INCH-POUND

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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON

TYPE 8939 *

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: Coaxial, tunable frequency 8,500 to 9,600 MHz, pulse type, integral magnet, 250 kW rated peak power output.

ABSOLUTE RATINGS:

Parameter:	Ef	If (surge)	tk	tpc	rrv	Du	epy	ib	VSWR
Unit:	V	a	sec	µs	kV/µs	---	kV	a	---
Maximum:	15	12	---	0.35	200	0.001	28	30	1.5:1
Minimum:	1/	---	150	0.18	90 2/	---	---	15	---

ABSOLUTE RATINGS:

			Temperature				Pressurization	
Parameter:	Pi	pi	Body	Input bushing	Tuner stop torque	Alt	Input	Output
Unit:	W	kW	°C	°C	inch-ounce	ft	psia	psia
Maximum:	600	800	130	165	48	10,000	45	45
Minimum:	---	---	-55 3/	-55 3/	4/	---	15 5/	15 5/

PHYSICAL CHARACTERISTICS:

Dimensions:	See figure 1	Marking:	See figure 1, note 8, and 8/ 28/
Mounting position:	Any	Cooling:	Forced air 9/
Mounting support:	See figure 1 (flange)	Magnet isolation:	10/
Input coupling:	See figure 1 6/ 7/	Width:	17 pounds (approximate)
Output coupling:	See figure 1 6/ 7/		

Test condition (1): 6/ 7/									Frequency		
Parameter:	Ef	tk	tpc	rrv	Du	Ib	VSWR	F	F	MHz	±
Unit:	V	sec	µs	kV/µs	---	mA dc	---	MHz	1	8,500	5
Maximum:	---	---	0.33	---	---	---	---	---	2	9,000	5
	13.75	---	---	---	0.0004	11	1.1:1	F1, F2, F3	3	9,600	5
Minimum:	1/	150	0.27	180	---	---	---	---			

Test condition (2): 6/ 7/								
Parameter:	Ef	tk	tpc	rrv	Du	Ib	VSWR	F
Unit:	V	sec	µs	kV/µs	---	mA dc	---	MHz
Minimum	---	---	0.33	---	---	---	---	---
	13.75	---	---	---	0.0006	16.5	1.1:1	F1, F2, F3
Maximum:	1/	150	0.27	180 2/	---	---	----	---

See footnotes at end of table I.

GENERAL:

Qualification: Required.

* Replaces Varian type SFD-382.

TABLE I. Testing and inspection.

Inspection	Method MIL-STD-1311	Conditions	Test	Symbol	Limits		Unit
					Min	Max	
Qualification inspection							
Torque	4223	T (body) = -55°C nonoperating to +130°C operating					
Starting			2	---	---	12	inch-ounces
Operating			2	---	---	10	inch-ounces
Mechanical tuning fatigue	4223	No voltages applied 12/	---	---	50,000	---	cycles
Low-frequency vibration	1031	No voltages applied 13/ 14/	---	---	---	---	---
High-frequency vibration	1031	No voltages applied 13/ 14/	---	---	---	---	---
Temperature coefficient	4027	F = F2; T = 70°C to 130°C 3/ 15/	1	$\Delta F/\Delta T$	---	0.25	MHz/°C
Shock, specified pulse	1042	Condition J 14/ 16/	---	---	---	---	---
Salt spray (corrosion)	1006	Method B 17/ 18/ 19/	---	---	---	---	---
Life test	4551	26/	---	t	2,000	---	hrs
Life test end points:	---						
Power output	4250		1	Po	80	140	W
RF bandwidth	4308		1	BW	---	2.5/tpc	MHz
Minor lobe ratio	4308		1	---	6	---	dB
Stability	4315	t = 180 seconds	1	MP	---	0.5	%
Resettability	4223	27/	1	ΔF	---	15	MHz
Conformance inspection, part 1		20/					
Pressurizing	4003	45 psia minimum, input and output	---	---	---	---	---
Heater current (nonoperating)	4289	Ef = 13.75 V	---	If	2.9	3.3	A
Warmup time	4303	1/	1, 2	---	---	---	---
Pulse voltage	4306		---	epy	23	27	kV
Power output	4250		1	Po	100	140	W
RF bandwidth	4308		1	BW	---	2.0/tpc	MHz
Minor lobe ratio	4308		1	---	10	---	dB

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method MIL-STD-1311	Conditions	Test	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 1 - Continued.		20/					
Stability	4315	t = 180 seconds	1	MP	---	0.25	%
Starting stability	4315	F = F3 21/	1	MP	---	0.25	%
Operating torque	4233	F1 through F3; no voltages applied	---	---	---	10	inch-ounces
Mechanical tuning range	4223	Upper limit 22/ Lower limit	1	F F	9,605 ---	--- 8,495	MHz MHz
Conformance inspection, part 2							
Forced cooling	1143	3/ 9/ 23/	2	ΔT (body)	---	90	°C
Frequency pushing figure	4311	24/	2	$\frac{\Delta F}{\Delta ib}$	---	125	kHz/a
Frequency pulling figure	4310		2	ΔF	---	6	MHz
Resettability	4223	F1 +50 $\pm$ 5 MHz; F2 $\pm$ 5 MHz; F3 -50 $\pm$ 5 MHz 25/	2	ΔF	---	3	MHz
Direct-interelectrode capacitance	4266	Cathode terminal to mounting plate	---	C	9	14	pF
Shelf life	---	90 days 11/	---	---	---	---	---
Conformance inspection, part 3							
Life test	4551	Group D 26/	---	t	500	---	hrs
Life test end points:	---						
Power output	4250		1	Po	80	140	W
RF bandwidth	4308		1	BW	---	$\frac{2.5}{tpc}$	MHz
Minor lobe ratio	4308		1	---	6	---	dB
Stability	4315	t = 180 seconds	1	MP	---	0.5	%
Resettability	4223	27/	1	ΔF	---	15	MHz

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

1/ Prior to the application of high voltage, the cathode shall be heated to the required initial operating temperature. This shall be done by applying 13.75 volts ± 5 percent for 150 seconds minimum. Upon the application of anode voltage, the heater voltage shall be reduced to the following schedule:

	Du	Ib (mA dc)	Ef (V) ±5 percent
Standby:	---	---	13.75
Test condition 1:	0.0004	11.0	9.0
Test condition 2:	0.0006	16.5	6.0

(1) For Pi between 0 and 375 W, Ef = 13.75 (1-Pi/800) ± 5 percent.
(2) For Pi between 375 W and 600 W, Ef = 19 (1-Pi/600) ± 5 percent.

2/ The characteristics of the applied pulse shall be those which result in proper starting and oscillation. The rate of rise of voltage (rrv) shall be measured in accordance with MIL-STD-1311 method 4304, except that the steepest tangent to the leading edge of the voltage pulse shall be measured above the 70 percent amplitude point.

3/ The temperature is to be measured at the point indicated on figure 1 (see notes 5 and 6 of figure 1).

4/ The tuning mechanism shall be capable of withstanding a static torque of 48 inch-ounces at the end of its travel.

5/ The tube under test (TUT) shall be capable of normal operation without electrical breakdown with the input bushing in air at normal atmospheric conditions.

6/ The minimum air pressure to assure prevention of electrical breakdown in the output coupling shall be 15 psig for voltage standing wave ratios up to 1.5:1 with phase shift variable over 360 electrical degrees. The tube shall be coupled directly to a UG-52/U choke flange modified so that mounting holes provide clearance for No. 8 bolts.

7/ The modulator shall be such that energy per pulse delivered to the tube, if arcing occurs, shall not greatly exceed the normal energy per pulse. The tube heater shall be protected against arcing by use of a connector that places a minimum of 4,000 pF across the heater directly at the input terminals.

8/ In addition to regular markings, the tuner dial settings for the following frequencies shall be marked on the tube during final testing by the manufacturer. The accuracy of these settings shall be -10 MHz at the start of life under conditions of test condition 2 with the body temperature approximately 80°C measured at the point specified on figure 1 when tuning is performed in the order of decreasing the frequency.

Frequency (MHz)	Dial setting	Frequency (MHz)	Dial setting
8,500	---	9,150	---
8,650	---	9,300	---
8,800	---	9,450	---
9,000	---	9,600	---

9/ With a total airflow of approximately 40 cfm at approximately 760 mmHg, divided equally and directed through the cooling fins toward the body of the tube from two .750 inch (19.05 mm) ducts placed. .500 inch (12.7 mm) to .750 inch (19.05 mm) from the cooling fins, the rise above ambient temperature specified herein shall not be exceeded.

10/ In handling and mounting the tube, care shall be exercised to prevent demagnetization. Ferromagnetic materials or energized magnets shall not be brought within 4 inches (101.6 mm) of the tube.

11/ This test shall be performed on four tubes per month when tube is in continuous production, but shipments of the month's production shall not be held pending completion of the test. So long as three of the four tubes for each of the first three months of a production run pass the test, and 75 percent of the cumulative quantity of tubes tested pass the test, tubes shall be considered to conform to this specification. If either of the conditions are not met, shipments shall be halted until three of four tubes of current production conform to test.

12/ The tuning shaft shall be continuously driven at a speed of 1,400 ± 50 rpm. At the completion of the test, the backlash shall not exceed 5 MHz. During the test, the tuning shaft may not be lubricated. A cycle consists of two complete excursions each in opposite directions through the tuning range of the tube.

TABLE I. Testing and inspection - Continued.

13/ The tube shall be vibrated in three axes, perpendicular to reference planes A, B, and C, figure 1, for a period of 1 minute in each plane.

14/ At the completion of this test, the tube shall meet the power output, voltage, and tuner torque requirements of test condition 1 of conformance inspection, part 1.

15/ Temperature measurements shall be made only after thermal equilibrium has been reached. The frequency shall be measured at the extremes of any 30°C temperature range.

16/ The tube shall be subjected to five impact shocks along each of three axes perpendicular to reference planes A, B, and C (figure 1). Each shock pulse shall be half-sine shape, and have a duration of 11 ± 1 ms. The mounting plate of the tube shall be bolted with brass bolts to the supporting fixture, and the shock pulse shall be measured on this fixture near the mounting plate.

17/ The salt solution concentration shall be 20 percent. The tuning mechanism may be completely cycled (cw and ccw) once prior to measuring static torque. The tube shall meet the requirements of Conformance inspection, part 1, after salt spray.

18/ The waveguide output flange and the high-voltage input bushing shall be enclosed for the salt spray test.

19/ At the conclusion of this test, the tuner starting torque shall not exceed 14 inch-ounces.

20/ Unless otherwise specified, the acceptance level for all tests listed under Conformance inspection, part 1, shall be 1.0. This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.

21/ After a holding period of 48 hours, the anode voltage shall be applied 150 seconds minimum after the application of the standby heater voltage. The missing pulse count test interval of 3 minutes shall start immediately after the application of anode voltage.

22/ The frequency range F1 to F3 shall be traversed by a tuning shaft rotation of 160 ± 4 turns. A mechanical over-run of 3 turns minimum shall be provided at each end of the tuning range before contacting the mechanical stops.

23/ The frequency shall be the frequency of minimum power output between F1 and F3.

24/ The pushing factor shall be measured in a 4 ampere step, 24 A to 28 A, and shall not exceed the limits specified herein. The peak current through the tube shall alternately be the limits as specified under this test condition. These tests shall be run to exclude the effects of thermal drift and frequency not due to pushing.

25/ The frequency obtained by tuning to a given angular position in one direction shall be reproducible within the specified limits when returning to that same position from the opposite direction after thermal equilibrium.

26/ The life test shall be conducted while the phase of a 1.5:1 minimum VSWR is cycled through 180 electrical degrees minimum, approximately every 15 minutes. Simultaneously the tube frequency shall be cycled, or changed in 150 MHz increments, each 50 hours to insure approximately equal operating time over the entire frequency range from F1 to F3. After the required standby condition, the following test cycle shall apply:

Condition	Ib (mA dc)	Ef (V)	Duration (minutes)
Standby	0	13.75	10
Test condition 1	11	9.0	110

NOTE: The accumulated time shall include both high voltage and standby time.

27/ At each of the dial settings and under the operating conditions specified in 8/, the measured frequency shall not differ from the stated frequency by more than the amount specified when tuning is performed in the order of increasing the frequency.

28/ Each magnetron shall be tested at an RF output of 300 kW at 9.0 GHz with a pulse width of 0.3 µs, at duty cycles of 0.0003 and 0.0004. The magnetron shall be marked as follows:

Duty cycle	Ib (mA dc)
0.0003	---
0.0004	---

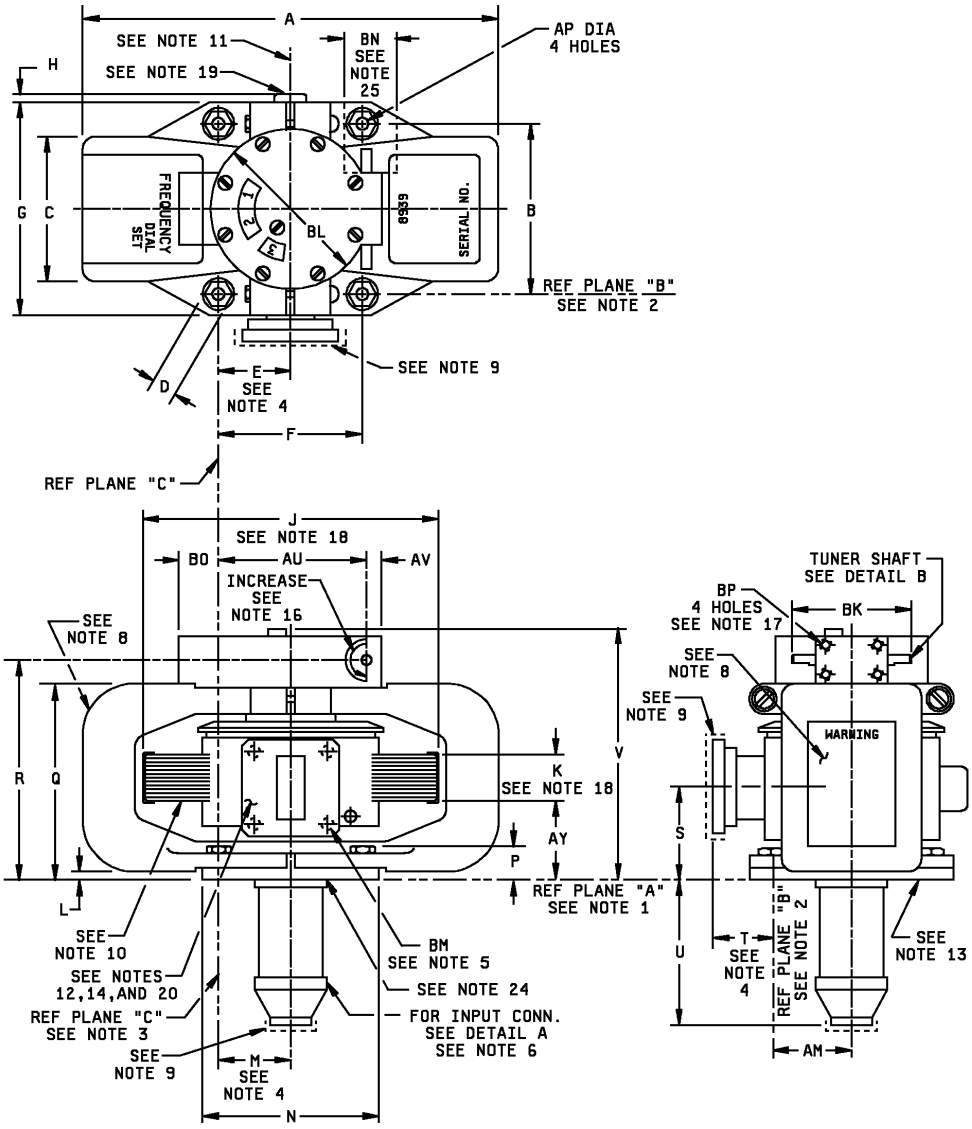

FIGURE 1. Outline drawing of electron tube type 8939.

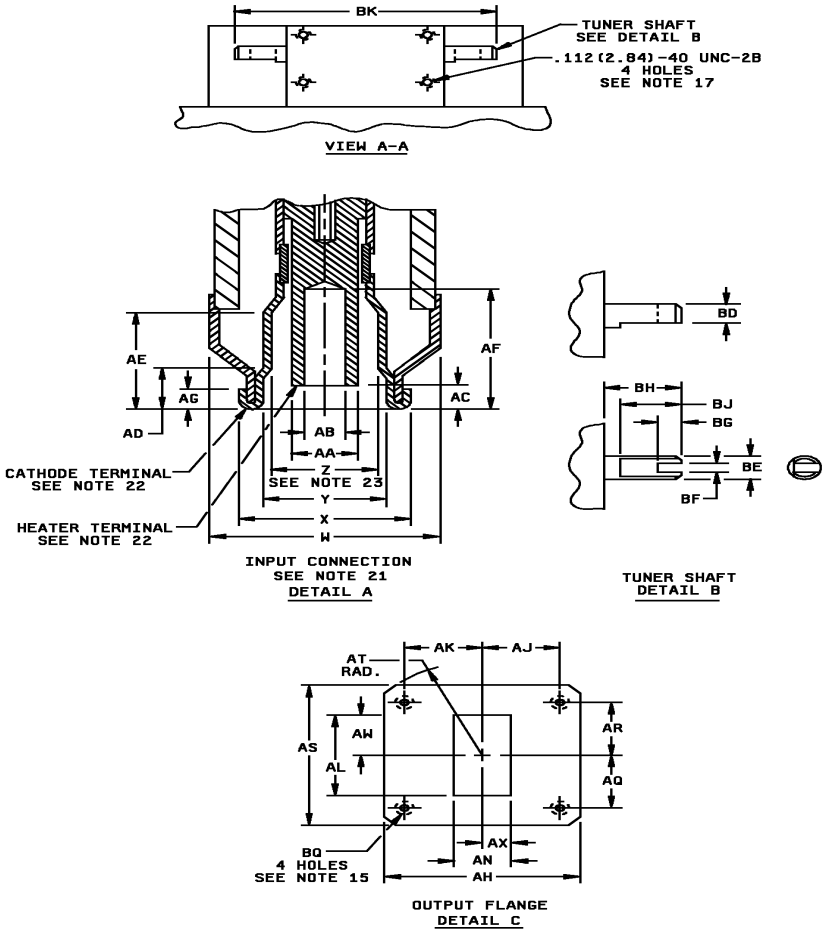

FIGURE 1. Outline drawing of electron tube type 8939 - Continued.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Qualification inspection				
A	---	9.400	---	238.76
C	---	2.780	---	70.61
D	.470	.530	11.94	13.46
L	.031	---	0.79	---
M	1.204	1.296	30.58	32.92
Q	---	3.900	---	99.06
V	---	5.000	---	127.00
Y	.603	.617	15.32	15.67
AD	---	.156	---	3.96
AE	.562	---	14.27	---
AG	.115	.135	2.92	3.43
AH	1.820	1.840	46.23	46.74
AL	1.119	1.125	28.42	28.58
AM	1.454	1.546	36.93	39.27
AN	.494	.500	12.55	12.70
AS	1.820	1.840	46.23	46.74
AV	.391	.421	9.93	10.69
AW	.5595	.5625	14.211	14.288
AX	.247	.250	6.27	6.35
BF	.038	.042	0.97	1.07
BG	.120	.130	3.05	3.30
BJ	.333	.353	8.46	8.97
Conformance inspection, part 1				
B	2.990	3.010	75.95	76.45
E	1.204	1.296	30.58	32.92
F	2.490	2.510	63.25	63.75
R	4.310	4.434	109.47	112.62
S	1.829	1.921	46.46	48.79
T	1.003	1.067	25.48	27.10
U	2.381	2.477	60.48	62.92
X	.825	.838	20.96	21.29
AC	.125	.187	3.18	4.75
AF	.750	---	19.05	---
AU	2.440	2.556	61.98	64.92
BH	.428	.448	10.87	11.38

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
W	1.062	1.125	26.97	28.58
Z	.532	.545	13.51	13.84
AA	.234	.266	5.94	6.76
AB	.164	.174	4.17	4.42
AJ	.735	.739	18.67	18.77
AK	.735	.739	18.67	18.77
AP	.276	.286	7.01	7.26
AQ	.674	.678	17.12	17.22
AR	.674	.678	17.12	17.22
BD	.153	.159	3.89	4.04
BE	.1855	.1885	4.712	4.788
BL	2.625	2.750	66.68	69.85
BN	.505	.525	12.83	13.34
BK	2.240	2.260	56.90	57.40
Nominal dimensions				
G	---	3.750	---	95.25
H	---	.297	---	7.54
J	---	5.400	---	137.16
K	---	1.200	---	30.48
N	---	3.390	---	86.11
P	---	.581	---	14.76
AT	---	1.150 RAD	---	29.21 RAD
AY	---	1.400	---	35.56
BM	4-40 NC X . 250 deep min		4-40 NC X 6.35 deep min	
BO	---	.800	---	20.32
BP	.112-40 UNC-2B		2.84-40 UNC-2B	
BQ	.164 -32 UNC 2B		4.17-32 UNC 2B	

FIGURE 1. Outline drawing of electron tube type 8939 - Continued.

NOTES:

1. Reference plane “A” is defined as a plane passing along the face of the mounting plate.
2. Reference plane “B” is defined as a plane perpendicular to plane “A” passing through the axis of the holes, as shown at reference plane “A”.
3. Reference plane “C” is defined as a plane mutually perpendicular to planes “A” and “B” passing through the axis of the holes, as shown at reference plane “A”.
4. Includes angular as well as lateral deviations. Dimension E is to centerline (℄) of waveguide and dimension M to ℄ of heater terminal.
5. Anode temperature to be measured at this point.
6. Input bushing temperature to be measured at this point.
7. For vibration of shock testing, the planes of testing shall be reference planes “A” - “B” - “C”.
8. WARNING: Maintain minimum clearance of 4 inches between magnet and magnetic materials (magnets, steel tools, and plates) Use no magnetic inspection tools.
9. Protective closure. To be removed before tube is used, and attached when the tube is not in use.
10. The inner laminations of the cooling fins are not painted. However, there may be an overspray protective paint.
11. Indicates direction of body cooling airflow.
12. Mates with modified choke flange, UG-52 B/U (MIL-DTL-3922/59) (clearance instead of threaded holes.)
13. With the tube mounted on the test fixture and with the specified air pressure applied so as to surround the entire input terminal beyond the magnetron mounting plate, the entire magnetron and fixture are to be submerged in water. No bubbles are allowed in a 1-minute interval. An equivalent test method to insure adequate air pressure containment is acceptable.
14. With the tube output flange clamped against a modified choke flange (UG-52 B/U) and using a gasket in accordance with A-A-55549, and with the specified air pressure applied to the interior of the waveguide, submerge entire tube and fixture in water. No bubbles are allowed in a 1-minute interval. An equivalent test method to insure adequate air pressure containment is acceptable.
15. A plane passing through the axis of two threaded holes perpendicular to the face of the output flange shall be parallel to planes “A” and “C” within .030 inch (0.76 mm).
16. The frequency increases as the tuner input shaft is driven in the direction indicated by the arrow.
17. The absence or presence of these holes does not impair serviceability of the tube.
18. This dimension refers to radiator fin size only.
19. Permanently attached protective closure for the exhaust tubulation of the tube will not restrict airflow nor impair serviceability of the tube.
20. The face of the waveguide flange shall be flat within .010 inch (0.25 mm) total indicator reading. The surface of this flange shall be of such a quality that a hermetic type seal can be effected.
21. Input connection mates with Jettron Products Inc., Hanover N. J. Connectors Catalog No. 90-006 and 90-030, or equivalent.
22. Heater terminal and cathode terminal shall be concentric within .010 inch (0.25 mm).
23. This diameter applies for length “AE” minus “AD”.

FIGURE 1. Outline drawing of electron tube type 8939 - Continued.

NOTES - Continued:

24. This identifies a north seeking pole. This may be tested by observing which compass needle points to the geographic south. The same compass needle will point toward the tube's north seeking pole when it is brought near the input stem of the tube. Care should be taken to insure that the tube field does not reverse the polarity of the compass.

25. This diameter identifies clearance area for mating shaft.

FIGURE 1. Outline drawing of electron tube type 8939 - Continued.

NOTES

Referenced documents. In addition to MIL-PRF-1, this specification sheet sheet references MIL-STD-1311, MIL-DTL-3922/59, and A-A-55549.

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 previous issue.

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

Preparing activity:
DLA - CC

(Project 5960-3752)

Review activities:
Army - AR
Navy - AS, MC, OS
Air Force - 99

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