominal dimensions	OAL	Width	Depth
	142 mm	40 mm	40 mm
Bulb designation	T5 (T16)		
Base type	GX32d-1		

Dimensional characteristics (definitions of Part II apply)

	Maximum lamp dim. (mm)	Maximum outline dim. (mm) (Note 2)
H (Base face to top of lamp) max	117	117
C (Width of lamp) max	41 (Note 1)	45
G (Depth of lamp) max	41 (Note 1)	45

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	15
Voltage (V)	53
Current (A)	0.325

The preceding lamp operating characteristics are based on base up operation in a preheat-start-type circuit in an ambient temperature of 25°C (77°F) with a 60 Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

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Cathode characteristics

Type	Low resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010

Reference ballast characteristics

Rated input voltage	*118*
Reference current	0.325 A
Impedance	290 ohms

The general requirements for reference ballasts are stated in American National Standard Specifications for Fluorescent Lamp Reference Ballast, ANSI C82-3.

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

The following values are intended to provide reliable starting at the ambient temperatures indicated and at higher temperatures up to a maximum of 110°F (43°C). At temperatures near the top of that range, however, initial starting will be secured but not necessarily immediate restarting.

Voltage between lamp terminals

at 32°F (0°C) and above, (Vrms) min	108V
at 32°F (0°C) and above, (Vpk) max	400V

The voltage limits shall be met at any primary voltage between 90% and 100% of rated voltage.

Preheat current

min at 90% of rated voltage	0.280A
max at 106% of rated voltage	0.650A

Cathode heat requirements

Dummy load resistor for both cathodes in series	25 ohms

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Ballast design note

The values in this standard are based on 60 Hz operating characteristics.

NOTE – A radio interference suppression capacitor is located internal to the lamp base. See Sections 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal operation (conditions of clause 14.4 apply)

Maximum temperature at point x on lamp base (°C) 90

NOTES
3 Point x is identified in Figure 1.
4 A higher guide post temperature may be acceptable. Consult lamp manufacturer.

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16-Watt, U-Shaped, 1-5/8-Inch Center T8, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	16W/11T8/U1/RS
Nominal wattage	16 watts
Nominal overall length	11 in (279 mm)
Bulb designation	T8 (T25), U-shaped
Base	2G13-41
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Lamp legs, center to center, nominal)	1-5/8	1-5/8	41	41
B (Base face to lamp end)	10.25	10.60	260.4	269.2
C (Bulb diameter in bend)	0.94	1.10	23.9	27.9
D (Bulb diameter in legs)	0.94	1.10	23.9	27.9
E (Distance between legs)	0.50	-	12.7	-
F (Distance to outside of legs)	-	2.75	-	69.9
G (Base face to beginning of Dimension H)	1.0	-	25.4	-
H (Length over which Dimensions D, E, and F apply)	6.0	-	152.4	-

Lamp legs shall be in the same plane over the unbent portion of the lamp; maximum deviation = 0.13 in (3.3 mm).

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	14.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	1.7
Total wattage (W)	16.2
Voltage (V)	65
Current (A)	0.265

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.265
Impedance (ohms)	800

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	11.0
Minimum (ohms)	8.0

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for two lamps
Rapid start		
Voltage between lamp terminals (Note 1)		
at 50°F (10°C) and above, (Vrms) min	140	210
at 50°F (10°C) and above, (Vrms) max	190	285
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°C) and above, (Vpeak) min	325	325
Waveshape of starting voltage crest factor, max	2.0	2.0
Starting capacitor size		
min (μF) (at 60 Hz)		0.04
max (μF) (at 60 Hz)		0.06

NOTES

1 These values are for lead circuits only. Values for lag circuits are under consideration.
2 These values are for crest factors of 1.55 to 2.0. Add 20% for crest factors less than 1.55.

Cathode heat requirements

Rapid start

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	11.0 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply)

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16-Watt, T4 Square-Shape Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	16W/T4/S5/GR8/PH		
Nominal wattage	16 Watts		
Nominal dimension	OAL	Width	Depth
	140 mm	140 mm	27 mm
Bulb designation	T4 (T13)		
Base	GR8		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	27.5	28
C (Length of lamp) max	138 (Note 1)	142
G (Width of lamp) max	138 (Note 1)	142

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	16
Voltage (V)	103
Current (A)	0.195

Cathode characteristics

Type	High resistance
Resistance (at 8V/cathode)	
Both cathodes in series, objective (ohms)	130

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Radio interference suppression capacitor

Min (μF) (at 60Hz)	0.001
Max (μF) (at 60Hz)	0.003

NOTE
3 The suppression capacitor may affect starting and operating performance of lamps used with high frequency ballasts

Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.195
Impedance (ohms)	878

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:

at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	TBD
at 0°F (-18°C) and above, (Vpeak) max	440

Preheat current

min at 90% of rated line voltage (A)	0.175
max at 110% of rated line voltage (A)	0.410

Cathode heat requirements

Dummy load resistor, for both cathodes in series	130 ohms

NOTE
4 A radio interference suppression capacitor is located internal to the lamp base. See clauses 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

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16-Watt, T4 Square-Shape Single-Based Preheat-Start Fluorescent Lamp with external means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	16W/T4/S5/GR10q/PH		
Nominal wattage	16 Watts		
Nominal dimension	OAL	Width	Depth
	140 mm	140 mm	27 mm
Bulb designation	T4 (T13)		
Base	GR10q		
Circuit application	Preheat (switch) start, external starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	27.5	28
C (Length of lamp) max	138 (Note 1)	142
G (Width of lamp) max	138 (Note 1)	142

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	16
Voltage (V)	103
Current (A)	0.195

Cathode characteristics

Type	High resistance
Resistance (at 8V/cathode)	
Both cathodes in series, objective (ohms)	130

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Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.195
Impedance (ohms)	878

Thermal conditions (conditions of clause 12 apply)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	u.c.
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.175
max at 110% of rated line voltage (A)	0.410

Cathode heat requirements

Dummy load resistor, for both cathodes in series	130 ohms

Information for starter design

Radio interference suppression capacitor (conditions of clause 13.1 apply)

Min (µF) (at 60Hz)	0.001
Max (µF) (at 60Hz)	0.003

Information for luminaire design (conditions of clause 14 apply)

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18-Watt, T4 Quad Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	18W/7T4/Q/G24/PH		
Nominal wattage	18 Watts		
Nominal dimension	OAL	Width	Depth
	175 mm	30 mm	30 mm
Bulb designation	T4 (T13)		
Base	G24d-2		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	150	150
C (Width of lamp) max.	28 (Note 1)	35
G (Depth of lamp) max.	28 (Note 1)	35

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position: Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	18
Voltage (V)	100
Current (A)	0.220

Cathode characteristics

Type: High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.220
Impedance (ohms)	815

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	198
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.190
max at 106% of rated line voltage (A)	0.375

Cathode heat requirements

Dummy load resistor, for both cathodes in series	80 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See clause 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (OC)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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18-Watt, 9-inch, T5 Single-Based, Preheat Fluorescent Lamp

Lamp description

Lamp abbreviation	18W/9T5/T/2G11/PH
Nominal wattage	18 watts
Nominal overall length	9 in (229 mm)
Bulb designation	T5 (T16)
Base	2G11
Circuit application	Preheat start

Dimensional characteristics (definitions of Part II apply)

	Lamp Dimension (Note 1)		Maximum Lamp Outline Dimension (Note 2)	
Lamp Length	Inches	Millimeters	Inches	Millimeters
Base face to top	*Max*	*Mat*		
of lamp (H)	8.8	225	8.8	225
Bulb depth (G)	0.8	20	0.9	24
Bulb width (C)	1.6	40	1.7	44

Lamp Holding Requirements

An auxiliary bulb holding device is required due to the long length of this single-based lamp. No mounting support shall be placed on or very near the bent end of the lamp. The bulb-holding device shall be located between 140mm (5.5") and 175mm (6.9") from base face of lamp.

NOTES

1 A UV resistant non-metallic saddle type clip is the preferred method to support the lamp. Metallic clips may change the starting characteristics of high-frequency operation of the lamp.

2 A support placed between the legs of the lamp is not recommended. The inside leg dimension is not controlled and varies in production. The minimum spacing between the legs is 1.8mm (0.071 in).

3 The lamp should be used in lamp holders that conform to ANSI C81.62.

Electrical Characteristics

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Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	18.0
Voltage (V)	59.0
Current (A)	0.380

The preceding lamp operating characteristics are based on horizontal operation in a preheat-start type circuit at an ambient temperature of 25°C (77°F) with a 60-Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section.

Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.380
Impedance (ohms)	240
Frequency (Hz)	60

The general requirements for reference ballasts are stated in American National Standard for Reference Ballasts for Fluorescent Lamps, ANSI C82.3.

Cathode Characteristics

Type	Low resistance

Information for Ballast Design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start circuits

Voltage between lamp terminals	
at 50°F (10°C) and above. (Vrms) min.	108
at 50°F (10°C) and above. (Vpeak) max.	440
Preheat current	
min at 90% of rated line voltage, (A)	0.315
max at 106% of rated line voltage, (A)	0.670

Cathode heat requirements

Dummy load resistor, for both cathodes in series	50 ohms

Information for luminaire design (conditions of clause 14 apply)

Only use ballasts designated for use with this preheat-start lamp (18W/9T5/T/2G11/PH). Do not use this lamp on rapid-start ballasts designated for the 18 watt, 10 inch, T5 lamp (18W/10T5/T/2G11/RS).

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18-Watt, Single-Based Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	18W/10T5/T/2G11/RS
Nominal wattage	18 Watts
Nominal overall length	10.4 inches (264mm)
Bulb designation	T5 (T16)
Base type	2G11
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Lamp Dimensions-Note 1				Lamp Outline Dimensions-Note 2	
	Inches		Millimeters		Inches	Millimeters
Lamp Length	Min	Max	Min	Max	Max	Max
Base face to top of lamp (H)	-	10.25	-	260.4	10.25	260.4
Bulb depth (G)	0.67	0.70	17.1	17.8	0.98	25.0
Bulb width (C)	1.46	1.55	37.2	39.4	1.80	46.0

NOTES

1 Lamp dimensions C & G apply to glass only in mounting area along lamp legs.
2 Conditions of clause 10.4 apply.

Auxiliary supports

An auxiliary bulb holding device is required due to the long length of this single-based lamp. No mounting support shall be placed on or very near the bent end of the lamp. The bulb-holding device shall be located between 7.5 inches (190 mm) and 8.5 inches (216 mm) from the base face of the lamp.

NOTES

3 A UV resistant non-metallic saddle type clip is the preferred method to support the lamp. Metallic clips may change the starting characteristics of high frequency operation of the lamp.
4 A support placed between the legs of the lamp is not recommended. The inside leg dimension is not controlled and varies in production. The minimum spacing between the legs is 1.8 mm (0.071 in.).
5 The lamp should be used in lamp holders that conform to 2G11 standards sheet, ANSI C81.62.

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Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	16.0
Approximate cathode wattage (with 3.6V on each cathode) (W)	2.5
Total wattage	18.5
Volts (V)	78
Current (A)	0.246

The preceding lamp operating characteristics are based on horizontal operation in a rapid-start type circuit at an ambient temperature of 25°C (77°F) with a 60-Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.250
Impedance (ohms)	850

The general requirements for reference ballasts are stated in ANSI C82.3.

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

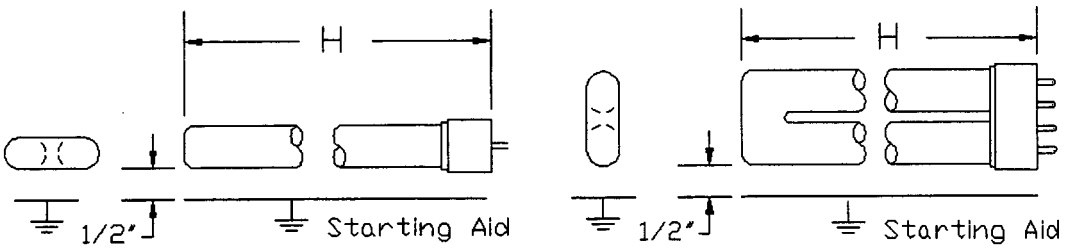
	Single-lamp ballast	Ballasts for two lamps
Rapid-start (starterless) circuits		
Voltage between lamp terminals		
at 50°F (10°C) and above, (Vrms) min	210	210
at 50°F (10°C) and above, (Vrms) max	270	270
Voltage lamp terminal to starting aid (Note 1)		
at 50°F (10°C) and above, (Vpeak) min	520	520
Voltage (°C) crest factor, min (@90% line)	1.85	1.85
Voltage (°C) crest factor, max	2.20	2.20
Starting capacitor size		
min (µF) (at 60 Hz)	-	0.04
max (µF) (at 60 Hz)	-	0.06

NOTES

6 These limits apply to the peak voltage between the lamp terminal delivering the highest voltage above ground and the grounded fixture.

7 The starting aid surfaces shall extend the full length of the lamp (distance H), at least 1 inch (25 mm) wide for edge mounting of lamps and at least 1.5 inch (38 mm) for flat mounting of lamps.

8 Maximum distance from bulb wall leg to starting aid is 1/2 inch (13 mm) for either edge mounting or flat mounting, as shown below:



Cathode heat requirement at rated input voltage

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply)

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18 Watt, T5 Single-Based Fluorescent Lamp

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	18W/5T5/M/2G10-3
Nominal wattage	18 Watts
Bulb designation	T5
Base specifications	2G10-3
Operating position	Any
Circuit application	Multiple / HF and 60 Hz

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	122	122
C (Width of lamp) max	79 (Note 1)	Note 3
G (Depth of lamp) max	18 (Note 1)	Note 3

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Electrical characteristics
Test position: Vertical, base-up

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	18
Voltage (V)	58
Current (A)	0.375

Reference ballast characteristics

Rated input voltage (V)	118
Reference current (A)	0.380
Impedance (ohms)	240

Cathode characteristics

Type	Low resistance
Hot resistance @ test current (ohms)	12± 2.4
Test current (A)	0.340

This test current will result in a stable Rh/Rc ratio of approximately 4.75.

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Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Starting Voltage	
Voltage between lamp terminals	
at 25°F(-4°C) and above, (Vrms) min	104
at 25°F(-4°C) and above, (Vpeak) max	400

Preheat current

Min at 90% of rated line voltage (A)	0.315
Max at 106% of rated line voltage (A)	0.670

Cathode heat requirements

Dummy load resistor, for both cathodes in series	50 ohms

Information for high frequency ballast design

Typical operating characteristics at 20-26 kHz	
Lamp current (A)	0.320
Lamp voltage (V)	50
Lamp wattage (W)	16

The remaining HF ballast design information applies over the range of 92% to 106% of rated input voltage.

Min lamp current (A)	0.260
Max lamp current (A)	0.425
Max current in any lead to a cathode (A)	0.640

Lamp starting requirements

Requirements without cathode preheating	
Min voltage across lamp, 10°C and above (Vrms)	u.c.
Max starting time (msec)	100

Current controlled preheat requirements	
Min preheat current I_k (A) to emission time t_e (S)	$i_k=(a/t_e+i_{min}^2)^{1/2}$
cathode constant a	0.290
I_{min}[A]:	0.310

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Max preheat current i_{max}[A]	
for t≤0.4s:	1.200
for 0.4s<t<2.0s:	1.350 - 0.350 t
for t≥2.0s:	0.650
Substitution resistor for each cathode (ohms)	12.5
Max voltage across lamp during preheat (Vrms)	130
Min voltage across lamp after preheat, 10°C and above (Vrms)	350
Min voltage across lamp after preheat, -15°C and above (Vrms)	380

NOTE
3 The same base, 2G10-3, is used for 18 through 36 watt sizes of this lamp family. The design of a ballast for use with one wattage must take into consideration the possible improper installation of a different wattage.

Information for luminaire design: (conditions of clause 14 apply)

Abnormal lamp operation: *(clause 14.5 applies)*

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20-Watt, Single-Based, Quad Tube Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	20W/6T5/Q/GX32/PH		
Nominal wattage	20		
Nominal dimensions	OAL	Width	Depth
	155 mm	40 mm	40 mm
Bulb designation	T5 (T16)		
Base type	GX32d-2		

Dimensional characteristics (definitions of Part II apply)

	Maximum lamp dim. (mm)	Maximum outline dim. (mm)
H (Base face to top of lamp)	130	130
C (Width of lamp)	41 (Note 1)	45 (Note 2)
G (Depth of lamp)	41 (Note 1)	45 (Note 2)

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Electrical characteristics

Electrical characteristics and light output vary with ambient temperature.

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	20
Voltage (V)	53
Current (A)	0.450

The preceding lamp operating characteristics are based on base up operation in a preheat-start-type circuit at an ambient temperature of 25°C (77°F) with a 60 Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

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Cathode characteristics

Type	Low resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (60Hz)	0.0008
max (μF) (60Hz)	0.010

Reference ballast characteristics

Rated input voltage	118 V
Reference current	0.450 A
Impedance	209 ohms

The general requirements for reference ballasts are stated in American National Standard Specifications for Fluorescent Lamp Reference Ballast, ANSI C82-3.

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

The following values are intended to provide reliable starting at the ambient temperatures indicated and at higher temperatures up to a maximum of 110°F (50°C). At temperatures near the top of that range, however, initial starting will be secured but not necessarily immediate restarting.

Voltage between lamp terminals

at 32°F (0°C) and above, (Vrms) min	108V
at 32°F (0°C) and above, (Vpk) max	400V

The voltage limits shall be met at any primary voltage between 90% and 110% of rated voltage.

Preheat current

min at 90% of rated voltage	0.405A
max at 106% of rated voltage	0.850A

Cathode head requirements

Dummy load resistor, for both cathodes in series	25 ohms

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Ballast design note

The values in this standard are based on 60 Hz operating characteristics.

NOTE – A radio interference suppression capacitor is located internal to the lamp base. See Sections 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal operation (conditions of clause 14.4 apply)

Maximum temperature at point x on lamp base (°C) 90

NOTES
3 Point x is identified in Figure 1.
4 A higher guide post temperature may be acceptable. Consult lamp manufacturer.

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20-Watt, 6-Inch Circular T9, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	20W/T9/C6/RS
Nominal wattage	20 watts
Nominal diameter	6-1/2 in (165 mm)
Bulb designation	T9 (T28) Circular
Base	G10q, Four-pin circular
Circuit application	Rapid start or preheat (switch) start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Inside of base to opposite wall)	4.12	4.38	104.6	111.3
B (Inside, other than Dimension A)	4.06	4.44	103.1	112.8
C & D (Lamp outside diameter)	6.25	6.75	158.7	171.5
D1 (Bulb, outside diameter)	1.03	1.22	26.2	31.0

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	17.0
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	19.0
Voltage (V)	49
Current (A)	0.380

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.380
Impedance (ohms)	575

Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for one 6-inch and one 8-inch lamp
Rapid start		
Voltage between lamp terminals (Note 1)		
at 50°F (10°C) and above, (Vrms) min	150	225
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°C) and above, (Vpeak) min	290	290
Waveshape of starting voltage		
crest factor, maximum	2.0	2.0
Starting capacitor size		
min (μF) (at 60 Hz)		0.008
max (μF) (at 60 Hz)		0.06
Preheat (switch) start		
Voltage between lamp terminals		
at 50°F (10°) and above, (Vrms) min	108	

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max
Preheat (switch) start	
Current during preheat	
at rated primary voltage	0.50 A min, 0.70 A max
Preheat time at 0.60-A	
preheat current	0.75 s min

Information for luminaire design (conditions of clause 14 apply)

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21-Watt, T4 Square-Shape Single-Based Preheat-Start Fluorescent Lamp with external means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	21W/T4/S5/GR10q/PH		
Nominal wattage	21 Watts		
Nominal dimension	OAL	Width	Depth
	140 mm	140 mm	27 mm
Bulb designation	T4 (T13)		
Base	GR10q		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	27.5	28
C (Length of lamp) max	138 (Note 1)	142
G (Width of lamp) max	138 (Note 1)	142

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position — The 21W lamp can be operated in any position except where the 90° lamp glass bends are higher than the 180° lamp glass bends.

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	21
Voltage (V)	102
Current (A)	0.260

Cathode characteristics

Type	High resistance
Resistance (at 8V/cathode)	
Both cathodes in series, objective (ohms)	70

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Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.260
Impedance (ohms)	684

Thermal conditions (conditions of clause 12 apply)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	u.c.
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.234
max at 110% of rated line voltage (A)	0.546

Cathode heat requirements

Dummy load resistor, for both cathodes in series	70 ohms

Information for starter design

Radio interference suppression capacitor (conditions of clause 13.1 apply)

Min (µF) (60Hz)	0.005
Max (µF) (at 60Hz)	0.008

Information for luminaire design (conditions of clause 14 apply)

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22-Watt, 8-Inch Circular T9, Rapid-Start Fluorescent Lamp

This standard data sheet is compatible with IEC Publication 60901.

Lamp description

Lamp abbreviation	22W/T9/C8/RS
Nominal wattage	22 watts
Nominal diameter	8-1/4 in (210 mm)
Bulb designation	T9 (T28) Circular
Base	G10q, Four-pin circular
Circuit application	Rapid start and preheat (switch)-start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Inside of base to opposite wall)	5.87	6.13	149.1	155.7
B (Inside, other than Dimension A)	5.81	6.19	147.6	157.2
C & D (Lamp outside diameter)	8.00	8.50	203.2	215.9
D1 (Bulb, outside diameter)	1.03	1.22	26.2	31.0

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	20.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	22.5
Voltage (V)	61
Current (A)	0.370

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.370
Impedance (ohms)	575

Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Ballasts	
	Single-lamp ballast	one 8-inch and one 12-inch lamp
Rapid start		
Voltage between lamp terminals (Note 1)		
at 50°F (10°C) and above, (Vrms) min	180	230
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°C) and above, (Vpeak) min	290	290
Waveshape of starting voltage crest factor, max	2.0	2.0
Starting capacitor size		
min (μF) (at 60 Hz)		0.008
max (μF) (at 60 Hz)		0.06
Preheat (switch) start		
Voltage between lamp terminals		
at 50°F (10°C) and above, (Vrms) min	108	

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max
Preheat (switch) start	
Current during preheat, at rated primary voltage	0.50 A min, 0.7 A max
Preheat time at 0.60-A preheat current	0.75 s min

Information for luminaire design (conditions of clause 14 apply)

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24-Watt, T5 Single-Based Fluorescent Lamp

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	24W/7T5/M/2G10-3
Nominal wattage	24 Watts
Bulb designation	T5
Base specifications	2G10-3
Circuit application	Multiple / HF and 60 Hz

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max.	165	165
C (Width of lamp) max	79 (Note 1)	Note 3
G (Depth of lamp) max	18 (Note 1)	Note 3

NOTES
1 *Applies along the length of the glass only.*
2 Conditions of clause 10.4 apply.

Electrical characteristics

Test position	Vertical, base-up

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	24.7
Voltage (V)	87
Current (A)	0.345

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.340
Impedance (ohms)	605

Cathode characteristics

Type	Low resistance
Hot resistance @ test current (ohms)	12± 2.4
Test current (A)	0.340

This test current will result in a stable Rh/Rc ratio of approximately 4.75.

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Thermal conditions
The conditions of clause 12 apply to a special test lamp.

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 25°F (-4°C) and above, (Vrms) min	198
at 25°F (-4°C) and above, (Vpeak) max	400
Preheat current	
min at 90% of rated line voltage (A)	0.315
max at 106% of rated line voltage (A)	0.670

Cathode heat requirements

Dummy load resistor, for both cathodes in series	50 ohms

Information for high frequency ballast design

Typical operating characteristics at 20-26 kHz	
Lamp current (A)	0.300
Lamp voltage (V)	75
Lamp wattage (W)	22

The remaining HF ballast design information applies over the range of 92% to 106% of rated input voltage.

Min lamp current (A)	0.260
Max lamp current (A)	0.425
Max current in any lead to cathode (A)	0.640

Lamp starting requirements

Requirements without cathode preheating	
Min voltage across lamp, 10°C and above (Vrms)	u.c.
Max starting time (msec)	100

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Current controlled preheat requirements	
Min preheat current I_k (A) to emission time t_e (S)	$i_k=(a/t_e+i_{min}^2)^{1/2}$
cathode constant a	0.290
I_{min}[A]:	0.310
Max preheat current i_{max}[A]	
for t≤0.4s:	1.200
for 0.4s<t<2.0s:	1.350 - 0.3500 t
for t≥2.0s:	0.650
Substitution resistor for each cathode (ohms)	12.5
Max voltage across lamp during preheat (Vrms)	170
Min voltage across lamp after preheat, 10°C and above (Vrms)	400
Min voltage across lamp after preheat, -15°C and above (Vrms)	440

NOTE

3 The same base, 2G10-3, is used for 18 through 36-watt sizes of this lamp family. The design of a ballast for use with one wattage must take into consideration the possible improper installation of a different wattage.

Information for luminaire design (conditions of clause 14 apply)

Abnormal lamp operation (clause 14.5 applies)

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24-Watt, U-Shaped, 1-5/8-Inch Center T8, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	24W/17T8/U1/RS
Nominal wattage	24 watts
Nominal overall length	17 in (432 mm)
Bulb designation	T8 (T25), U-shaped
Base	2G13-41
Circuit application	Rapid start

Dimensional characteristics (*definitions of Part II apply*)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Lamp legs, center to center, nominal)	1-5/8	1-5/8	41	41
B (Base face to lamp end)	16.25	16.60	412.8	421.6
C (Bulb diameter in bend)	0.94	1.10	23.9	27.9
D (Bulb diameter in legs)	0.94	1.10	23.9	27.9
E (Distance between legs)	0.50	-	12.7	-
F (Distance to outside of legs)	-	2.75	-	69.9
G (Base face to beginning of Dimension H)	1.0	-	25.4	-
H (Length over which Dimensions D, E, and F apply)	12.0	-	304.8	-

Lamp legs shall be in the same plane over the unbent portion of the lamp; maximum deviation = 0.13 inch (3.3 mm).

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	22.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	1.7
Total wattage (W)	24.2
Voltage (V)	99
Current	0.265

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.265
Impedance (ohms)	733

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	11.0
Minimum (ohms)	8.0

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for two lamps
Rapid start		
Voltage between lamp terminals (Note 1)		
at 50°F (10°C) and above, (Vrms) min.	170	260
at 50°F (10°C) and above, (Vrms) max.	230	355
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°C) and above, (Vpeak) min	325	325
Waveshape of starting voltage crest factor, max	2.0	2.0
Starting capacitor size		
min (μF) (at 60 Hz)		0.04
max (μF) (at 60 Hz)		0.06

NOTES

1 These values are for lead circuits only. Values for lag circuits are under consideration.
2 These values are for crest factors of 1.55 to 2.0. Add 20% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	11.0 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply)

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24-27-Watt, Single-Based Rapid-Start Fluorescent Lamp

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	24-27W/13T5/T/2G11/PH-RS
Nominal wattage	27 watts for rapid start (24 watts for preheat)
Nominal overall length	12.8 inches (324mm)
Bulb designation	T5 (T16)
Base type	2G11
Circuit application	Preheat (switch) start and rapid start

Dimensional characteristics (definitions of Part II apply)

	Lamp Dimensions (Note 1)				Lamp Outline Dimensions (Note 2)	
	Inches		Millimeters		Inches	Millimeters
Lamp Length	Min	Max	Min	Max	Min	Max
Base face to top of lamp (H)	-	12.60	-	320.0	12.60	320.0
Bulb depth (G)	0.67	0.70	17.1	17.8	0.98	25.0
Bulb width (C)	1.46	1.55	37.2	39.4	1.80	46.0

NOTES

1 Lamp dimensions C & G apply to glass only in mounting area along lamp legs.
2 Conditions of clause 10.4 apply.

Auxiliary supports

An auxiliary bulb holding device is required due to the long length of this single-based lamp. No mounting support shall be placed on or very near the bend end of the lamp. The bulb-holding device shall be located between 9.5" (241 mm) and 10.5" (267 mm) from base face of lamp.

NOTES

3 A UV resistant non-metallic saddle type clip is the preferred method to support the lamp. Metallic clips may change the starting characteristics of high-frequency operation of the lamp.
4 A support placed between the legs of the lamp is not recommended. The inside leg dimension is not controlled and varies in production. The minimum spacing between the legs is 0.071 in. (1.8 mm).
5 The lamp should be used in lamp holders that conform to 2G11 standards sheet, ANSI C81.62.

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Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	23.6
Approximate cathode wattage (with 3.6V on each cathode) (W)	2.1
Total wattage	25.7
Volts (V)	87
Current (A)	0.335

The preceding lamp operating characteristics are based on horizontal operation in a rapid-start type circuit at an ambient temperature of 25°C (77°F) with a 60-Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.340
Impedance (ohms)	605

The general requirements for reference ballasts are stated in American National Standard for Reference Ballasts for Fluorescent Lamps, ANSI C82.3.

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

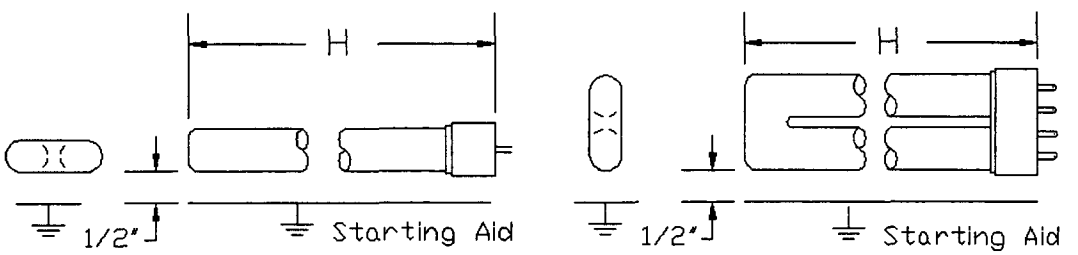
	Single-lamp ballast	Ballasts for two lamps
Rapid-start (starterless) circuits		
Voltage between lamp terminals		
at 50°F (10°C) and above, (Vrms) min	220	240
at 50°F (10°C) and above, (Vrms) max	285	310
Voltage lamp terminal to starting aid (Note 1)		
at 50°F (10°C) and above, (Vpeak) min	520	520
Voltage (°C) crest factor, min (@90% line)	1.80	1.75
Voltage (°C) crest factor, max	2.20	2.20
Starting capacitor size		
min (µF) (at 60 Hz)	-	0.04
max (µF) (at 60 Hz)	-	0.06

NOTES

6 These limits apply to the peak voltage between the lamp terminal delivering the highest voltage above ground and the grounded fixture.

7 The starting aid surfaces shall extend the full length of the lamp (distance H), at least 1" (25 mm) wide for edge mounting of lamps and at least 1.5" (38 mm) for flat mounting of lamps.

8 Maximum distance from bulb wall leg to starting aid is 1/2" (113 mm) for either edge mounting or flat mounting, as shown below:



Cathode heat requirement at rated input voltage

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

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For preheat (switch) start

Voltage between lamp terminals	
at 50°F (10°C) and above, (Vrms) min	198
at 50°F (10°C) and above, (Vpeak) max	400
Preheat current	
min at 90% of rated line voltage, (A)	0.305
max at 106% of rated line voltage, (A)	0.670
Cathode heat requirements	
Dummy load resistor, for both cathodes in series	50 ohms

Information for luminaire design (conditions of clause 14 apply)

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26-Watt, T4 Quad Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	26W/8T4/Q/G24/PH		
Nominal wattage	26 watts		
Nominal dimension	OAL	Width	Depth
	195 mm	30 mm	30 mm
Bulb designation	T4 (T13)		
Base	G24d-3		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	170	170
C (Width of lamp) max	28 (Note 1)	35
G (Depth of lamp) max	28 (Note 1)	35

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position: Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	26
Voltage (V)	105
Current (A)	0.325

Cathode characteristics

Type: High resistance

Radio interference suppression capacitor (conditions of clause 13.1 apply)

min (μF) (at 60Hz)	0.0008
max (μF) (at 60Hz)	0.010 (Note 3)

NOTE
3 A lower maximum value of capacitance is under consideration.

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Reference ballast characteristics

Rated input voltage (V)	220
Reference current (A)	0.315
Impedance (ohms)	546

Thermal conditions (conditions of clause 12 apply to a special test lamp)

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	198
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.270
max at 106% of rated line voltage (A)	0.550

Cathode heat requirements

Dummy load resistor, for both cathodes in series	25 ohms

NOTE - A radio interference suppression capacitor is located internal to the lamp base. See Sections 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal lamp operation (clause 14.4 applies)

Maximum temperature at point X on lamp base (°C)	90

NOTES
4 Point X is identified in Figure 1.
5 A higher guide-post temperature may be acceptable. Consult the lamp manufacturer.

Abnormal lamp operation (clause 14.5 applies)

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27-Watt, Single-Based, Quad Tube Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	27W/7T5/Q/GX32/PH		
Nominal wattage	27		
Nominal dimensions	OAL	Width	Depth
	171 mm	40 mm	40 mm
Bulb designation	T5 (T16)		
Base type	GX32d-3		

Dimensional characteristics (definitions of Part II apply)

	Maximum lamp dim. (mm)	Maximum outline dim. (mm)
H (Base face to top of lamp)	146	146
C (Width of lamp)	41 (Note 1)	45 (Note 2)
G (Depth of lamp)	41 (Note 1)	45 (Note 2)

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Electrical characteristics

Electrical characteristics and light output vary with ambient temperature.

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	27
Voltage (V)	54
Current (A)	0.625

The preceding lamp operating characteristics are based on base up operation in a preheat-start-type circuit in an ambient temperature of 25°C (77°F) with a 60 Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

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Cathode characteristics

Type	Low resistance

Radio interference suppression capacitor (conditions of 13.1 apply)

min (μF) (60Hz)	0.0008
max (μF) (60Hz)	0.010

Reference ballast characteristic

Rated input voltage	118
Reference current	0.625A
Impedance	154 ohms

The general requirements for reference ballasts are stated in American National Standard Specifications for Fluorescent Lamp Ballast, ANSI C82.3.

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

The following values are intended to provide reliable starting at the ambient temperatures indicated and at higher temperatures up to a maximum of 110°F (43°C). At temperatures near the top of that range, however, initial starting will be secured but not necessarily immediate restarting.

Voltage between lamp terminals	
at 32°F (0°C) and above, (Vrms) min	108 V
at 32°F (0°C) and above, (Vpk) max	400 V

The voltage limits shall be met at any primary voltage between 90% and 110% of rated voltage.

Preheat current	
min at 90% of rated voltage	0.540 A
max at 106% of rated voltage	1.080 A

Cathode heat requirements

Dummy load resistor, for both cathodes in series	25 ohms

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Ballast design note

The values in this standard are based on 60 Hz operating characteristics.

NOTE – A radio interference suppression capacitor is located internal to the lamp base. See Sections 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

Normal operation (conditions of clause 14.4 apply).

Maximum temperature at point x on lamp base (°C) 90

NOTES
3 Point x is identified in Figure 1.
4 A higher guide post temperature may be acceptable. Consult lamp manufacturer.

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28-Watt, T6 Square-Shape Single-Based Preheat-Start Fluorescent Lamp with internal means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	28W/T6/S8/GR8/PH		
Nominal wattage	28 Watts		
Nominal dimension	OAL	Width	Depth
	205 mm	205 mm	35 mm
Bulb designation	T6 (T19)		
Base	GR8		
Circuit application	Preheat (switch) start, internal starter		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	33	35
C (Length of lamp) max	205 (Note 1)	207
G (Width of lamp) max	205 (Note 1)	207

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	28
Voltage (V)	108
Current (A)	0.320

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V/cathode)	
Both cathodes in series, objective (ohms)	18

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Radio interference suppression capacitor

Min (μF) (at 60Hz)	0.001
Max (μF) (at 60Hz)	0.003

NOTE
3 The suppression capacitor may affect starting and operating performance of lamps used with high frequency ballasts.

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.320
Impedance (ohms)	578

Thermal conditions (conditions of clause 12 apply)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	u.c.
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.290
max at 110% of rated line voltage (A)	0.670

Cathode heat requirements

Dummy load resistor, for both cathodes in series	18 ohms

NOTE
4 A radio interference suppression capacitor is located internal to the lamp base. See clauses 11.3 and 13.1 for further details.

Information for luminaire design (conditions of clause 14 apply)

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28-Watt, T6 Square-Shape Single-Based Preheat-Start Fluorescent Lamp with external means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	28W/T6/S8/GR10q/PH-RS		
Nominal wattage	28 Watts		
Nominal dimension	OAL	Width	Depth
	205 mm	205 mm	35 mm
Bulb designation	T6 (T19)		
Base	GR10q		
Circuit application	Preheat (switch) start and rapid start		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	33	35
C (Length of lamp) max	205 (Note 1)	207
G (Width of lamp) max	205 (Note 1)	207

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position	Any

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage	28.0
Approximate cathode wattage (with 3.6V on each cathode)	2.0
Total wattage (W)	30
Voltage (V)	108
Current (A)	0.32

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V/cathode)	
Each cathode, objective (ohms)	9
Min (ohms)	7

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Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.320
Impedance (ohms)	578

Thermal conditions (conditions of clause 12 apply)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	u.c.
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.290
max at 110% of rated line voltage (A)	0.670

Cathode heat requirements

Dummy load resistor, for both cathodes in series	18 ohms

Rapid start (starterless circuits)

	Single Lamp	Ballasts for two Lamps
Voltage between lamp terminals (Note 1)		
at 50°F (10°)C and above, (Vrms) min	220	240
at 50°F (10°)C and above, (Vrms) max	285	310
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°)C and above, (Vrms) min	520	520
Waveshape of starting voltage crest factor, max	2.2	2.2
Starting capacitor size		
min (μF) (at 60Hz)	u.c.	u.c.
max (μF) (at 60Hz)	u.c.	u.c.

NOTES
3 These values are for lead circuits only. For lag circuits, add 3%.
4 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

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28-Watt, T6 Square-Shape Single-Based
Preheat-Start Fluorescent Lamp
with external means of starting

Cathode heat requirements

Voltage, applied continuously	3.6V nominal
Limits	2.5V min, 4.0V max
Dummy load resistor	9.6 ± 0.1 ohms
Voltage across dummy load	3.4V min, 4.5V max

Information for starter design

Radio interference suppression capacitor (conditions of clause 13.1 apply)

Min (µF) (at 60Hz)	0.001
Max (µF) (at 60Hz)	0.003

Information for luminaire design (conditions of clause 14 apply)

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31-Watt, U-Shaped, 1-5/8-Inch Center T8, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	31W/23T8/U1/RS
Nominal wattage	31 watts
Nominal overall length	23 in (584 mm)
Bulb designation	T8 (T25), U-shaped
Base	2G 13-41
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Lamp legs, center to center, nominal)	1-5/8	1-5/8	41	41
B (Base face to lamp end)	22.25	22.60	562.2	574.0
C (Bulb diameter in bend)	0.94	1.10	23.9	27.9
D (Bulb diameter in legs)	0.94	1.10	23.9	27.9
E (Distance between legs)	0.50	-	12.7	-
F (Distance to outside of legs)	-	2.75	-	69.9
G (Base face to beginning of Dimension H)	1.0	-	25.4	-
H (Length over which Dimensions D, E, and F apply)	16.0	-	406.4	-

Lamp legs shall be in the same plane over the unbent portion of the lamp; maximum deviation = 0.13 inch (3.3 mm).

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	29.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	1.7
Total wattage (W)	31.2
Voltage (V)	135
Current (A)	0.265

Reference ballast characteristics

Rated input voltage (V)	300
Reference current (A)	0.265
Impedance (ohms)	910

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	11.0
Minimum (ohms)	8.0

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for two lamps Option A	Option B
Rapid start			
Voltage between lamp terminals (Note 1)			
at 50°F (10°C) and above, (Vrms) min	200	300	315
Voltage lamp terminal to starting aid (Note 2)			
at 60°F (15°C) and above, (Vpeak) min	260	260	260
at 50°F (10°C) and above, (Vpeak) min	290	290	290
Waveshape of starting voltage crest factor, maximum	2.0	2.0	2.0
Starting capacitor size			
min (μF) (at 60 Hz)		0.08	0.04
max (μF) (at 60 Hz)		0.12	0.06

NOTES

1 These values are for lead circuits only. Values for lag circuits are under consideration.
2 These values are for crest factors of 1.55 to 2.0. Add 20% for crest factors less than 1.55.

Cathode heat requirements

Rapid start

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	11.0 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Ground plane spacing

The requirements of 13.2 apply. However, a spacing of up to 0.75 in (19 mm) is allowed if the ground plane is at least 2 in (51 mm) wide.

Information for luminaire design (conditions of clause 14 apply)

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32-Watt, U-Shaped, 6-Inch Center T8, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	32W/23T8/U6/RS
Nominal Wattage	32 watts
Nominal overall length	23 in (584 mm)
Bulb designation	T8 (T25), U-shaped
Base	2G13-152
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Lamp legs, center to center, nominal)	6.0	6.0	152.0	152.0
B (Base face to lamp end)	22.25	22.60	565.2	574.0
C (Bulb diameter in bend)	0.89	1.15	22.6	29.2
D (Bulb diameter in legs)	0.94	1.10	23.9	27.9
E (Distance between legs)	4.70	-	119.4	-
F (Distance outside of legs)	-	7.10	-	180.3
G (Base face to beginning of dimension H)	1.0	-	25.4	-
H (Length over which dimensions D, E, and F apply)	16.0	-	406.4	-

Lamp legs shall be in the same plane over the unbent portion of the lamp; maximum deviation = 0.13 inch (3.3mm).

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	30.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	1.7
Total wattage (W)	32.2
Voltage (V)	137
Current (A)	0.265

Reference ballast characteristics

Rated input voltage (V)	300
Reference current (A)	0.265
Impedance (ohms)	910

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	11.0
Minimum (ohms)	8.0

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for two lamps Option A	Ballasts for two lamps Option B
Rapid start			
Voltage between lamp terminal (Note 1)			
at 50°F (10°C) and above, (Vrms) min	200	300	315
Voltage lamp terminal to starting aid (Note 2)			
at 60°F (15°C) and above, (V peak) min	260	260	260
at 50°F (11°C) and above, (V peak) min	290	290	290
Waveshaping of starting voltage crest factor max	2.0	2.0	2.0
Starting capacitor size			
min (μF) (at 60 Hz)		0.08	0.04
max (μF) (at 60 Hz)		0.12	0.06

NOTES

1 These values are for lead circuits only. For lag circuits, the values are under consideration.
2 These values are for crest factors of 1.55 to 2.0. Add 20% for crest factors less than 1.55.

Cathode heat requirements

Rapid start

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	11.0 ohms ± 0.1 ohms
Voltage across dummy load	3.4 V min, 4.5 V max

Ground plane spacing

The requirements of 14.2 apply. However, a space of up to 0.75 in (19 mm) is allowed if the ground plane is at least 2 in (51 mm) wide.

Information for luminaire design (conditions of clause 14 apply)

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32-Watt, 12-Inch Circular T9, Rapid-Start Fluorescent Lamp

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	32W/T9/C12/RS
Nominal wattage	32 watts
Nominal diameter	12 in (305 mm)
Bulb designation	T9 (T28) Circular
Base	G10q, Four-pin circular
Circuit application	Rapid start and preheat (switch) start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Inside of base to opposite wall)	9.43	9.69	239.5	246.1
B (Inside, other than Dimension A)	9.31	9.69	236.5	246.1
C & D (Lamp outside diameter)	11.50	12.00	292.1	304.8
D1 (Bulb, outside diameter)	1.03	1.22	26.2	31.0

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	31.0
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	33.0
Voltage (V)	84
Current (A)	0.430

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.425
Impedance(ohms)	470

Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for one 8-inch and one 12-inch lamp	Ballasts for one 12-inch and one 16-inch lamp
Rapid start			
Voltage between lamp terminals (Note 1)			
at 50°F (10°C) and above, (Vrms) min	200	230	285
Voltage lamp terminal to starting aid (Note 2)			
at 50°F (10°C) and above, (Vpeak) min	290	290	290
Waveshape of starting voltage crest factor, maximum	2.0	2.0	2.0
Starting capacitor size			
min (μF) (at 60 Hz)		0.008	0.008
max (μF) (at 60 Hz)		0.06	0.06
Preheat (switch) start			
Voltage between lamp terminals			
at 50°F (10°C) minimum, (Vrms) min	132		

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max
Preheat (switch) start	
Current during preheat,	
at rated primary voltage	0.55 A min, 0.75 A max
Preheat time at 0.65-A	
preheat current	1.0 s min

Information for luminaire design (conditions of clause 14 apply)

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32-Watt, 12-Inch Circular T10, Rapid-Start Fluorescent Lamp

This standard data sheet is compatible with IEC Publication 60901.

Lamp description

Lamp abbreviation	32W/T10/C12/RS
Nominal wattage	32 watts
Nominal diameter	12 in (305 mm)
Bulb designation	T10 (T32) Circular
Base	G10q, Four-pin circular
Circuit application	Rapid start and preheat (switch)-start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Inside of base to opposite wall)	9.43	9.69	239.5	246.1
B (Inside, other than Dimension A)	9.31	9.69	236.5	246.1
C & D (Lamp outside diameter)	11.75	12.25	298.5	311.2
D1 (Bulb, outside diameter)	1.16	1.34	29.5	34.0

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	31.0
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	33.0
Voltage (V)	81
Current (A)	0.425

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.425
Impedance (ohms)	470

Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for one 8-inch and one 12-inch lamp	Ballasts for one 12-inch and one 16-inch lamp
Rapid start			
Voltage between lamp terminals (Note 1)			
at 50°F (10°C) and above, (Vrms) min	200	230	285
Voltage lamp terminal to starting aid (Note 2)			
at 50°F (10°C) and above, (Vpeak) min	290	290	290
Waveshape of starting voltage crest factor, max	2.0	2.0	2.0
Starting capacitor size			
min (μF) (at 60 Hz)		0.008	0.008
max (μF) (at 60 Hz)		0.06	0.06
Preheat (switch) start			
Voltage between lamp terminals			
at 50°F (10°C) and above, (Vrms) min	132		

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V *nominal*
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max
Preheat (switch) start	
Current during preheat,	
at rated primary voltage	0.55 A min, 0.75 A max
Preheat time at 0.65-A	
preheat current	1.0 s min

Information for luminaire design (conditions of clause 14 apply)

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36-Watt, T5 Single-Based Fluorescent Lamp

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	36W/9T5/M/2G10-3
Nominal wattage	36 Watts
Bulb designation	T5 (T16)
Base specifications	2G10-3
Circuit application	Multiple / HF and 60 Hz

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max.	217	217
C (Width of lamp) max	79 (Note 1)	85
G (Depth of lamp) max	18 (Note 1)	20

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Electrical characteristics

Test position: Vertical, base-up

Lamp operating characteristics (conditions of clause 11 apply)

Wattage (W)	36
Voltage (V)	106
Current (A)	0.435

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

Cathode characteristics

Type	Low resistance
Hot resistance @ test current (ohms)	11± 2.2
Test Current (A)	0.385

This test current will result in a stable Rh/Rc ratio of approximately 4.75.

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Thermal Conditions (conditions of clause 12 apply to a special test lamp)

Lamp starting requirements

Preheat (switch) start

Voltage between lamp terminals	
at 25°F (-4°C) and above, (Vrms) min	198
at 25°F (-4°C) and above, (Vpeak) max	400
Preheat Current	
min at 90% of rated line voltage (A)	0.365
max at 106% of rated line voltage (A)	0.775

Cathode heat requirements

Dummy load resistor, for both cathodes in series	40 ohms

Information for ballast design (conditions of clause 13 apply)

Information for high frequency ballast design

Typical operating characteristics at 20-26 kHz	
Lamp current (A)	0.360
Lamp voltage (V)	90
Lamp wattage (W)	32

The remaining HF ballast design information applies over the range of 92% to 106% of rated input voltage.

Min lamp current (A)	0.300
Max lamp current (A)	0.500
Max current in any lead to cathode (A)	0.700

Lamp starting requirements

Requirements without cathode preheating	
Min voltage across lamp, 10°C and above (Vrms)	u.c.
Max starting time (msec)	100

Current controlled preheat requirements

Min preheat current I_k (A) to emission time t_e (S)	$i_k=(a/t_e+i_{min}^2)^{1/2}$
Cathode constant a	0.380
I_{min}[A]:	0.360
Max preheat current i_{max}[A]	
for t≤0.4s:	1.400
for 0.4s<t<2.0s:	1.550 - 0.400 t
for t≥2.0s:	0.750
Substitution resistor for each cathode (ohms)	11

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Max voltage across lamp during preheat (Vrms)	190
Min voltage across lamp after preheat, 10°C and above (Vrms)	420
Min voltage across lamp after preheat, -15°C and above (Vrms)	460

NOTES

3 The same base, 2G10-3, is used for 18 through 36 watt sizes of this lamp family. The design of a ballast for use with one wattage must take into consideration the possible improper installation of a different wattage.

4 In the case where a lamp does not start, any continuation of cathode heating shall not lead to overheating of the lamp ends.

5 In the case whre one of the electrodes is depleted or broken, while the lamp continues to operate (partial rectification) overheating of the lamp ends should be prevented by suitable measures in the circuit.

Information for luminaire design (conditions of clause 14 apply)

Abnormal lamp operation (clause 14.5 applies)

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36-39-Watt, Single-Based Rapid-Start Fluorescent Lamp

The data on this standard sheet is compatible with IEC 60901.

Lamp description

Lamp abbreviation	36-39W/16T5/T/2G11/PH-RS
Nominal wattage	39 watts for rapid start (36 watts for preheat)
Nominal overall length	16.5 inches (419 mm)
Bulb designation	T5 (T16)
Base type	2G11
Circuit application	Preheat (switch) start and rapid start

Dimensions characteristics (definitions of Part II apply)

	Lamp Dimensions (Note 1)				Lamp Outline Dimensions (Note 2)	
	Inches		Millimeters		Inches	Millimeter
Lamp Length	Min	Max	Min	Max	Max	Max
Base face to top of lamp (H)	-	16.34	-	415.0	16.34	415.0
Bulb depth (G)	0.67	0.70	17.1	17.8	0.98	25.0
Bulb width (C)	1.46	1.55	37.2	39.4	1.80	46.0

NOTES

1 Lamp Dimensions C & G apply to glass only in mounting area along lamp legs.
2 Conditions of clause 10.4 apply.

Auxiliary supports (clause 14.3.1 applies)

An auxiliary bulb holding device is required due to the long length of this single-based lamp. No mounting support shall be placed on or very near the bend end of the lamp. The bulb-holding device shall be located between 13" (330mm) and 14" (356mm) from base face of lamp.

NOTES

3 A UV resistant non-metallic saddle type clip is the preferred method to support the lamp. Metallic clips may change the starting characteristics of high-frequency operation of the lamp.
4 A support placed between the legs of the lamp is not recommended. The inside leg dimension is not controlled and varies in production. The minimum spacing between the legs is 0.071" (1.8mm).
5 The lamp should be used in lamp holders that conform to 2G11 standards sheet, ANSI C81.62.

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Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	35.9
Approximate cathode wattage (with 3.6V on each cathode) (W)	2.2
Total wattage	38.1
Voltage (V)	107
Current (A)	0.428

The preceding lamp operating characteristics are based on horizontal operation in a rapid-start type circuit at an ambient temperature of 25°C (77°F) with a 60-Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

The general requirements for reference ballasts are stated in American National Standard for Reference Ballasts for Fluorescent Lamps, ANSI C82.3.

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

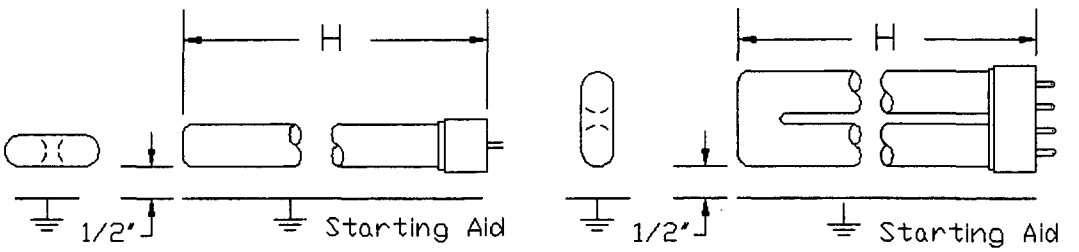
	Single-lamp ballast	Ballasts for two lamps
Rapid-start (starterless) circuits		
Voltage between lamp terminals		
at 50°F (10'C) and above, (Vrms) min	230	300
at 50°F (10°C) and above, (Vrms) max	300	390
Voltage lamp terminal to starting aid (Note 1)		
at 50°F (10°C) and above, (Vpeak) min	520	520
Voltage (°C) crest factor, min (@90% line)	1.80	1.60
Voltage (°C) crest factor, max	2.2	2.2
Starting capacitor size		
min (µF) (at 60 Hz).	-	0.04
max (µF) (at 60 Hz)	-	0.06

NOTES

6 These limits apply to the peak voltage between the lamp terminal delivering the highest voltage above ground and the grounded fixture.

7 The starting aid surfaces shall extend the full length of the lamp (distance H), at least 1" (25 mm) wide for edge mounting of lamps and at least 1.5" (38 mm) for flat mounting of lamps.

8 Maximum distance from bulb wall leg to starting aid is 1/2" (13 mm) for either edge mounting or flat mounting, as shown below:



Cathode heat requirements at rated input voltage

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

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For preheat (switch) start

Voltage between lamp terminals	
at 50°F (10°C) and above, Vrms) min	198
at 50°F (10°C) and above, (Vpeak) max	400
Preheat current	
min at 90% of rated line voltage, (A)	0.365
max at 106% of rated line voltage, (A)	0.775

Cathode heat requirements

Dummy load resistor, for both cathodes in series	40 ohms

Information for luminaire design (conditions of clause 14 apply)

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38-Watt, T6 Square-Shape Single-Based Preheat or Rapid Start Fluorescent Lamp with external means of starting

The data on this standard sheet is compatible with IEC 60901.

Lamp description:

Lamp abbreviation	38W/T6/S8/GR10q/PH-RS		
Nominal wattage	38 Watts		
Nominal dimension	OAL	Width	Depth
	205 mm	205 mm	35 mm
Bulb designation	T6 (T19)		
Base	GR10q		
Circuit application	Preheat (switch) start and rapid start		

Dimensional characteristics (definitions of Part II apply)

	Finished lamp (mm)	Maximum lamp outline (mm) (Note 2)
H (Base face to top of lamp) max	33	35
C (Length of lamp) max	205 (Note 1)	207
G (Width of lamp) max	205 (Note 1)	207

NOTES
1 Applies along the length of the glass only.
2 Conditions of clause 10.4 apply.

Operating position — The 38W lamp can be operated in any position except where the 90° lamp glass bends are higher than the 180° lamp glass bends.

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage	38.5
Approximate cathode wattage (with 3.6V on each cathode)	2.0
Total wattage (W)	40.5
Voltage (V)	110
Current (A)	0.43

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6V/cathode)	
Each cathode, objective (ohms)	9
Min (ohms)	7

Lamp starting time (seconds) (u.c.)

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

Thermal conditions (conditions of clause 12 apply)

Information for ballast design (conditions of clause 13 apply)

Preheat (switch) start

Voltage between lamp terminals:	
at 0°F (-18°C) and above, (Vrms) min	200
at 0°F (-18°C) and above, (Vrms) max	u.c.
at 0°F (-18°C) and above, (Vpeak) max	440
Preheat current	
min at 90% of rated line voltage (A)	0.390
max at 110% of rated line voltage (A)	0.780

Cathode heat requirements

Dummy load resistor, for both cathodes in series	18 ohms

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38-Watt, T6 Square-Shape Single-Based Preheat or Rapid Start Fluorescent Lamp with external means of starting

For rapid start

	Ballast for one lamp	Ballast for two lamps
Voltage between lamp terminals (Note 1)		
at 50°F (10°)C and above, (Vrms) min	230	300
at 50°F (10°)C and above, (Vrms) max	300	390
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°)C and above, (Vrms) min	520	520
Waveshape of starting voltage crest factor, max	2.2	2.2
Starting capacitor size		
min (μF) (at 60Hz)		u.c.
max (μF) (at 60Hz)		u.c.

NOTES
3 These values are for lead circuits only. For lag circuits, add 3%.
4 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Voltage, applied continuously	3.6V nominal
Limits	2.5V min, 4.5V max
Dummy load resistor	9.0 ± 0.1 ohms
Voltage across dummy load	3.4V min, 4.5V max

Information for starter design

Radio interference suppression capacitor (conditions of clause 13.1 apply)

Min (μF) (at 60Hz)	0.005
Max (μF) (at 60Hz)	0.008

Information for luminaire design (conditions of clause 14 apply)

Maximum starting aid distance for Rapid Start ½" (13 mm)

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Not for Resale

40-Watt, Single-Based Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	40W/22T5/T/2G11/RS
Nominal wattage	40
Nominal overall length	22.4 inches (570mm)
Bulb designation	T5 (T16)
Base type	2G11
Circuit application	Rapid Start

Dimensional characteristics (definitions of Part II apply)

	Lamp Dimensions (Note 1)				Lamp Outline Dimensions (Note 2)	
	Inches		Millimeters		Inches	Millimeters
Lamp Length	Min	Max	Min	Max	Max	Max
Base face to top of lamp (H)	-	22.30	-	566.4	22.30	566.4
Bulb depth (G)	0.67	0.70	17.1	17.8	0.98	25.0
Bulb width (C)	1.46	1.55	37.2	39.4	1.80	46.0

NOTES
1 Lamp dimensions C & G apply to glass only in mounting area along lamp legs.
2 Conditions of clause 10.4 apply.

Auxiliary supports

An auxiliary bulb holding device is required due to the long length of this single-based lamp. No mounting support shall be placed on or very near the bent end of the lamp. The bulb-holding device shall be located between 18.0" (457 mm) and 20.0" (508 mm) from base face of lamp.

NOTES

3 A UV resistant non-metallic saddle type clip is the preferred method to support the lamp. Metallic clips may change the starting characteristics of high-frequency operation of the lamp.
4 A support placed between the legs of the lamp is not recommended. The inside leg dimension is not controlled and varies in production. The minimum spacing between the legs is 0.71 in. (1.8 mm).
5 The lamp should be used in lamp holders that conform to 2G11 standards sheet, ANSI C81.62.

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Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	36.7
Approximate cathode wattage (with 3.6V on each cathode) (W)	2.2
Total wattage	38.9 W
Voltage (V)	169.0
Current (A)	0.270

The preceding lamp operating characteristics are based on horizontal operation in a rapid-start type circuit at an ambient temperature of 25°C (77°F) with a 60-Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

Reference ballast characteristics

Rated input voltage (V)	400
Reference current (A)	0.270
Impedance (ohms)	1240

The general requirements for reference ballasts are stated in American National Standard for Reference Ballasts for Fluorescent Lamps, ANSI C82.3.

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

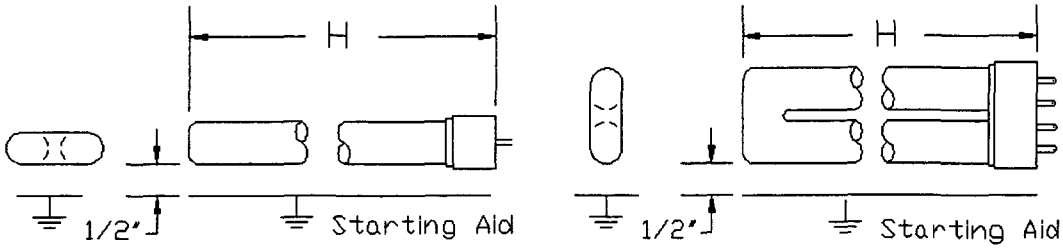
	Single-lamp ballast	Ballasts for two lamps
Rapid-start (starterless) circuits		
Voltage between lamp terminals		
at 50°F (10°C) and above, (Vrms) min	275	400
at 50°F (10°C) and above, (Vrms) max	355	520
Voltage lamp terminal to starting aid (Note 1)		
at 50°F (10°C) and above, (Vpeak) min	520	520
Voltage (°C) crest factor, min (@90% line)	1.60	1.65
Voltage (°C) crest factor, max	2.20	2.20
Starting capacitor size		
min (μF) (at 60 Hz)	-	0.04
max (μF) (at 60 Hz)	-	0.06

NOTES

6 These limits apply to the peak voltage between the lamp terminal delivering the highest voltage above ground and the grounded fixture.

7 The starting aid surfaces shall extend the full length of the lamp (distance H), at least 1" (25 mm) wide for edge mounting of lamps and at least 1.5" (38 mm) for flat mounting of lamps.

8 Maximum distance from bulb wall leg to starting aid is 1/2" (13 mm) for either edge mounting or flat mounting, as shown below:



Cathode heat requirement at rated input voltage

Voltage	3.6 V nominal
Limits during operation	2.5 V min,, 4.4 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply)

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40-Watt, U-Shaped, 3-5/8-Inch Center T12, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	40W/23T12/U3/RS
Nominal wattage	40 watts
Nominal overall length	23 in (584 mm)
Bulb designation	T12 (T38), U-shaped
Base	2G13-92
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Lamp legs, center to center, nominal)	3-5/8	3-5/8	92	92
B (Base face to lamp end)	22.13	22.53	562.1	572.3
C (Bulb diameter in bend)	1.33	1.63	33.8	41.4
D (Bulb diameter in legs)	1.41	1.59	35.8	40.4
E (Distance between legs)	1.96	-	49.7	-
F (Distance to outside of legs)	-	5.30	-	134.5
G (Base face to beginning of Dimension H)	1.0	-	25.4	-
H (Length over which Dimensions D, E, and F apply)	16.0	-	406.4	-

Lamp legs shall be in the same plane over the unbent portion of the lamp; maximum deviation = 0.13 in (3.3 mm).

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	39.0
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	41.0
Voltage (V)	103
Current (A)	0.420

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for two lamps	Ballasts for three lamps
Rapid start			
Voltage between lamp terminals (Note 1)			
at 50°F (10°C) and above, (Vrms) min	200	256	395
at 50°F (10°C) and above, (Vrms) max	260	330	525
Voltage lamp terminal to starting aid (Note 2)			
at 50°F (10°C) and above, (Vpeak) min	280	240	280
Waveshape of starting voltage crest factor, max	2.0	2.0	2.0
Starting capacitor size			
min (μF) (at 60 Hz)		0.04	0.04
max (μF) (at 60 Hz)		0.06	0.06

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start

Voltage	3.6 V nominal
Limits during operation.	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply)

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40-Watt, U-Shaped, 6-Inch Center T12, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	40W/23T12/U6/RS
Nominal wattage	40 watts
Nominal overall length	23 in (584 mm)
Bulb designation	T12 (T38), U-shaped
Base	2G13-152
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Lamp legs, center to center, nominal)	6	6	152	152
B (Base face to lamp end)	22.25	22.60	565.2	574.0
C (Bulb diameter in bend)	1.33	1.63	33.8	41.4
D (Bulb diameter in legs)	1.41	1.59	35.8	40.4
E (Distance between legs)	4.30	-	109.2	-
F (Distance to outside of legs)	-	7.70	-	195.6
G (Base face to beginning of Dimension H)	1.0	-	25.4	-
H (Length over which Dimensions D, E, and F apply)	16.0	-	406.4	-

Lamp legs shall be in the same plane over the unbent portion of the lamp; *maximum deviation* = 0.13 in (3.3 mm).

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	38.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	40.5
Voltage (V)	100
Current (A)	0.430

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

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Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for two lamps	Ballasts for three lamps
Rapid start			
Voltage between lamp terminals (Note 1)			
at 50°F (10°C) and above, (Vrms) min	200	256	395
at 50°F (10°C) and above, (Vrms) max	260	330	525
Voltage lamp terminal to starting aid (Note 2)			
at 50°F (10°C) and above, (Vpeak) min	280	240	280
Waveshape of starting voltage crest factor, max	2.0	2.0	2.0
Starting capacitor size			
min (μF) (at 60 Hz)		0.04	0.04
max (μF) (at 60 Hz)		0.06	0.06

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start

Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

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40-Watt, 16-Inch Circular T9, Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	40W/T9/C16/RS
Nominal wattage	40 watts
Nominal diameter	16 in (406 mm)
Bulb designation	T9 (T28) Circular
Base	G10q, Four-pin circular
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (Inside of base to opposite wall)	13.43	13.69	341.1	347.7
B (Inside, other than Dimension A)	13.31	13.69	338.1	347.7
C & D (Lamp outside diameter)	15.50	16.00	393.7	406.4
D1 (Bulb, outside diameter)	1.03	1.22	26.2	31.0

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	39.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	41.5
Voltage (V)	109
Current (A)	0.420

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for one 12-inch and one 16-inch lamp
Rapid start		
Voltage between lamp terminals (Note 1)		
at 50°F (10°C) and above, (Vrms) min	205	285
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°C) and above, (Vpeak) min	290	290
Waveshape of starting voltage crest factor, max	2.0	2.0
Starting capacitor size		
min (μF) (at 60 Hz)		0.008
max (μF) (at 60 Hz)		0.06

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V nominal
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply)

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40-Watt, 16-Inch Circular T10, Rapid-Start Fluorescent Lamp

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Lamp description

Lamp abbreviation	40W/T10/C16/RS
Nominal wattage	40 watts
Nominal diameter	16 in (406 mm)
Bulb designation	T10 (T32) Circular
Base	G10q, Four-pin circular
Circuit application	Rapid start

Dimensional characteristics (definitions of Part II apply)

	Inches		Millimeters	
	Min	Max	Min	Max
A (inside of base to opposite wall)	13.43	13.69	341.1	347.7
B (Inside, other than Dimension A)	13.31	13.69	338.1	347.7
C & D (Lamp outside diameter)	15.75	16.25	400.0	412.8
D1 (Bulb, outside diameter)	1.16	1.34	29.5	34.0

Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	39.5
Approximate cathode wattage (with 3.6 V on each cathode) (W)	2.0
Total wattage (W)	41.5
Voltage (V)	108
Current (A)	0.415

Reference ballast characteristics

Rated input voltage (V)	236
Reference current (A)	0.430
Impedance (ohms)	439

Cathode characteristics

Type	Low resistance
Resistance (at 3.6 V)	
Objective (ohms)	9.6
Minimum (ohms)	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

	Single-lamp ballast	Ballasts for one12-inch and one 16-inch lamp
Rapid start		
Voltage between lamp terminals (Note 1)		
at 50°F (10°C) and above, (Vrms) min	205	285
Voltage lamp terminal to starting aid (Note 2)		
at 50°F (10°C) and above, (Vpeak) min	290	290
Waveshape of starting voltage crest factor, max	2.0	2.0
Starting capacitor size		
min (μF) (at 60 Hz)		0.008
max (μF) (at 60 Hz)		0.06

NOTES

1 These values are for lead circuits only. For lag circuits, add 3%.
2 These values are for crest factors of 1.55 to 2.0. Add 10% for crest factors less than 1.55.

Cathode heat requirements

Rapid start	
Voltage	3.6 V *nominal*
Limits during operation	2.5 V min, 4.0 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply).

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50-Watt, Single-Based Rapid-Start Fluorescent Lamp

Lamp description

Lamp abbreviation	50W/22T5/T/2G11/RS
Nominal wattage	50 watts
Nominal overall length	22.4 in (570 mm)
Bulb designation	T5 (T16)
Base	2G11
Circuit application	Rapid start

Dimensions characteristics (definitions of Part II apply)

	Finished Lamp Dimensions (Note 1)				Lamp Outline Dimensions (Note 2)	
	Inches		Millimeters		Inches	Millimeters
Lamp Length	Min	Max	Min	Max	Max	Max
Base face to top of lamp (H)	-	22.30	-	566.4	22.30	566.4
Bulb depth (G)	.67	.70	17.1	17.8	0.98	25.0
Bulb width (C)	1.46	1.55	37.2	39.4	1.80	46.0

NOTES

1 Lamp dimensions C & G apply to glass only in mounting area along lamp legs.
2 Conditions of clause 10.4 apply.

Auxiliary supports

An auxiliary bulb holding device is required due to the long length of this single-based lamp. No mounting support shall be placed on or very near the bent end of the lamp. The bulb-holding device shall be located between 18.0" (457 mm) and 20.0" (508 mm) from base face of lamp.

NOTES

3 A UV resistant non-metallic saddle type clip is the preferred method to support the lamp. Metallic clips may change the starting characteristics of high-frequency operation of the lamp.
4 A support placed between the legs of the lamp is not recommended. The inside leg dimension is not controlled and varies in production The minimum spacing between the legs is 0.71 in. (1.8 mm).
5 The lamp should be used in lamp holders that conform to 2G11 standards sheet, ANSI C81.62.

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Electrical characteristics

Lamp operating characteristics (conditions of clause 11 apply)

Wattage	
Arc wattage (W)	47.9
Approximate cathode wattage (with 3.6V on each cathode) (W)	2.1
Total wattage	50.0
Voltage (V)	147
Current (A)	0.430

The preceding lamp operating characteristics are based on horizontal operation in a rapid-start type circuit at an ambient temperature of 25°C (77°F) with a 60-Hz sinusoidal power supply and a reference ballast having the characteristics shown in the following section:

Reference ballast characteristics

Rated input voltage (V)	400
Reference current (A)	0.430
Impedance (ohms)	800

The general requirements for reference ballasts are stated in American National Standard for Reference Ballasts for Fluorescent Lamps, ANSI C82.3.

Cathode characteristics

Type	Low resistance
Resistance (at 3.6V)	
Objective	9.6
Minimum	7.0

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Information for ballast design (conditions of clause 13 apply)

Lamp starting requirements

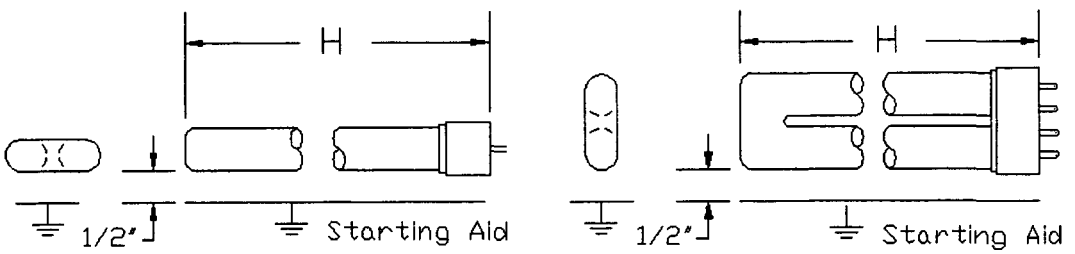
	Single-lamp ballast	Ballasts for two lamps
Rapid-start (starterless) circuits		
Voltage between lamp terminals		
at 50°F (10°C) and above, (Vrms) min	275	400
at 50°F (10°C) and above, (Vrms) max	355	520
Voltage lamp terminal to starting aid (Note 1)		
at 50°F (10°C) and above, (Vpeak) min	520	520
Voltage (0°C) crest factor, min (@90% line)	1.60	1.65
Voltage (0°C) crest factor, max	2.2	2.2
Starting capacitor size		
min (μF) (at 60 Hz)	-	0.04
max (μF) (at 60 Hz)	-	0.06

NOTES

6 These limits apply to the peak voltage between the lamp terminal delivering the highest voltage above ground and the grounded fixture.

7 The starting aid surfaces shall extend the full length of the lamp (distance H), at least 1"(25mm) wide for edge mounting of lamps and at least 1.5" (38 mm) for flat mounting of lamps.

8 Maximum distance from bulb wall leg to starting aid is 1/2" (13 mm) for either edge mounting or flat mounting, as shown below:



Cathode heat requirements

Rapid start

Voltage	3.6V nominal
Limits during operation	2.5 V min, 4.4 V max
Dummy load resistor	9.6 ohms ± 0.1 ohm
Voltage across dummy load	3.4 V min, 4.5 V max

Information for luminaire design (conditions of clause 14 apply).

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	SINGLE-CAPPED FLUORESCENT LAMP DATA SHEET High frequency Dual-shaped	Page 1

Nominal wattage	Circuit	Cathode	Cap
55W	HF starterless	Preheated	2G11

Dimensions mm		
A	B	C
Max.	Max.	Max.
40	20	535

Cap. See sheet 7004-82 of IEC 60061-1

Starting characteristics				
Frequency kHz	Preheat current A	Preheat time s	Open Circuit voltage (r.m.s.) V	Starting time s
20-26	0,760	2	350	0,1

Electrical characteristics					
Frequency	Rated wattage	Voltage(r.m.s.) at lamp terminals V			Rated lamp current
kHZ	W	Rated	Minimum	Maximum	A
20-26	55	101	91	111	0,550

Test position: horizontal: with the plane through the limbs horizontal.

NOTE To reduce the time for testing, other positions may be used by agreement between the manufacturer and testing authorities. In case of dispute the horizontal position shall be reference test position.

Cathode characteristics			
Test current	Resistance of each cathode Ω		
A	Rated	Minimum	Maximum
0,500	8	6	10

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	SINGLE-CAPPED FLUORESCENT LAMP DATA SHEET High frequency — Dual-shaped	Page 2

Frequency kHz	Nominal wattage W	Rated voltage V	Calibration current A	Resistance Ω
20-26	55	202	0,550	185

Information for HF ballast design			
Frequency		kHz	≥20
Current in any lead to cathode	A	Max.	0,780
Lamp operating current	A	Min.	0,450
		Max.	0,650
Current controlled preheating			
Minimum preheat current i_k (A) to emission time t_e (s)		a	0.680
$I_K=(a/t_e + i_m^2)^{0,5}$		i_m(A)	0,525
Maximum preheat current	A	$t \leq 0,4$	1,800
		$0,4 < t < 2,0$	2,000-0,500 t
		$t \geq 2,0$	1,000
Open circuit voltage across lamp (without starting aid)	V	$t \leq t_e$ Max. (r.m.s.)	220
		$t \geq t_e$ Min. (r.m.s.)	360
Substitution resistor for each cathode		Ω	7
Voltage controlled preheat			
*			

Information for luminaire design			
Maximum lamp outline: see sheet 60901-IEC-A210, with dimension H:		mm	535
Lamp and support: distance from cap reference plane	mm	Min.	450
		Max.	485
Gap between the limbs of the lamp	mm	Min.	1,8

* Under consideration

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