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Replaceable Bulbs for Headlamps

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REPLACEABLE BULBS FOR HEADLAMPS

1. SCOPE:

This technical report covers performance requirements, design requirements, and design guidelines for replaceable bulbs which may be used in headlamp applications.

2. DEFINITIONS:

- 2.1 Replaceable Bulb (Bulb): A radiant energy source with related envelope and mounting base which is removable from the headlamp for the purpose of replacement.
- 2.2 Accurate-Rated Replaceable Bulb: A seasoned bulb operated at design luminous flux shown in Table 2 and having its filaments located within the tolerances indicated in figures specified in Table 1.
- 2.3 Seasoning: Energizing the filament of a bulb at design voltage for a period of time equal to 1% of design life or 10 h maximum, whichever is shorter.
- 2.4 Low-Beam Filament: Filament coil designed to provide low beam function.
- 2.5 High-Beam Filament: Filament coil designed to provide high beam function.
- 2.6 Filament Rotation: Any non-parallelism of either coil with respect to the centerline of the design nominal filament location or any additional width of the end view of the filament in excess of the outside diameter of the first full coil.

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2.7 Rated Average Lab Life: An average life in hours which is obtained by laboratory life testing of bulbs sampled over a long period of production time. Some bulbs will burn longer, some shorter. Average lab life is obtained in closely controlled laboratory testing of bulbs at the specified test voltage. It is not necessarily the same as service life; shock, vibration, voltage fluctuations, temperature, and other environmental influences may result in a shorter service life.

2.8 Design Life: The theoretical operational time in hours of a replaceable headlamp bulb filament energized at 14.0 V.

2.9 Gaging Standard: A gage produced for each bulb type with all critical tolerances affecting filament location equal to one-tenth the stated tolerances in the design requirements.

3. BULB MARKING:

3.1 Requirements: Bulbs shall be marked with the following information:

3.1.1 Manufacturer's name and/or trademark.

3.1.2 Trade number (ANSI).

3.1.3 Date code.

4. TESTS:

4.1 Bulbs: Unless otherwise specified, bulbs used in the tests shall be representative of bulbs in regular production. Testing to determine average lab life shall be done on lot sizes established by the manufacturer. The manufacturer shall obtain and be able to supply the data.

4.2 Test Procedures:

4.2.1 Deflection Test:

4.2.1.1 The bulb shall be rigidly mounted in a fixture in a manner indicated in Fig. 1.

4.2.1.2 A force of 18.0 ± 0.4 N shall be applied for a minimum of 2.0 s and a maximum of 5.0 s at locations shown in Fig. 1 using a rod with a hard rubber tip with a minimum radius of 1.0 mm.

4.2.1.3 A separate bulb shall be used for each load application at 0, 90, 180, and 270 deg.

4.2.2 Sealing Test: Applies to bulbs designed for an air tight fit to the headlamp.

4.2.2.1 The bulb shall be inserted into a fixture as shown in Fig. 2 and retained by the same method intended for application, or equivalent.

- 4.2.2.2 The chamber shall be gradually pressurized to 70.0 ± 1.0 kPa gage while the fixture and terminal end of the bulb is completely submerged in water. The 70 kPa gage pressure shall be held for 60 s. The bulb shall be observed for the presence of air bubbles during the 60 s time period.
- 4.2.3 Color Test: The bulb shall be tested in accordance with SAE J578.
- 4.2.4 Wattage Test: The wattage of each filament shall be determined at $12.8 \text{ V} \pm 20 \text{ mV DC}$. Filaments shall be seasoned prior to wattage measurement.
- 4.2.5 Luminous Flux Test:
- 4.2.5.1 Each filament shall be seasoned and photometered at $12.8 \text{ V} \pm 20 \text{ mV DC}$ to determine luminous flux.
- 4.2.5.2 The tests shall be conducted in accordance with IES Approved Method for Electrical and Photometric Measurements of General Service Incandescent Filament Lamps, Illuminating Engineering Society, New York, NY, Publication LM-45.
- 4.2.6 Luminous Flux Maintenance Test:
- 4.2.6.1 The luminous flux for each filament shall be determined in accordance with 4.2.5. The bulb shall then be energized in a horizontal burning position in the test enclosure shown in Fig. 3.
- 4.2.6.2 The test voltage shall be $14.0 \pm 0.1 \text{ V DC}$. Two-filament bulbs shall be tested by cycle burning the high-beam filament for 12 min and the low-beam filament for 48 min during each hour of testing.
- 4.2.6.3 The luminous flux of a single filament bulb shall be measured after burning for 70% of the design life shown in Table 2.
- 4.2.6.4 The luminous flux of each filament of two-filament bulbs shall be measured in accordance with 4.2.5 after the low-beam filament on-time equals 70% of the design life specified in Table 2 when tested according to 4.2.6.2.
- 4.2.7 Filament Rated Average Lab Life Test:
- 4.2.7.1 The filament shall be energized at $14.0 \pm 0.1 \text{ V}$ in a horizontal burning position in the test enclosure shown in Fig. 3.
- 4.2.7.2 The filament shall be unenergized for 15 min during each 24 h of testing. The off time is not part of the test time of the filament being tested.
- 4.2.7.3 Each filament shall be tested separately and a different bulb shall be used for each filament.
- 4.2.7.4 The test may be terminated at 150% of design life.

5. REQUIREMENTS:

5.1 Performance Requirements: A bulb, when tested in accordance with the test procedures specified in section 4, shall meet the following requirements:

5.1.1 Deflection Requirement: After the load application, the permanent deflection of the glass envelope of the bulb shall not exceed 0.13 mm.

5.1.2 Sealing Requirement: While the fixture and terminal end is submerged, and while viewed without magnification, no bubble(s) shall develop outside the test fixture.

5.1.3 Color Requirement: The color of the light from the bulb shall be white, as defined in SAE J578.

5.1.4 Wattage Requirement: The measured wattage for each filament shall not exceed the design wattage listed in Table 2 by more than 7.5%.

5.1.5 Luminous Flux Requirement:

5.1.5.1 For bulbs with no opaque coating, the measured luminous flux shall be within $\pm 12\%$ of the design luminous flux listed in Table 2.

5.1.5.2 For bulbs with opaque coating, the measured luminous flux shall be within $\pm 15\%$ of the design luminous flux listed in Table 2.

5.1.6 Maintenance of Luminous Flux Requirement (When Tested in Accordance With 4.2.6.1): For samples from each lot tested, the average luminous flux value for single filament bulbs or each filament of two-filament bulbs after burning for 70% of design life, shall be no less than 90% of the initial average luminous flux value.

5.2 Design Requirements:

5.2.1 Bulbs and bulb holders shall meet the dimensional requirements contained in the figures referenced in Table 1 to ensure interchangeability and proper optical performance.

5.2.2 Accurate-rated bulbs shall meet the dimensional requirements shown in each applicable figure referenced in Table 1. Separate bulbs may be used for high and low beam.

6. GUIDELINES:

6.1 Filament Rated Average Lab Life Guideline: Rated average lab life shall approximate design life. The design life for the filament(s) of each bulb type is shown in Table 2.

6.2 Replaceable Bulb Filament End Coil Definition: See Fig. 11. This guideline is intended to depict the current methods which are being used by the lighting industry for identifying the end of filaments and recommend a common practice for other configurations.

TABLE 1 - Replaceable Bulbs and Related Dimensional Figures

CONTENTS OF FIGURES RELATIVE TO:

BULB IDENTIFICATION	DIMENSIONAL SPECIFICATIONS STANDARD BULB	SPECIFICATIONS FOR BULB HOLDERS	MEASUREMENT METHOD - BULB FILAMENT DIMENSION AND TOLERANCE	DIMENSIONAL LOCATION FOR ACCURATE-RATED BULB
9004	Fig. 4 - 4.3	4.4	4.5, 4.6	4.6
9005	Fig. 5 - 5.4	5.5	5.6	5.6, 5.7
9006	Fig. 6 - 6.4	6.5	5.6	5.6, 6.6
9007	Fig. 7 - 7.3	7.4	7.5, 7.6	7.6
H1	Fig. 8, 8.1	8.2	8.3	8.4
H3	Fig. 9, 9.1	9.2	9.3	9.4
H4	Fig. 10 - 10.2	10.3	10.4 - 10.6	10.1

TABLE 2 - Replaceable Headlamp Bulbs

Designation	Number of Filaments	Design Wattage (Watts) at 12.8 V U.B./L.B. ¹	Luminous Flux (Lumens) at 12.8 V U.B./L.B. ¹	Design Life (Hours) @ 14 V U.B./L.B. ³	Filament Type
9004 (ANSI)	2	65/45	1200/700 ²	150/320	C6/C6
9005 (ANSI)	1	65	1700	150	C8
9006 (ANSI)	1	55	1000 ²	320	C8
9007	2	65/55	1350/1000 ²	150/320	C8/C8
H1	1	60.5	1410	320	C8
H3	1	60.5	1310	320	C6
H4	2	67/60.5	1500/910 ²	150/320	C8/C8

¹Wattage and lumen measurements shall be made with the direct current test voltage regulated within 1/4 of 1%. The bulb filaments shall be subject to seasoning prior to wattage and lumen measurement.

²With opaque coating

³Guideline

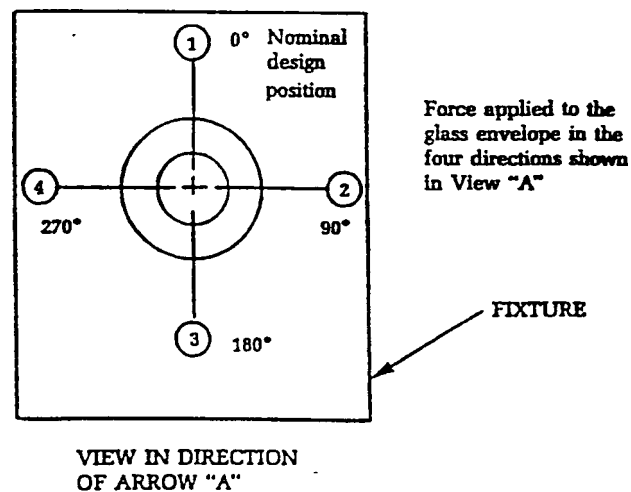
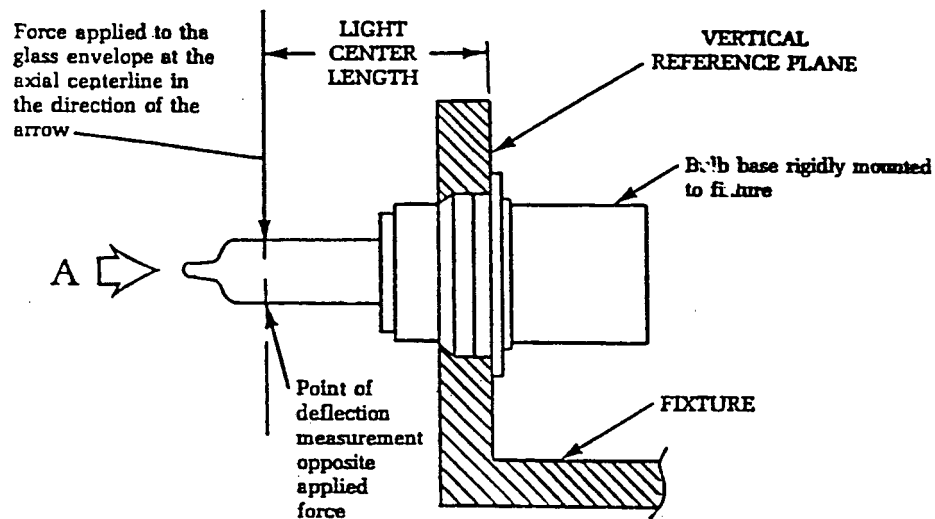


FIGURE 1 - Bulb Deflection Test

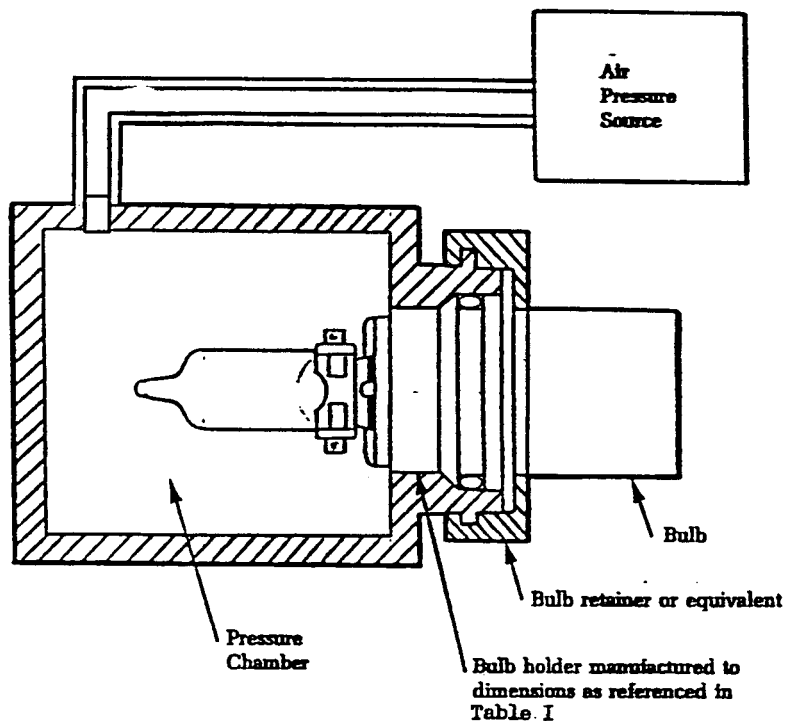
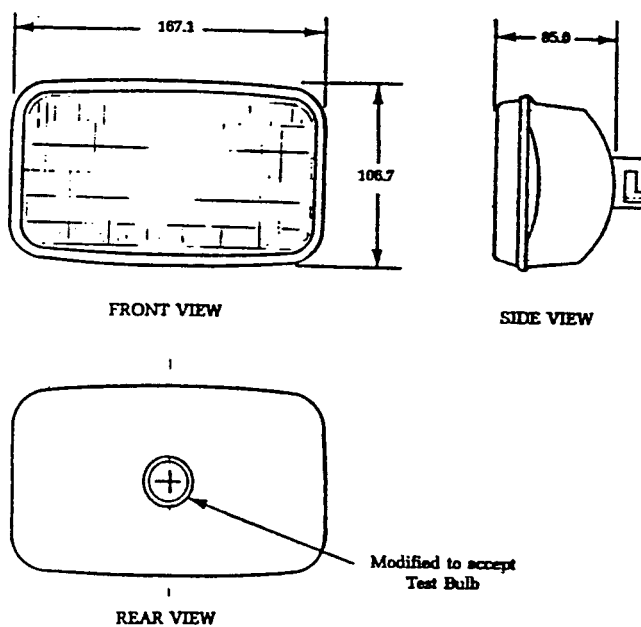


FIGURE 2 - Test for Airtight Seal



Dimensions in mm

FIGURE 3 - Test Enclosure Dimensions

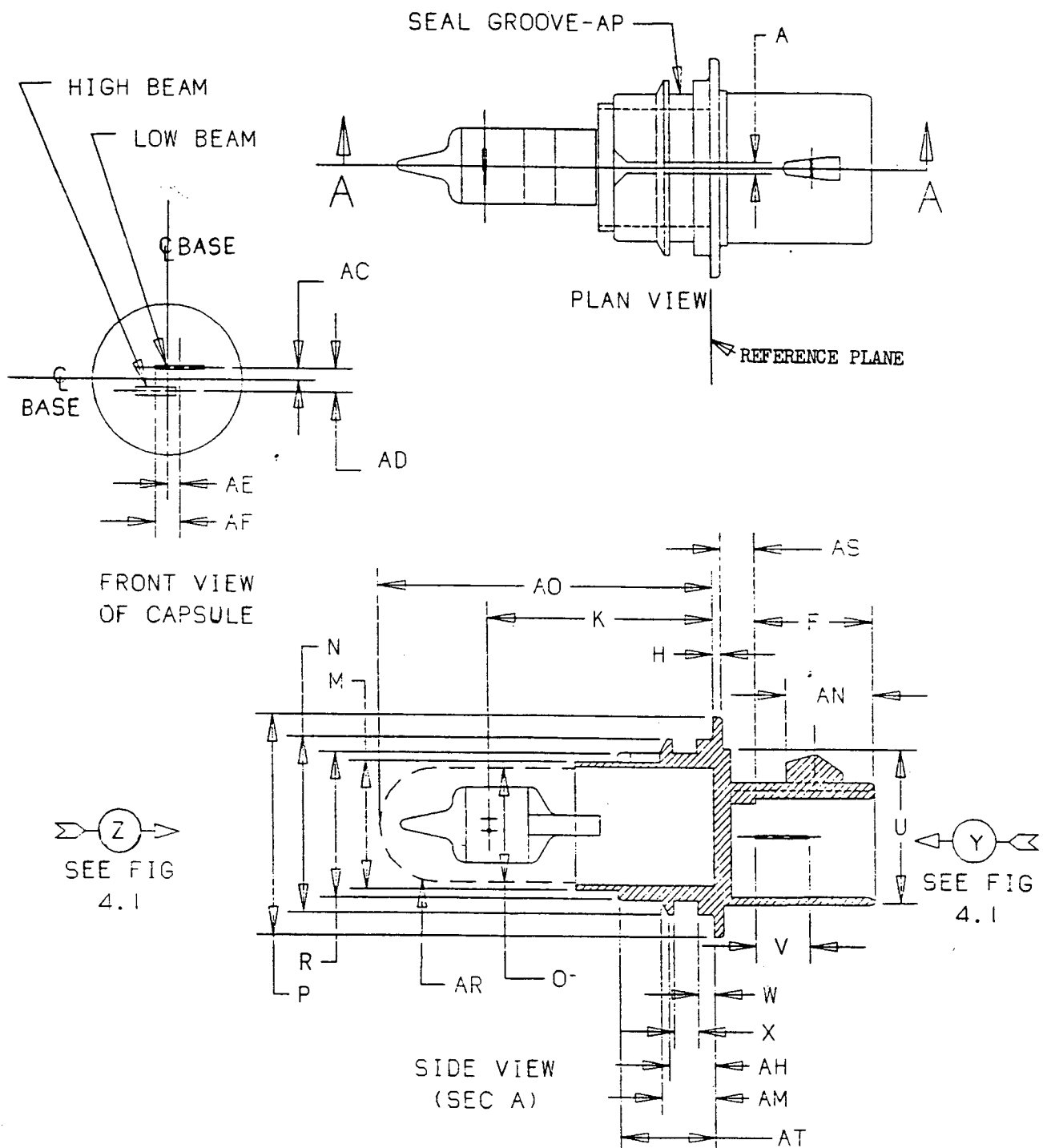


FIGURE 4 - Specification for the 9004 Replaceable Bulb

Dimensional Specifications - Fig. 4

<u>Dimension</u>	<u>Inches</u>	<u>Millimeters</u>
A	(0.085/0.083) 0.002 Either Side CL	(2.15/2.10) 0.05 Either Side CL
F	0.906 $\pm$ 0.008	23.00 $\pm$ 0.20
H	0.079 $\pm$ 0.004	2.00 $\pm$ 0.20
K Low Beam	1.752 $\pm$ 0.010	44.50 $\pm$ 0.25
High Beam	CL High Beam to be within $\pm$ 0.025 of CL of low beam	CL High Beam to be within $\pm$ 0.64 of CL of low beam
M	0.978 max	24.85 max
N	(1.335/1.331) 0.002 Either Side CL	(33.90/33.80) 0.05 Either Side CL
O	0.965 max	24.5 max
P	1.673 $\pm$ 0.008	42.50 $\pm$ 0.20
R	(1.126/1.122) 0.002 Either Side CL	(28.60/28.50) 0.05 Either Side CL
U	1.181 $\pm$ 0.008	30.00 $\pm$ 0.20
V	0.413 $\pm$ 0.020	10.50 $\pm$ 0.50
W	0.128 $\pm$ 0.008	3.25 $\pm$ 0.20
X	0.189 $\pm$ 0.008	4.80 $\pm$ 0.20
AC	0.045 $\pm$ 0.015	1.15 $\pm$ 0.38
AD	0.091 $\pm$ 0.025	2.30 $\pm$ 0.64
AE	0.047 $\pm$ 0.015	1.20 $\pm$ 0.38
AF	0.094 $\pm$ 0.032	2.40 $\pm$ 0.80
AH	0.356 $\pm$ 0.008	9.05 $\pm$ 0.20
AM	0.415 $\pm$ 0.008	10.54 $\pm$ 0.20
AN	0.673 $\pm$ 0.008	17.10 $\pm$ 0.20
AO	2.756 max	70.0 max
AP	Seal must withstand a minimum of 70 kPa (10 psig) when bulb-seal assembly is inserted into a cylindrical aperture of 34.3/34.2 mm (1.350/1.346 in).	
AR	Glass capsule and supports shall not exceed this envelope.	
AS	0.335 $\pm$ 0.080	8.5 $\pm$ 2.0
AT	0.748 $\pm$ 0.020	19.00 $\pm$ 0.50

FIGURE 4 (Continued)

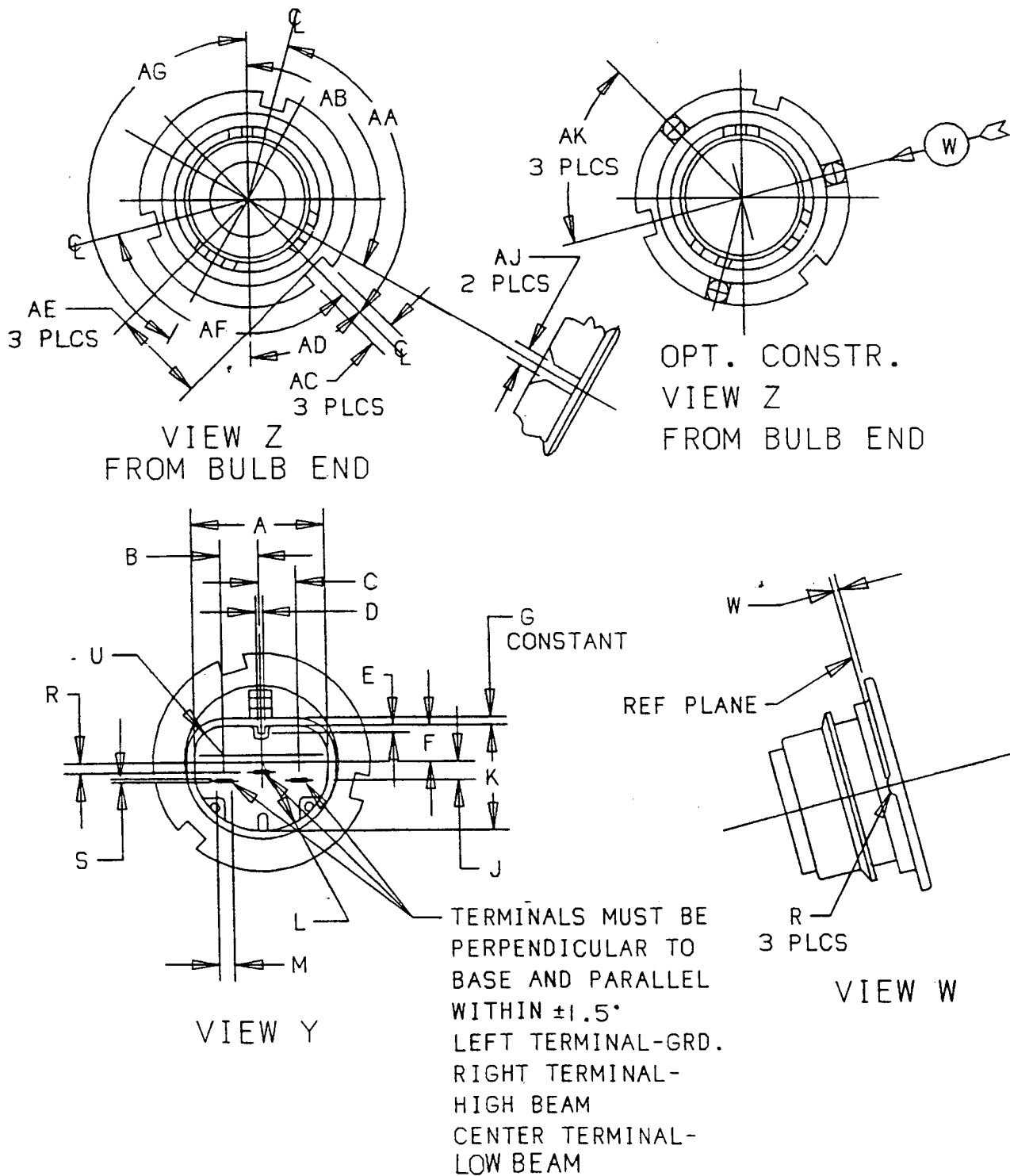


FIGURE 4.1 - Specification for the 9004 Replaceable Bulb

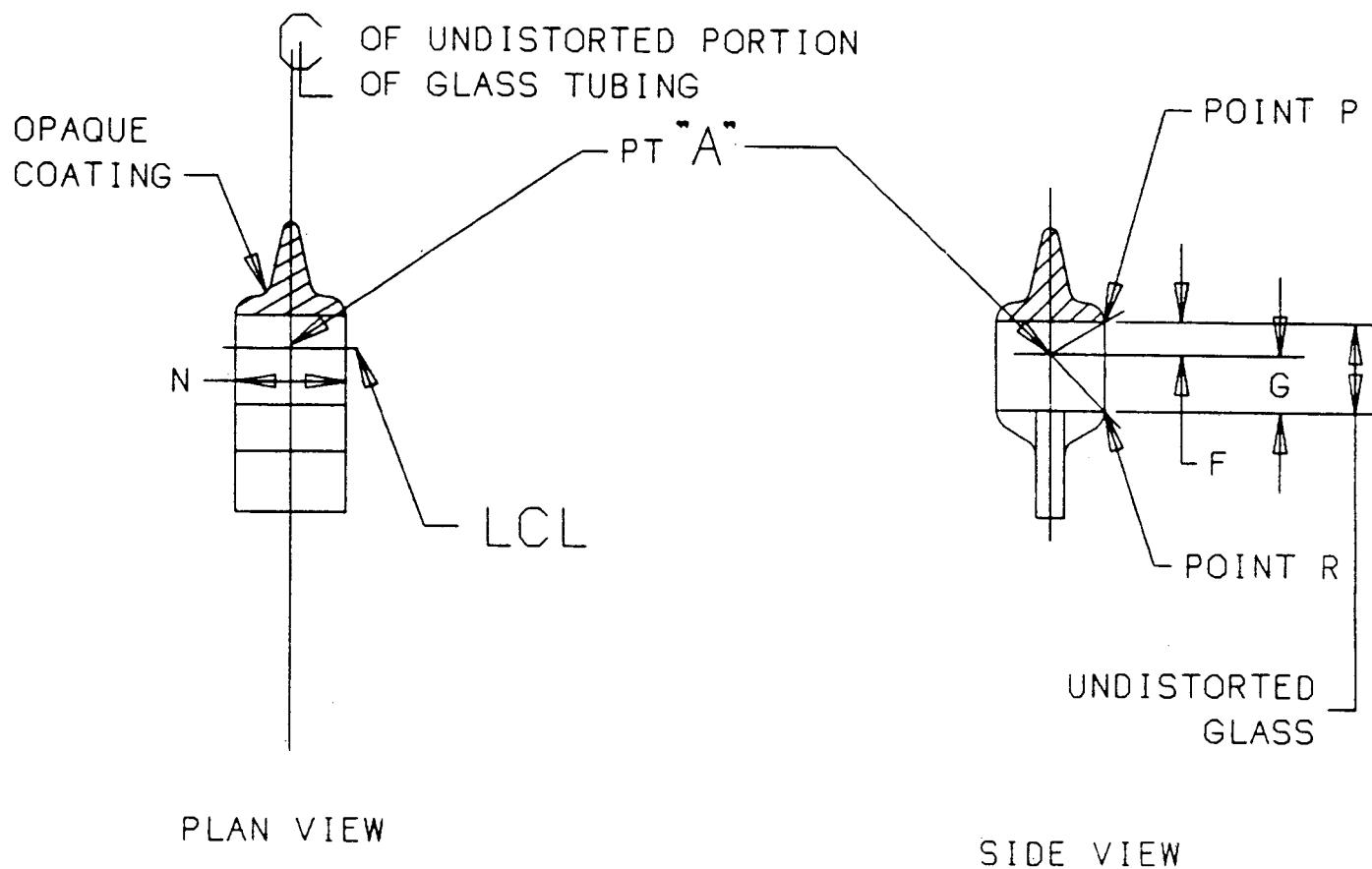


Dimensional Specifications - Fig. 4.1

<u>Dimension</u>	<u>Inches</u>	<u>Millimeters</u>
AA	120 deg	120 deg
AB	120 deg	120 deg
AC	0.193 min	4.9 min
AD	44 deg 30 min	44 deg 30 min
AE	0.722 ± 0.008	18.35 ± 0.20
AF	120 deg	120 deg
AG	150 deg	150 deg
AJ	0.142 ± 0.008	3.6 ± 0.20
AK	60 deg	60 deg
A	1.028 ± 0.008	26.10 ± 0.20
B	0.289 ± 0.010	7.35 ± 0.25
C	0.289 ± 0.010	7.35 ± 0.25
D	0.051 ± 0.008	1.30 ± 0.20
E	0.055 ± 0.008	1.40 ± 0.20
F	0.278 ± 0.006	7.05 ± 0.15
G	0.059 ± 0.008	1.50 ± 0.20
J	0.142 ± 0.010	3.60 ± 0.25
K	0.811 ± 0.008	20.60 ± 0.20
L	0.535 ± 0.008R	13.60 ± 0.20R
M	0.118 ± 0.004	3.00 ± 0.10
R	0.075 ± 0.010	1.90 ± 0.25
S	0.025 ± 0.002	0.63 ± 0.05
U	0.222 ± 0.008R	5.65 ± 0.20R
W	0.010 ± 0.006	0.25 ± 0.15

TOLERANCE FOR ALL ANGULAR
DIMENSIONS ±1 DEG

FIGURE 4.1 (Continued)

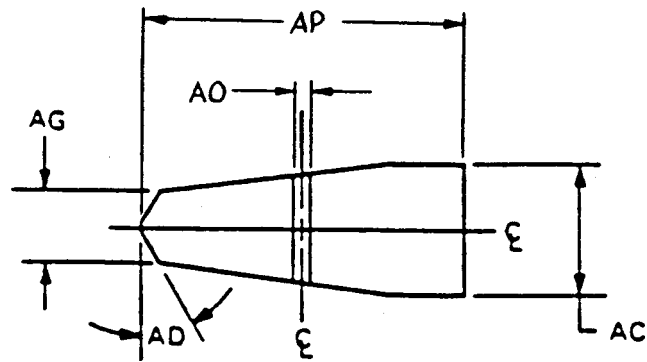


Dimensional Specifications - Fig. 4.2

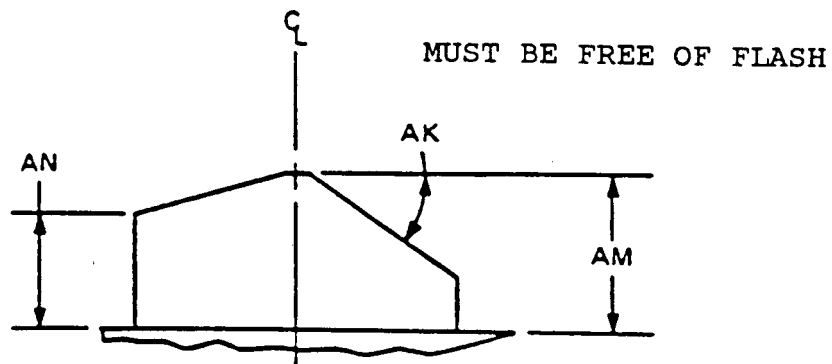
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F	$(N/2) \tan 38 \text{ deg} \pm 0.039 \text{ in } (\pm 1.0 \text{ mm})$
G	$(N/2) \tan 43 \text{ deg min}$
N	Actual capsule diameter (to be established by manufacturer).
P	Entire radius and distorted glass shall be covered to the plane passing through point "P", perpendicular to the glass capsule centerline.

FIGURE 4.2 - Dimensional Specifications



EXPLODED PLAN VIEW



EXPLODED SIDE VIEW

FIGURE 4.3 - Specification for the 9004 Replaceable Bulb Locking Feature



Dimensional Specifications – Fig. 4.3

<u>Dimension</u>	<u>Inches</u>	<u>Millimeters</u>
AC	0.179 $\pm$ 0.008	4.55 $\pm$ 0.20
AD	30 deg $\pm$ 3	30 deg $\pm$ 3
AG	0.098 $\pm$ 0.008	2.50 $\pm$ 0.20
AK	35 deg $\pm$ 3	35 deg $\pm$ 3
AM	0.217 $\pm$ 0.008	5.50 $\pm$ 0.20
AN	0.157 $\pm$ 0.008	4.00 $\pm$ 0.20
AO	0.02 $\pm$ 0.008	0.5 $\pm$ 0.20
AP	0.45 $\pm$ 0.008	11.4 $\pm$ 0.20

FIGURE 4.3 (Continued)

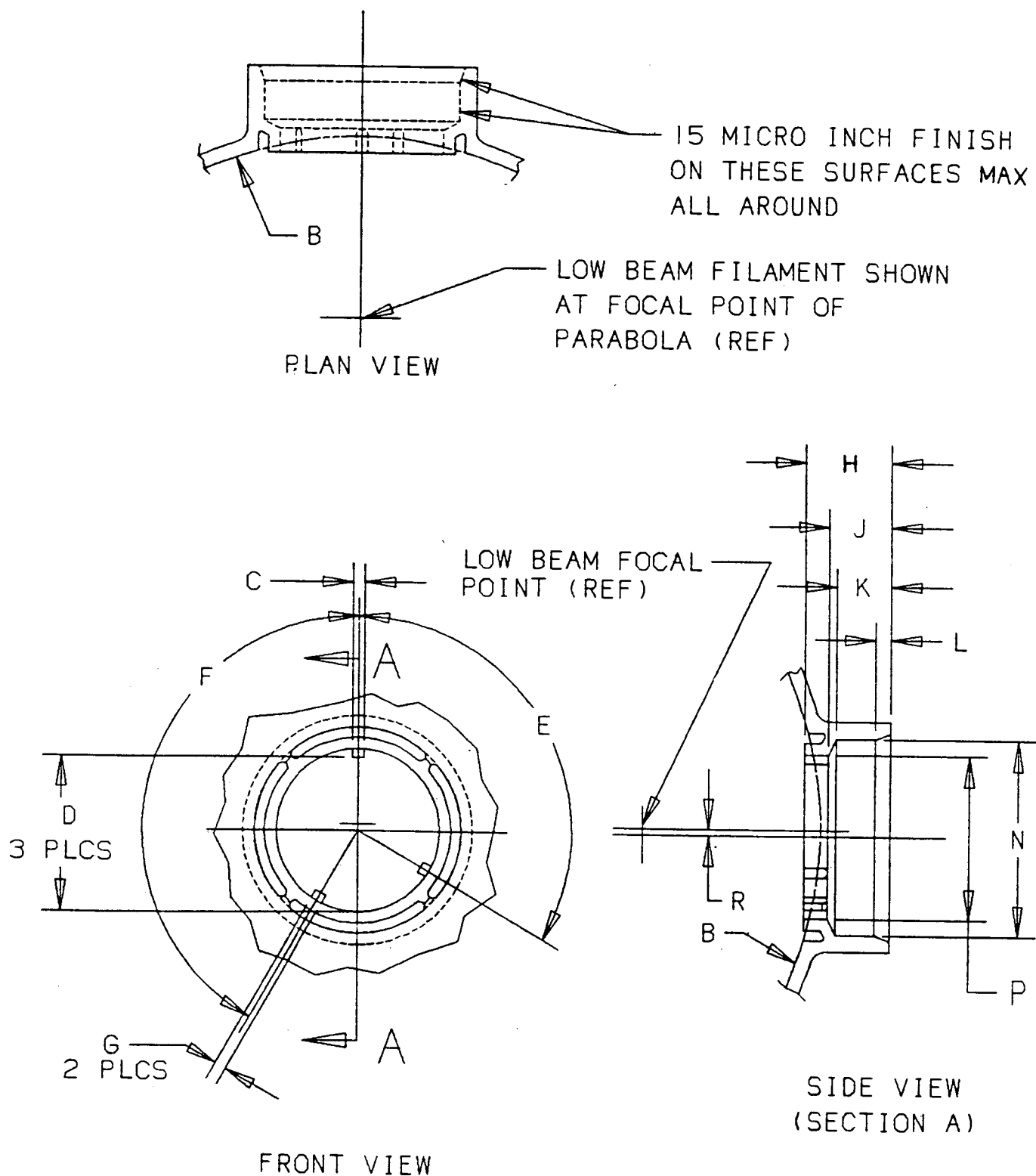


FIGURE 4.4 - Specification for the 9004 Replaceable Bulb
Bulb Holder

Dimensional Specifications - Fig. 4.4

<u>Dimension</u>	<u>Inches</u>	<u>Millimeters</u>
B	Ref Line	Ref Line
	Lamp Parabola	Lamp Parabola
C	0.079 ± 0.002	2.00 ± 0.05
	0.002 Either Side of CL	0.05 Either Side of CL
D	1.067 ± 0.008	27.10 ± 0.20
E	120 deg	120 deg
F	150 deg	150 deg
G	0.079 ± 0.008	2.00 ± 0.20
H	0.596 ± 0.008	15.15 ± 0.20
J	0.437 ± 0.008	11.10 ± 0.20
K	0.374 ± 0.008	9.50 ± 0.20
L	0.108 ± 0.008	2.75 ± 0.20
N	$1.348 +0.003/-0.002$	$34.24 +0.08/-0.05$
P	$1.130 +0.004/-0.002$	$28.70 +0.10/-0.05$
	Diameter P shall be concentric to diameter N within ± 0.002	Diameter P shall be concentric to diameter N within ± 0.05
R	0.045 ± 0.004	1.15 ± 0.10

TOLERANCE FOR ALL ANGULAR
DIMENSIONS ± 1 DEG

FIGURE 4.4 (Continued)

Referenced to Figs. 4 and 4.6 and Guideline Fig. 11

1. BULB FILAMENT DIMENSION AND LOCATION TEST:

Filament locations relative to the bulb base (with O-ring removed) shall be determined for both production and accurate-rated bulbs, as outlined below. For the actual conduct of these measurements, gaging standards shall be used for equipment calibration purposes.

- 1.1 Low-Beam Filament Location Test: The location shall be determined by measuring from the midpoint of the smallest rectangle which encloses the filament image to the axial centerline of the base (see Fig. 4.6):

- a. Axially – in the right side view
- b. Vertically – in the right side view
- c. Transversely – in the plan view

- 1.2 High-Beam Filament Location Test: The location shall be determined as indicated in 1.1.

2. LOW-BEAM FILAMENT LOCATION:

Production bulbs (refer to Fig. 4.6).

- 2.1 Axial: The low-beam filament axial or fore/aft location shall be measured in the right side view from the reference plane of the base to the center of the smallest rectangle which encloses the low-beam filament image.
- 2.2 Vertical: The low-beam filament vertical or up/down location shall be measured in the right side view from a horizontal plane through the base centerline to the center of the smallest rectangle which encloses the low-beam filament image.
- 2.3 Transverse: The low-beam filament transverse or left/right location shall be measured in the plan view from the vertical plane through the center of the base to the midpoint of the smallest rectangle which encloses the low-beam filament image.

3. HIGH-BEAM FILAMENT LOCATION:

Production Bulbs (refer to Fig. 4.6).

- 3.1 Axial: The high-beam filament axial location shall be measured in the right side view of the high-beam filament from the centerline of the low-beam filament to the centerline of the smallest rectangle which encloses the high-beam filament image.

FIGURE 4.5 – Dimensional Specifications for the 9004 Replaceable Bulb
Filament Dimension and Location Measurement Method

- 3.2 Vertical: The high-beam filament vertical location shall be measured in the right side view of the high-beam filament from the centerline of the low-beam filament to the centerline of the smallest rectangle which encloses the high-beam filament image.
- 3.3 Transverse: The high-beam filament horizontal location shall be measured in the plan view of the high-beam filament from the midpoint of the low-beam filament to the midpoint of the smallest rectangle which encloses the high-beam filament image.

FIGURE 4.5 (Continued)

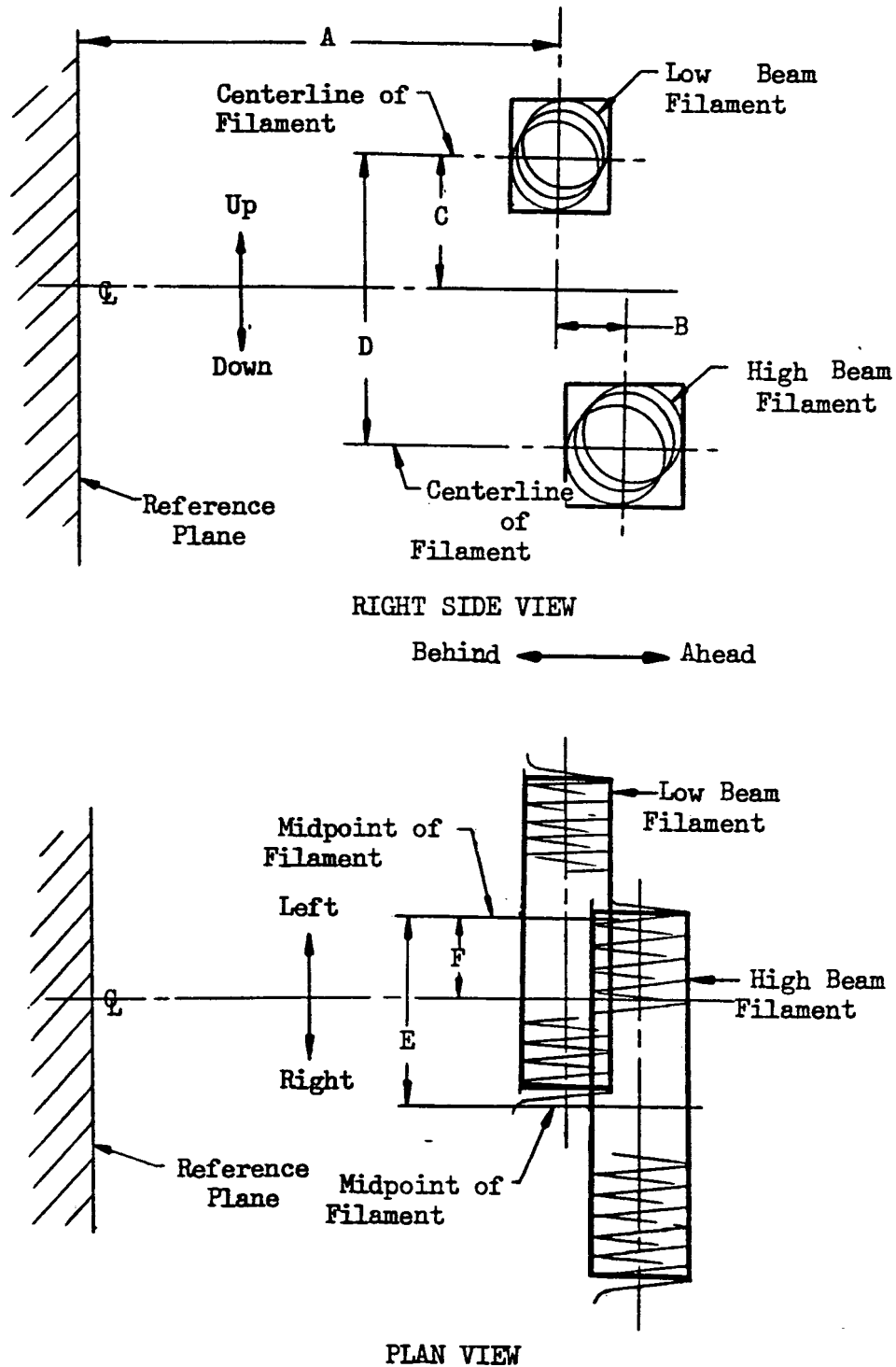


FIGURE 4.6 - Dimensional Specifications 9004
Replaceable Bulb
Filament Dimension and Location - Measurement Method



<u>Letter</u>	<u>Accurate-Rated Bulb Dimension (mm)</u>
A	44.50 ± 0.15
B	0.00 ± 0.25
C	1.15 ± 0.20
D	2.30 ± 0.25
E	2.40 ± 0.40
F	1.20 ± 0.20
Low-Beam Filament Length ^{1,3}	4.80 ± 0.40
High-Beam Filament Length ^{2,3}	4.80 ± 0.40

¹Low-beam filament rotation shall not exceed 0.3 diameters of the coil.

²High-beam filament rotation shall not exceed 0.4 diameters of the coil.

³The length of any filament shall be considered to be the length of the smallest rectangle which encloses the filament image in the plan view or right side view, as appropriate.

FIGURE 4.6 (Continued)

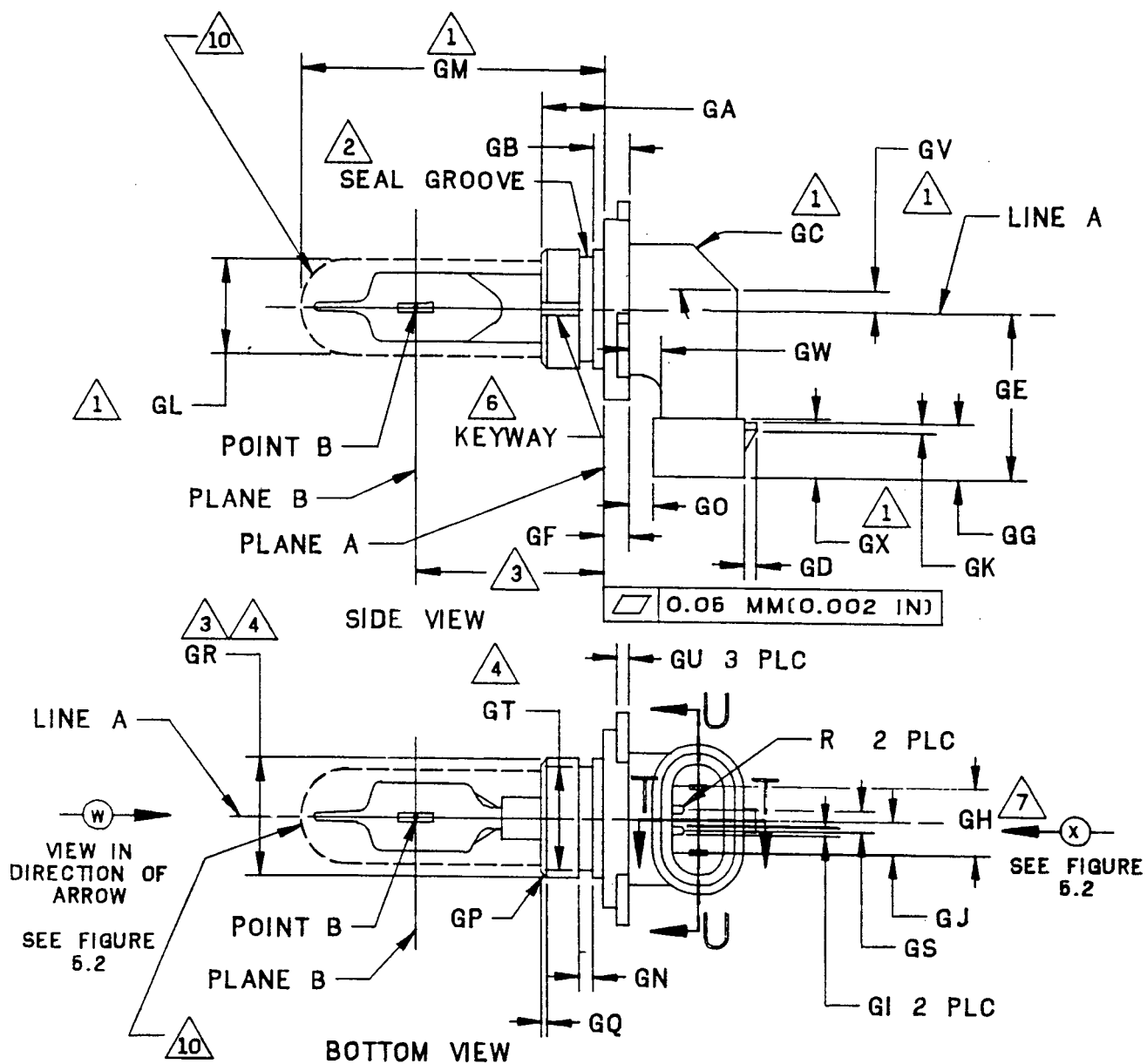


FIGURE 5 - Specification for the 9005 Replaceable Bulb

DIMENSION	INCHES	MILLIMETERS
GA	0.591 max/0.217 min	15.00 max/5.50 min
GB	0.236	6.00
GC	45 deg	45 deg
GD	0.079	2.00
GE	1.09	27.8
GF	0.165	4.20
GG	0.346	8.80
GH	0.433	11.00
GI	0.055	1.40
GJ	0.217 $\pm$ 0.006	5.50 $\pm$ 0.15
GK	0.06	1.5
GL	0.775 diameter	19.68 diameter
GM	2.165	55.00
GN	0.093	2.36
GO	0.157	4.00
GP	45 deg chamfer	45 deg chamfer
GQ	0.039	1.00
GR	0.787 $\pm$ 0.002 diameter	20.00 $\pm$ 0.05 diameter
GS	0.138	3.50
GT	0.687 $\begin{smallmatrix} +0.004 \\ -0.000 \end{smallmatrix}$ diameter	17.46 $\begin{smallmatrix} +0.10 \\ -0.00 \end{smallmatrix}$ diameter
GU	0.079	2.00
GV	0.138	3.5
GW	0.209 min	5.30 min
GX	0.378	9.60

- 1 Dimensions shown are maximum – may be smaller.
- 2 Bulbs must be equipped with a seal. The bulb-seal assembly must withstand a minimum of 70 kPA (10 psig) when the assembly is inserted into a cylindrical aperture of 20.22 $\pm$ 0.10 mm (0.796 $\pm$ 0.004 in).
- 3 See Fig. 5.4.
- 4 Diameters must be concentric within 0.20 mm (0.008 in).
- 5 Glass bulb periphery must be optically distortion free axially within the included angles about Point B.
- 6 Key and keyway are optional construction. Keyway required for aftermarket only.
- 7 Measured at terminal base. Terminals must be perpendicular to base and parallel within $\pm$ 1.5 deg.
- 8 Diameters must be concentric within 0.20 mm (0.008 in).
- 9 Absolute dimension. No tolerance.
- 10 Glass capsule and supports shall not exceed this envelope and shall not interfere with insertion past the lamp's key.

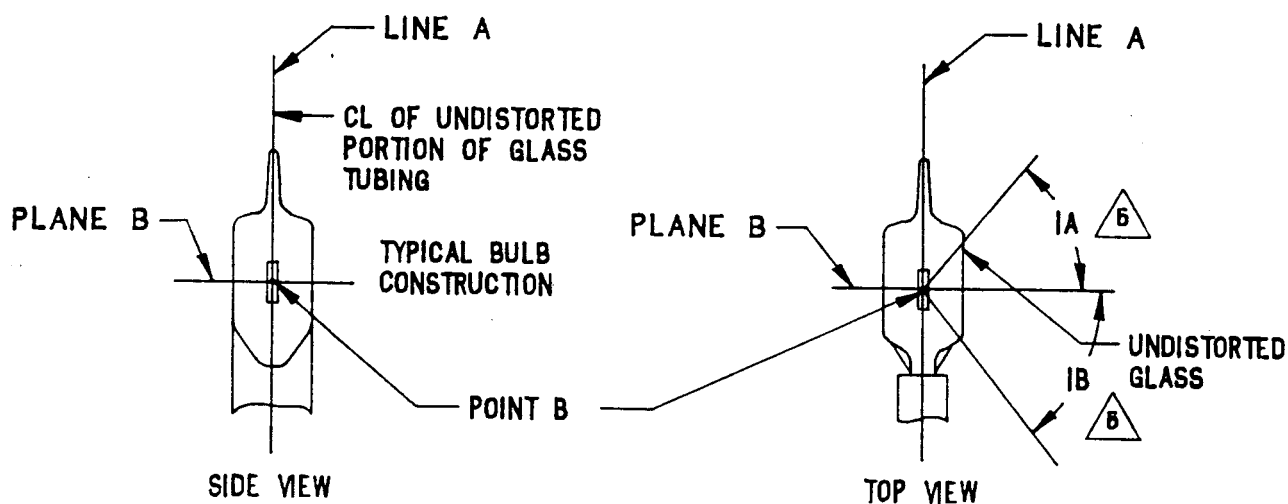
TOLERANCES UNLESS OTHERWISE SPECIFIED

INCHES
 2 Place Decimals $\pm$ 0.02
 3 Place Decimals $\pm$ 0.010
 Angular $\pm$ 1 deg

MILLIMETERS
 1 Place Decimals $\pm$ 0.5
 2 Place Decimals $\pm$ 0.30
 Angular $\pm$ 1 deg

FIGURE 5 (Continued)





POINT B IS INTERSECTION OF PLANE B AND CENTERLINE OF UNDISTORTED GLASS TUBING

<u>DIMENSION</u>	<u>INCHES</u>	<u>MILLIMETERS</u>
1A	45 deg min	45 deg min
1B	52 deg min	52 deg min

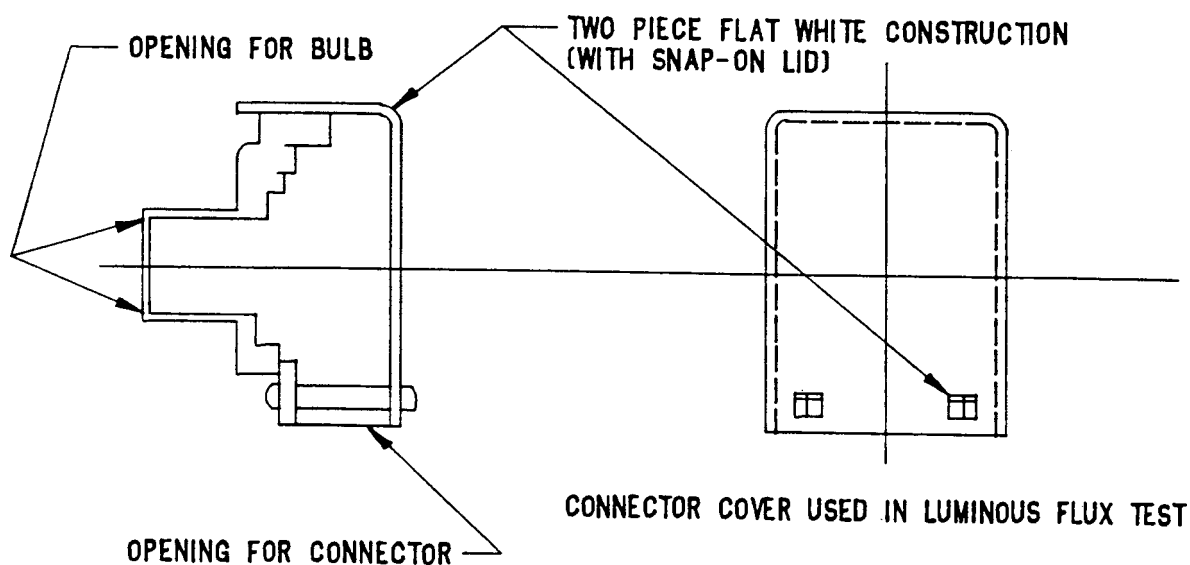


FIGURE 5.1 - Specification for the 9005 Replaceable Bulb

