

ANSI_IEC C81.62-2005

Revision of ANSI C81.62-2003

American National Standard

For Electric Lampholders

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ANSI_IEC C81.62—2005
Revision of ANSI_IEC C81.62-2003

American National Standard

Approved: August 31, 2005 Secretariat: ANSLG-- National Electrical Manufacturers Association

Electric Lampholders

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Foreword (*This foreword is not part of American National Standard C81.62-2005*)

In 1990 and 1991 the American National Standards for lamp bases, lampholders and gauges were split into three separate standards to line up with the IEC format. ANS C81.61, ANS for Electric Lamp Bases paralleled IEC 60061-1; ANS C81.62, ANS for Lampholders for Electric Lamps paralleled IEC 60061-2 and ANS C81.63, Gauges for Electric Lamp Bases and Lampholders paralleled IEC 60061-3. Also a fourth standard, ANS C81.64 Guidelines for Electrical Lamp Bases, Lampholders and Gauges was published to parallel IEC 60061-4 in 1993.

In 1996, the first IEC data sheets were adopted "as is" as Nationally Acknowledged International Standards and published as Supplement g to the existing C81.61, 62 and 63 standards. Now many more (if not most) ANSI base standard sheets are IEC sheets adopted as ANSI standards.

In 2003, a revision and consolidation of ANSI C81.62 was issued to include, first, a reference to all IEC lampholder standard sheets adopted as ANSI standards. Second, standard sheets for a small number of lampholders used mainly in North America or not harmonized with IEC were included in Part II. Part III contained any United States deviations to the IEC standard sheets, which had been adopted as Nationally Acknowledged International Standards that are published in IEC 60061-2. Part IV contained an informative annex on first versus third angle projection and related standards.

This standard updates the 2003 edition.

Information concerning the approval of this standard is based on the documents listed in the table below:

Amendment/Change	CDV	RV
Revision	C81/2652	C81/2653

Anthony Tufano, Chairman, ASC C81
David Mullen, Technical Coordinator
Randolph N. Roy, ANSLG Secretariat
Matthew C. Clark, Coordinating Editor

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PART I - General Information and Requirements

1 Scope

This standard sets forth the specifications for lampholders for electric lamps.

2 Normative references

The following publications 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 publications indicated below.

ANSI_IEC C81.61 – 2005, *Bases (Caps) for Electric Lamps*

ANSI_IEC C81.63 – 2005, *Gauges for Electric Lamp Bases and Lampholders*

IEC 60061-2005, *Lamp caps and holders together with gauges for the control of interchangeability and safety*
Part 1: Caps
Part 2: Lampholders
Part 3: Gauges

UL 496-2004, *Edison-Base Lampholders*

UL 542-1999, *Lampholders, Starters, and Starter Holders for Fluorescent Lamps*

3 General information

Two types of lampholder standard sheets are identified in this standard, and all these are listed in Table 1, *ANSI and IEC Lampholder Standard Sheets.* All lampholder types are listed in color to indicate their applications: Blue for automotive and miniature; green for general lighting service including common Edison screw lampholders; red for fluorescent; and black for miscellaneous.

For some lampholders either no international standard exists or the international standard is not acceptable at this time. For such lampholders an ANSI standard sheet is included. These standard sheets are identified in Table 1-- ANSI and IEC Lampholder Standard Sheets under the column heading "ANSI C81.62". These Standard Sheets are found in Part I.

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Certain standard sheets from IEC standard 60061 and its amendments, *Lamp caps and holders together with gauges for the control of the interchangeability and safety, Part 2: Lampholders*, have been adopted as Nationally Acknowledged International Standards and constitute part of the American National Standard for Lampholders. The standard sheets for these lampholders are not included, but are identified in Table I--ANSI and IEC Lampholder Standard Sheets under the column heading "IEC 60061-2". Any United States deviations from these standard sheets are found in Part II.

These IEC standards are available from:

American National Standards Institute
Attn: “eStandard Store”
25 West 42nd Street, 4th Floor
New York, NY 10036

Or by calling 212 642-4900 during normal business hours. They may also be purchased electronically at the following URL www.ansi.org
Or http://webstore.ansi.org/ansidocstore/default.asp

The drawings on the internationally standardized (IEC) sheets are in first angle projection rather than the third angle commonly used in the North American (ANSI) approved standard sheets. Annex A explains the difference between the two systems. In addition, the common American term "Base" is internationally known as "Cap". Internationally the decimal point (.) is not used in dimensions, rather a comma (,) separates a decimal number e.g. 4,5 rather than 4.5. However in the designation of a fit the decimal point is used e.g. GY6.35.

This Standard is used in conjunction with ANSI_IEC C81.61, *Bases (Caps) for Electric Lamps*; ANSI_IEC C81.63, *Gauges for Bases and Lampholders for Electric Lamps* and IEC 60061, *Lamp caps and holders together with gauges for the control of interchangeability and safety, Part 1: Caps , and Part 3: Gauges.* In addition the safety requirements for Edison screw lampholders are found in UL 496, *Edison-Base Lampholders* and the safety requirements for fluorescent lamp bases and starter holders are found in UL 542, *Lampholders, Starters, and Starter Holders for Fluorescent Lamps*.

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Table 1 - ANSI and IEC Lampholder Standard Sheets

System	Description	Standard Sheets	
		IEC 60061-2	ANSI C81.62
Bayonet lampholders			
B/BX8.4d	Holder	7005-140-1	
BA9/12.5	Miniature bayonet lampholder		2-10-3
BA15s, BA15d	Candelabra single and double-contact bayonet		2-20-2
BAY15s, BAY15d	Single- and double contact bayonet for offset pins		2-20-2
BAZ15d	Double contact bayonet for offset and non-aligned pins		2-20-2
BY22d	Multipurpose sleeved double-contact bayonet	7005-17-5	
Edison screw lampholders			
E5	Midget screw lampholder	7005-20-5	
E10	Miniature screw	7005-20-5	
E11	Mini-candelabra screw	7005-6-1	
E12	Candelabra screw	7005-28-1	
E17	Intermediate screw	7005-20-5	
E26/24	Single-contact medium screw	7005-21A-1	
Edison threads	Thread length and top of thread to center contact dimensions for E5, E10, E17, and E26 lampholders	7005-20-5	
E26d	Double-contact medium screw	7005-29-2	
E26/50x39	Skirted medium screw for PAR lamps	7005-21A-1	
E26/53x39	Extended skirted medium screw for R- lamps	7005-21A-1	
EX26	Single-contact medium screw with extended insulation		2-911-1
E39	Single-contact mogul screw	7005-24A-3	
E39d	Double-contact mogul screw		2-187-1
EP39	Position-oriented mogul screw		2-202-2
EX39	Exclusionary mogul screw for HID lamps		2-210-2
Single pin lampholders			
Fc2	HID slide side contact lampholder	7005-114-1	
Fa8	Fluorescent single-pin	7005-58-1	
Multiple pin lampholders and connectors			
G4	Two-pin lampholder for single ended TH (tungsten halogen) GLS (general lighting service) lamps	7005-72-1	
GU4	Two-pin lampholder for MR11 GLS lamps with retainer springs	7005-108-2	
GZ4	Two-pin connector for MR11 projection lamps	7005-67-1	
G5	Fluorescent miniature two-pin lampholder		2-310-3
G5.3	Two-pin for single-ended TH (tungsten halogen) projection lamps	7005-73-1	
GU5.3	Two-pin for MR16 GLS lamps with retainer springs	7005-109-2	
GX5.3	Two-pin lampholder and connector for MR13 and low voltage MR16 projection lamps	7005-73A-4	
GY5.3	Two-pin lampholder for high voltage MR16 projection lamps	7005-73B-4	
G/GX/GY6.35	Two-pin lampholders for single-ended TH GLS lamps	7005-59-2	
GZ6.35	Two-pin connector for MR16 projection lamps	7005-59A-3	
2G7	Four-pin compact fluorescent lampholder , two retainer springs	7005-102-1	
2GX7	Four-pin compact fluorescent , four retainer springs	7005-103-1	
GU7	Two-pin turn-and-lock lampholder for reflector lamps	7005-113-2	
G7.9	Side pin for high voltage reflector projection lamps	7005-139-1	
GX7.9	Side pin for low voltage reflector projection lamps	7005-139-1	
GR8	Two-pin lampholder for compact fluorescent	7005-68-4	
2G8	Lampholder	7005-141-1	
G8.5	Miniature two-pin for HID projection lamps	7005-122-1	
G9	Two-contact lampholders for single ended TH lamps	7005-129-1	

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Table 1 - ANSI and IEC Lampholder Standard Sheets

System	Description	Standard Sheets	
		IEC 60061-2	ANSI C81.62
Multiple pin lampholders and connectors, continued			
G9.5	Two-pin lampholder for single-ended TH lamps	7005-70-1	
GX9.5	Two-pin for single-ended TH lamps, longer length and width with side retainer springs.	7005-70A-2	
GY9.5	Uneven two-pin lampholders for single ended TH and HID lamps	7005-70B-2	
GZ9.5	Uneven two-pin for single ended TH and HID lamps, longer length	7005-70B-2	
G10q	Four pin circular fluorescent lampholder	7005-56-1	
GR10q	Four-pin compact fluorescent	7005-77-3	
GU10	Lampholder for aluminized reflector lamps	7005-121-2	
GZ10	Lampholder	7005-120-2	
2G10	Four-pin compact fluorescent, four retainer springs	7005-118-1	
2G11	Four-pin compact fluorescent, two retainer springs	7005-82-2	
G12	Two-pin lampholder for HID projection lamps	7005-63-1	
GX12	Lampholder	7005-135-1	
G13	Fluorescent medium two-pin		2-406-2
2G13	U-shaped fluorescent lampholders with spacing variants		2-420-2
2GX13	Circular fluorescent, pins on opposite sides of bulb	7005-125-2	
G16d	Mogul and extended mogul end prong connector		2-430-2
G17t	Three-pin prefocus for incandescent projection lamps		2-440-1
G17q	Four-pin prefocus for high voltage incandescent projection lamps		2-440-1
GX17q	Four-pin prefocus for low voltage incandescent projection lamps		2-440-1
G20	Fluorescent mogul two-pin lampholder		2-452-1
G22	Medium bipost for incandescent and single ended TH lamps	7005-75-2	
G23	Two-pin compact fluorescent, low preheat current, two retainers	7005-69-1	
GX23	Two-pin compact fluorescent, high preheat current, four retainers	7005-86-1	
G24d, G24q	Two-pin and four-pin compact fluorescent lampholders, two retainers, seven keyway variants for different ballasts.	7005-78-7	
G24Xd, GX24q	Two-pin and four-pin compact fluorescent, two retainers, circular outer platform, seven keyway variants for different ballasts	7005-78-7	
GY24d	Two-pin compact fluorescent, two retainers, reversed pins, four keyway variants for different ballasts.	7005-78-7	
G32d, G32q	Two-pin and four-pin compact fluorescent, two retainers, five keyway variants for different ballasts.	7005-87-3	
GX32d, GX32q	Two-pin and four-pin compact fluorescent, two retainers, rectangular outer platform, five keyway variants for different ballasts	7005-87-3	
GY32d	Two-pin compact fluorescent, two retainers, reversed pins, five keyway variants for different ballasts.	7005-87-3	
G38	Mogul bipost for incandescent and single ended TH lamps	7005-76-2	
Prefocus lampholders and connectors			
P8.25d	Two-pin prefocus lampholder for lamps in printed circuit boards		2-530-1
PG12, PGX12	Two-pin prefocus for HID lamps, five keyway variants for different ballasts	7005-64-4	
P12.4d	Two-pin prefocus for lamps in printed circuit boards		2-550-1
PG13, PGJ13	Auto recessed two-pin straight and right angle prefocus connectors and mounting hole for signal and fog lamps	7005-107-2	
PGJ19	Auto right angle prefocus with five keyway and two connector variants for various applications	7005-110-1	
PGJ19-1	For H8 headlamp replaceable inner bulb		
PGJ19-2	For H11 headlamp replaceable inner bulb		
PGJ19-5	For H9 headlamp replaceable inner bulb		
P20d. PX20d, PY20d, PZ20d	Auto right angle prefocus with keyway variants for various applications	7005-31-2	
P20d	For HB3 (9005) headlamp replaceable inner bulb		
P20d straight	For straight base HB3A headlamp replaceable inner bulb		
PX20d	For HIR (9011) headlamp replaceable inner bulb		
PY20d	For 9145 headlamp replaceable inner bulb		

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Table 1 - ANSI and IEC Lampholder Standard Sheets

System	Description	Standard Sheets	
		IEC 60061-2	ANSI C81.62
Prefocus lampholders and connectors, continued			
PG20	Auto snap lock lampholders for recessed pin contacts with twelve keyway variants for various applications	7005-127-2	
PGU20	Auto snap lock lampholders for side contacts with twelve keyway variants for various applications	7005-127-2	
P22d, PX22d	Auto right angle prefocus with keyway variants for various applications	7005-32-2	
P22d	For HB4 (9006) headlamp replaceable inner bulb		
P22d straight	For HB4A headlamp replaceable inner bulb		
PX22d	For HIR (9012) headlamp replaceable inner bulb		
PK22s	Auto prefocus for H3 (9200) headlamp replaceable inner bulb	7005-47-2	
PKX22s	Auto prefocus with key variant	7005-37-1	
PX26d	Lampholder for H7 headlamp	7005-5-3	
P26.4t	Auto prefocus lampholder	7005-128-2**	
P28s	Medium prefocus for flange reference plane	7005-42-1	
P29	Auto prefocus lampholder for HB1 (9004) headlamp replaceable inner bulb	7005-66-1	
P30s, P30d	Candelabra prefocus lampholders		2-709-1
P32d	Auto prefocus lampholders for side contacts with six key variants for discharge headlamp bulbs	7005-111-1	
P32d-2	For D2S discharge headlamp replaceable inner bulb		
P32d-3	For D2R discharge headlamp replaceable inner bulb		
PK32d	Auto prefocus lampholders with six key variants for discharge headlamp bulbs	7005-111-1	
PK32d-2	For D1S discharge headlamp replaceable inner bulb		
PK32d-3	For D1R discharge headlamp replaceable inner bulb		
P38t	Lampholder for H14 bulb	7005-133-1	
P40	Mogul prefocus for base with flange reference plane		2-715-2
P43t	Auto prefocus lampholder for H4 and HB3 (9003) headlamp replaceable inner bulb	7005-39-4	
Recessed base lampholders			
R7s, RX7s	Regular and extended recessed single-contact lampholders for double-ended TH and HID lamps, combined pair of lampholders	7005-53-4	
R7s, RX7s	Recessed single-contact lampholders, contact details	7005-53A-5	
R17d	Fluorescent recessed double contact		2-777-2
Flanged and side lampholders			
SX4	Sub-midget flanged lampholder		2-850-1
S14	Single and double-contact side holders for double-ended lamps	7005-112-1	
Wedge base lampholders			
W2.5x16q	Auto wedge base lampholder	7005-104-1	
WU2.5x16	Auto wedge base lampholder, keyway variant	7005-104D-1	
WX2.5x16q	Auto wedge base lampholder, keyway variant	7005-104A-1	
WY2.5x16q	Auto wedge base lampholder, keyway variant	7005-104B-1	
WZ2.5x16q	Auto wedge base lampholder, keyway variant	7005-104C-1	
W4.3x8.5d	Wedge base lampholder	7005-115-1	
Miscellaneous lampholders			
	Fluorescent lamp starter holder		2-900-1
	"UNO" thread form for medium screw lampholders		4-2-1
	Electrolier size metal shell for medium screw lampholders		4-5-1
	Electrolier size metal cap for medium screw lampholders		4-6-1

** Indicates a US deviation, see Part III

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PART II
ANSI Standard Sheets for Lampholders for Electric Lamps

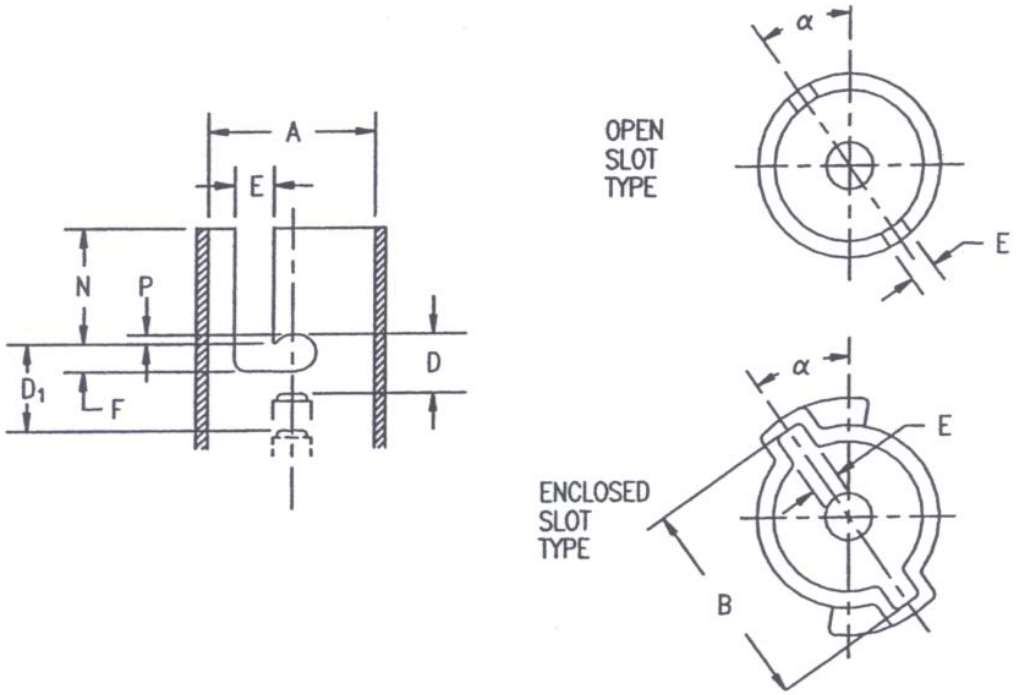
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BA9 Miniature Bayonet Lampholder

The designation assigned in accordance with the system of International Electrotechnical Commission (IEC) is BA9. This standard is equivalent to IEC 60061.

The drawing is intended only to indicate the dimensions to be controlled.



Reference	Standard Dimensions (millimeters)		Nearest Equivalent (inches)	
	Min	Max	Min	Max
A	9.32	9.44	0.367	0.372
B	11.05	-	0.435	-
D (Note 1)	-	3.8	-	0.150
D_1	6.65	-	0.262	-
E (Note 1)	2.2	-	0.087	-
F	2.2	-	0.087	-
N	-	4.4	-	0.173
P	0.5	-	0.020	-
α	28° Nominal		28° Nominal	

NOTE
These values have been rounded down by 0.01mm to agree with international standards.

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Gauging
The 3-14 “Go” gauge shall enter the lampholder until seated. The 1-14 “Not-Go” gauge shall not enter the lampholder.

The minimum retention gauge, 3-15, shall enter the Lampholder and rotate until seated. The gauge pins shall be retained by the holder-retaining slots.

Lampholders are required to exert a minimum bulb contact pressure of 3.0N, when measured with a minimum bulb base or gauging designed to meet minimum bulb base specifications.

The maximum retention gauge, 3-15, shall enter the Lampholder with a maximum force of 40N, and shall rotate until seated with a maximum torque of 0.3Nm.

See ANSI_IEC C81.63 for gauges.

Base
See ANSI_IEC C81.61, Standard Sheet 1 -10.

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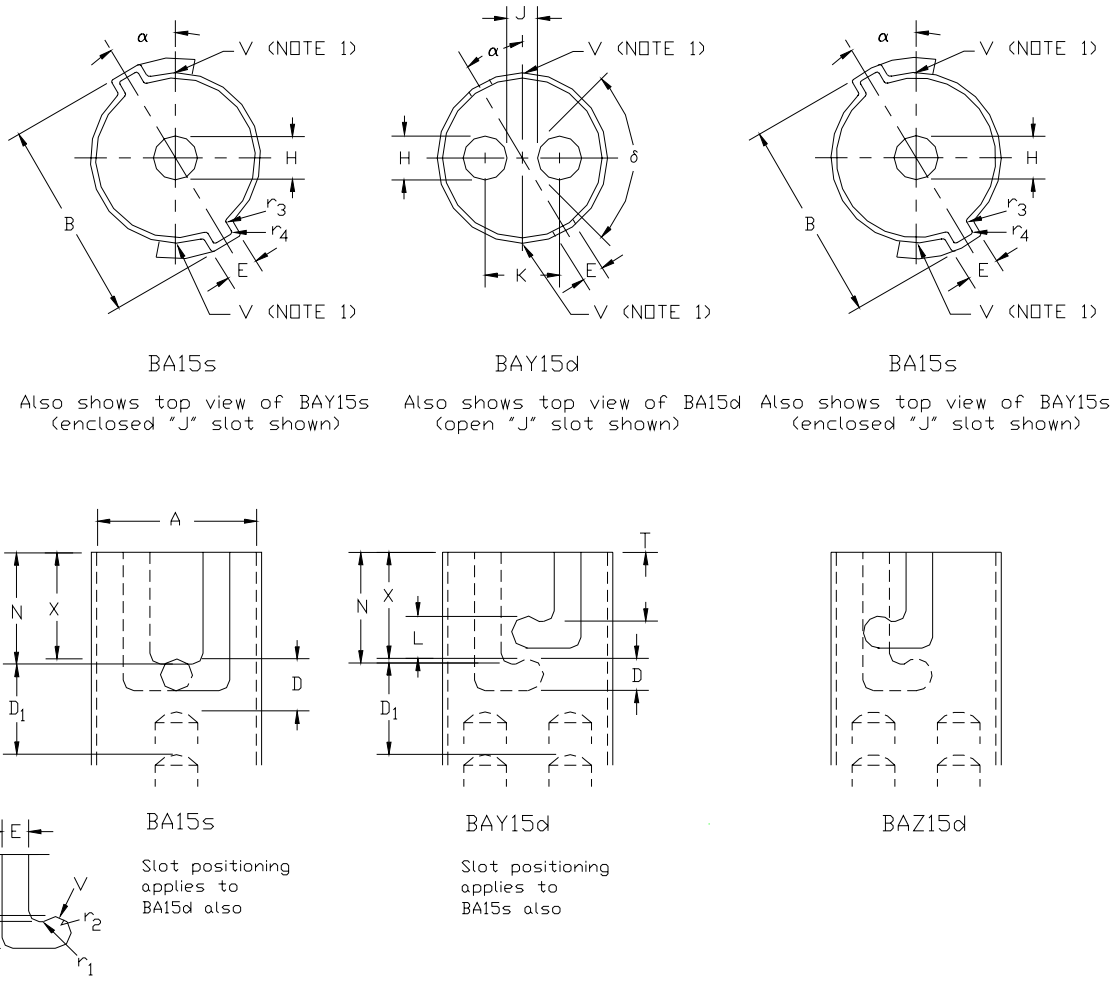
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BA15, BAY15 and BAZ15 Candelabra Bayonet Lampholders

The designations assigned to these lampholders by the International Electrotechnical Commission (IEC) are BA15, BAY15, and BAZ15.

These lampholders are very similar to, but not completely identical with the lampholders in IEC 60061. In the United States they are used for both automotive and nonautomotive applications.

The drawing is intended only to illustrate the dimensions to be controlled.



BA15s

Also shows top view of BAY15s (enclosed "J" slot shown)

BAY15d

Also shows top view of BA15d (open "J" slot shown)

BA15s

Also shows top view of BAY15s (enclosed "J" slot shown)

BA15s

Slot positioning applies to BA15d also

BAY15d

Slot positioning applies to BA15s also

BAZ15d

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Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A	0.6045	-	0.609	15.33	-	15.47
B	0.670	-	-	17.02	-	-
D	-	-	0.217	-	-	5.50
D_1	0.325	-	-	8.25	-	-
E (Note 2)	0.106	-	0.126	2.70	-	3.20
F	0.106	-	-	2.70	-	-
H (Note 3)	0.096	-	-	2.50	-	-
J (Note 4)	0.047	-	-	1.20	-	-
K (Note 3)	0.272	-	0.290	6.90	-	7.36
L	0.122	-	0.130	3.10	-	3.30
N	-	-	0.343	-	-	8.70
P	0.030	-	-	0.75	-	-
T	-	-	0.209	-	-	5.30
X (Note 5)	0.283	-	-	7.20	-	-
r_1*	-	-	0.093	-	-	2.36
r_2*	-	0.030	-	-	0.75	-
r_3* (Note 6)	-	-	0.050	-	-	1.27
r_4* (Note 6)	-	-	0.030	-	-	0.76
α (degrees)	-	29°	-	-	-	-
δ (degrees)	-	45°	-	-	-	-
θ (degrees)	-	150°	-	-	-	-

NOTES
1 Point V denotes the resting point of base pins. For BA15 lampholders intended for optical control, the difference in heights between the two resting points "V" shall not exceed 0.2 mm (0.008 in.).
2 Other slots or recesses in the holder barrel are permissible if their width is less than 1.8 mm (0.070 in.).
3 Dimensions H and K refer to the contact face of plunger contacts only.
4 Lampholders intended for use at 100V and above shall provide a spacing of not less than 1.2 mm (0.047 in.) between the two contacts, and between the contacts and the shell of the lampholder.
5 Dimension X applies to lampholders intended for optical control. A value of 5.00 mm (0.197 in.) is under consideration for other applications.
6 This dimension applies to enclosed "J" slots only.
7 This dimension applies to lampholders accepting bases with circular contacts only. For lampholders accepting bases with oval shaped contacts only, this dimension is 30° nominal.
* These dimensions are for lampholder design and are not to be gauged.

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General requirements
Contacts shall be so designed and spaced that they will not short to each other or to the shell when a lamp is being inserted or removed from the lampholder. Special attention should be given to Note 7 and the fact that some base eyelets or solder contacts may not be of a circular cross-section.

Contact types other than plungers may be suitable.

Slots
This standard covers complete "J" slots only. The slots may be either enclosed or open.

Testing
The following requirements are under consideration.

The forces required to depress each contact individually to positions of 6.32 mm (0.25 in) and 7.50 mm (0.30 in) beyond the horizontal plane through the resting point(s) "V" (the resting point of the reference notch in the case of BAY15 and BAZ15 holders) shall be not less than 5 N (1.1 lbf) (22.5 lb x f). This shall not be more than 20 N (4.5 lb x f) (90 lb x f), respectively (not more than 10 N (2.2 lb x f) (45 lb x f) for plunger contacts in BA15d, BAY15d, and BAZ15d lampholders). The contact positions specified correspond with those resulting from the fitting of bases of which the values of dimension D_1 are minimum and maximum respectively.

Gauging
In certain designs of lampholders, the inside diameter of the shell can be accurately checked only with the lampholder mounted in the fixture in which it is to be used.

The minimum retention gauge 3-24, when fully installed and seated in the lampholder, shall be retained against a minimum of 25N (5.6 lb x f) axial pull out force. The maximum retention gauge 3-24 shall enter the lampholder with a maximum force of 60N (13.5 lb x f) and shall rotate until seated with a maximum torque of 0.6 N.m (0.225 ft x lbs).

For applications demanding optical control or minimum photometric output, gauge 3-23 shall be used. Gauge 3-23, when fully inserted and locked, the surface of the gauge pin must be flush with or above the surface of the gauge base.

See ANSI_IEC C81.63 for gauges.

Base
See ANSI_IEC C81.61, Standard Sheet 1-20.

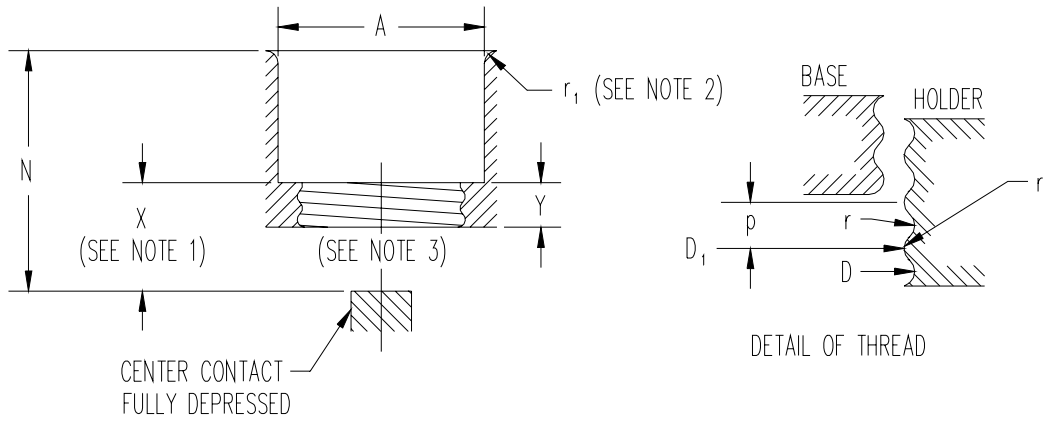
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EX26 Single-Contact Medium Screw Lampholder

At the time of issuance of this standard there was no comparable IEC standard in existence.

The drawing is intended only to indicate the dimensions to be controlled.



Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
A	1.281	1.320	32.54	33.53
D	1.043	--	26.54	--
D_1	0.977	0.987	24.80	25.07
N	1.490	1.572	37.84	39.93
X (Note 1)	0.672	0.750	17.07	19.05
Y	0.276	--	7.00	--
r_1 (Note 2)	0.078	0.109	1.98	2.77

NOTES
1 The X dimension is measured to the top of the threaded portion of the shell.
2 The surface of the insulating material in this area shall be smooth and free of any sharp protrusions which could scratch the glass of the lamp.
3 It may be necessary to cut-out a portion of the lampholder “husk” to visualize the threads or use an insulated probe to check.

Form of EX26 medium screw threads	
Threads per inch	7
Pitch of thread, *p*	0.14286 in (3.629 mm)
Radius of thread, *r*	0.0469 in (1.191 mm)
Direction of threads	right hand

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Gauging
Threaded "Go" Gauge 7006-25B: It shall be possible to screw gauge 7006-25B into a lampholder smoothly. When the gauge is fully seated, the rim of the screw shell of the holder shall be coplanar with or project beyond surface Y_1, but shall not project beyond surface Y_2.

"No-go" Plug Gauge 7006-26A: This gauge shall not enter a lampholder, by its own mass, so far that the thread protrudes beyond surface T.

Threaded Gauge for Testing Contact-making, Gauge 3-911: When the 3-911 gauge is fully seated in a lampholder, the indicator lamp in the test circuit shall light.

See ANSI_IEC C81.63 for gauges.

Base
See ANSI_IEC C81.61, Standard Sheet 1-157.

NOTE – The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights.

By publication of this standard, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. The patent holder has, however, filed a statement of willingness to grant a license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license. Details may be obtained from the standards engineer.

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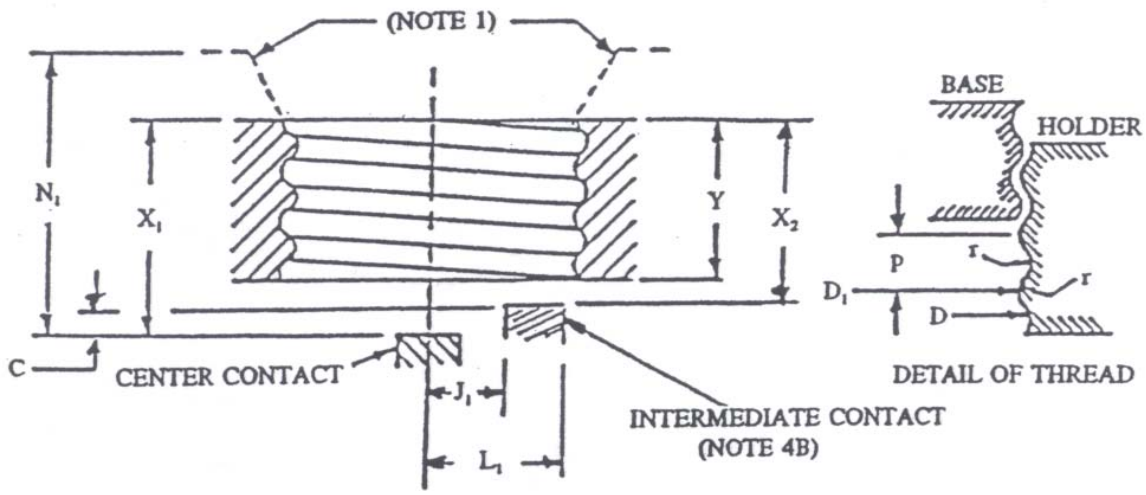
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E39d Double Contact Mogul Screw Lampholder

The designation assigned to this lampholder by the International Electrotechnical Commission (IEC) is E39d.

At the time of publication, there was no equivalent IEC standard.

The drawing is intended only to indicate the dimensions to be controlled.



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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
C	0.062	0.188	1.57	4.77
D	1.565	1.577	39.75	40.06
D_1	1.465	1.477	37.21	37.52
J_1	0.310	-	7.87	-
L_1	-	0.443	-	11.25
N (Note 2)	1.625	1.688	41.28	42.88
X_1 (Notes 3, 4)	1.000	1.185	25.40	30.10
X_2 (Notes 3, 4)	0.875	0.937	22.23	23.79

NOTES

1 Limits of the insulation shoulder profile are determined by the contact-making gauge. See IEC Standard Sheet 7006-24D for details of contact making gauge.

2 Dimension N defines the depth of the holder cavity, measured from the plane of the depressed center contact to the plane of the rim of the insulating liner or outer body, if made of insulating material. N Max does not apply if the insulating material outer body is flared and extends beyond the specified limit to provide further protection. For further details, see ANSI/UL 496.

3 Dimensions X_1 and X_2 are measured to the top of the threaded portion of the screw shell.

4 Contacts.

a. The center and intermediate contacts shall not be of opposite polarity.
b. The contact configuration is optional, particularly the intermediate, which may be a “ring” shape.
c. Either the center or the intermediate contact shall be capable of movement in an axial direction. It is also permissible for both of the contacts to be of a movable type.
d. All 39d lampholders shall meet the following two requirements:
   - Either the center contact in its stationary or fully depressed position shall be within the limits given for X_1, or the intermediate contact in its stationary or depressed position shall be within the limits for X_2.
   - When one of the two contacts has been found to comply with the preceding requirement, the other contact shall be capable of moving over the range indicated by dimension C (from C Min. to C Max.) with respect to the plane of the fully depressed position of the first contact.

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Form of E39 mogul screw threads	
Threads per inch	4
Pitch of thread, *p*	0.25000 in. (6.350 mm)
Radius of thread, *r*	0.0906 in. (2.301 mm)
Direction of threads	right hand

Gauging
There are no standard gauges in existence or under consideration.

Base
See ANSI_IEC C81.61, Standard Sheet 1-187.

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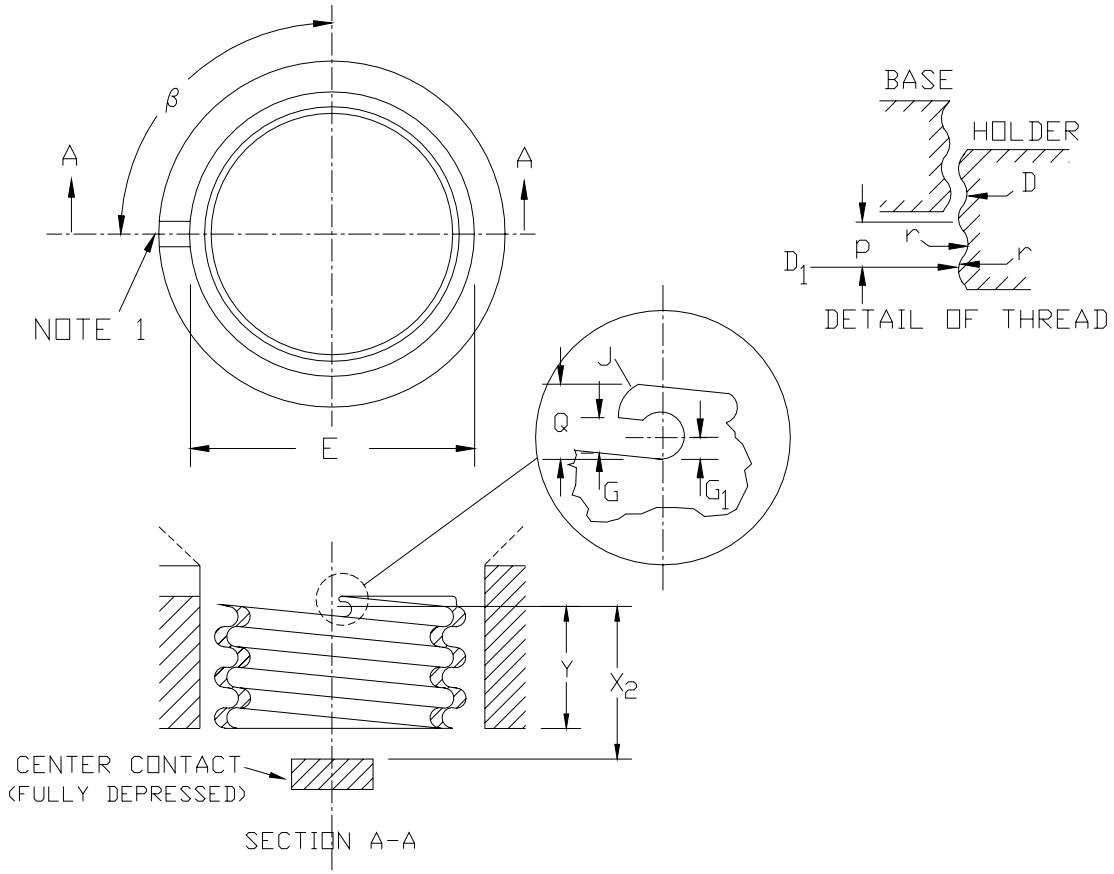
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EP39 Position-Oriented Mogul Screw Lampholder

The designation assigned to this base in accordance with the coding system of the International Electrotechnical Commission (IEC) is EP39.

At the time of issuance of this standard, there was no comparable IEC standard in existence.

The drawing is intended only to indicate the dimensions to be controlled.



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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
D (Note 2)	1.565	1.577	39.75	40.06
D_1	1.465	1.477	37.21	37.52
E	1.750	-	44.45	-
G_1 (Note 3)	0.060R	0.065R	1.52R	1.65R
J	0.016R	0.046R	0.41R	1.17R
Q	0.220	0.240	5.59	6.10
G	0.098	0.108	2.50	2.74
X_2 (Note 4)	1.060	-	26.92	-
Y (Note 5)	0.650	-	16.50	-
ß (degrees)	85°	95°	85°	95°

NOTES
1 The notch in the insulating body of the lampholder is provided to aid the proper orientation of an assembled lampholder in a luminaire. For horizontal lamp applications, this notch would be located at the low end of the vertical diameter.
2 Each lampholder shall have a stop for proper positioning of the lamp arc tube. Plane A-A indicates the beginning of the thread and the location of the cutout (stop) position at 90 degrees to the notch in the body of the lampholder. The thread cutout starts at the beginning of the thread and follows the thread for 360 degrees, thus removing one thread crest and one thread root.
3 The center for radius G_1 is located 0.015 inch (0.381mm) above the major thread diameter D_1, of the holder. Circumferentially, the center of this locking slot is located by the angle beta from the notch in the insulating body. See note 1.
4 The X_2 dimension is measured by the Minimum Insertion Gauge (see ANSI_IEC C81.63, Standard Sheet 3-204) and represents the distance from the centerline of the locking hole to the fully depressed center contact.
5 The Y dimension represents the distance from the centerline of the locking hole to the bottom of the thread.
6 The maximum torque used for lamp insertion shall be 25 lbf-in (2.8 Newton-meter).
7 The central contact shall make a good electrical connection when the lamp is fully inserted.
8 The base pin locking device shall provide a minimum unlocking torque of 10 lbf-in (1.1 Newton-meter) when a position-oriented mogul lamp base is fully inserted in the lampholder.
9 Insulation slope is controlled by the holder gauge.

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Form of EP39 Mogul Screw Threads	
Threads per inch	4
Pitch of thread, *p*	0.250 in (6.350 mm)
Radius of thread, *r*	0.0906 in (2.301 mm)
Direction of threads	right hand

Gauging
Threaded "Go" Gauge 7006-24E: It shall be possible to screw this gauge into a lampholder smoothly. When the gauge is inserted as far as it will go, the threaded portion of the lampholder shall be coplanar with or project beyond surface Y_1, but shall not project beyond surface Y_2.

"Not-go" Plug Gauge 3-191: This gauge shall not enter the screw thread of a lampholder, by its own mass, so far that the thread protrudes beyond surface t.

Threaded Gauge for Testing Minimum Insertion Clearance, Gauge 3-204: It shall be possible to screw the gauge 3-204 into a lampholder until the pin engages the pin-lock stop of the holder.

Threaded Gauge for Testing Contact-making, Gauge 3-205: When gauge 3-205 is fully seated in a lampholder, the indicator lamp (IL) shall light. In this position there shall be a clearance between the gauge and the upper edge of the holder if the holder is made of ceramic or other material that may scratch a glass bulb. This clearance may be verified by the use of a feeler gauge 0.003 in (0.08mm) thick and 0.2 in (5.0mm) wide.

Base
See ANSI_IEC C81.61, Standard Sheet 1-202.

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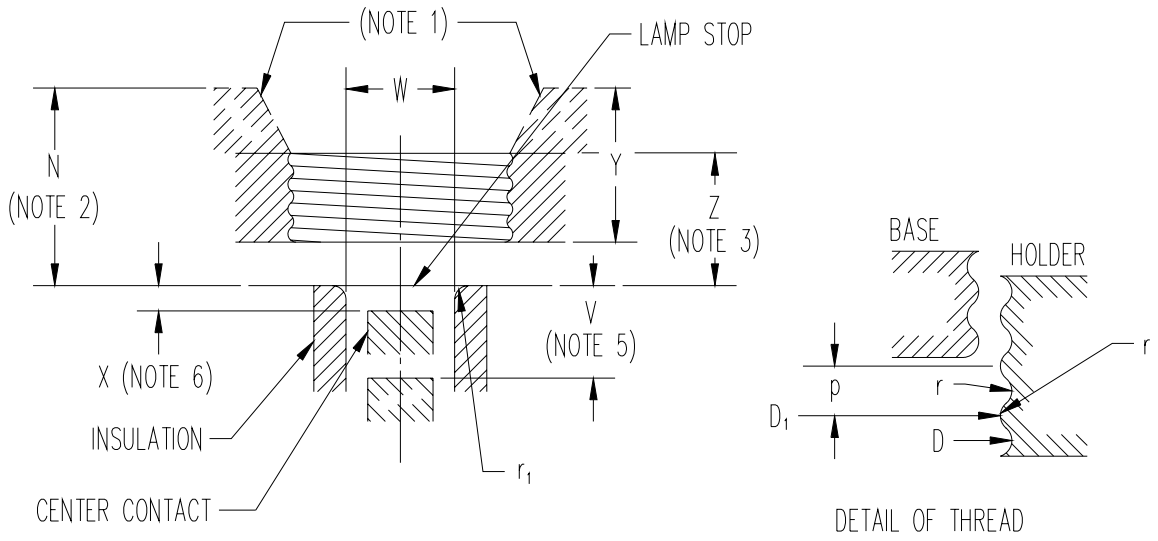
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EX39 Mogul Screw Lampholder

At the time of issuance of this standard there was no comparable IEC standard in existence.

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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
D (Note 4)	1.565	1.577	39.75	40.06
D_1 (Note 4)	1.465	1.477	37.21	37.52
N (Note 2)	1.360	1.421	34.54	36.09
X (Note 6)	0.171	0.218	4.34	5.54
Y	0.860	-	21.82	-
W	0.593	0.625	15.06	15.88
Z (Note 3)	0.875	0.937	22.23	23.80
V (Note 5)	-	0.343	-	8.71
r_1	0.028	0.046	0.71	1.17

NOTES
1 Limits of the insulation shoulder profile are determined by the contact-making gauge (see ANSI_IEC C81.63 Standard Sheet 3-211 for details of contact-making gauge).
2 Dimension N defines the depth of the holder cavity measured from the lamp stop to the rim of the insulating liner or outer body, if made of insulating material. N max does not apply if the insulating material outer body is flared and extends beyond the specified limit to provided further protection. For further details, see ANSI/UL 496.
3 Dimension Z is measured to the top of the threaded portion of the shrew shell.
4 For certain applications, such as roadway lighting, the lampholder may incorporate features that are designed to enhance gripping action on a lamp's base. Such features in the shell section are permitted to compromise the uniformity of dimensions D and D_1, subject to meeting gauging requirements.
5 Dimension V is for free travel of center contact.
6 Dimension X is to prevent electrical contact when E39 based lamp is inserted.

Form of EX39 Mogul Screw Threads	
Threads per inch	4
Pitch of thread, p	0.25000 in (6.350 mm)
Radius of thread, r	0.0906 in (2.301 mm)
Direction of threads	right hand

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Gauging
Threaded "Go" Gauge 3-210: It shall be possible to screw this gauge into a lampholder smoothly. When the gauge is inserted as far as it will go, the threaded portion of the lampholder shall be coplanar with or project beyond surface y_1, but shall not project beyond surface y_2.

"No-go" Plug Gauge 3-191: This gauge shall not enter the lampholder, by its own mass, so far that the thread protrudes beyond surface T.

Threaded Gauge for testing contact making 3-211: When this gauge is fully seated in a lampholder, the indicator lamp (IL) in the test circuit shall light. In this position there shall be a clearance between the gauge and the upper edge of the holder, if the holder is made of ceramic or other material that may scratch a glass bulb. This clearance may be verified by the use of a feeler gauge 0.003 in (0.08 mm) thick and 0.2 in (5.00 mm) wide.

Maximum Insertion Torque Gauge 3-213: It shall be possible to screw the gauge into the lampholder until it is fully seated with a torsion not exceeding 35 lb. fin. (3.9 Nm). It shall be possible to remove the gauge without exceeding 35 lb. fin. (3.9 Nm).

Minimum Torsion Gauge 3-212-1: This test shall be made after the lampholder under test has been checked by means of the gauge shown on Sheet 3-213. After the gauge is fully seated in the lampholder, the torque necessary for its removal shall not be less than 8 lb. fin. (9.0 Nm).

E39 Contact Making Gauge 7006-24D: When the gauge is fully seated the indicator lamp shall NOT light.

See ANSI_IEC C81.63 for Gauges.

Base
See ANSI_IEC C81.61, Standard Sheet 1-210.

> NOTE – The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights.
>
> By publication of this standard, no position is taken with respect to the validity of this claim or of any patent rights in connection therewith. The patent holder has, however, filed a statement of willingness to grant a license under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license. Details may be obtained from the standards developer.

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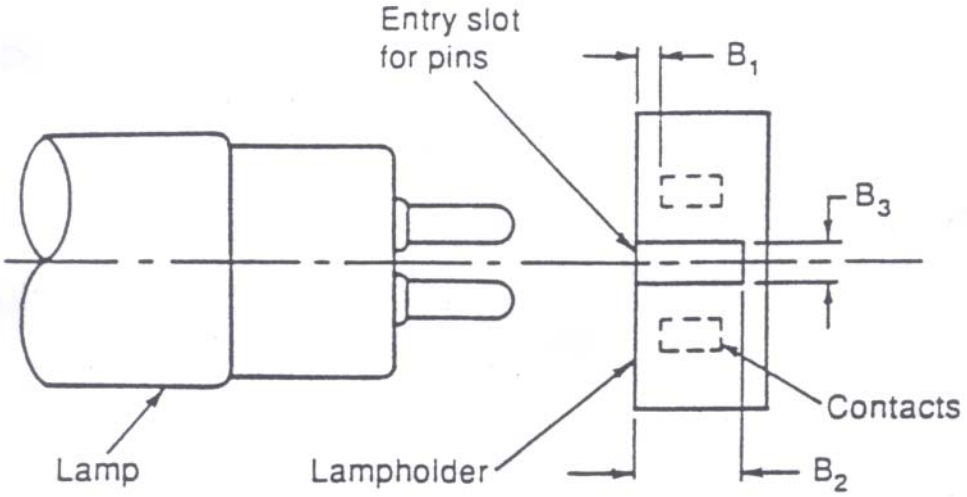
G5 Miniature Bipin Lampholder

The designation assigned to this lampholder by the International Electrotechnical Commission (IEC) is G5. This standard sheet is similar to IEC 60061-2, Standard Sheet 7005-51.

The drawing is intended only to indicate the dimensions to be controlled.

These are inflexible (rigidly fixed) lampholders.

This type of lampholder requires a turning motion for the insertion of a lamp.



B_1- The distance between the live contacts and the lampholder face shall not be greater than 0.100 inch (2.54 mm).

B_2 - The entry slots of inflexible lampholders shall have a depth not less than 0.265 inch (6.73 mm).*

B_3 - The width of the entry slots shall be great enough to accommodate the lamp-base pins with allowance for misalignment both of the lamp bases (with respect to each other) and of the lampholders. The gauge shown in ANSI_IEC C81.63, Standard Sheet 3-317 has the base pins at its two ends so arranged as to simulate a lamp with the maximum rotation misalignment of pins.

Clearance for live parts
When no lamp is in place, a test probe having a hemispherical end with a radius of 0.205 inch (5.21 mm) shall not be able to contact live metal parts.

* IEC 60061-2, Standard Sheet 7005-51 requires a minimum depth of 0.290 inch (7.35 mm).

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Lamp retention requirement, inflexible lampholders
The following requirements apply to those types of lampholders requiring rotation of the lamp during insertion. Test devices are to be applied to an individual lampholder to evaluate the maximum torque or force upon insertion and removal, and the minimum torque or force upon removal. The values given are for a single lamp-base test device in a single lampholder. These test devices are specified on Standard Sheet 3-314 as Device A, B, and C.

The following are the requirements pertaining to retention:

1 All lampholders shall have detents or other similar arrangements of contact springs (or other lampholder parts) to give a definite indication of when a lamp has reached its normal seating position.

2. Lampholders for rotational motion, with outside contacts:
   a. On the initial cycle the torque required to properly insert and remove Device A and Device B shall not exceed 2.0 lbf-in. (0.23 N-m).
   b. Simultaneously, the torque required to rotate each test device out of its seated position, including Device C, shall not be less than 0.5 lbf-in. (0.55 N-m).

The simulated lamp base by which the torque is applied to the holder is described on ANSI_IEC C81.63, Standard Sheet 3-314. If the holders being tested have push-in terminals, a single No. 18 AWG or 0.072 mm solid wire should be inserted in each terminal before the test is made. As a preconditioning cycle, there shall be one clockwise and one counter-clockwise rotation or one insertion and withdrawal routine of each device before the initial measurement is taken.

Gauging
G5 lampholders of the flexible (rigidly fixed) type shall satisfy the gauges specified on ANSI_IEC C81.63, Standard Sheets 3-313, 3-317, and 3-318.

Gauge 3-313
Both the minimum and maximum 3-313 gauges shall enter the lampholder far enough to bring the gauge face into contact with the holder face. Each gauge shall be easily removable by hand without causing breakage of any parts of the lampholder.

G5 lampholders that require rotation of the lamp during insertion shall be tested using the following procedure for each of the two 3-313, "go" gauges: The maximum pin spacing gauge shall be inserted by first rotating the gauge in a clockwise direction to seat it in the lampholder an then rotating it in a counter-clockwise direction to remove it from the holder. The gauge shall then be inserted with a counter-clockwise rotation and removed with a clockwise rotation. The procedure shall then be repeated using the minimum pin spacing gauge.

Lampholders shall show good engagement with the pins of the minimum-spacing gauge after having been tested with the gauge having pins set at maximum spacing.

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Gauge 3-317
When the lampholders are mounted at their minimum permissible spacing (as recommended by the manufacturer) with respect to a nominal lamp length of 9 inches (228.6 mm) it should be possible to insert and remove the 3-317 gauge without difficulty. The force required to insert the gauge in the direction of the lamp axis shall not exceed 3.3 lb. (15 N). The force in the direction perpendicular to the lamp axis is under consideration.

Gauge 3-318
The insertion of the 3-318 gauge shall cause both indicator lamps of the test circuit to light. The indicator lamps shall remain lighted while simulating all possible operating positionsof the lamp including any possible axial movement.

See ANSI_IEC C81.63 for gauges.

Push-in terminals
G5 lampholders employing push-in type terminals should be designed to accept connecting wires having strip lengths ranging from a minimum of 0.359 inch (9.13 mm) to a maximum of 0.453 inch (111.51 mm). (It is recognized that there may be existing designs that do not meet this requirement.)

Base
See ANSI_IEC C81.61, Standard Sheet 1-310.

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G13 Medium Bipin Fluorescent Lampholder

The designation assigned to this lampholder by the International Electrotechnical Commission (IEC) is G13.

This standard sheet is similar to IEC 60061-2, Standard Sheet 7005-50.

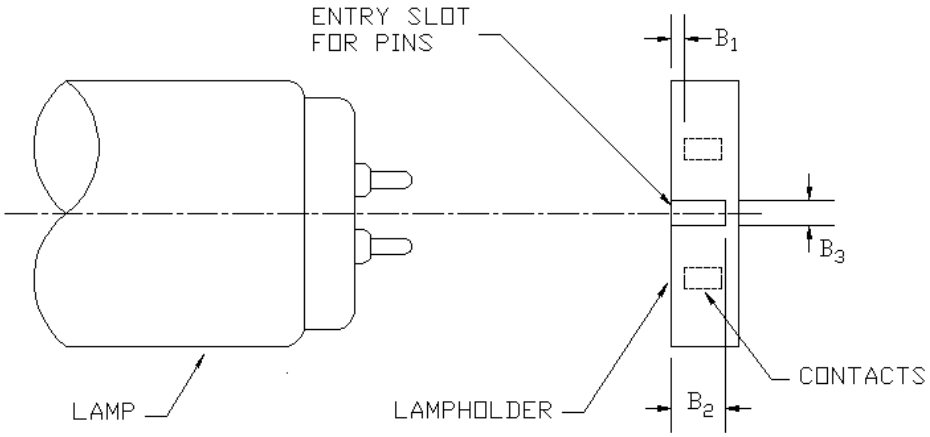
The drawing is intended only to illustrate the dimensions to be controlled.

Specific types of lampholders

Inflexible (rigidly fixed) Lampholders
Inflexible lampholders are a pair of lampholders intended for rigid mounting and in which no axial movement of the contacts is provided or is needed, either for the insertion and removal of the lamp compensation for variation in lamp lengths.

This type of lampholder includes:

- those that require a turning motion for the insertion of a lamp; and
- those in which insertion of the lamp is accomplished by lateral motion at right angles to the plane of the base pins.



B_1 – The distance between the live contacts and the lampholder face shall not be greater than 0.100 inch (2.54mm).

B_2 – The entry slots of inflexible lampholders shall have a depth not less than 0.250 inch (6.35mm). *

B_3 – The width of the entry slots shall be great enough to accommodate the lamp-base pins with allowance for misalignment both of the lamp bases (with respect to each other) and of the lampholders. This requirement applies only to the type of lampholder in which the lamp is rotated during insertion into the holder. The gauge shown on ANSI_IEC C81.63, Standard Sheet 3-417 has the base pins at its two ends so arranged as to simulate a lamp with the maximum rotational misalignment of pins.

* IEC 60061-2 requires a minimum depth of 0.290 inch (7.35mm).

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Flexible lampholders
Flexible lampholders are a pair of lampholders in which the base of each holder is rigidly mounted in the luminaire but which has one or both of the lampholders so designed as to allow axial movements of the contacts to provide compensation for variations in lamp lengths and, where necessary, to permit insertion and removal of the lamp.

NOTE – Contact may be made on either the end or the sides of the base pins. Contact may be made on either the ends or the sides of the base pins with due regard to the general requirements below.

Flexible mounted lampholders
Flexibly mounted lampholders are a pair of lampholders that do not in themselves provide for any axial movement of the contact system but that are intended to be mounted in a luminaire in a specified manner so that the combination provides the necessary axial movement of the contact system.

NOTE – Lampholders of this type may or may not be suitable for rigid mounting also. The manufacturer's instructions should state clearly whether both or only one of the methods of mounting are intended.

Lampholders for U-shaped lamps
Details for 2G13 lampholders appear on Standard Sheet 2-420.

NOTES
1 As a preconditioning cycle, there shall be one clockwise and one counterclockwise rotation or one insertion and withdrawal routine of each test device before the initial measurement is taken.
2 If the holders being tested have push-in lead-wire terminals related to the spring action of the contacts, a single No. 18 AWG solid wire should be inserted into each terminal before any test is made.

Clearance of live parts
When no lamp is in place, a test probe having a hemispherical end with a radius of 0.205 inch (5.21mm) shall not be able to contact live metal parts.

Manufacturer's mounting instructions
These are instructions supplied by the lampholder manufacturer or responsible vendor in order to ensure correct mounting and operation of the lampholder and which shall contain at least the following information:

- Method of mounting
- Mounting distance, with tolerance or reference to standard sheets,
- Lampholders should be used as a pair,
- Allowable angle of displacement of the pair of lampholders, and
- Required mounting plate thickness, if the lampholder is designed for screwless mounting.

NOTE – The above information might be part of the manufacturer or responsible vendor's catalog.

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Push-in terminals
G13 lampholders employing push-in type terminals shall be designed to accept connecting wire with strip length ranging from a minimum of 0.359 inch (9.13mm) to a maximum of 0.453 inch (11.5mm).

Gauging
Double-ended "Go" Gauges, 3-417: It shall be possible to insert and remove, without difficulty, both Gauge I and Gauge II of 3-417 in a combined pair of flexible or inflexible lampholders mounted at the minimum tolerance according to the manufacturer's instruction. The force required to insert each Gauge in the direction of the lamp axis shall not exceed 6.6 lb (30N).
The force in the direction perpendicular to the lamp axis is under consideration.

Double-ended Gauges for Testing Contact-making, gauges 3-418: When inserting Gauges III, IV, and V of 3-418 into a pair of flexible or inflexible lampholders mounted at the maximum tolerance according to the manufacturer's instructions, the two test lamps shall light.

> NOTE – When testing a combined pair of lampholders in a luminaires, the value of dimension B shall be equal to dimension B minimum of the related lamp, with a tolerance of –0.002 inch (-0.05mm).

See ANSI_IEC C81.63 for gauges.

General requirements:

Lampholder design shall provide for the entry and removal of finished lamps as evaluated by the lamp retention and gauging requirements that follow. Particular attention must be given to diameter, cross-sectional shape, non-uniform end shape, and length allowances for base pins as defined on finished lamps. See ANSI_IEC C81.61, standard sheet 1-406. These factors may also affect the electrical contact function of the system. It is recommended that the contact be achieved on the sides of the pins in the "no crimp" zones.

Lamp Retention Requirements, Inflexible Lampholders
The following requirements cover two types of lampholders: those requiring rotation of the lamp during insertion and those requiring lateral push-in motion. Test devices are to be applied to an individual lampholder to evaluate the maximum torque or force upon insertion and removal, and the minimum G13 torque or force upon removal. These test devices are specified on Standard Sheet 3-414, (ANSI_IEC C81.63) as Device A, B, and C.

The following are the requirements pertaining to retention:

1) All lampholders shall have detents or other similar arrangements of contact springs (or other lampholder parts) to give a definite indication of when a lamp has reached its normal seating position.

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2) Lampholders for rotational motion, with outside contacts:

   a) On the initial cycle, the torque required to properly inset and remove Device A and Device B shall not exceed 6.0 lbf-in (0.68 N-m). See note 1.

   b) Simultaneously, the torque required to rotate each test device out of its seated position shall not be less than 1.0 lbf-in (0.11 N-m). As a future objective, the value 1.25 lbf-in (0.14 N-m) is under consideration.

3) Lampholders for lateral push-in motion:

   a) Device B, and Device C shall not exceed 12 lbf-in (53.4 N-m). See note 1.

   b) Simultaneously, the force required to withdraw each test device from its normal seated position shall not be less than 3 lbf-in (13.3 N-m).

Base
See ANSI_IEC C81.61, Standard Sheet 1-406.

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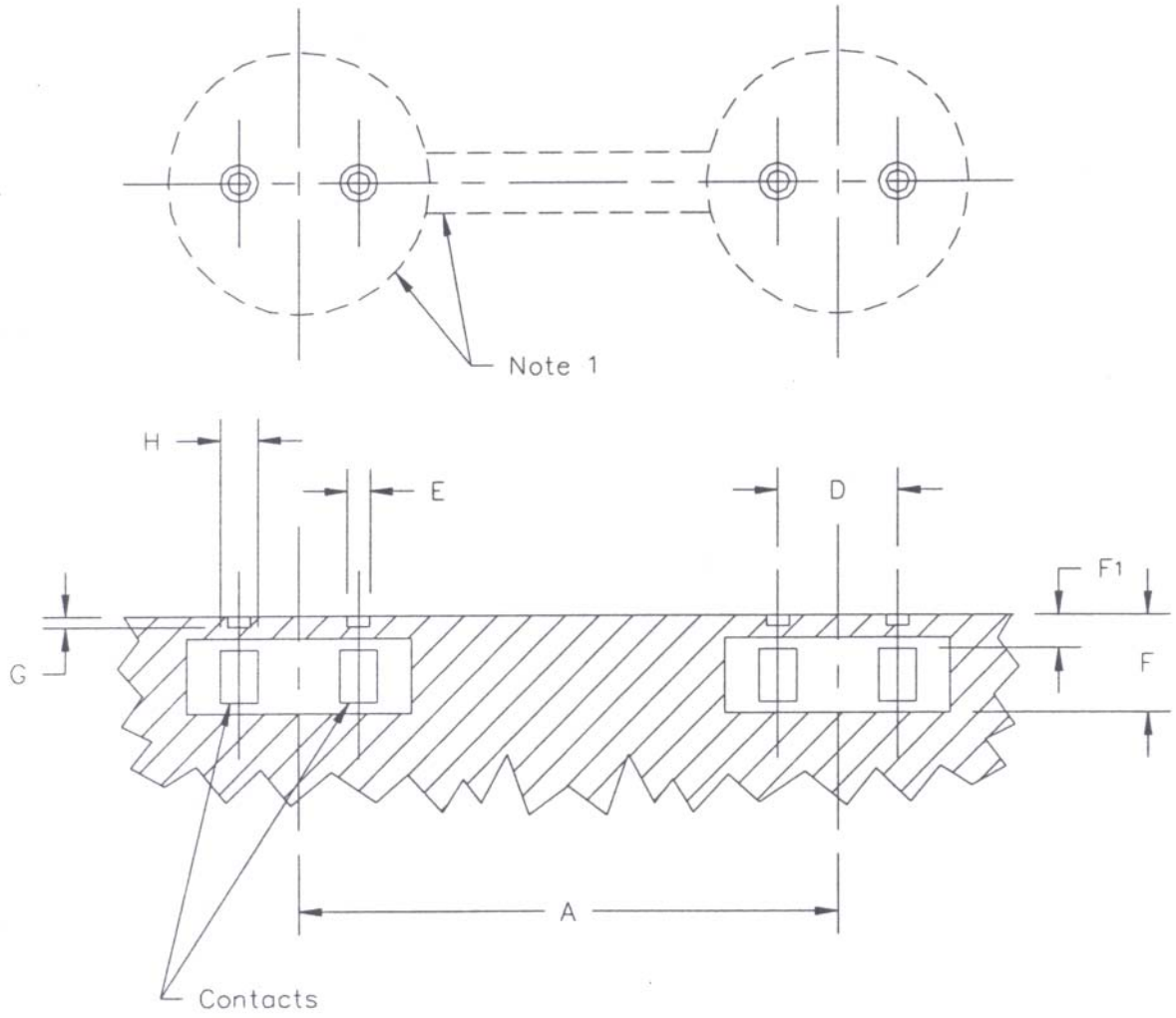
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2G13 U-Shaped Fluorescent Lampholder

The designation assigned to this lampholder, in accordance with the coding system of the International Electrotechnical Commission (IEC), is 2G13.

This standard sheet is similar to IEC 60061-2, Standard Sheet 7005-33.

The drawing is intended only to indicate the dimensions to be controlled.



Axial Insertion Type Lampholder

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2G13-41 (1 5/8 in. spacing)

Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A	-	1.625	-	-	41	-
D	-	0.500	-	-	12.70	-
F	0.301	-	-	7.65	-	-
F_1	-	-	0.10	-	-	2.5

2G13-92 (3 5/8 in. spacing)

Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A	-	3.625	-	-	92	-
D	-	0.500	-	-	12.70	-
F	0.301	-	-	7.65	-	-
F_1	-	-	0.10	-	-	2.5

2G13-152 (6 in. spacing)

Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A	-	6.00	-	-	152	-
D	-	0.500	-	-	12.70	-
F	0.301	-	-	7.65	-	-
F_1	-	-	0.10	-	-	2.5

NOTES
1 Dashes indicate free space to be reserved for the lamp base that is to be checked by means of the gauge shown on ANSI_IEC C81.63, Standard Sheet 3-423.
2 Dimensions E, G, and H are checked by means of the gauge shown on ANSI_IEC C81.63, Standard Sheet 3-423.
3 The force required to axially withdraw each test device from its normal seated position shall not be less than 13.3 N (3 lbs.).

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General Design Requirements
Lampholders intended for use with U-shaped fluorescent lamps shall be so designed as to take into account the allowable tolerance in the center-to-center distance between the two legs of the lamp. In some cases, it may also be desirable to provide for mounting arrangements of the holder in the luminaire so as to permit adjustment to fit different nominal leg spacings currently used in standard U-shaped fluorescent lamps.

Auxiliary Lamp Holding Devices
It is not intended that lampholders of this type provide the entire holding function. Supplementary lamp holding or retention devices may be necessary. Such devices shall be shaped and positioned with reference to the applicable lamp data sheet in *American National Standard for Dimensional and Electrical Characteristics of Fluorescent Lamps,* ANSI C78.1. The base standard sheet, 1-420, does not allow use of the leg brace for any holding purpose.

Clearance For Life Parts
When no lamp is in place the lampholder shall meet the requirements of UL 542.

Gauging
2G13 lampholders for U-shaped lamps shall be checked with the gauges specified on Standard Sheets 3-423 and 3-424, in that order.

"Go" Gauge 3-423: It shall be possible to insert each end of the gauge into the lampholder until surface X is in contact with the face of the holder. In each test position, electrical continuity shall be indicated.

Gauge for Testing Contact Making, Gauge 3-424: In all possible positions of the gauge, while surface X of the gauge is in contact with the face of the lampholder, contact as indicated on the electrical continuity circuit shall be maintained between the gauge pins and the holder contacts.

See ANSI_IEC C81.63 for gauges.

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Lamp Retention Devices
Lampholders for U-shaped lamps shall meet the lamp retention requirements given below. The values given apply to a single test device applied with lateral motion in an individual G13 section of the holder. Lampholders 2G13 shall be checked with the test device specified on ANSI_IEC C81.63, Standard Sheet 3-424.

1) There shall be a detent or other similar arrangement of the contact springs (or other lampholder parts) to give a definite indication of when the lamp has reached its normal seating position.

2) The force required to withdraw the test device from its normal seating position shall not be less than 3 lbf (13.3 N) and not more than 12 lbf (53.4 N).

Base
See ANSI_IEC C81.61, Standard Sheet 1-420.

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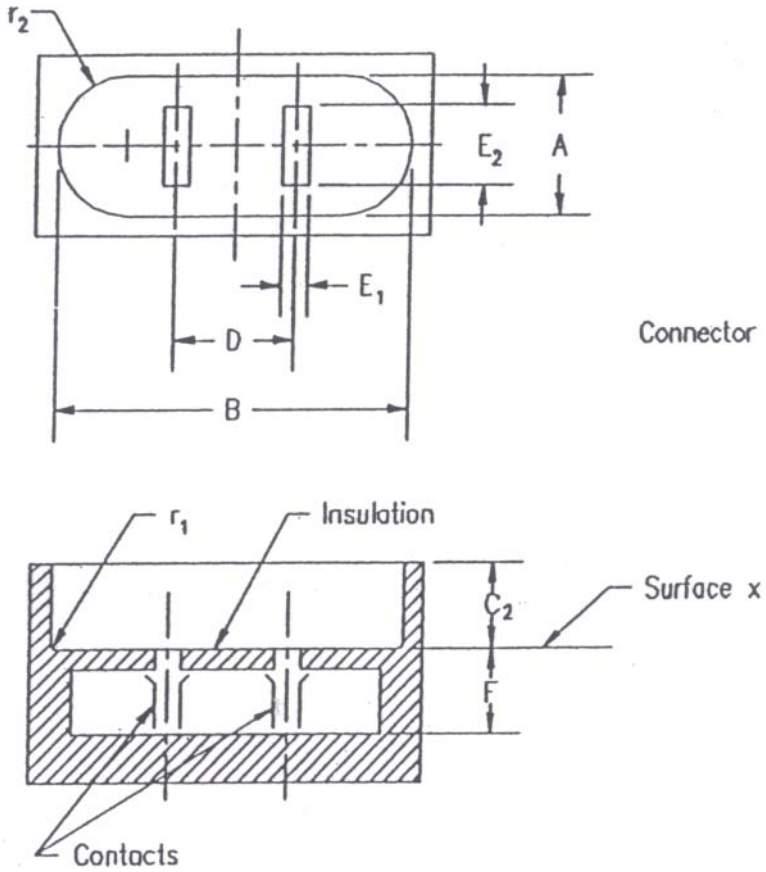
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G16d Mogul End-Prong Connector

The designation assigned to this connector, in accordance with the coding system of the International Electrotechnical Commission (IEC), is G16d.

At the time of issuance of this standard, there was no comparable IEC standard in existence.

The drawing is, intended only to indicate the dimensions to be controlled.



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Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A (Note 1)	0.780	-	0.880	19.81	-	22.35
B (Note 1)	2.115	-	2.145	53.72	-	54.49
C_2	0.420	-	0.460	10.66	-	11.69
D	-	0.656	-	-	16.66	-
E_1	0.054	-	0.084	1.37	-	2.14
E_2	0.333	-	0.362	8.45	-	9.20
F	0.544	-	-	13.81	-	-
r_1	-	-	0.036	-	-	0.91
r_2	-	-	0.355	-	-	9.02

NOTES
1 Dimensions A and B apply on surface x, at the bottom of the connector cavity. The sides of the cavity may flare outward for ease of installation. These dimensions provide additional clearance (to allow convection cooling).
2 This connector performs the function of electrical connection only; it is not intended to provide mechanical support to a lamp.

Gauging
"Go" Gauge 3-433: It shall be possible to insert each end of this gauge into a connector.

See ANSI_IEC C81.63 for gauges.

Base
See ANSI_IEC C81.61, Standard Sheets 1-430 and 1-431.

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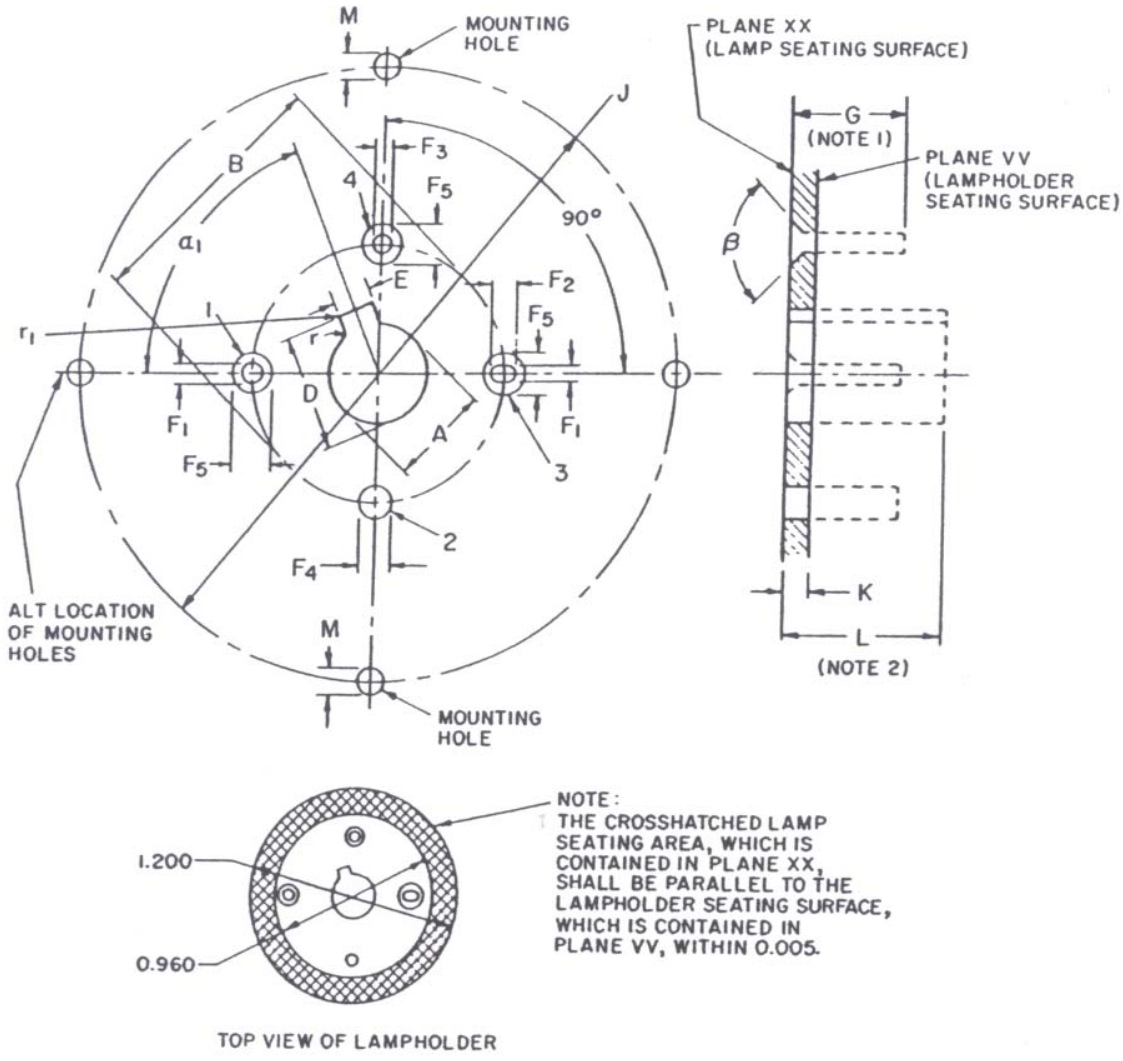
G/GX17q Four-Pin Prefocus Lampholders

The designations assigned to these lampholders by the International Electrotechnical Commission (IEC) are G17q and GX17q.

This standard sheet is equivalent to IEC 60061.

The drawings are intended only to indicate the dimensions to be controlled.

Holder for lamps with pin arrangement 1 (Gl7q)

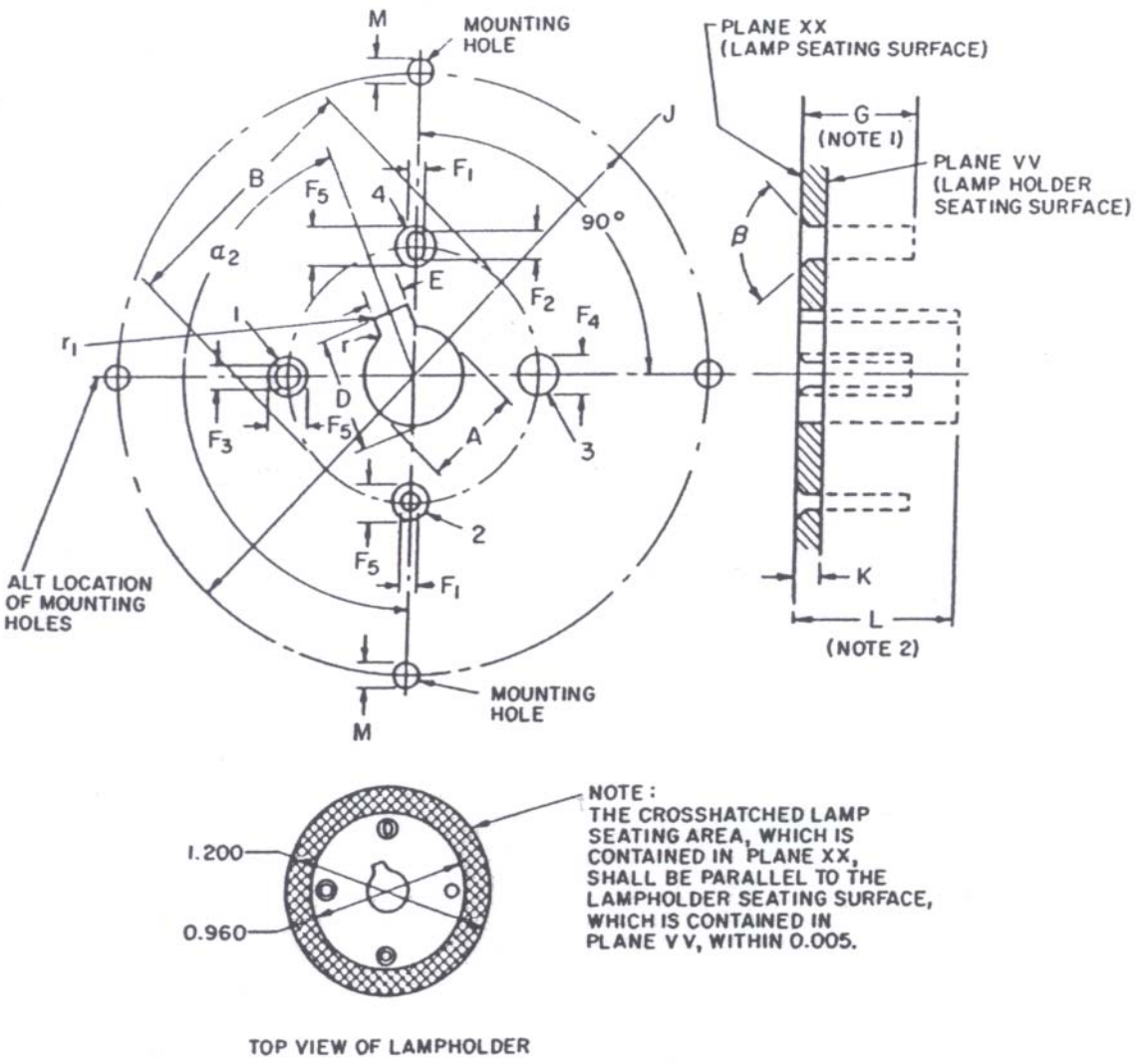


NOTES
1 Dimension G indicates the minimum clearance that must be provided for lamp pins.
2 Dimension L indicates the minimum clearance that must be provided for the center post.

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Holder for Lamps with Pin Arrangement 2 (GX17q)



NOTES
1 Dimension G indicates the minimum clearance that must be provided for lamp pins.
2 Dimension L indicates the minimum clearance that must be provided for the center post.

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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
A	0.271	0.282	6.88	7.16
B	0.684	0.690	17.37	17.52
D	0.321	0.337	8.15	8.56
E_1	0.094	0.098	2.39	2.49
F_1	0.052	0.055	1.32	1.40
F_2	0.075	-	1.90	-
F_3	0.062	-	1.57	-
F_4	0.150	-	3.81	-
F_5	0.150	0.182	3.81	4.62
G	0.296	-	7.52	-
J	1.745	1.755	44.32	44.58
K	0.130	0.140	3.30	3.56
L	0.546	-	13.86	-
M	0.127	0.137	3.22	3.48
r	0.018	0.028	0.46	0.71
r_1	-	0.010	-	0.25
α_1 (degrees)	67°	68°	-	-
α_2 (degrees)	157°	158°	-	-
β (degrees)	79°	81°	-	-

Gauging

"Go" Gauge for G17 Lampholders Having Pin Arrangement No. 1, Gauge 3-443: Each end of the gauge shall enter the lampholder until the surface of the gauge butts against the surface of the lampholder.

“Go" Gauge for G17 Lampholders Having Pin Arrangement No. 2, Gauge 3-444: Each end of the gauge shall enter the lampholder until the surface of the gauge butts against the surface of the lampholder.

Two-pin Contact-making Gauge 3-445: Electrical contact shall be established after each end of the gauge enters the appropriate holes of the holder (holes 1 and 4 for lamps using pin arrangement 1, and holes 1 and 2 for lamps using pin arrangement 2) and when the surface of the gauge butts against the surface of the holder.

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Rotation Gauge 3-446: With the holder held down on the two appropriate alignment pins, insert the gauge in the lampholder until the surface of the gauge butts against the lampholder. Rotate the gauge to its limits and read the angle on the scale in degrees.

See ANSI_IEC C81.63 for gauges.

Base
See ANSI_IEC C81.61, Standard Sheets 1-439 and 1-440 for bases.

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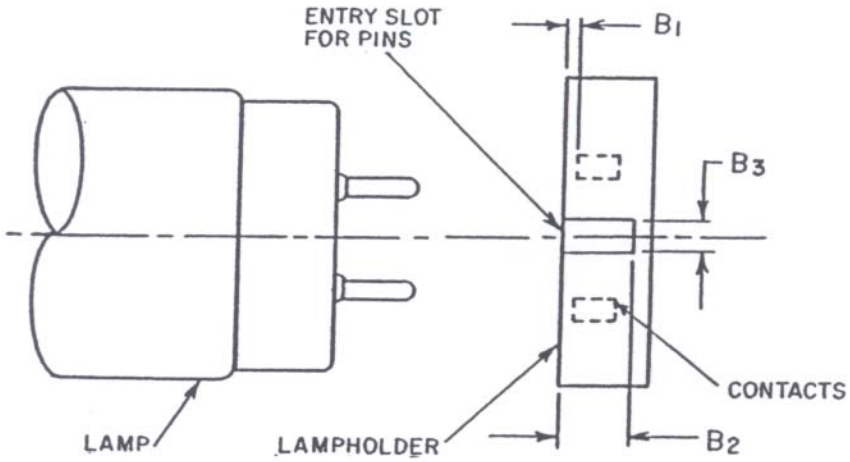
G20 Mogul Bipin Fluorescent Lampholder

The designation assigned to this lampholder by the International Electrotechnical Commission (IEC) is G20.

This standard sheet is similar to IEC 60061-2, Standard Sheet 7005-53.

The drawing is intended only to indicate the dimensions to be controlled.

Inflexible (rigidly fixed) lampholders
This type of lampholder requires a turning motion for the insertion of a lamp.



B_1 - The distance between the live contacts and the lampholder face shall not be greater than 0.216 in (5.49 mm).

B_2 - The entry slots of inflexible lampholders shall have a depth not less than 0.625 in (15.87mm).

B_3 - The width of the entry slots shall be great enough to accommodate the lamp-base pins with allowance for misalignment both of the lamp bases (with respect to each other) and of the lampholders. The gauge shown on ANSI_IEC C81.63, Standard Sheet 3-459 has the base pins at its two ends so arranged as to simulate a lamp with the maximum rotational misalignment of pins.

Clearance for live parts
When no lamp is in place, a test probe having a hemispherical end with a radius of 0.205 in. (5.21 mm) shall not be able to contact live metal parts.

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Flexible lampholders
Flexible lampholders are those which make provision for movement of one or both of the lampholders, or a section of one or both of the lampholders, in order to permit insertion of a lamp and also to accommodate variations in the lengths of the lamps. Contact may be made on either the end or the sides of the base pins.

Clearance for live parts
When no lamp is in place, a test probe having a hemispherical end with a radius of 0.205 in. (5.21 mm) shall not be able to contact live metal parts.

Gauging
G20 lampholders of the flexible type shall satisfy the gauges shown on ANSI_IEC C81.63, Standard Sheets 3-455, 3-456, 3-459, and 3460.

"Go" Gauge 3-455: Without using undue force, it shall be possible to insert the gauge into the lampholder and turn it until it reaches the normal operating position of the lamp.

Torsion Test Device, Gauge 3-456: The simulated lamp base should be inserted into the lampholder until surface x is in contact with the holder face. The torque may be applied to either the test device or to the lampholder, the other being rigidly mounted.

Double-ended Gauge, Maximum Length Lamp and Minimum Lampholder Spacing, Gauge 3-459: With the holders mounted at their minimum permissible spacing (as recommended by the manufacturer) with respect to a nominal length lamp of 12 in (304.8 mm), it should be possible to insert and remove the gauge without difficulty.

Double-ended Gauge, Minimum Length Lamp and Maximum Lampholder Spacing, Gauge 3-460: With the lampholders mounted at their maximum permissible spacing (as recommended by the manufacturer) with respect to a nominal length lamp of 12 in (304.8 mm), the insertion of the gauge shall cause both indicator lamps (IL) of the test circuit to light, and the indicator lamps shall remain lighted in spite of any possible axial movement of the gauge between the two lampholders.

See ANSI_IEC C81.63 for gauges.

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Lamp Retention Requirements
The following requirements apply to those types of lampholders requiring rotation of the lamp during insertion. The values given are for a single lamp-base test device described on ANSI_IEC C81.63, Standard Sheet 3-456, in a single lampholder.

a) There shall be a detent or other similar arrangement of the contact springs (or other lampholder parts) to give a definite indication of when the lamp has reached its normal seating position.

b) The torque required to rotate the lamp out of its normal seating position shall not be less than 2.0 inch-pounds (0.23 Newton-meter).

If the holders being tested have push-in terminals, a single No. 18 gauge solid wire should be inserted in each terminal before the test is made. As a preconditioning cycle, there should be one clockwise and one counterclockwise rotation of the torsion test device before the minimum measurement is taken.

Base
See ANSI_IEC C81.61, Standard Sheet 1-452.

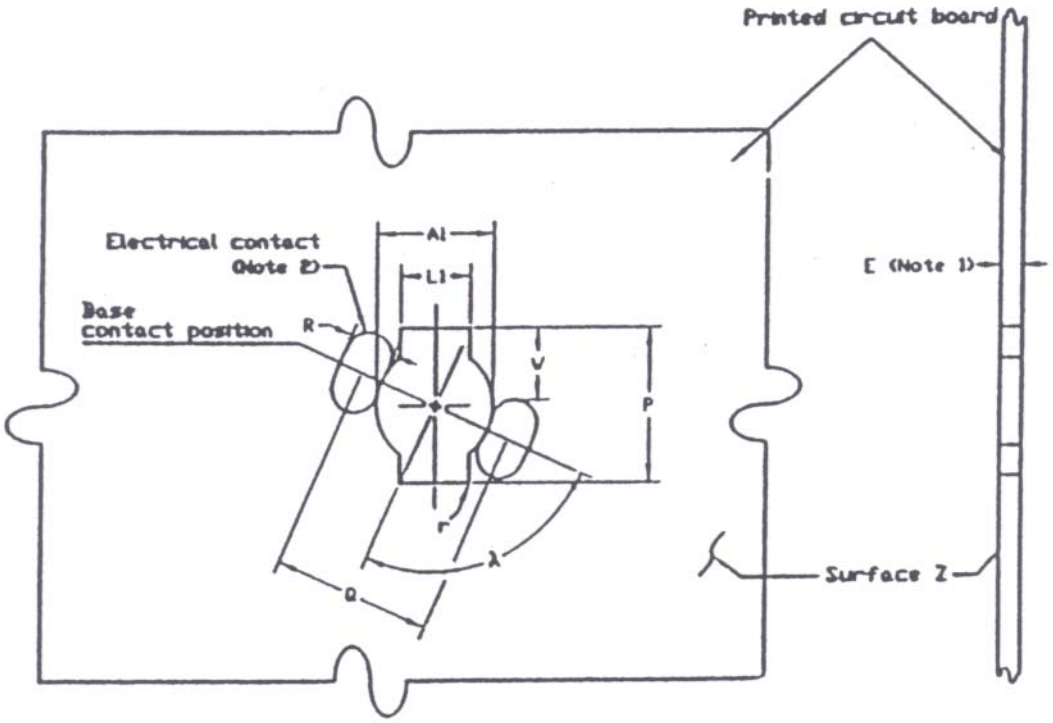
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P8.25d Lampholder

The designation assigned in accordance with the system of the International Electrotechnical Commission (IEC) is P8.25d. At the time of issuance of this Standard there was no comparable IEC Publication in existence. It is commonly known as the PCT 1-3/4 in the United States.

This drawing is intended only to indicate the dimensions to be controlled.



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Reference	Standard Dimensions (inches)		
	Min	Nom	Max
A_1	8.63	-	8.76
E (Note 1)	-	1.52	-
L_1	5.08	-	5.20
P	11.40	-	-
Q	-	12.00	-
R (Note 2)	-	3.50	-
W (Note 2)	5.20	-	6.00
r	-	0.81	-
λ	-	90°	-

NOTES
1 Dimension E represents a typical board thickness including the electrical contact. Other thicknesses are optional.
2 Electrical contact configuration is optional.
3 This holder provides clearances for each insertion of a base. Therefore, retention of the base is not assured and means of retention should be provided by the base itself.

Gauging
No gauges have been developed for this fit.

Base
See ANSI_IEC C81.61 Standard Sheet 1-530.

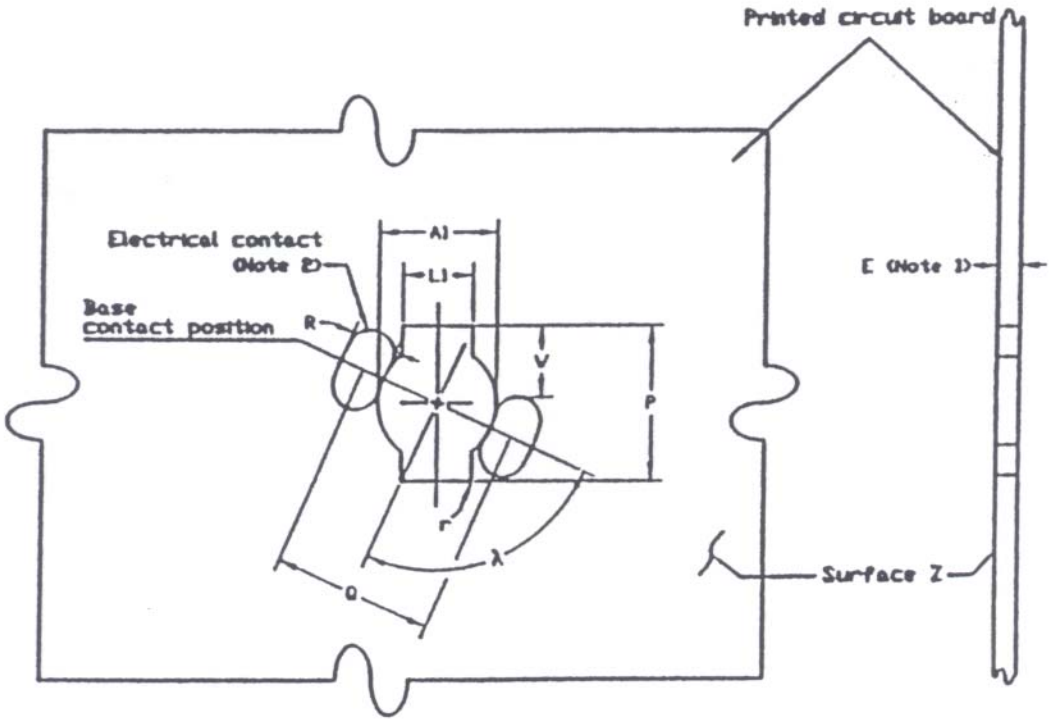
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P12.4d Lampholder

The designation assigned in accordance with the system of the International Electrotechnical Commission (IEC) is P12.4d. At the time of issuance of this Standard there was no comparable IEC Publication in existence. It is commonly known as the PCT 3-1/4 in the United States.

This drawing is intended only to indicate the dimensions to be controlled.



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Reference	Standard Dimensions (inches)		
	Min	Nom	Max
A_1	12.70	-	12.97
E (Note 1)	-	1.52	-
L_1	6.51	-	6.76
P	-	15.88	-
Q	-	16.68	-
R (Note 2)	-	3.50	-
W (Note 2)	5.84	-	6.60
r	-	0.81	-
λ	-	90°	-

NOTES
1 Dimension E represents a typical board thickness including the electrical contact. Other thicknesses are optional.
2 Electrical contact configuration is optional.
3 This holder provides clearances for easy insertion of a base. Therefore, retention of the base is not assured and means of retention should be provided by the base itself.

Gauging
No gauges have been developed for this fit.

Base
See ANSI_IEC C81.61 Standard Sheet 1-550.

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P30 Candelabra Prefocus Lampholders

This standard sheet covers both single and double-contact lampholders.

The designation assigned by the International Electrotechnical Commission (IEC) to the single-contact lampholder is P30s-10.3 and to the double-contact lampholder is P30d-10.3.

The P30s holder differs from the Precision Holder P30s shown in IEC Publication 60061-2, *Lamp caps and holders together with gauges for the control of interchangeability and safety, Part 2: Lampholders*, in many aspects, because it is not designed for highly precise applications.

The drawing is intended only to indicate the dimensions to be controlled.

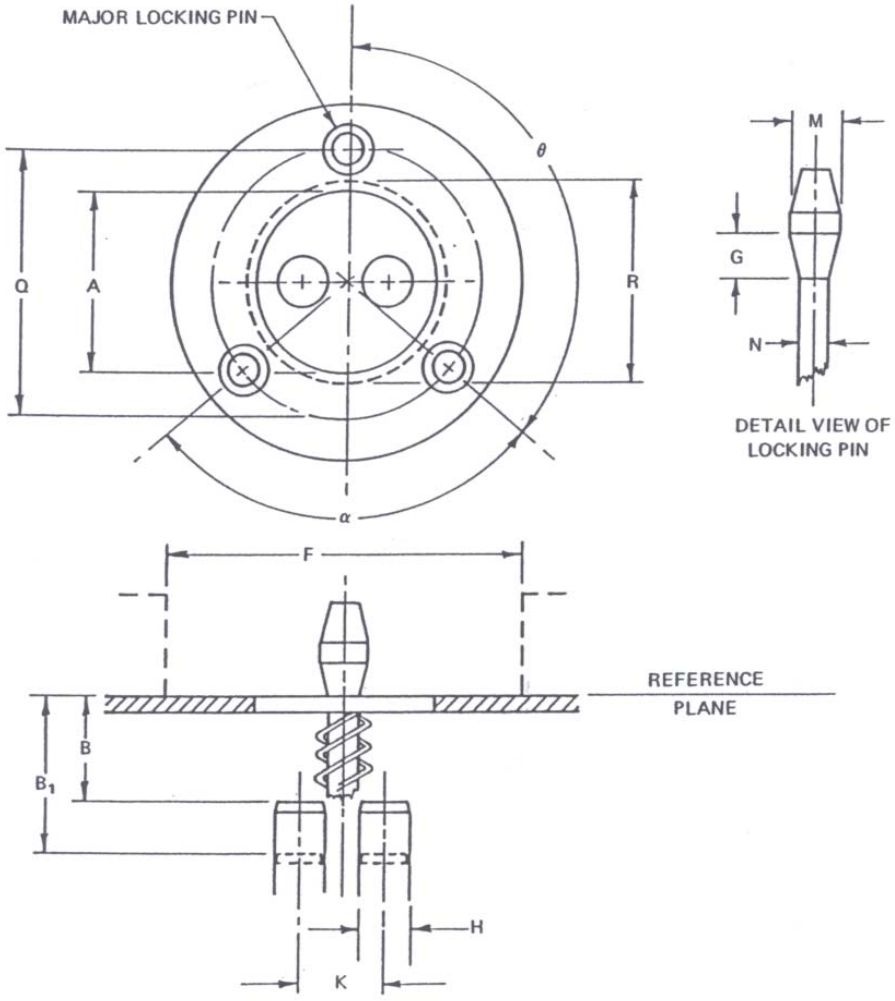


Figure 1 – Double-contact lampholder

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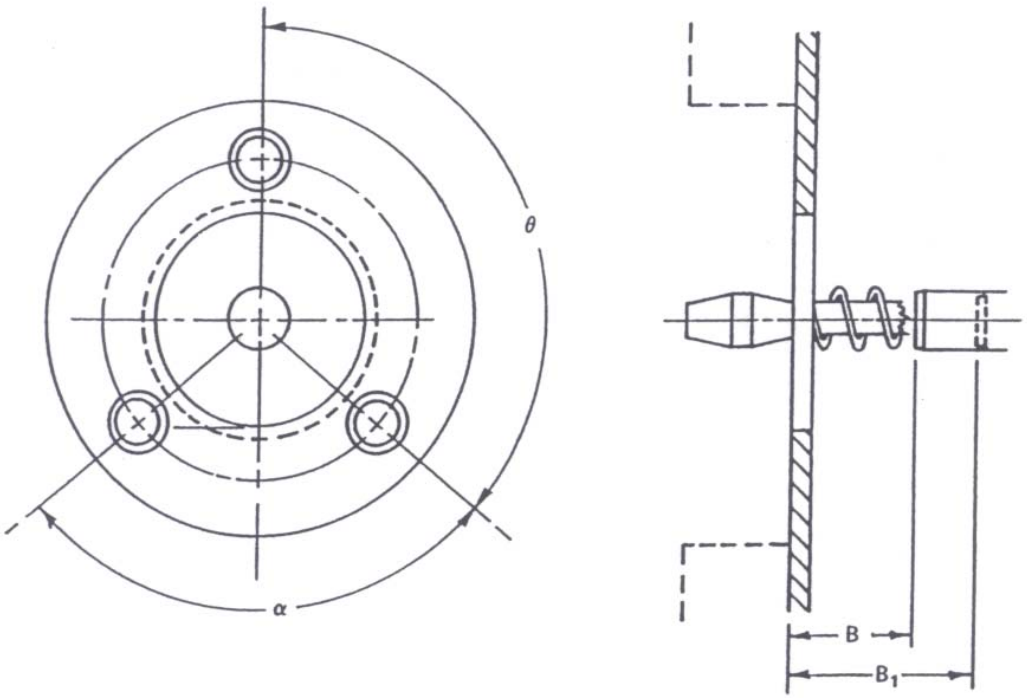


Figure 2 – Single-contact lampholder

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Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A	0.625	-	-	15.87	-	-
B (Note 4)	-	-	0.350	-	-	8.90
B_1 (Note 4)	0.516	-	-	13.10	-	-
F (Note 2)	1.190	-	-	30.22	-	-
G	0.065	-	0.080	1.65	-	2.03
H	-	-	0.218	-	-	5.54
K	0.272	-	0.290	6.90	-	7.37
M	0.175	-	0.185	4.44	-	4.70
N	0.072	-	0.075	1.82	-	1.91
Q	0.895	-	0.898	22.73	-	22.81
R (Note 3)	0.670	-	-	17.01	-	-
α (degrees)	-	100°	-	-	100°	-
θ (degrees)	-	130°	-	-	130°	-

NOTES
1 The means of retention shall make contact only with the prefocus ring of the lamp base.
2 F defines the diameter of the area to be kept clear for the prefocus collar of the base.
3 R defines a clearance zone that the locking pins shall not enter, to avoid interference with the upper body of a base.
4 Dimensions B and B_1 are specified so that these lampholders will accept the standard P30s-10.3 or P30d-10.3 bases. Bases with other collar positions may be in use, requiring different lampholder dimensions, but they are considered to be nonpreferred. Such bases would have a different identifier following the hyphen.

Gauging
Gauges have not been developed for this lampholder.

Base
See ANSI_IEC C81.61, Standard Sheet 1-709

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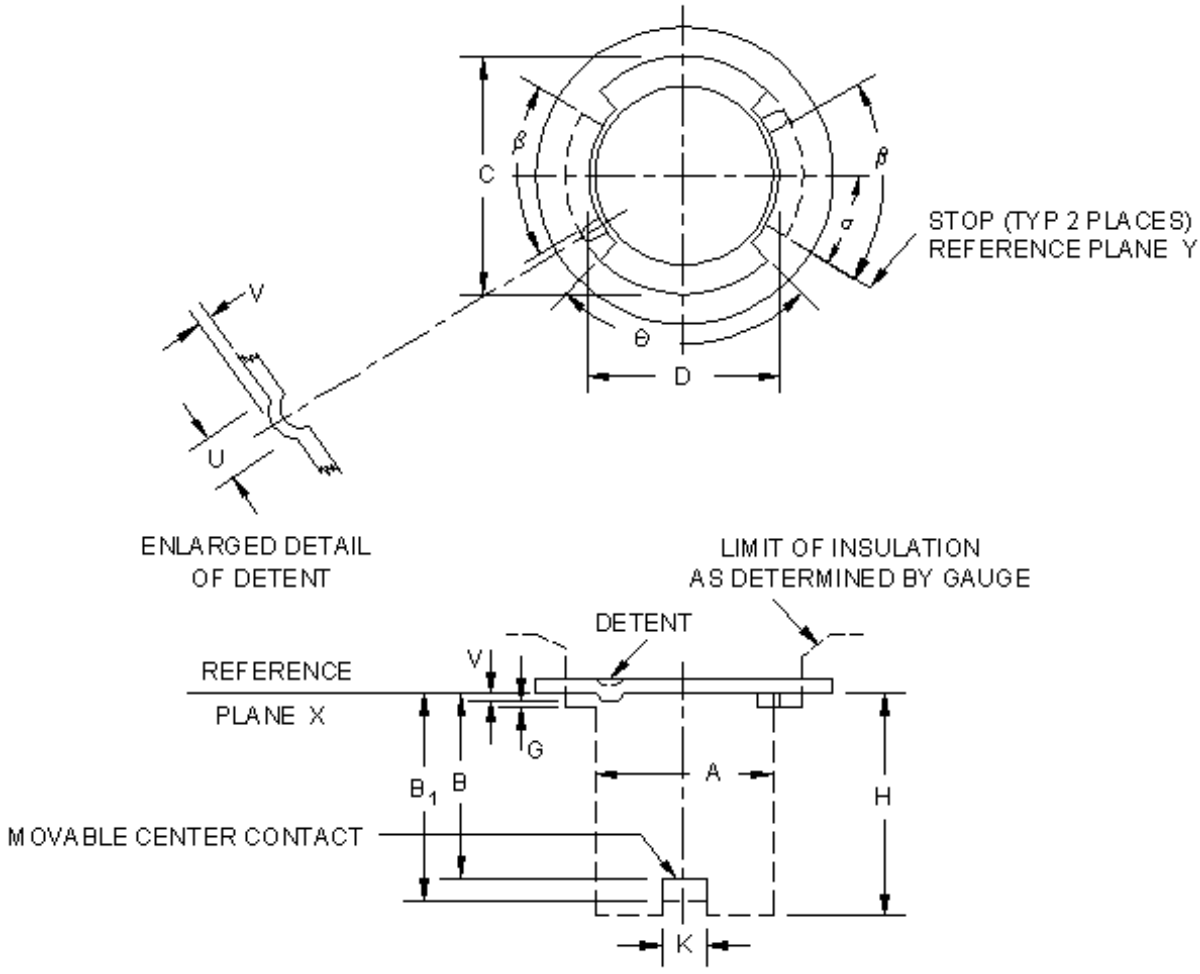
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P40 Mogul Prefocus Lampholder

The designation assigned to this lampholder by the International Electrotechnical Commission (IEC) is P40s/41.

There are several differences between this lampholder and the similarly identified holder found in IEC Publication 60061-2, *Lamp caps and holders together with gauges for the control of interchangeability and safety, Part 2: Lampholders*. Primarily the A, B_1, C, and D dimensions differ; this lampholder has a looser tolerance on A, a shorter B_1 contact travel, a smaller C diameter, and a larger D diameter. These differences would not prevent the entry of foreign lamp bases. The center contact diameter is nominally larger than the IEC drawing, and the flange keyways are larger, which will not affect the fit. The limits for insulation above the reference plane are smaller for this holder.

The drawing is intended only to indicate the dimensions to be controlled.



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References	Standard Dimensions (Inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
A	1.562	1.583	39.67	40.20
B	-	1.560	-	39.62
B_1	1.750	-	44.45	-
C	2.056	-	52.22	-
D	1.637	1.685	41.58	42.80
G	0.078	-	1.98	-
H	1.807	-	45.90	-
K	0.440	-	11.2	-
U	-	0.152	-	3.86
V	-	0.048	-	1.22
β (degrees)	72°	73°	72°	73°
Θ (degrees)	73°	77-1/2°	73°	77-1/2°
σ (degrees)	36°	36-1/2°	36°	36-1/2°

Gauging
"Go" Gauge 3-718: It shall be possible to insert the gauge into a lampholder without using undue force, until it reaches the normal operating position of a lamp.

See ANSI_IEC C81.63 for gauges.

Bases
See ANSI_IEC C81.61, Standard Sheet 1-715.

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R17d Recessed Double-Contact Lampholder

The designation assigned to this lampholder by the International Electrotechnical Commission (IEC) is R17d. This standard sheet is similar to IEC 60061-2, Standard Sheet 7005-57.

The drawings are intended only to indicate the dimensions to be controlled. They also illustrate the two basic types of contacts that are in common use.

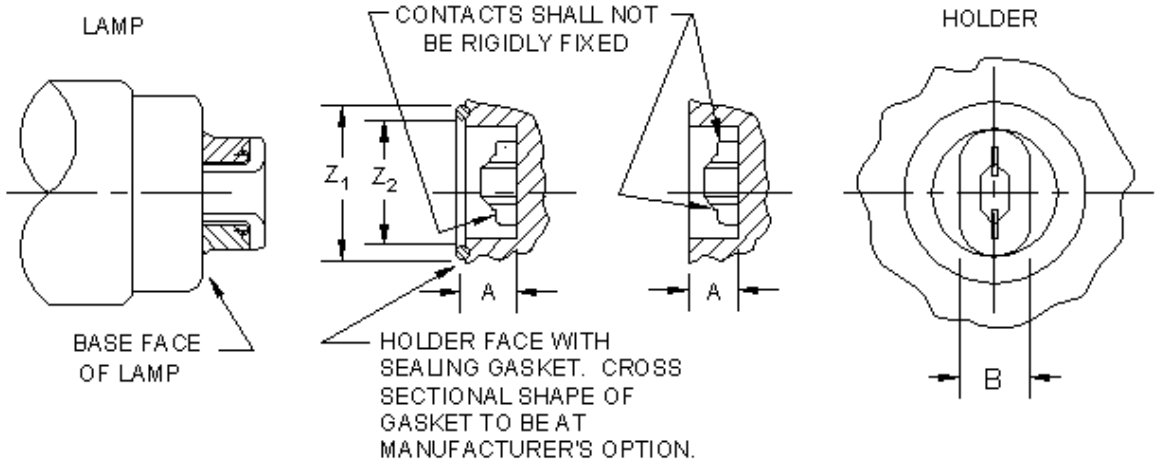


Figure 1 – End of corner contacts

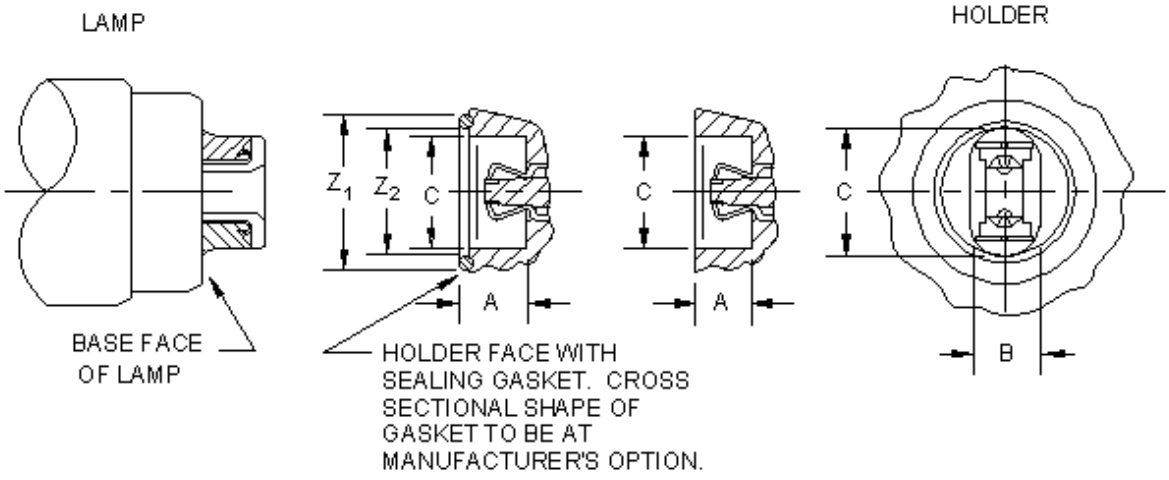


Figure 2 – Internal wiping contacts

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Reference	Requirements
A	The unobstructed depth from the holder face shall be not less than 0.320 inch (8.13mm) (See NOTES 1 and 2).
B, C	The width and length of the opening shall be great enough to accommodate the "Go" gauge as shown on Standard Sheet 3-780 and to ensure that a lamp may be removed in any direction without binding such that breakage of the base boss could result. Maximum values of width and length are established by the requirements of the contact-making gauge (See ANSI_IEC C81.63, Standard Sheets 3-781 and 3-785) and the application of the test probe (See section on Clearances).
Z_1, Z_2	Z_2 = 0.750 inch (19.1mm) max. Z_1 = 0.896 inch (22.76mm) max. Exceeding these limits gives no assurance that the gasket will have a flat surface of the base on which to seat.

NOTES
1 For gasketed designs of holders, the unobstructed depth shall not be less than 0.340 inch (8.64mm) on new lampholders or less than 0.320 inch (8.13mm) should the gasket be fully compressed or removed, whichever results in the smaller measurement.
2 It is recognized that older designs of holders exist in which the lamp base boss rests on the bottom the holder cavity. In such cases, a minimum depth of 0.307 inch (7.80mm) is accepted for the holder cavity.

General design features
The design of the holder shall make provision for the movement of one or both of the holders, or a section of one or both of the holders, in order to permit the insertion of the lamp and to accommodate the variations in the length of the lamps. The design shall also allow for a misalignment of 3° between the axis of the lamp and the axis of the lampholder.

During operation, it is normal for lampholders to reach temperatures of 200°F (93°C). Contacts should be designed to withstand these temperatures without deformation for the life of the fixture.

Contacts
Contact may be made with the lamp either on the ends of the lamp contacts, or on the internal surfaces of the lamp contacts, or a combination of both. Figures 1 and 2 illustrate two of the possible variations. The electrical contacts shall be so designed that they will (1) make and maintain electrical contact with the "minimum base" gauges ANSI_IEC C81.63, Standard Sheets
3-781 and 3-785, and (2) will not prevent the acceptance of the "maximum base" gauges ANSI_IEC C81.63 Standard Sheets 3-780 and 3-784.

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Contact resistance
The resistance of the lampholder contacts and connections, when measured as follows, shall not exceed 0.200 ohm.

a) On lampholders equipped with leads, the resistance shall be measured between points 3 inches (76.2mm) from where the leads come out of the holder.

b) On holders without leads, it will be necessary to attach leads of the minimum size for which the holder was designed (but not smaller than No. 18AWG or 0.75 mm^2 solid wire). The resistance shall be measured between points 3 inches (76.2mm) from where the leads come out of the holder.

c) The lamp base used shall meet the dimensional requirements of ANSI_IEC C81.61, Standard Sheet 1-777 and shall have shorted contacts with overall resistance not in excess of 0.01 ohm.

d) The base shall be fully seated in the holder, no matter what the position of the plunger.

e) Resistance measurements shall be made by the bridge method.

Spring loading
The force required to fully compress the spring on the compressible end shall be not less than 8 lbf (35.6 newtons) not greater than 20 lbf (89.0 newtons)

Clearance for live parts
When no lamp is in place, a test probe having a hemispherical end with a radius of 0.205 inch (5.21mm) shall not be able to contact live metal parts.

Gauging
When gauging individual lampholders: “Go” Gauge 3-780: It shall be possible to insert the holder into the recess of the gauge until the face of the holder is flush with surface x. (For older lampholder designs which have a shallower cavity, surface x of the gauge may not always be able to touch the holder face; but the separation, if any, should not exceed 0.015 inch (0.38mm). It shall be possible to rotate the gauge axis in a manner that provides an axial misalignment of 3 degrees between the gauge and holder.

Gauge for Checking Contact-making, Gauge 3-781: When the gauge is inserted in the holder, electrical contact shall be established between the gauge and holder contacts. The contact shall be maintained regardless of any movement that may be possible between the gauge and holder. Contact shall also be maintained when the gauge axis is rotated in a manner that provides an axial misalignment of 3 degrees between the gauge and holder.

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When gauging lampholder spacing using double-ended Gauge for Checking Maximum Length Lamp and Minimum Lampholder Spacing, Gauge 3-784, it shall be possible to insert and remove this gauge from holders at their minimum permissible spacing (as recommended by the manufacturer) with input to the nominal length lamp of 18 inches (457.2mm), without difficulty or breakage of only holder parts.

Double-ended Gauge for Checking Maximum Length Lamp and Minimum Lampholder Spacing, Gauge 3-785: It shall be possible to insert this gauge in holders at their maximum permissible spacing (as recommended by the manufacturers) with respect to a nominal length lamp of 18 inches (457.2mm). The insertion shall cause both indicator lamps of the test circuit to light, and shall remain lighted in spite of any possible axial movement between the two holders. When inserting the gauge to T12 (T38) size holders, the force on the gauge shall not be less than 2 lbf (8.9 N). For lampholders designed to accept PG17 and TH17 lamps, the force shall not be less than 4 lbf (17.8 N).

See ANSI_IEC C81.63 for gauges.

Push-in terminals
Lampholders employing push-in type terminals should be designed to accept connecting wires having strip lengths ranging from a minimum of 0.359 inch (9.13 mm) to a maximum of 0.453 inch (11.51mm). (It is recognized that there may be existing designs that do not meet this requirements.)

Base
See ANSI_IEC C81.61, Standard Sheet 1-777.

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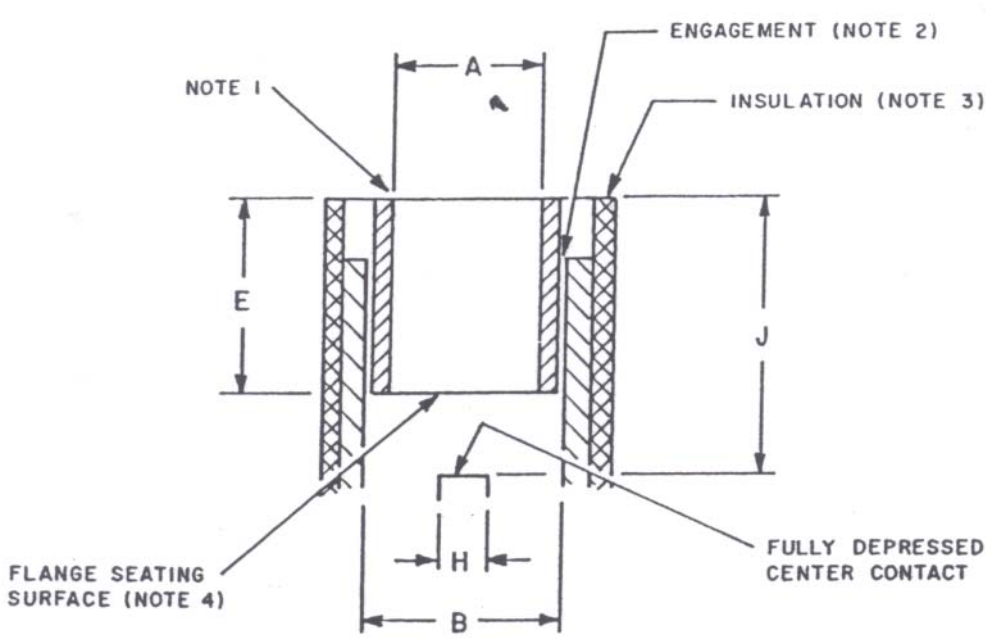
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SX4 Submidget Flanged Lampholder

The designation assigned to this lampholder in accordance with the coding system of the International Electrotechnical Commission (IEC) is SX4.

At the time of publication there was no equivalent IEC standard.

The drawing is intended only to indicate the dimensions to be controlled.



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Reference	Standard Dimensions (inches)			Nearest Metric Equivalent (millimeters)		
	Min	Nom	Max	Min	Nom	Max
A (dia)	0.160	-	0.166	4.06	-	4.22
B (dia) (Note 5)	0.190	-	-	4.83	-	-
E (Note 6)	0.090	-	0.120	2.28	-	3.05
H	-	0.120	-	-	3.05	-
J	0.165	-	0.209	4.19	-	5.31

NOTES
1 In many applications, a cover or lens is attached directly to the inner section of the lampholder. In such an arrangement, space shall be provided for the bulb of the lamp to ensure interchangeability of lamps.
2 Where separate parts are used to provide dimensions A and B, the engagement surface shall provide electrical continuity and mechanical stability by means of mating screw threads or equally effective features.
3 Insulation layer should be provided for those applications where mounting case is not part of the electrical return circuit.
4 Alternatively, three longitudinal-bearing ridges (equally spaced circumferentially) may be provided.
5 The relationship between diameter B and dimension J shall be as follows:
   a) In lampholder designs requiring the lamp to be inserted from the bulb end of the holder, diameter B shall be applicable over the full length of dimension J.
   b) In lampholders permitting insertion of the lamp from the eyelet contact end of the holder, diameter B shall be applicable only over that portion of dimension J that is not in the zone described by dimension E.
6 Dimension E is length over which diameter A applies.
7 This lampholder is appropriate for low voltage applications only.

Gauging

NOTE - Separate standard sheets have not been developed for this holder. Commercially available plug gauges may be used for gauging.

1. With diameter A exposed, it shall be possible to insert a plug gauge that is 0.160 inch through 0.001 inch in diameter into the zone defined by dimension E.

2. It shall be possible to insert a plug gauge that is 0.162 inch through 0.001 inch in diameter into the diameter A opening.

3. The lampholder Shall accept a plug gauge that is 0.187 inch through 0.001 inch in diameter for either the full length of dimension J or that portion of J that does not include dimension E. The intended-direction of lamp entry into the holder shall determine the particular requirement.

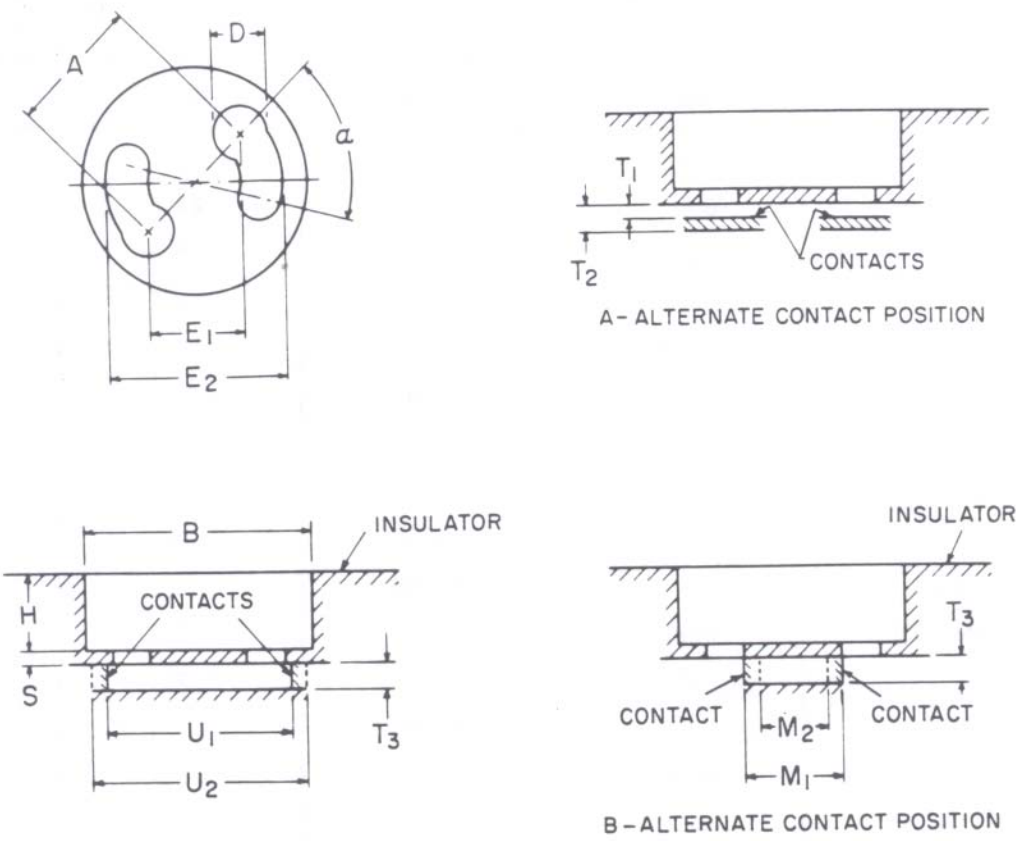
Base
See ANSI_IEC C81.61, Standard Sheet 1-850.

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Fluorescent Lamp Starter Holder

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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
A	0.492	0.508	12.5	12.9
B	0.855	-	21.7	-
D	0.212	-	5.4	-
E_1	0.342	0.362	8.7	9.2
E_2	0.638	0.658	16.2	16.7
H	-	0.591	-	15.0
M_1 (Note 1)	0.331	-	8.4	-
M_2 (Note 2)	-	0.291	-	7.4
S	-	0.059	-	1.5
T_1 (Note 1)	-	0.059	-	-
T_2 (Note 2)	0.098	-	2.5	-
T_3	0.091	-	2.3	-
U_1 (Note 1)	-	0.669	-	17.0
U_2 (Note 2)	0.709	-	18.0	-
α (degrees)	45°	-	-	-

NOTES
1 Rest position of contacts.
2 Contacts fully depressed.

Gauging

"Go" Gauges "A" and "B", Gauges 3-900: Both Gauges "A" and "B" shall, in turn, enter the starter holder smoothly until they reach the normal operating position of a starter.

Contact-making and Retention Gauge 3-901: When this gauge is inserted into the starter holder in the normal operating position of a starter, the test circuit lamps shall light. In this position the gauge shall be retained by the starter holder.

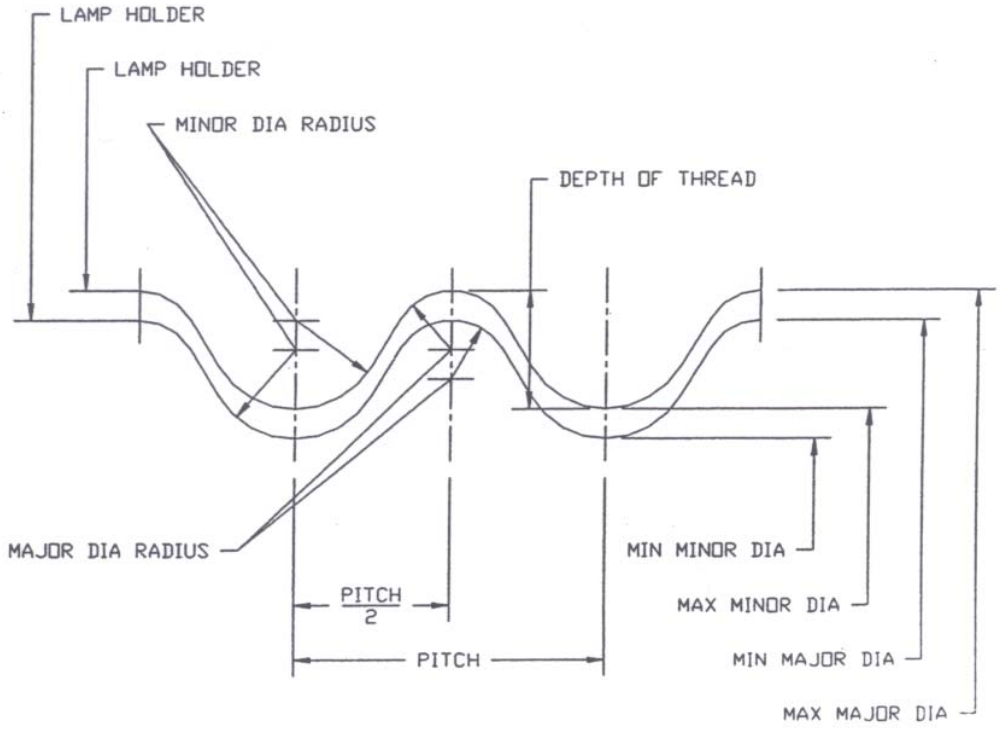
See ANSI_IEC C81.63 for gauges.

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"UNO" Thread Form For Medium Screw Lampholders

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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
Major diameter	1.2860	1.2980	32.664	32.969
Minor diameter	1.2500	1.2620	31.750	32.055

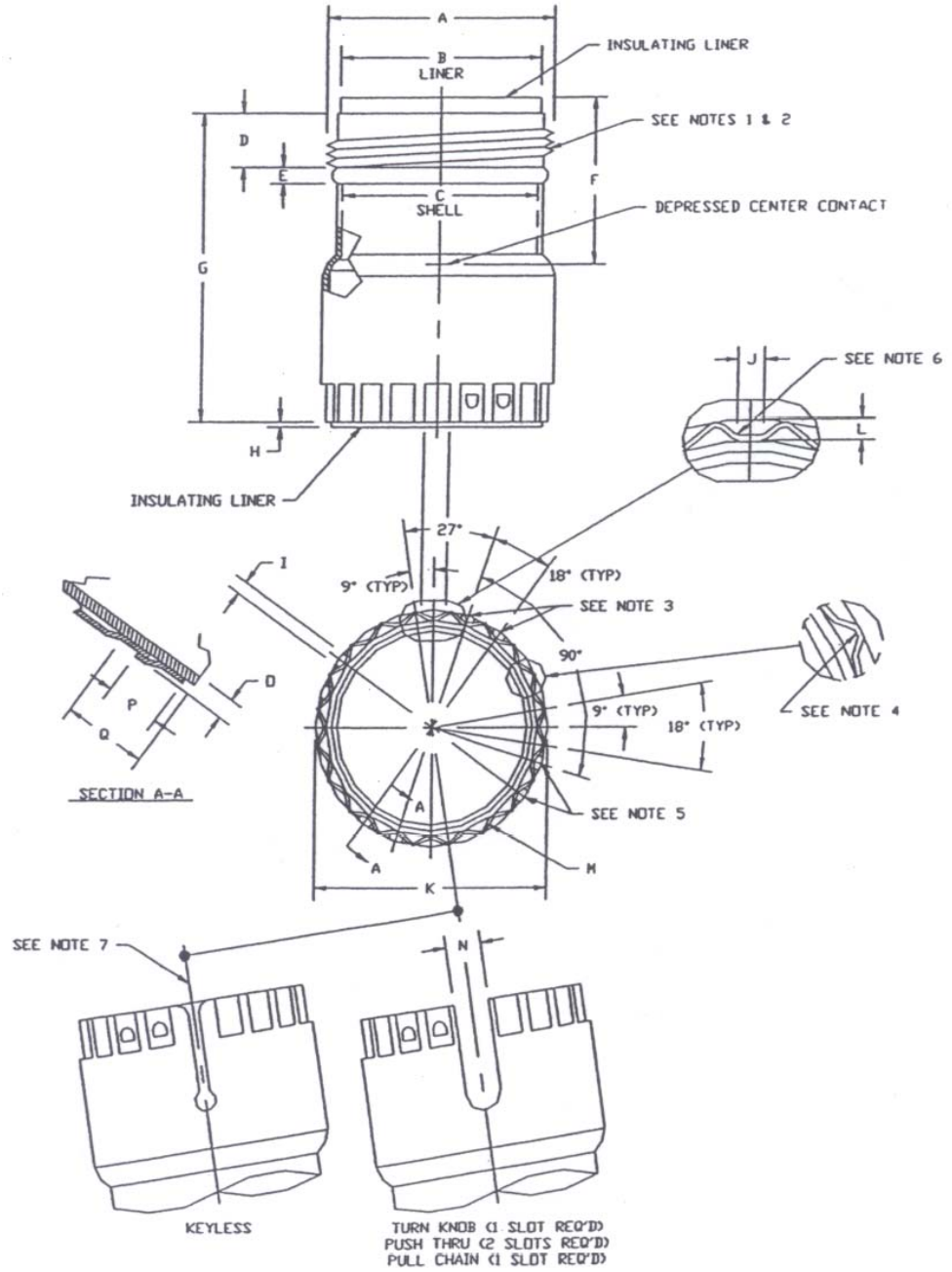
Form of Thread	
Threads per inch	18
Pitch of thread, *p*	0.0055 inch (1.410mm)
Depth of thread	0.018 inch (0.457mm)
Direction of threads	right hand
Major diameter radius	0.0094 inch (0.239mm)
Minor diameter radius	0.0143 inch (0.363mm)

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Electrolier Size Metal Shell for Medium Screw Lampholders

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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
A	1.290	-	32.77	-
B	1.191	1.201	30.25	30.51
C	1.210	1.216	30.73	30.89
D	0.296	0.328	7.52	8.33
E	0.109	0.140	2.77	3.56
F	0.937	1.000	23.80	25.40
G	1.780	1.838	45.21	46.69
H	0.005	0.015	0.00	0.38
I	0.088	0.098	2.24	2.49
J	0.093	0.125	2.36	3.18
K	1.344	1.350	34.14	34.29
L	0.045	0.050	1.14	1.27
M (radius)	0.250	-	6.35	-
N	0.281	0.335	7.14	8.51
O	0.045	0.050	1.14	1.27
P	0.146	0.153	3.71	3.96
Q	0.203	-	5.16	-
R	0.625	0.656	15.88	16.66

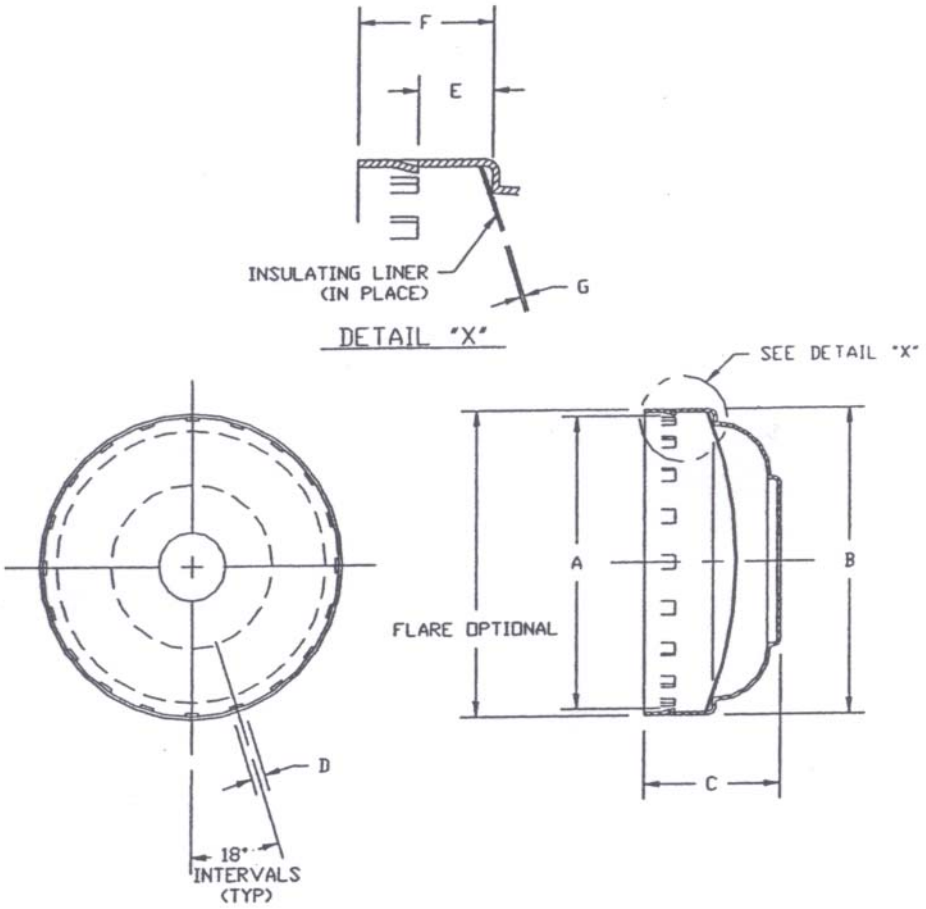
NOTES
1 Standard “UNO” thread 2-1/4 threads minimum. (See Std Sheet 4-2 for dimensions)
2 Use of “UNO” thread is optional.
3 Two pairs of locking nibs 180° apart.
4 Two anti-rotational nibs if required, same height as O.D.
5 Two additional pairs of nibs optional.
6 Blend radius optional.
7 Slit for shell removal optional.

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Electrolier Size Metal Cap for Medium Screw Lampholders

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Reference	Standard Dimensions (inches)		Nearest Metric Equivalent (millimeters)	
	Min	Max	Min	Max
A	1.292	1.295	32.82	32.89
B	1.352	1.357	34.34	34.47
C	0.600	0.633	15.24	16.08
D	0.073	0.083	1.85	2.11
E	0.171	0.180	4.34	4.57
F	0.297	0.375	7.54	9.53
G	0.012	0.018	0.30	0.46

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PART III
United States Deviations to IEC Harmonized Lampholder Standard Sheets

Holder	Sheet Number	Deviation
P/PJ26.4t	7005-128-2	It may be noted that due to differences in accepted conventions the drawings in NHTSA Part 564 are not completely identical to this IEC standard. In principle, however, the requirements are understood to be identical.

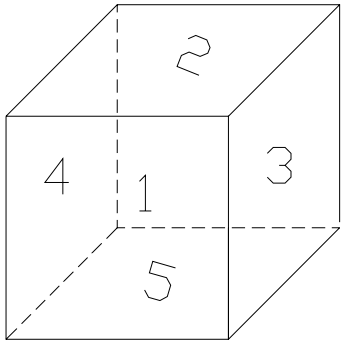
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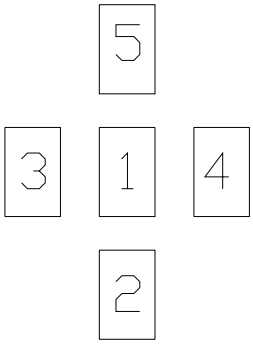
ANNEXES

ANNEX A
Contrast of Projection Methods on Engineering Drawings (Informative)

I. European Method: First angle projection

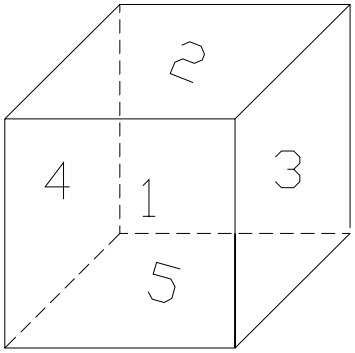


Product

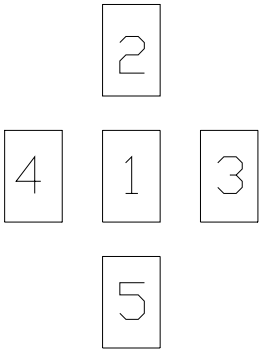


Drawing projections

II. American Method: Third angle projection



Same Product



Drawing projections

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ANNEX B
Bibliography
(informative)

B.1 Related Standards

These standards are listed here for information

ANSI C81.64-1993, *Guidelines and General Information for Electric Lamp Bases, Lampholders, and Gauges*

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