

INCH-POUND

MIL-PRF-1/1049H  
16 June 2004  
SUPERSEDING  
MIL-PRF-1/1049G  
25 June 1999

PERFORMANCE SPECIFICATION SHEET  
ELECTRON TUBE, IMAGE CONVERTER  
TYPE 6914

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this document and the latest issue of MIL-PRF-1.

DESCRIPTION: Infrared sensitive (S1 photocathode surface; P-20 phosphor image screen).  
See figure 1.  
Weight: 3 ounces (85 grams) nominal.  
Mounting position: Any.

ABSOLUTE RATINGS:

Parameter:	Eb	Light flux	ib <u>2</u> /	Ib	Rb	TA
Unit:	kV dc	lux	$\mu$ A dc	$\mu$ A dc	M $\Omega$	$^{\circ}$ C
Maximum:	16	---	3.5	0.35	---	68
Minimum:	---	---	----	----	----	-54
Test condition:	16	<u>1</u> /	----	---	100	20 to 23

See footnotes at the end of table I.

GENERAL:

Qualification - Required.

Holding period: 4/

Stabilization: 3/

TABLE I. Testing and inspection.

Inspection	MIL-STD-1311 Method	Conditions	Acceptance Level <u>23/</u>	Symbol	Limits		Unit
					Min	Max	
<u>Conformance inspection, part 1</u>							
Shock	---	<u>6/</u>	----	---	----	---	---
Irradiation surge	---	<u>7/</u>	----	----	----	----	----
Conversion index	---	<u>8/</u>	----	CI	15	----	----
Conversion index decay	---	<u>4/ 5/</u>	----	----	----	----	----
Conversion index to background	---	<u>5/ 9/</u>	----	CI/B	4	---	---
Alignment and image shift	---	<u>10/</u>	----	----	----	----	----
Center resolution	---	<u>11/ 12/</u>	---	Res	50	---	1-p/mm
Peripheral resolution	---	<u>11/ 12/</u>	---	Res	12	---	1-p/mm
Center magnification	---	<u>13/</u>	---	Cmx	0.742	0.790	---
Distortion	---	<u>14/</u>	---	---	9	13	%
Cathode and screen spots	---	<u>5/ 15/</u>	----	----	----	----	----
Breakdown	---	<u>5/ 16/</u>	----	----	----	----	----
Dark current	---	Light flux = 0 <u>5/ 17/</u>	---	Llk	---	0.02	μA
<u>Conformance inspection, part 2</u>							
Cathode and screen uniformity	---	<u>18/</u>	2.5	----	----	----	----
Vibration (1)	---	<u>19/ 22/</u>	1	----	----	----	----
Vibration (2)	---	<u>20/ 22/</u>	2.5	----	----	----	----
Temperature cycling and thermal shock	---	<u>21/ 22/</u>	1	----	----	----	----
Permanence of marking	1105		---	----	----	----	----

1/ Unless otherwise specified, the radiation source shall be a tungsten filament lamp operated at a color temperature of 2,854°K. A Corning No. 2540 filter (melt No. 1613, of .103 inch (2.61 mm) thickness), or equivalent, shall be placed between the radiation source and the photocathode. The quantity of radiation from the source incident on the photocathode for the individual tests shall be the amount stated in the note describing the particular test.

2/ The period of time of ib for any single period shall not exceed 2 minutes, and the tube shall not be subjected to more than 10 such periods during its life.

3/ The tube shall be held for a manufacturer's stabilizing period of at least 2 weeks. Prior to this period, the temperature, vibration, and shock tests shall be made; at the end of the two-week period, the irradiation surge and initial conversion index tests shall be made in the order listed. (See 4/).

TABLE I. Testing and inspection - Continued.

4/ After a holding period of 672 hours, which shall not include the manufacturer's stabilizing period of at least 336 hours, the conversion index of the tube shall not be less than 15, and shall not have slumped more than 20 percent from the initial value measured at the end of the stabilizing period. If the conversion index has slumped more than 20 percent, but still is above the minimum value of 15, the tube shall be held an additional 2 weeks. At the end of the 6-week period, the tube shall have a conversion index of not less than 15 and shall not have slumped more than 30 percent of the initial value. After completing the above conversion index test, the manufacturer shall have a period of 24 hours to screen out tubes he feels do not meet the requirements specified herein.

5/ This test is to be performed at the conclusion of the holding period.

6/ Upon completion of the vibration (1) test specified, each tube, in a proper holder, shall be energized with 16 kilovolts for a stabilization period of 15 seconds in a darkened room (not more than 0.01 footcandle (0.11 lux)). At the end of this period, with the tube still energized and no incident light on the photocathode, it shall be subjected to shock impacts in the following manner:

The shock impacts shall be applied in a way to generate nominal half-sine wave pulses having a minimum of 75 G's at the peak. The duration of each shock pulse shall be  $6 \pm 2$  milliseconds measured between the 10 percent values of the peak amplitude. The energy under the shock curve shall be not less than 0.25 G second and the after oscillations shall be not greater than 15 percent of the peak amplitude of the nominal half-sine wave pulse. The tube shall be subjected to six shock pulses parallel to, and six shock pulses perpendicular to, its longitudinal axis. Presence of flashing or electrical bursting during more than two shocks in each direction shall be cause for rejection.

7/ The image tube shall be subjected to an irradiation surge by exposing the photocathode to radiation from a tungsten light source (which need not be the one specified in 1/) for a period of at least 5 seconds to produce a minimum of 3.5  $\mu$ A of photocathode current. The image of the source on the screen of the tube shall not disintegrate nor shall any part of the image darken or be blanked out during the irradiation surge.

8/ The radiation source, specified in 1/, shall be used to produce a circular image .750 inch (19.05 mm) in diameter on the center of the photocathode. The amount of incident flux on the photocathode (prior to interposing the filter) shall be  $0.01 \pm 0.0005$  lux. The light output of the tube shall be read with a Weston Model 856 RRV photronic cell, or equivalent, provided with a Viscor filter or equivalent and truncated lucite cone. The cone shall be 1.562 inches (39.67 mm) in diameter at its base, 1.125 inches (28.58 mm) in diameter at its top, and 1.6875 inches (42.86 mm) in height. The base of the cone shall be cemented to the photronic cell window. The cone top shall be in contact with the image screen of the tube. The photronic cell and cone shall be precalibrated from a diffused light source. The small end of the cone shall be placed to cover the excited area of the image screen. The conversion index is defined as:

$$CI = F_1/F_2T$$

$F_1$  is the total available luminous flux emitted by the phosphor screen of the tube at the operating voltage specified.

$F_2$  is the unfiltered flux from the 2,854°K light source incident on the photocathode of the tube.

$T$  is the filter factor of a calibrated Corning No. 2540 (melt number 1613, .103 inch (2.61 mm) thickness) infrared filter, or equivalent, interposed between the light source and photocathode. This filter factor is the percentage of 2,854°K hololumen flux transmitted by the infrared filter and is determined by the following:

$$T = \frac{\int_0^{\infty} R\lambda J\lambda t\lambda d\lambda}{\int_0^{\infty} R\lambda J\lambda d\lambda}$$

Where  $R\lambda$  = The relative spectral response of an EIA S-1 photosurface.

$J\lambda$  = The relative spectral distribution of the 2,854°K color temperature radiation source.

$t\lambda$  = The spectral transmission of the infrared filter.

$d\lambda$  = The differential of the wavelength of the radiation.

TABLE I. Testing and inspection - Continued.

- 9/ The radiation source and filter specified in 1/ shall be used. The source shall be adjusted to produce a .750 inch (19.05 mm) diameter circle image on the center of the photocathode. The amount of radiation incident on the photocathode (prior to interposing the filter) shall be  $0.01 \pm 0.0005$  lux. The 5819 or 1P21 photomultiplier shall be adjusted to give 227 microamperes of anode current. The radiation from the source shall then be excluded from the photocathode and the brightness shall be read in terms of anode current (LB) of the photomultiplier tube. The ratio of conversion index to background (CI/B) = 1.00/LB.
- 10/ After the completion of the vibration, shock, and temperature tests specified, the resolution pattern described on figure 2 shall be focused on the photocathode and the image of the pattern observed on the screen of the tube with a 10 power microscope. The microscope shall be aligned with the geometric axis of the tube (which shall be the center line of the 1.680 inch (42.69 mm) diameters at each end of the tube as shown on figure 1) and it shall be focused for best resolution of the test pattern image. With the microscope focused and aligned with the tube operating at normal voltage, a test spot shall then be projected on the center (tube axis) of the photocathode and the image of the spot shall be observed on the screen. The center of the test spot image shall fall on the screen within a 0.045 inch (1.14 mm) radius circle concentric with the tube axis. Following the alignment test, the position of the center of this image shall be recorded. After application of electrical shock, resulting from 10 cycles of alternate periods of 15 seconds with and 10 seconds without application of the rated tube voltage, the center of the above image shall not displace more than 0.0025 inch (0.064 mm) in any direction from its initially recorded position.
- 11/ This test shall be performed with a 10 power or greater microscopic monocular; a tungsten radiation source and infrared filter (which need not be the source and filter specified in 1/), a resolution test pattern, and a condenser lens system to project the resolution test pattern upon the image tube photocathode. The test pattern shall be placed between the radiation source and the filter and shall be focused on the photocathode for best equal resolution of line sets in the central area of the image tube screen. The input radiation level shall be adjusted by the operator to obtain best contrast of the resolution patterns. The image shall be resolved when all lines in each resolution group can be counted. The resolution test pattern shall be projected 1:1 on the photocathode of the tube. (Projection other than 1:1 may be used provided the chart size is such that the projected image on the photocathode meets the requirements of 12/ or 13/, as applicable.)
- 12/ The resolution pattern for this test, shown on figure 2, shall consist of 3 groups (marked 12, 50, and 12). In the center resolution group, marked 50, each set of lines shall have 8 black lines with a minimum length-to-width ratio of 15 to 1. In the peripheral groups, marked 12, each set of lines shall have 5 black lines with a minimum length-to-width ratio of 5 to 1. The width of each black line and the distance between the black lines in the group marked 50 shall be 0.00039 inch (0.0099 mm). The width of each black line and the distance between the black lines in the two groups marked 12 shall be 0.0016 inch (0.041 mm). The arrangement and orientation of the groups and the sets of lines in each group shall be as shown on figure 2.
- 13/ Magnification is defined as the ratio of the separation of the two image points to the separation of corresponding object points; the latter being located on a diameter and equidistant from the tube axis. Paraxial magnification is obtained only if the object points are very close to the tube axis. Center magnification ( $M_x$ ) is a close approximation to paraxial magnification and shall be measured with a nominal chordal separation of object points of  $20 \pm 0.4$  percent of the useful minimum cathode diameter. The object points shall be projected on the photocathode with nominal monochromatic visible light.
- 14/ A second magnification measurement shall be made to determine the percentage of distortion. The procedure used to determine the center magnification (see 13/) shall be used except for the spacing of the points or lines on the photocathode which shall have a separation of  $80 \pm 0.4$  percent of the useful minimum cathode diameter. Percentage distortion shall be determined by the following formula:

$$D = \frac{M_2 - M_1}{M_1} \times 100$$

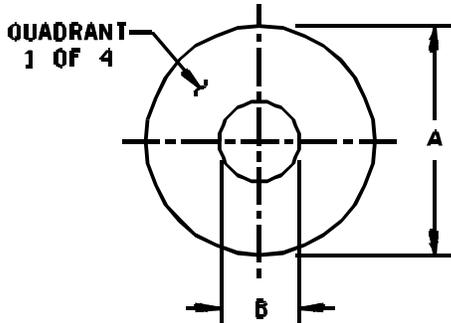
Where: D = Percentage distortion.

$M_1$  = Magnification obtained in center magnification test.

$M_2$  = Second magnification determined as above.

TABLE I. Testing and inspection - Continued.

15/ The test equipment used for this test shall be approved by the qualifying activity prior to the start of testing. When the tube screen is observed with a 2.5 power magnifier and with no radiation incident on photocathode, there shall be no ion spots or cold emission that appear as bright streaks or blemishes. Spots less than .0008 inch (0.020 mm) in diameter will not be counted, however, there shall be no unacceptable concentration of such spots. There shall be no flickering or pulsating light during functional testing for blemishes. The intensity of light in the right and left sides shall appear to be equal. Any spots that change from light to dark or dark to light, in the fluorescent screen, shall be cause for reject. When the screen is viewed through a 10 power microscope and with the radiation level on the photocathode adjusted to obtain the best spot contrast, the opaque or dark spots shall not exceed the size and quantities shown:



	<u>Inches</u>	<u>Millimeters</u>
A	0.860	21.84
B	0.300	7.62

Size of spots <u>1/</u> (inches)	Number of spots within .300 inch (7.62 mm) diameter circle <u>2/</u>	Number of spots, within area bounded by two circles .300 inch (7.62 mm) and .860 inch (21.84 mm) in diameter <u>3/</u>
.0008 to .0016 (0.020 to 0.041 mm)	3	10
.0016 to .006 (0.041 to 0.15 mm)	0	8
.006 to .009 (0.15 to 0.23 mm)	0	5
.009 to 0.012 (0.23 to 0.30 mm)	0	2
Greater than .012 (0.30 mm)	0	0

1/ If the distance between two spots is less than the maximum dimension of either spot, they shall be considered as one spot with a size equal to the sum of the maximum dimensions of the two spots plus the amount of separation between them.

2/ The .300 inch (7.62 mm) and .860 inch (21.84 mm) circles on the image screen shall be concentric with the tube axis.

3/ There shall not be more than two spots, blemishes, or scratches in each of the four quadrants except sizes .0008 to .0016 inch (0.020 to 0.041 mm) wherein two of the four quadrants may contain three spots.

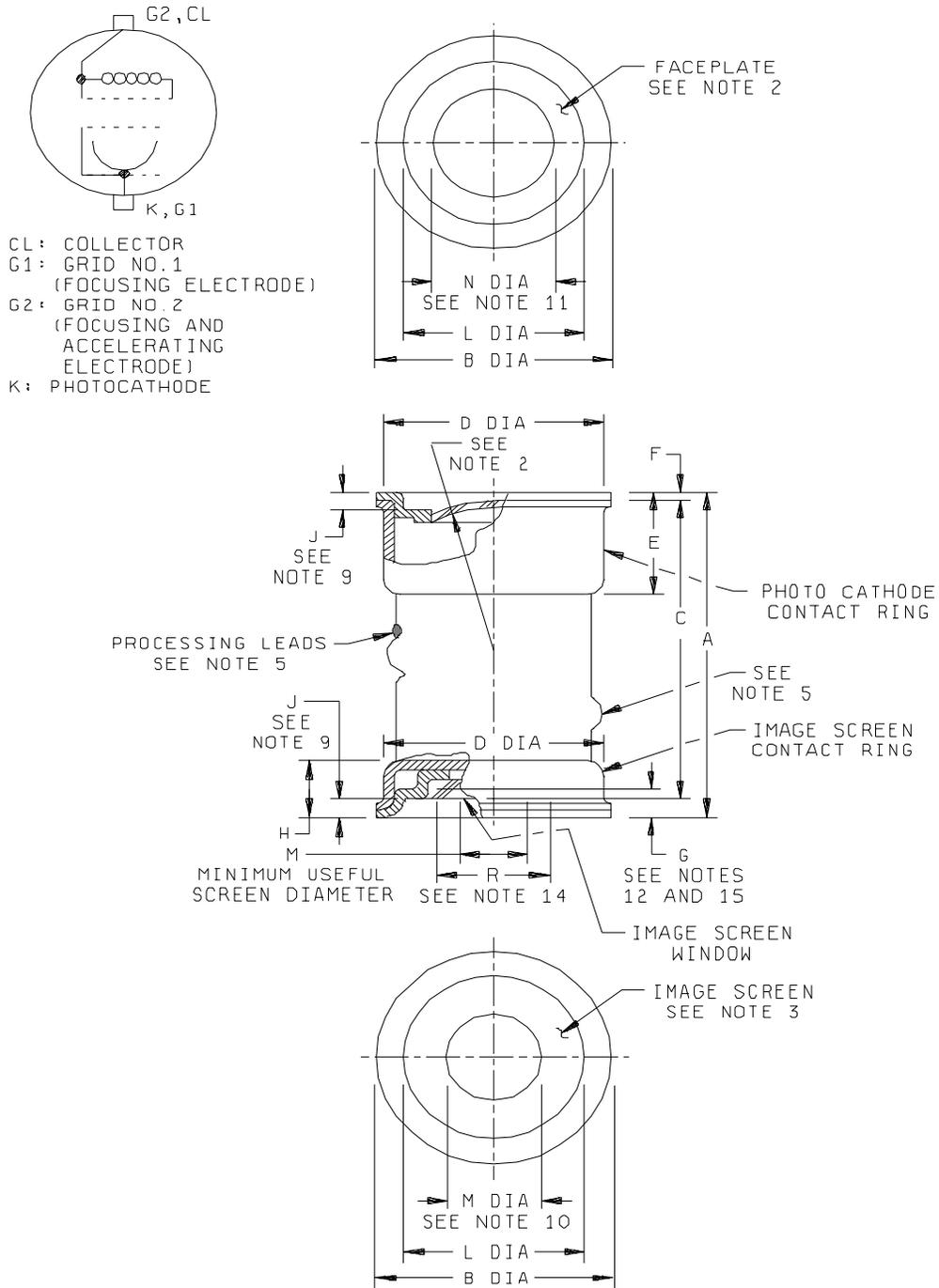
16/ Apply 18 kilovolts for 10 seconds. The tube shall be rejected for intermittent or continuous arcing.

17/ To measure total tube dark current Llk, a microammeter shall be connected in series with the grounding terminal of the tube. This test shall be performed in an atmospheric environment of 40 to 50 percent relative humidity.

TABLE I. Testing and inspection - Continued.

- 18/ The background shading shall be uniformly graded so that there is no line of demarcation between light and dark areas. Two tests shall be performed.
- a. With no radiation incident on the photocathode.
  - b. With the radiation uniformly distributed over the photocathode produced by filtering through Corning filter No. 2540, 0.1 to 0.4 lumens/square foot from a tungsten source operating at a color temperature of 2,854°K.
- 19/ The tubes shall be rigidly mounted, singly or in groups, in a vertical position with the cathode end up, and subjected to a simple harmonic motion having an amplitude of not less than .063 inch (1.59 mm) (total excursion .125 (3.18 mm)), at a frequency of 30 Hz, for a period of 2.5 minutes. No voltage potential shall be applied to the tube during the above vibration test. Any tube submitted for qualification shall be tested only once, after which a certification that the vibration test has been performed shall be issued.
- 20/ The tubes shall be rigidly mounted, singly or in groups, in a vertical position with the cathode end up, and subjected to a simple harmonic motion having an amplitude of not less than  $0.040 \pm 0.0025$  inch ( $1.02 \pm 0.064$  mm) (total excursion  $0.080 \pm 0.005$  inch ( $2.03 \pm 0.13$  mm)) at a frequency of  $50 \pm 2$  Hz, for a period of 2 minutes. No voltage potential shall be applied to the tube during the above vibration test.
- 21/ The tube shall be placed in a test chamber and internal temperature of the chamber raised gradually to 68°C. After not less than 1-hour at 68°C, the chamber temperature shall be lowered to 52°C and held for at least 1-hour. At the end of this period, the tube shall be removed immediately to room temperature (approximately 22°C) and shall remain at this temperature for not less than 1-hour. At the end of this period, the tube shall be replaced in the test chamber and the internal temperature of the chamber lowered gradually to minus 54°C. After not less than 1-hour at minus 54°C, the chamber shall be raised to minus 32°C and held for not less than 1-hour. At the end of this period, the tube shall be removed immediately to room temperature (approximately 22°C). Evidence of deformation, cracks, or breakage shall constitute failure of this test.
- 22/ The following post environmental tests shall be performed and shall meet test limits specified in conformance inspection, part 1: conversion index, conversion index to background, alignment and image shift, center resolution, cathode and screen spots, breakdown, dark current, and threshold sensitivity.
- 23/ This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.

MIL-PRF-1/1049H



CL: COLLECTOR  
 G1: GRID NO. 1  
 (FOCUSING ELECTRODE)  
 G2: GRID NO. 2  
 (FOCUSING AND  
 ACCELERATING  
 ELECTRODE)  
 K: PHOTOCATHODE

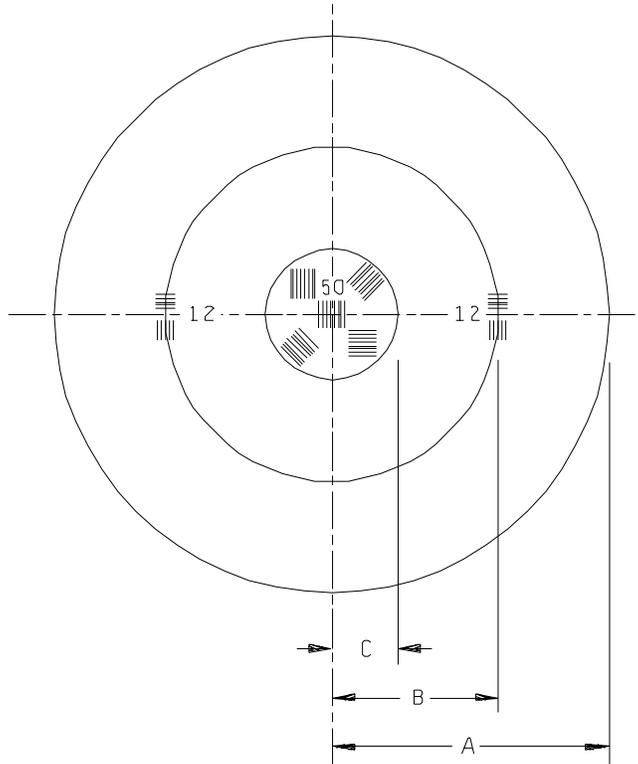
FIGURE 1. Outline drawing of electron tube type 6914.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
A	2.875	2.975	73.03	75.57
B	1.855	1.905	47.13	48.39
C	2.650	2.768	67.31	70.31
F	.068	.128	1.73	3.25
G	.090	.150	2.29	3.81
L	1.680	1.694	42.67	43.03
Reference dimensions (see note 1)				
D	1.796 MAX		45.62 MAX	
E	.900 design center		22.86 design center	
H	.400 design center		10.16 design center	
J	.120 design center		3.05 design center	
M	.860		21.84	
N	1.000		25.40	

## NOTE:

1. These dimensions are for information only and are not required for inspection purposes.
2. Faceplate dimensions (see note 13).  
Radius of curvature (inside and outside) shall be 2.33 inches (59.2 mm) minimum and 2.43 inches (61.7 mm).  
Thickness at center shall be .061 inch (1.55 mm) minimum and .069 inch (1.75 mm) maximum.  
Variation in edge thickness shall be .004 inch (0.10 mm) maximum.
3. Image screen dimensions (see note 13).  
Thickness at center shall be .095 inch (2.41 mm) minimum and .105 inch (2.67 mm) maximum.  
Variation in edge thickness shall be .010 inch (0.25 mm) maximum.
4. Refractive index for faceplate and image screen glass shall be  $1.49 \pm .04$  inch (37.8  $\pm$  1.0 mm).
5. No part of that portion of the tube included between metal contact ring shall protrude beyond dimension B.
6. Tube axis is established by centerline through dimension L.
7. The following ratio shall govern dimensions A, C, F, and G: A minimum  $\leq C + F + G \leq$  A maximum.
8. All exposed metal parts shall be nickel plated.
9. Dimension J measures depth to bearing surface of metal shoulder.
10. Minimum useful image screen diameter.
11. Minimum useful cathode diameter.
12. Depth to outside surface of image screen window.
13. Faceplate and image screen dimensions are for guidance on component parts.  
Conformance check of these dimensions shall be made prior to tube assembly.
14. No glass or other protuberance permitted inside minimum diameter R, protuberance beyond this diameter shall not exceed .031 inch (0.79 mm) deviation from flatness of external surface of image screen within a minimum diameter of 1.260 inch (32.00 mm) shall not exceed .002 inch (0.05 mm) from peak to valley.
15. Dimension G applies over 1.260 inch (32.00 mm) diameter only.

FIGURE 1. Outline drawing of electron tube type 6914 - Continued.



Letter	Inches	Millimeters
A	0.500	12.70
B	0.300	7.62
C	0.120	3.05

NOTE: Dimensions are in inches.

FIGURE 2. Resolution pattern for tube type 6914.

NOTES

Referenced documents. In addition to MIL-PRF-1, this specification sheet references MIL-STD-1311.

Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - CR  
Navy - EC  
Air Force - 11  
DLA - CC

Preparing activity:  
DLA - CC

(Project 5960-3717)

Review activities:

Army - AR  
Navy - AS, CG, MC, SH  
Air Force - 19, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at [www.dodssp.daps.mil](http://www.dodssp.daps.mil).