INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON

TYPE 2J51A

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 MIL-PRF-1.

DESCRIPTION: Pulsed, mechanically tunable frequency 8,500 to 9,600 MHz, 45 kw peak power output, integral magnet, air cooled.

ABSOLUTE RATINGS:

Parameter: Unit:	Ef V	tpc μs	Du ---	tk sec	Pi W	ib a	VSWR ---	T(anode) °C	Tuner torque in.-lb.	Alt ft
Maximum: Minimum:	7.0 ---	3.4 0.1	0.0011 ---	--- 120	230 ---	15.5 12.5	1.5 ---	150 -55	2.5 ---	10,000 ---

PHYSICAL CHARACTERISTICS:

Dimensions:	See figure 1.	Marking:	See 1/ and figure 1.
Mounting position:	Any.	Magnet isolation:	See 3/ and figure 2.
Mounting support:	Mounting flange (see figure 1).	Weight:	5 pounds (approximate).
Output coupling:	See 2/ and figure 1.		

TEST CONDITIONS:

Parameter: Unit:	Ef V	tpc μs	trv μs (max)	Du ---	Ib mA dc	VSWR --- (max)	F MHz
Test condition 1: Test condition 2: Test condition 3:	0 5.0 0	1.0 ± 0.1 0.11 ± 0.01 3.50 ± 0.1	0.07 0.07 0.12	0.001 0.00033 0.0011	14 4.7 15.5	1.10:1 1.10:1 1.10:1	F1, F3, F5 F1, F3, F5 F1, F3, F5

Frequency 1/		
F	MHz	MHz
F1	8,500	10
F2	8,600	10
F3	9,000	10
F4	9,375	13
F5	9,600	20

See footnotes at the end of table I.

GENERAL:

Qualification - Required.

TABLE I. Testing and inspection.

Inspection	MIL-STD-1311 Method	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
Qualification inspection								
Barometric pressure, reduced	4028	---	1	F5; pressure = 380 mmHg	---	---	---	---
Temperature coefficient	4027	Fig 1 (17) and fig 2	1	F3; Ib = 10 mA dc; T(anode) = 70°C to 100°C; magnetic field, 4 shunts	$\frac{\Delta F}{\Delta T}$	---	0.25	MHz/°C
Low-temperature operation	1047	---	3	F5; Ib = 17.5 mA dc; VSWR = 1.5:1	---	---	---	---
Forced cooling	1143	12/	1	Pi-Po = 150 W; TA = 50°C (max)	T	---	TA +50	°C
Pulse voltage	4306	Fig 2	1	F3; magnetic field, 4 shunts	epy	9	11	kv
Vibration, mechanical	1032	13/ 14/	---	No voltages applied	---	---	---	---
Shock, specified pulse	1042	14/	---	Test condition A, except 15G; no voltages applied	---	---	---	---
Operating torque or force	4223	---	---	TA = -55°C to +125°C	---	---	2.0	in.-lb.
Direct-interelectrode capacitance	4266	---	---		C	4.0	8.0	pF
Mechanical tuning fatigue	4223	15/	---		---	2,500	---	Cycles
Voltage tuning	---	16/	1		∆epy	0	+1.5	kv
Tuning characteristics	---	11/	1		---	---	---	---
Conformance inspection, part 1		4/	---					
Pressurizing	4003	---	---	40 psia	---	---	---	---
Heater current, nonoperating	4289	---	---	Ef = 6.3 V; tk = 120 (max)	If	0.90	1.10	A
Pulse voltage	4306	---	3	F3	epy	13	15	kv
Power output (1)	4250	---	3		Po	44	---	W
Pulse stability (1)	4315	5/	3	Ib = 17.5 mA dc; VSWR = 1.5:1	MP	---	1.0	%

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	MIL-STD-1311 Method	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
Conformance inspection, part 2								
RF bandwidth	4308	6/	3	VSWR 1.5:1; Ib = 13.5 and 17.0 mA dc	BW	---	3.5/tpc	MHz
		6/	1	VSWR = 1.5:1; Ib = 12.5 and 15.5 mA dc	BW	---	2.5/tpc	MHz
		6/	2	Ib = 4.1 and 5.1 mA dc	BW	---	2.20/tpc	MHz
Minor lobe ratio	4308	6/	1	Ib = 12.5 and 15.5 mA dc	SL	6	---	dB
		6/	2	VSWR = 1.5:1; Ib = 4.1 and 5.1 mA dc	SL	8	---	dB
Power output	4250	7/	1	F1, F2, F3, F4, and F5	Po	40	---	W
		---	2	F3	Po	13	---	W
Mechanical tuning range	4223	---	1		F	8,500	9,600	MHz
Operating torque or force	4223	---	---	TA = 25°C ± 5°C	---	---	10	in.-oz.
Resettability	4223	---	1	F4	ΔF	---	10	MHz
Pulse stability (2)	4315	5/	2	VSWR = 1.5:1; Ib = 5.3 mA dc	MP	---	1.0	%
Frequency pulling figure	4310	8/	1		ΔF	---	18	MHz
Conformance inspection, part 3								
Intermittent life	4551	9/	---	Group D; VSWR = 1.5:1 (min); cycled through λg every 30 minutes (approximate)	--- t	250 500	--- ---	Cycles hrs
Intermittent life-test end points:	---							
Resettability	4223	10/	1	F4	ΔF	---	15	MHz
Power output (1)	4250	10/	3		Po	36	---	W
Pulse stability (2)	4315	5/ 10/	2	VSWR = 1.5:1; Ib = 5.3 mA dc	MP	---	2	%
Pulse stability (1)	4315	5/ 10/	3	VSWR = 1.5:1; Ib = 17.5 mA dc	MP	---	2	%
RF bandwidth	4308	6/	3	Ib = 13.5 and 17.0 mA dc	BW	---	4.2/tpc	MHz

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

1/ In addition to regular markings, the tuner dial readings for the following frequencies, with the exception of 9,000 MHz shall be stamped on the tube:

Frequency	Marking
8,500 ± 10 MHz	F1
8,600 ± 10 MHz	F2
9,000 ± 10 MHz	F3
9,375 ± 13 MHz	F4
9,600 ± 20 MHz	F5

These markings shall apply after thermal equilibrium under the conditions of test condition (3) at an anode temperature of 80°C ± 10°C. These frequency ranges shall be obtained by rotating the tuning dial gear in a continuously clockwise direction.

2/ The tube under test (TUT) may be coupled directly to a M85/1-073 waveguide with a M3922/59-007 choke flange. However, for a minimum VSWR at this coupling, it is recommended that a specially designed choke flange be used which mates with the angular M85/1-073 output of the tube to provide a straight section of M85/1-073 waveguide through the coupling network.

3/ In handling and mounting the tube, care shall be exercised to prevent demagnetization. Ferromagnetic materials or energized magnets shall not be brought within 2 inches (50.8 mm) of the tube.

4/ Unless otherwise specified, the acceptance level for all tests listed under conformance inspection, part 1, shall be 1.0. This specification uses an accept on zero (c = 0) sampling plan in accordance with MIL-PRF-1, TABLE III.

5/ The missing pulses (MP) shall be counted during the last 3 minutes of a test interval not to exceed 6 minutes. A missing pulse is defined as one whose energy within a ± 1 percent frequency range of the normal test frequency is 70 percent or less than that of a normal pulse.

6/ The rf bandwidth and minor lobes shall be within the limits specified when a VSWR of 1.5:1 is introduced in the load at a distance no greater than one-half meter from the TUT coupling flange, the phase being adjusted to a point to be determined by the tube manufacturer for the worst spectrum.

7/ This test shall be conducted at a sufficient number of frequencies to insure that power output is above the minimum value throughout the specified tuning range.

8/ The pulling measurement shall be made at the frequency of maximum power output. This frequency to be determined by the tube manufacturer.

9/ The life-test cycle shall be as specified below:

Test condition	Ib	Ef	Duration
Warm up	0	6.3	2 minutes
2	4.7	5.0	60 minutes
3	15.5	0	60 minutes
Off	0	0	58 minutes

Starting at F1, the frequency will be increased in 100 MHz increments every 10 hours.

10/ The TUT shall pass all applicable conformance inspection, parts 1 and 2, tests at the end of the specified life, with the condition that the criteria for acceptance be modified in accordance with the life-test end points, with accept on zero failures (c = 0).

11/ With the tuning dial adjusted for a frequency of 9,000 MHz, an operating frequency of 9,600 MHz shall be obtained by rotating the tuning shaft 64 ± 12 turns such that the large dial gear moves counterclockwise. A frequency of 8,500 MHz shall be attained by turning the shaft 47 ± 6 turns in the opposite direction from the 9,000 MHz setting.

12/ With an airflow at standard atmospheric pressure of 25 cfm directed at the cooling fins from an orifice of 1.172 inches (29.77 mm) and 1.359 inches (34.53 mm) the rise above ambient specified shall not be exceeded. The anode temperature shall be measured at that point indicated on figure 1. The ambient temperature shall be approximately 50°C. The orifice shall be located .25 inch (6.35 mm) from the cooling fins.

TABLE I. Testing and inspection - Continued.

13/ The TUT shall be vibrated at a frequency of 50 to 500 to 50 Hz during a 5-minute interval for each plane. The sinusoidal displacement shall be adjusted to maintain acceleration at 5G.

14/ At the conclusion of this test, the TUT shall meet the requirements of method 4250, power output (1) and method 4315, pulse stability (1).

15/ A cycle consists of two complete excursions each in opposite directions through the tuning range of the TUT. The tuning shaft shall be continuously driven at a speed of approximately 650 rpm. The TUT shall meet end-of-life requirements at completion of this test.

16/ The change in voltage required to maintain constant current shall be measured as the frequency is changed from F1, 8,500 MHz to F5, 9,600 MHz.

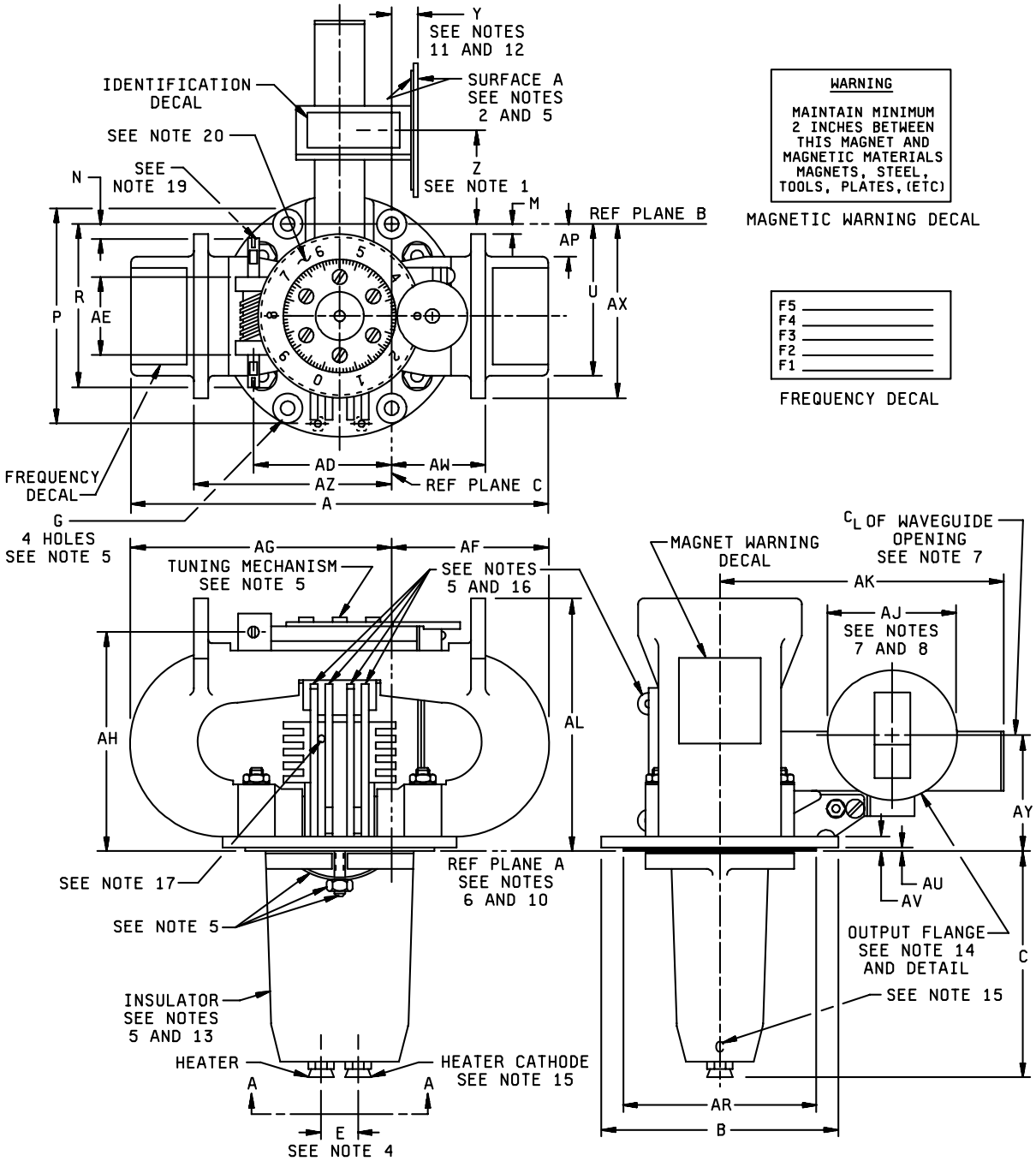


FIGURE 1. Outline drawing of electron tube type 2J51A.

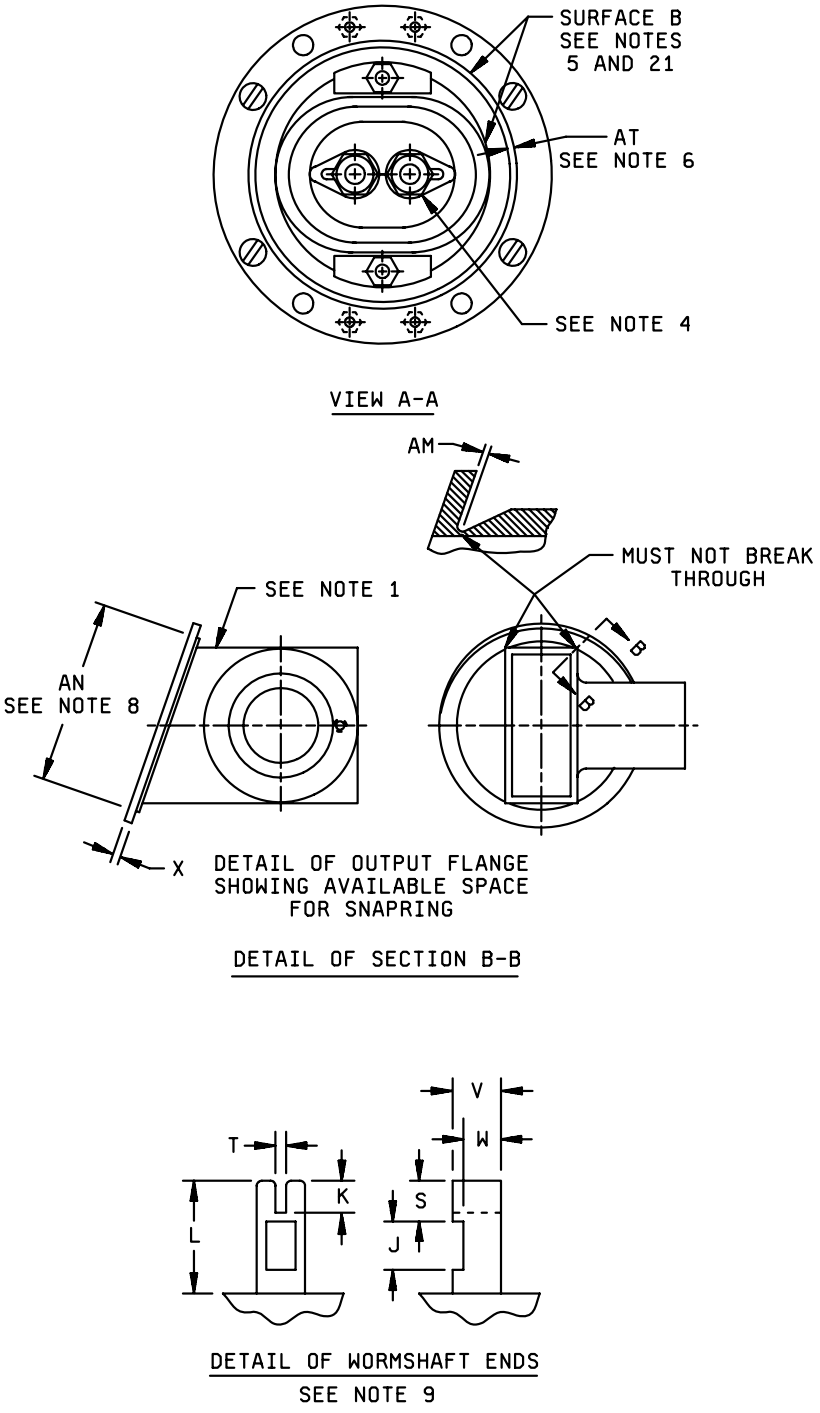


FIGURE 1. Outline drawing of electron tube type 2J51A - Continued.

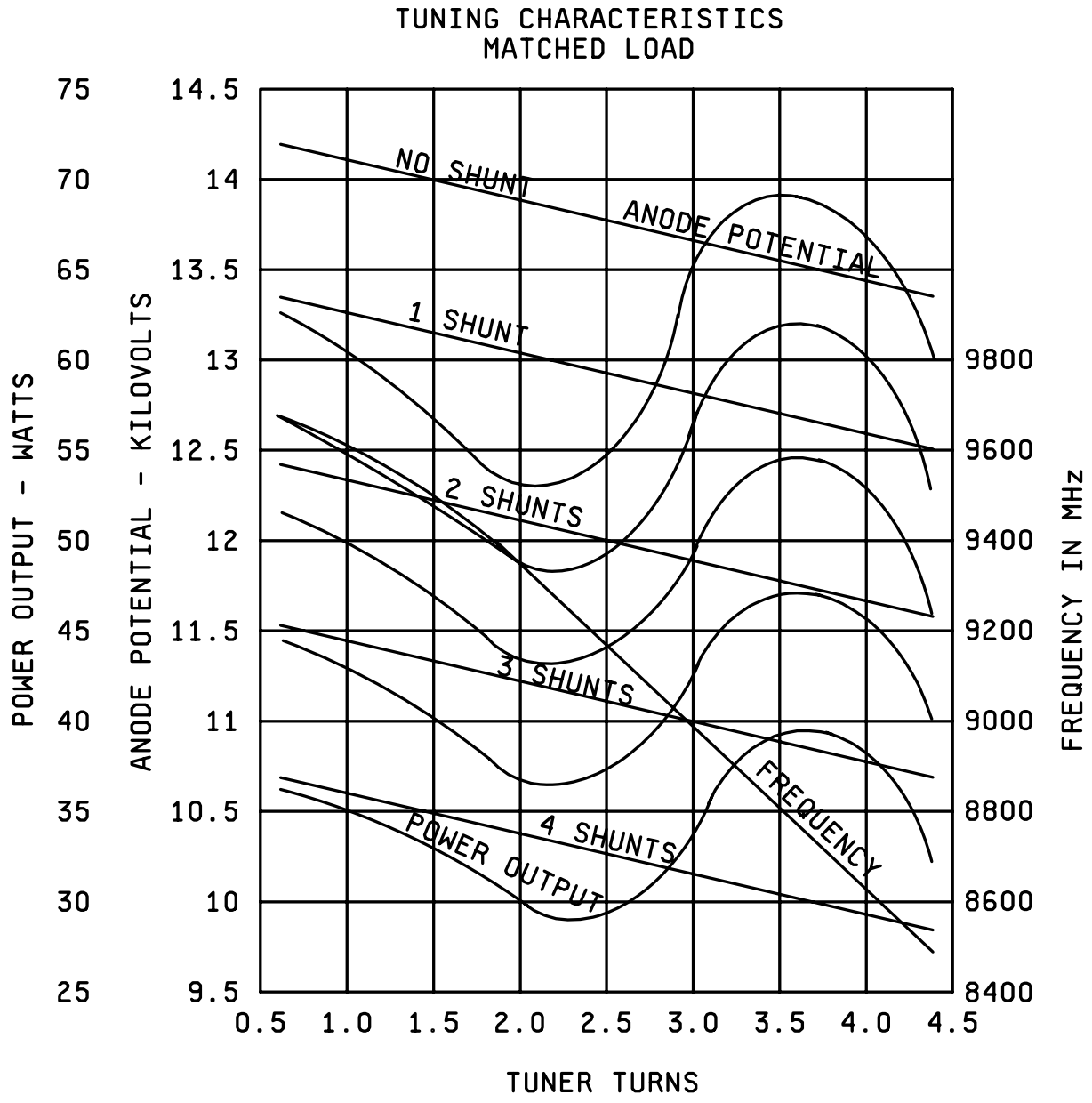
Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Qualification inspection				
W	.151	.161	3.84	4.09
X	.080	.090	2.03	2.29
AU	.023	.039	0.58	0.99
AV	.156	---	3.96	---
Conformance inspection, part 1 (see note 3)				
K	.115	.135	2.92	3.43
M	.042	---	1.07	---
N	.230	.290	5.84	7.37
R	2.105	2.165	53.47	54.99
Y	.261	.301	6.63	7.65
Z	1.173	1.213	29.79	30.81
AD	1.954	1.984	49.63	50.39
AE	.990	1.010	25.15	25.65
AH	2.834	2.874	71.98	73.00
AJ	1.743	1.757	44.27	44.63
AM	.021	.031	0.53	0.79
AN	1.438	1.446	36.53	36.73
AX	---	2.453	---	62.31
AY	1.542	1.582	39.17	40.18
Conformance inspection, part 2				
A	---	5.938	---	150.83
B	3.219	3.281	81.76	83.34
C	2.921	3.047	74.19	77.39
E	.490	.510	12.45	12.95
G	.190	.196	4.83	4.98
J	.188	.203	4.78	5.16
L	.428	.448	10.87	11.38
P	2.869	2.881	72.87	73.18
S	.141	.156	3.58	3.96
T	.040	.045	1.02	1.14
U	---	2.188	---	55.58
V	.187	.190	4.75	4.83
AF	---	2.250	---	57.15
AG	---	3.688	---	93.68
AK	---	3.906	---	99.21
AL	---	3.281	---	83.34
AP	.308	---	7.82	---
AR	2.620	2.630	66.55	66.80
AT	.057	.067	1.45	1.70
AW	---	1.344	---	34.14
AZ	---	2.781	---	70.64

FIGURE 1. Outline drawing of electron tube type 2J51A - Continued.

NOTES:

1. Section of waveguide M85/1-073.
2. Surface A shall provide hermetic seal with waveguide.
3. Unless otherwise specified, the acceptance levels for all tests listed under conformance inspection, part 1, and shall be 1.0. This specification uses an accept on zero (c = 0) sampling plan in accordance with MIL-PRF-1, TABLE III.
4. Jacks shall be locking type. Jack holes shall lie within .023 inch (0.58 mm) radius of specified location. Centerlines of holes shall be perpendicular to mounting plate within 3 degrees. Conformance inspection, part 2.
5. All metal surfaces shall be painted with heat-resistant, noncorrosive paint except surfaces A and B, tuning mechanism, parts associated with insulator, magnet shunts, four mounting holes G, and area included within .219 inch (5.56 mm) radius of center of each hole G (qualification inspection). Paint may be omitted from back of output flange.
6. With surface defined by dimension AT and reference plane A resting on a flat surface, a gauge .010 inch (0.25 mm) thick and .125 inch (3.18 mm) wide shall not enter between surfaces at any point. Conformance inspection, part 2.
7. Diameter AJ shall be concentric with waveguide opening within .010 inch (0.25 mm).
8. Diameters AJ and AN shall be concentric within .005 inch (0.13 mm).
9. A sleeve .195 inch (4.95 mm) inside diameter, .406 inch (10.31 mm) outside diameter, and 1.000 inch (25.40 mm) long shall pass over ends of shaft to face of worm bracket. Conformance inspection, part 2.
10. Any part of assembly which extends below surface defined by reference plane A shall lie within 1.109 inch (28.17 mm) radius of true center of mounting plate.
11. Tolerances include angular and lateral deviations.
12. Defines relationship between surface A and mounting holes G.
13. Insulator shall be pyrex glass or equal.
14. Protective cover shall be provided for output flange. Waveguide opening shall be kept covered when tube is not in use.
15. Common heater-cathode connection shall be identified by letter C.
16. Four magnet shunts. Number of shunts required shall be in accordance with applicable technical information. Unused shunts may be removed by gripping tabs with pliers and pulling away from tube.
17. Anode temperature shall be measured at this point.
18. Frequency markings F1, F2, F4, and F5 correspond with settings at 8,500, 8,600, 9,375, and 9,600 MHz, respectively.
19. Frequency is increased by turning this end of wormshaft in counterclockwise direction. Complete frequency range is covered in approximately 125 turns. Tuning mechanism shall operate smoothly over entire mechanical tuning range when subjected to torque of 10 inch-ounces applied to wormshaft. In equipments, not less than 10 inch-ounces nor more than 2.5 inch-pounds shall be applied to the drive shaft. Gear and worm threads shall be free from any obstruction.
20. Number which appears on geneva indicates number of complete revolutions of tuning gear from 0 to 4. With geneva and gear set at 3 and 0, respectively, frequency of tube is 9,000 $\pm$ 25 MHz under test condition 3.
21. Surface B shall provide hermetic seal with associated mounting surface.

FIGURE 1. Outline drawing of electron tube type 2J51A - Continued.



NOTES:

1. Tubes to be supplied with four magnetic shunts. Shunts may be removed as needed to establish various operating points.
2. The chart reveals the manner in which frequency, power output, and anode voltage vary with tuner position for five different gauss levels with a pulse repetition rate of 1,000 pps, a current pulse width of 1.0 microsecond, and a peak anode current of 14 amperes.

FIGURE 2. Frequency characteristics.

Referenced documents. In addition to MIL-PRF-1, this document references the following:
MIL-STD-1311

Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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

Preparing activity:
DLA - CC

(Project 5960-2008-022)

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 http://assist.daps.dla.mil.