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 17 September 1999  
 SUPERSEDING  
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 5 June 1975

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, GAS SWITCHING  
 TYPE 6164

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:** TR, bandpass, controlled phase shift, frequency range 8,500 to 9,600 MHz.

**ABSOLUTE RATINGS:**

Parameter:	Incident power	Ebb	pr	Du	Alt
Unit:	kw	V dc	pps	---	ft
Maximum:	---	---	1,000	0.001	10,000
Minimum:	4	-750	---	---	---

**PHYSICAL CHARACTERISTICS:** See figure 1.

Application: 1/

**TEST CONDITIONS:**

Parameter:	Incident power	tp1	tp2	pr	Ebb	Ri	$\sigma'$	F
Unit:	kw	$\mu$ s	$\mu$ s	pps	V dc	Meg	---	MHz
Tolerance:	$\pm 10\%$	$\pm 0.15$	$\pm 0.15\%$	---	$\pm 25$	---	max	$\pm 6\%$
Test condition 1:	40	1.0	0.5	1,000	-625	3.3	1.10	F3
Test condition 2:	200	1.0	---	1,000	-625	3.3	---	F3

Frequency	
F	MHz
1	8,500
2	8,775
3	9,050
4	9,325
5	9,600

**GENERAL:**

Qualification - Not required.

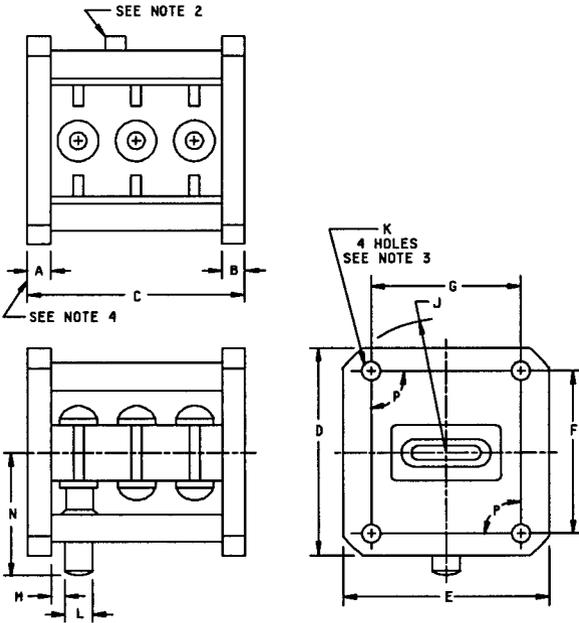
TABLE I. Testing and inspection.

Requirement or test	Method	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
<u>Conformance inspection, part 1</u>		2/						
Temperature cycling (nonoperating)	1027	---	---	10 cycles (minimum)	---	---	---	---
Ignitor voltage drop	4406	---	---	li = 100 $\mu$ A dc	Eid	200	375	V dc
Insertion loss	4416	---	---	F = F3 $\pm$ 50 MHz; Ri = 3.3 Meg; Ebb = -625 $\pm$ 25 V dc	Li	---	1.0	dB
Flat-leakage power	4452	---	1		pF	---	30	mw
Spike-leakage energy	4452	---	1		Ws	---	0.15	erg
Position of short	4494	3/	1	F3 $\pm$ 10 MHz	Distance	---	$\pm$ .007	inch
Reflection difference	---	4/	---	F1 through F5; Ebb = -625 $\pm$ 25 V dc; Ri = 3.3 Meg	SWR	---	2	dB
Transmission difference	---	4/	---	F1 through F5; Ebb = -625 $\pm$ 25 V dc; Ri = 3.3 Meg	Phase	---	5	degrees
<u>Conformance inspection, part 2</u>								
Degradation due to vibration	4021	---	---		---	---	---	---
Dielectric material strain	4101	---	---		---	---	---	---
Ignitor ignition time	4401	---	---	Ebb = -625 $\pm$ 25 V dc; Ri = 3.3 Meg	t	---	5	sec
Recovery time	4471	---	2		t	---	10	$\mu$ s
Arc loss	4488	---	1	po = 4 kw $\pm$ 10%	La	---	0.8	dB
<u>Conformance inspection, part 3</u>								
Life tests	---	---	2	Group D	t	500	---	hrs
Life-test end points:	---							
Insertion loss	4416	---	---	F = F3 $\pm$ 50 MHz; Ri = 3.3 Meg; Ebb = -625 $\pm$ 25 V dc	Li	---	1.2	dB
Flat-leakage power	4452	---	1		pF	---	30	mw
Spike-leakage energy	4452	---	1		Ws	---	0.15	erg
Recovery time	4471	---	2		t	---	15	$\mu$ s
Temperature cycling life	1027	---	---	Group C; 12 cycles (minimum)	---	---	---	---

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

- 1/ The type 6164 is an integral cavity broad-band transmit-receive tube designed for use in the M85/1-073-120 waveguide. The magnitude of the vector difference between tubes of low-level reflection and transmission are not greater than 4 dB SWR and 10°, respectively, over the range of 8,500 to 9,500 MHz.
- 2/ Unless otherwise specified, the acceptance level for all tests listed under conformance inspection, part 1, shall be 1.0 in accordance with MIL-PRF-1, Table III accept on zero (c = 0) sampling plan.
- 3/ With a metal plate shorting the line, the position of the VSW minimum shall be determined. The metal plate shall be replaced by the tube under test and the position of the VSW minimum of the flat position of the pulse shall be measured and shall be .032 inch (0.81 mm) further from the magnetron within the limits specified.
- 4/ This test shall be conducted in accordance with test procedure for reflection and transmission differences described herein.
- 5/ Revision letters are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 1 (see note 5)				
A	.190	.220	4.83	5.59
B	.190	.220	4.83	5.59
C	1.973	1.993	50.11	50.62
D	1.844	1.906	46.84	48.41
E	1.844	1.906	46.84	48.41
J	1.125 R	1.188 R	28.58 R	30.18 R
K	.169 DIA (see note 3)		4.29 DIA (see note 3)	
L	.245 DIA	.255 DIA	6.22 DIA	6.48 DIA
M	.156	---	3.96	---
N	---	1.281	---	32.54
Conformance inspection, part 2				
F	1.468	1.480	37.29	37.59
G	1.356	1.368	34.44	34.75
P	89.5°	90.5°	89.5°	90.5°

NOTES:

1. Silver plate 100 MSI, or equivalent.
2. Exhaust tube shall not extend beyond flange more than .25 inch (6.35 mm).
3. The rectangle formed by the centers of the four .169 inch (4.29 mm) diameter holes shall be centered on the flange face within .031 inch (.794 mm).
4. The planes of the two waveguide-flange surfaces shall be parallel within  $\pm .002$ , maximum.
5. Unless otherwise specified, the acceptance level for all tests listed under conformance inspection, part 1, shall be 1.0 in accordance with MIL-PRF-1, Table III except on zero (c = 0) sampling plan.

FIGURE 1. Outline drawing of electron tube type 6164.

## TEST PROCEDURE

Reflection and transmission differences

1. Purpose. The purpose of this test is to measure the reflection and transmission differences.

2. Procedure. The reflection and transmission differences shall be measured, with ignitor currents in the range specified, by comparing the tube under test (TUT) with a standard dummy at F1, F2, F3, F4, and F5, in a special waveguide bridge circuit. The testing procedure and equipment used in testing the TUT shall be as follows.

2.1 Tuning. The tuning and low-level acceptance testing of the tube shall be accomplished by comparing the tube with a comparison-standard dummy (see 2.6), in the waveguide bridge circuit (see 2.5). The TUT and the comparison-standard dummy may be inserted in opposite branches of the waveguide bridge circuit in the test openings designated 1 and 2.

2.2 Signal. The signal source and difference measuring display shall comprise a continuously-swept oscillator covering the frequency band from 8,500 to 9,600 MHz, synchronized with a dual-channel oscillographic display (Polarad Model I, or equivalent). This signal display shall consist of two signals proportional to the magnitude of the vector differences in reflection and transmission between the TUT and the comparison-standard dummy, as obtained from the detectors designated R and T in the waveguide bridge circuit.

2.3 Maximum difference. This specification specifies the maximum magnitude of the vector differences in low-level reflection and transmission between each tube and the comparison-standard dummy. The values of these vector differences are as follows.

- a. 2 dB SWR in reflection.
- b. 5 degrees in transmission.

2.4 Acceptance limits. The acceptance limits specified in the specification sheet and covered above in 2.3 shall be set by comparing each of the differential standards described below in 2.7.1 and 2.7.2 with the precision guide section described below in 2.7.3. The precision guide section shall be inserted in one of the test openings and the differential standards inserted successively in the other test opening shown on figure 3. The magnitude of each of the resulting display deflections shall be adjusted to correspond with limit lines on the scope face by adjusting the gain controls of each display circuit. The setting of waveguide attenuator P<sub>1</sub> shall be determined experimentally beforehand by adjusting it for the maximum amount of attenuation which permits both steps of the calibration procedure described above to be performed without readjusting the attenuator or without excessive noise on the display; a minimum attenuation of 6 dB is required to pad the oscillator from the bridge circuit.

2.5 Waveguide bridge circuit. The waveguide bridge circuit is shown on figure 3, and shall meet the following requirements.

2.5.1 Mechanical. The mechanical requirements of the waveguide bridge circuit are as follows:

- a. The waveguide parts shall have the inner dimensions of M85/1-073-120 waveguide (1.497 x 1.122 inches) (38.02 x 28.50 mm).
- b. Both waveguides at the test openings 1 and 2 shall be terminated by M3922/59-007 flanges.
- c. Each pair of flanges at test openings 1 and 2 shall be fastened rigidly together to maintain the waveguides parallel and aligned, and the openings  $2.000 \pm .002$  inches ( $50.80 \pm 0.05$  mm) long.
- d. Test parts in openings 1 and 2 shall be held to flanges nearest signal input by even pressure applied at four points at opposite end.

2.5.2 Electrical. The electrical requirements of the waveguide bridge circuit are as follows:

- a. Over the band from 8,500 to 9,600 MHz, the reflection measured in either direction at the planes shall be as indicated below:

<u>Plane</u>	<u>Maximum SWR</u>
A	less than 3 dB
B	less than 2 dB
C	less than 3 dB
D	less than 2 dB

- b. Over the band, the input to pads P<sub>2</sub> and P<sub>3</sub>, with precision guide sections on figure 8 in test openings 1 and 2, shall be down 35 dB from the signal input at plane A.
- c. Waveguide pads P<sub>2</sub> and P<sub>3</sub> shall introduce at least 10 dB of attenuation. Pad P<sub>1</sub> is adjustable with a minimum attenuation of 6 dB and is set as described above in 2.4, acceptance limits.

2.6 Comparison-standard dummy. The comparison-standard dummy shall be similar to that shown on figure 2 and shall meet the following electrical requirements.

2.6.1 Reflection. The reflection at 12 frequencies of the comparison-standard dummy shall fall within a radius of 0.5 dB SWR (1.06 VSWR measured at the center of a Smith Chart) of the following locations on a Smith Chart when measured as described:

Frequency (+5 MHz)	Re s i s t a n c e $\frac{R}{Z_0}$	Location	Re a c t a n c e $j\frac{X}{Z_0}$
8,500	1.19		-.27
8,600	1.08		+.12
8,700	.91		-.02
8,800	.73		+.10
8,900	.82		+.24
9,000	1.01		+.12
9,100	.91		-.12
9,200	.73		-.09
9,300	.71		+.06
9,400	.88		+.16
9,500	1.03		+.10
9,600	1.27		+.18

These measurements shall be made in M85/1-073-120 waveguide with the dummy followed by a termination that has a reflection of less than 0.1 dB SWR. The reference for the measurement shall be at the input flange of the dummy, marked IN, corresponding to the high-power end of a 6164 TR tube.

2.6.2 Transmission. The transmission properties of the comparison-standard dummy shall be tested by determining the frequencies of resonance in the circuit shown on figure 4 with the fittings shown on figure 5. For this test, it shall be possible to measure the frequency to within  $\pm 1$  MHz. The minimum loss in transmission through the comparison-standard dummy shall occur at the following frequencies:

8,394  $\pm$  5 MHz  
 8,556  $\pm$  5 MHz  
 8,966  $\pm$  5 MHz  
 9,433  $\pm$  5 MHz  
 9,705  $\pm$  5 MHz

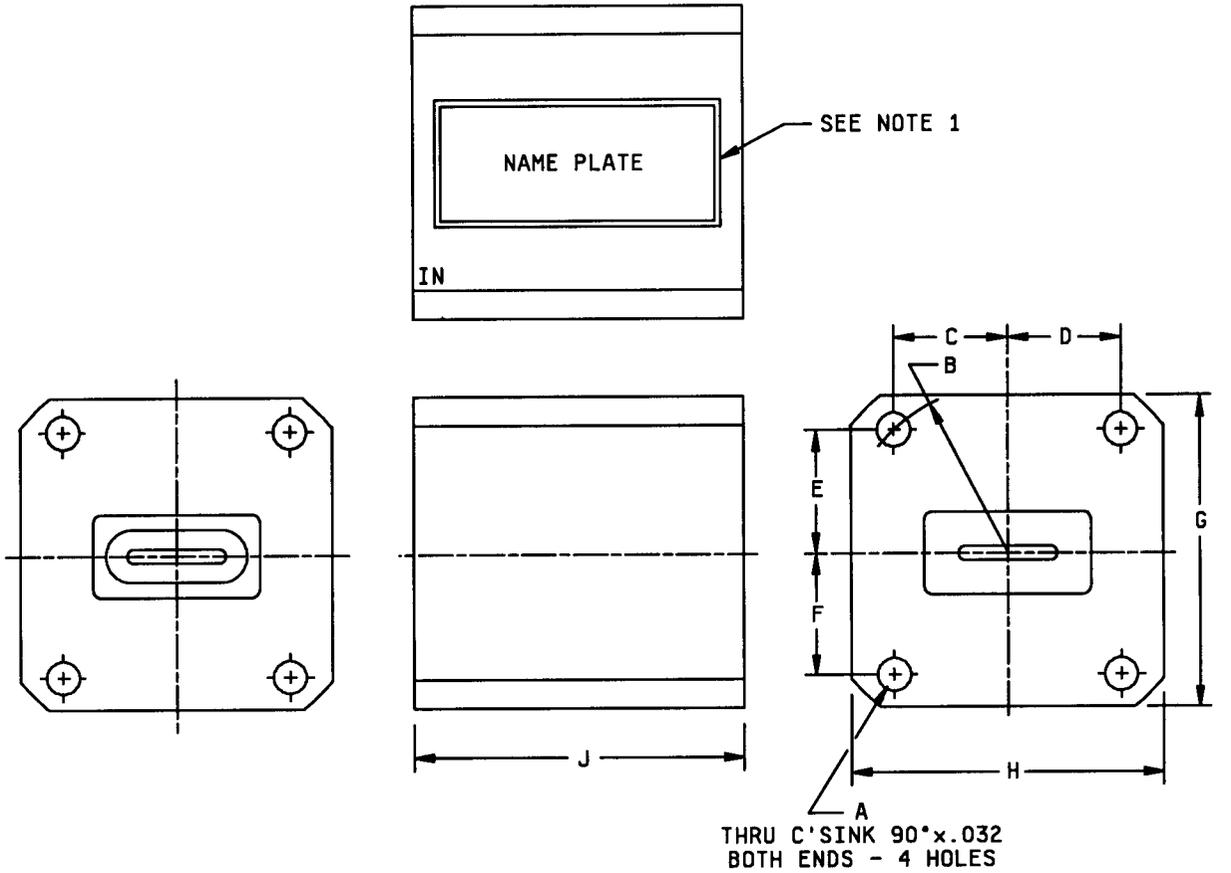
2.6.3 Stability. The comparison-standard dummy shall meet all the requirements specified in 2.6, 2.6.1, and 2.6.2 after temperature cycling over the range of -50°C to +100°C.

## 2.7 Differential standards.

2.7.1 Reflection. The differential reflection standard used to determine the reflection acceptance limits of 2.0 dB SWR shall be shown on figure 6.

2.7.2 Transmission. The differential transmission standard used to determine the transmission acceptance limits of 5.0 degrees shall be as shown on figure 7. An alternate design such as the Wheeler Laboratories Model 261, or equivalent, is also acceptable.

2.7.3 Precision guide. The precision guide used in the waveguide comparison circuit with the differential standards shall be as shown on figure 8.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
C	.674	.678	17.12	17.22
D	.674	.678	17.12	17.22
E	.735	.739	18.67	18.77
F	.735	.739	18.67	18.77
G	1.870	1.970	47.50	50.04
J	1.973	1.993	50.11	50.62
Reference				
A	.201 DIA		5.11 DIA	
B	1.000 R		25.4 R	
H	1.875		47.62	

NOTES:

1. The nameplate shall give the following information:

- (a) The organization that tuned and tested the tube.
- (b) The model and serial number of the tube.
- (c) The date the tube was completed and sealed.

2. The electrical performance of the tube shall conform to tube requirements specified in 2.6, 2.6.1, 2.6.2, and 2.6.3.

FIGURE 2. Comparison - standard dummy tube.

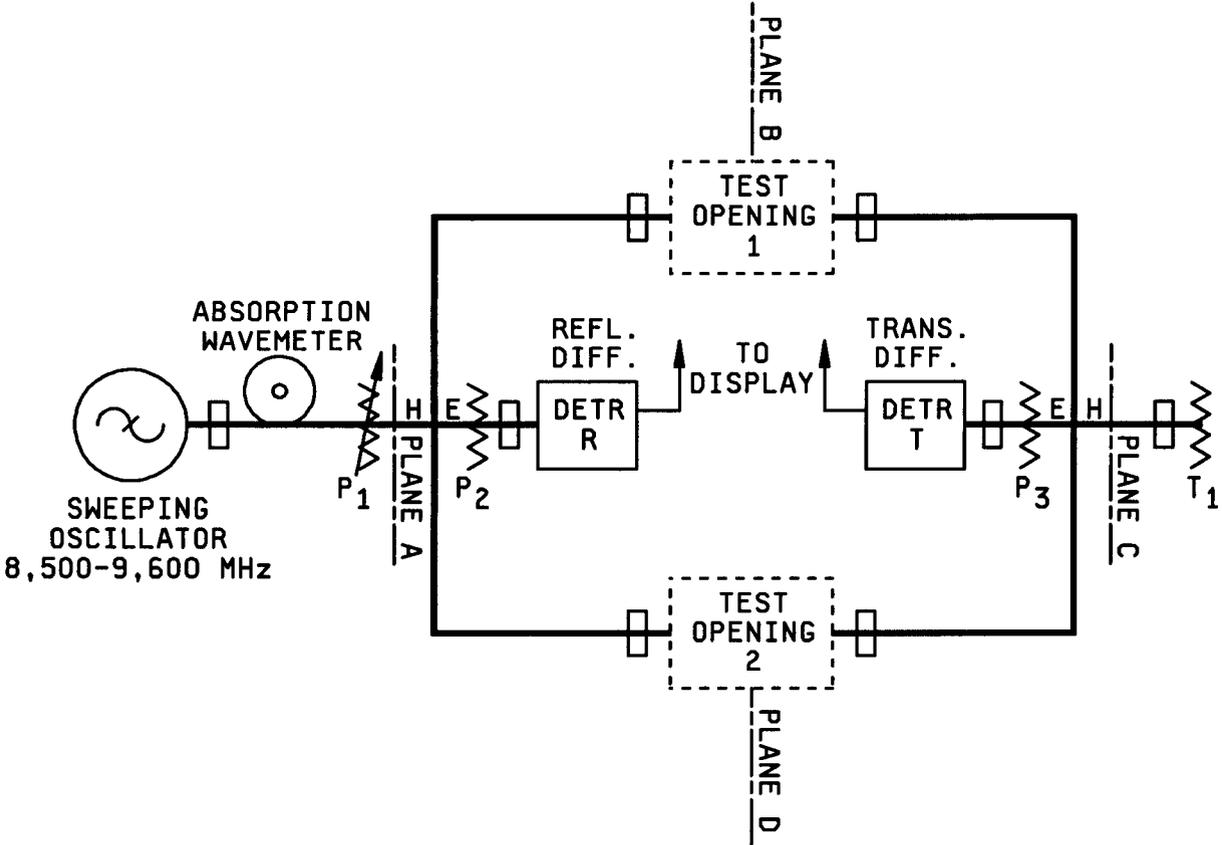
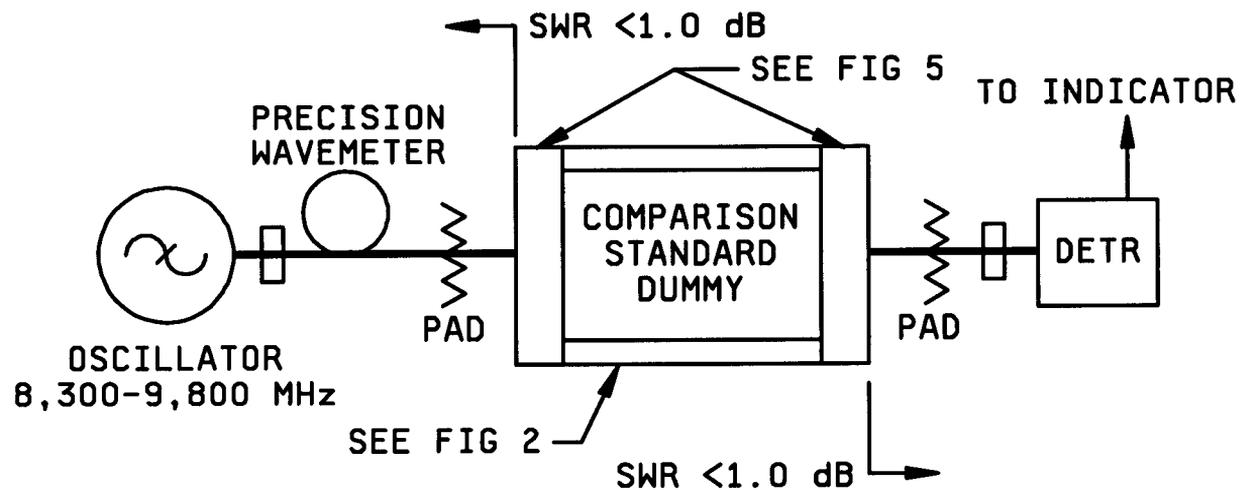
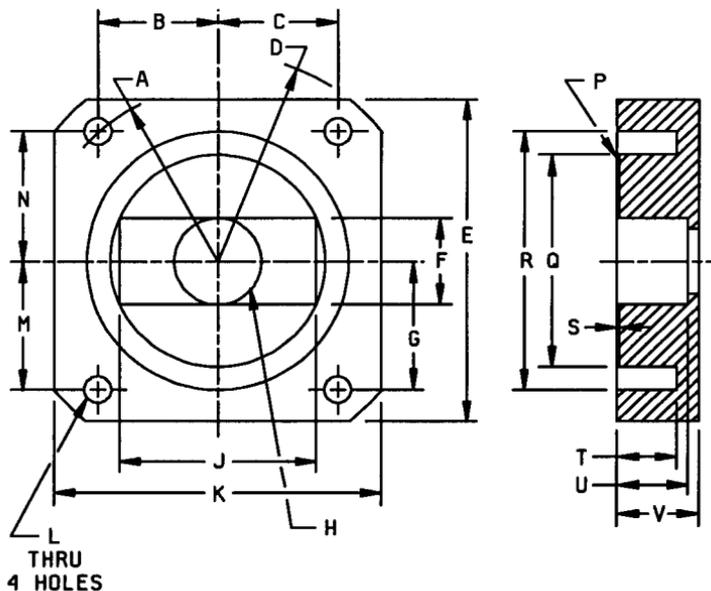


FIGURE 3. Waveguide bridge circuit.

FIGURE 4. TR resonance test circuit.

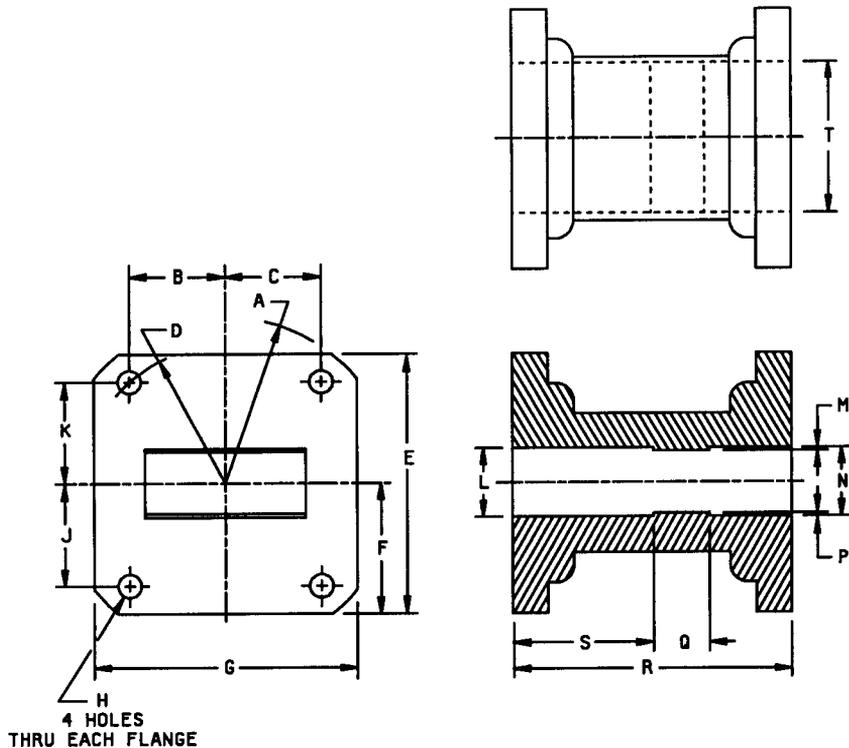


Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection				
A	1.000 RAD		25.40 RAD	
B	.674	.678	17.12	17.22
C	.674	.678	17.12	17.22
D	1.245 RAD	1.255 RAD	31.62 RAD	31.88 RAD
E	1.870	1.880	47.50	47.75
F	.495	.499	12.57	12.67
G	.933	.943	23.70	23.95
H	.4075 DIA	.4175 DIA	10.35 DIA	10.60 DIA
J	1.121	1.123	28.47	28.52
K	1.870	1.880	47.50	47.75
L	.164 DIA	.174 DIA	4.16 DIA	4.42 DIA
M	.735	.739	18.67	18.77
N	.735	.739	18.67	18.77
P	.025 RAD	.035 RAD	0.64 RAD	0.89 RAD
Q	1.267	1.273	32.18	32.33
R	1.492	1.498	37.90	38.05
S	.014	.016	0.35	0.41
T	.342	.348	8.68	8.84
U	.4005	.4015	10.17	10.20
V	.461	.463	11.71	11.76

## NOTES:

1. Part can be built up from M3922/59-007 flange.
2. Unless otherwise specified, tolerance on all decimal dimensions to be  $\pm .005$ .

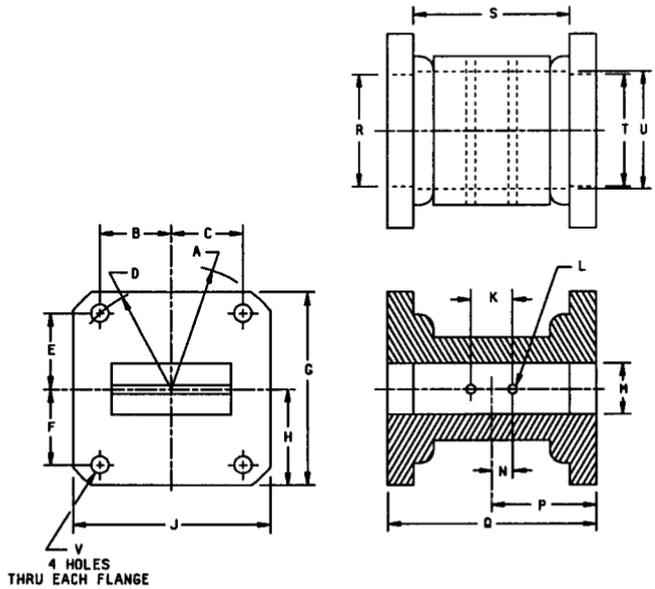
FIGURE 5. TR tube test part.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection				
A	1.245 RAD	1.255 RAD	31.62 RAD	31.88 RAD
B	.674	.678	17.12	17.22
C	.674	.678	17.12	17.22
D	1.000 RAD		25.40 RAD	
E	1.870	1.880	47.50	47.75
F	.933	.943	23.70	23.95
G	1.870	1.880	47.50	47.75
H	.164 DIA	.174 DIA	4.16 DIA	4.412 DIA
J	.735	.739	18.67	18.77
K	.735	.739	18.67	18.77
L	.4965	.4975	12.611	12.636
M	.0265	.0275	0.67	0.70
N	.4965	.4975	12.61	12.64
P	.0265	.0275	0.67	0.70
Q	.395	.405	10.03	10.30
R	1.982	1.984	50.34	50.39
S	.995	1.005	25.27	25.53
T	1.121	1.123	28.47	28.52

NOTE: Unless otherwise specified, tolerance on all decimal dimensions IS to be  $\pm .005$ .

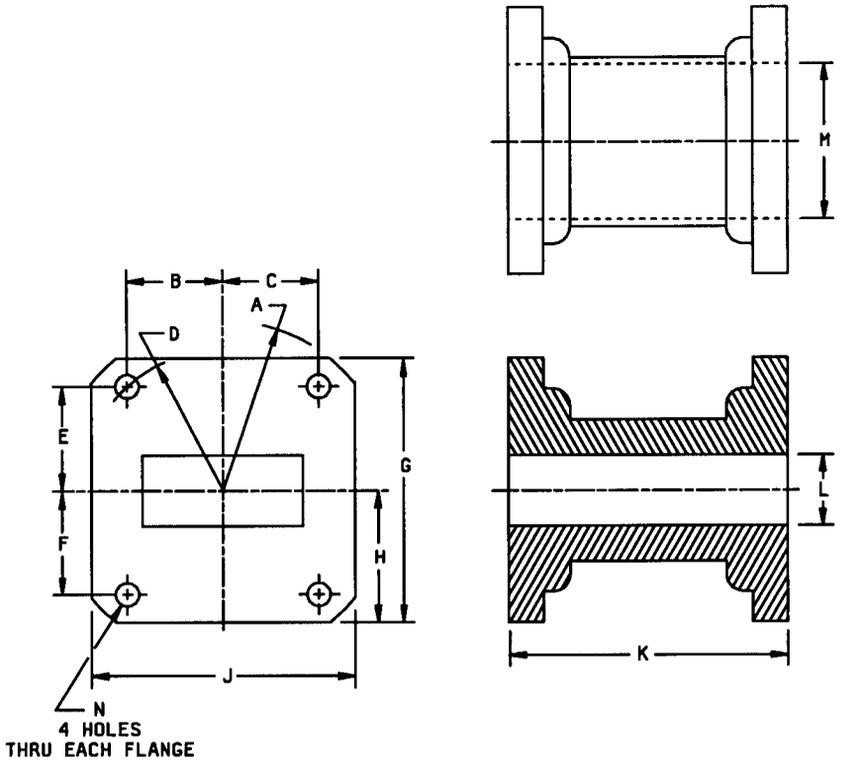
TABLE 6. Differential reflection standard.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection				
A	1.245 RAD	1.255 RAD	31.62 RAD	31.88 RAD
B	.674	.678	17.12	17.22
C	.674	.678	17.12	17.22
D	1.000 RAD		25.40 RAD	
E	.735	.739	18.67	18.77
F	.735	.739	18.67	18.77
G	1.870	1.880	47.50	47.75
H	.933	.943	23.70	23.95
J	1.870	1.880	47.50	47.75
K	.393	.403	9.98	10.24
L	.086 DIA	.088 DIA	2.18 DIA	2.23 DIA
M	.496	.498	12.60	12.65
N	.194	.204	4.93	5.18
P	.986	.996	25.04	25.30
Q	1.982	1.984	50.34	50.39
R	1.121	1.123	28.47	28.52
S	1.552	1.562	39.42	39.67
T	1.121	1.123	28.47	28.52
U	1.136	1.138	28.85	28.91
V	.164 DIA	.174 DIA	4.16 DIA	4.42 DIA

NOTES: Unless otherwise specified, tolerance on all decimal dimensions is to be  $\pm .005$ .

FIGURE 7. Differential transmission standard.



Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection				
A	1.245 RAD	1.255 RAD	31.62 RAD	31.88 RAD
B	.674	.678	17.12	17.22
C	.674	.678	17.12	17.22
D	1.000 RAD		25.40 RAD	
E	.735	.739	18.67	18.77
F	.735	.739	18.67	18.77
G	1.870	1.880	47.50	47.75
H	.933	.943	23.70	23.95
J	1.870	1.880	47.50	47.75
K	1.982	1.984	50.34	50.39
L	.496	.498	12.60	12.65
M	1.121	1.123	28.47	28.52
N	.164 DIA	.174 DIA	4.16 DIA	4.42 DIA

NOTES: Unless otherwise specified, tolerance on all decimal dimensions is to be  $\pm .005$ .

FIGURE 8. Precision standard guide.

**Custodians:**

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

**Preparing activity:**  
DLA - CC

(Project 5960-3553)

**Review activities:**

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