

CV 5134

MIL-E-1/846G
9 March 1960
SUPERSEDED
MIL-E-1/846F
18 June 1957

MILITARY SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON

JAN-2J51A

This specification sheet forms a part of the latest issue of Military Specification MIL-E-1.

DESCRIPTION: Pulse type, 8,500 to 9,800 Mc mechanically tunable, 45 kw nominal peak power output, permanent magnet, air-cooled, unipotential cathode

ABSOLUTE RATINGS: SEE NOTE 1

<u>Independent</u>		Parameter:	Ef	tk	VSWR	Tuner torque	T (anode)	Alt
Unit:	V	sec	---	---	1.5	in.-lb	°C	ft
Maximum:	7.0	---	---	---	---	2.5	150	10,000
Minimum:	---	120	---	---	---	---	-56	---
					(see note 2)	(see note 3)		

<u>Dependent</u>		Parameter:	lb	Pi	Ef	Du	tpc		
Unit:	a	W	---	---	V	---	us	trv	
Maximum:	15.5	230	---	---	(see note 4)	0.0011	3.4	min	
Minimum:	12.5	---	---	---	---	---	0.1		

tpc	trv
us	min
3.4	0.12
1.0	0.08
0.1	0.08

STORAGE, HANDLING, AND INSTALLATION

Magnet isolation: See note 5
Vibration and shock: See note 6
Mounting position: Any
Mounting support: Mounting flange

Output coupling: See note 7
Input connections: See figure 1
Weight: Approx 5 pounds

PAR. NO.	TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	SYMBOL	LIMITS		UNIT
						Min	Max	
<u>General</u>								
3.1	Qualification	Required for JAN marking	---	---	---	---	---	---
3.6	Performance	(See note 8)	---	---	---	---	---	---
3.7	Marking	(See note 9)	---	---	---	---	---	---
4.5	Holding period	t = 168 hr	---	---	---	---	---	---
4.9.2	Dimensions	(See fig. 1)	---	---	---	---	---	---
<u>Qualification inspection (see note 10)</u>								
4.9.12	Low pressure	Osc (1); F5; pressure = 380 mmHg	---	---	---	---	---	---
4.9.14	Temperature coefficient	Osc (1); F3; magnetic field, 4 shunts; Ib = 10 mAdc; T (anode) = 70° to 100° C (see note 3)	---	---	ΔF/ΔT	---	0.25	Mc/°C
4.9.15.1	Low-temperature operation	Osc (3); F5; Ib = 17.5 mAdc; VSWR = 1.5	---	---	---	---	---	---
4.16.7	Stability	(See note 11)	---	---	MP	---	2.0	%

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PAR. NO.	TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	SYMBOL	LIMITS		UNIT
						Min	Max	
	<u>Qualification inspection</u> (see note 10) - Contd							
4.16.1	Air cooling	Osc (1); P _I -P _o = 150 W; T _A = 50° C max (see note 12)	---	---	T	---	T _A /50	°C
4.16.3.5	Pulse voltage	Osc (1); F3; magnetic field, 4 shunts	---	---	epy	9	11	kv
---	Variable-frequency vibration	No voltages (see note 13)	---	---	---	---	---	---
---	Shock test	G = 15 (see note 14)	---	---	---	---	---	---
---	Tuner drive torque	T _A = -55° C and +125° C	---	---	Torque	---	2.0	in.-lb
---	Anode-cathode capacity		---	---	C	4.0	8.0	uuf
---	Mechanical fatigue	(See note 15)	---	---	---	2,500	---	cycles
---	Voltage tuning	Osc (1) (see note 16)	---	---	Δepy	0	+1.5	kv
---	Tuning characteristics	Osc (1) (see note 17)	---	---	---	---	---	---
	<u>Acceptance inspection,</u> <u>part 1 (production)</u>							
4.9.13	Pressurizing	40 psi abs min	}	}	---	---	---	---
4.10.8	Heater current	E _f = 6.3 V; t _k = 180 max			II	0.9	1.1	A
4.16.3	Oscillation (3)	VSWR = 1.1 max except where noted			---	---	---	---
---	Magnetic field	No shunt			---	---	---	---
4.16.3.2	Heater-cathode Warmup time	t _k = 120 max at E _f = 6.3 V; E _f = 0 V for test			---	---	---	---
4.16.3.3	Pulse characteristics	t _{pc} = 3.4 to 3.6 us; D _u = 0.001; t _{rv} = 0.12 us max			---	---	---	---
4.16.3.4	Average anode current	I _b = 16.5 mAdc			---	---	---	---
4.16.3.5	Pulse voltage	F3			epy	13	15	kv
4.16.3.6	Power output	VSWR = 1.1 max; F1; F3; F5			P _o	44	---	W
4.16.7	Stability	I _b = 17.5 mAdc; F1; F3; F5; VSWR = 1.5 (see note 11)			MP	---	1	%
	<u>Acceptance inspection,</u> <u>part 2 (design)</u>							
---	Spectrum measurements	Osc (3); VSWR = 1.5; I _b = 13.5 and 17.0 mAdc (see note 19)	---	---	---	---	---	---
4.16.3.7	RF bandwidth	F1; F3; and F5 (see note 20)	6.5	L6	BW	---	1.0	Mc
---	Tuner drive torque	T = approx 25° C	6.5	L6	Torque	---	10	in.-oz

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PAR. NO.	TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	SYMBOL	LIMITS		UNIT
						Min	Max	
	<u>Acceptance inspection, part 2 (design) - Contd</u>							
4.16.3	Oscillation (1)	VSWR = 1.1 max except where noted	---	---	---	---	---	---
---	Magnetic field	No shunts except as noted	---	---	---	---	---	---
4.16.3.2	Heater-cathode warmup time	tk = 120 max at Ef = 6.3 V Ef = 0 V for test	---	---	---	---	---	---
4.16.3.3	Pulse characteristics	tpc = 0.9 to 1.1 us; Du = 0.001; trv = 0.07 us max	---	---	---	---	---	---
4.16.3.4	Average anode current	Ib = 14 mAdc	---	---	---	---	---	---
4.16.3.6	Power output	F1; F2; F3; F4; and F5 (see note 21)	6.5	L6	Po	40	---	W
---	Tunable frequency		6.5	L6	F	8,500	9,600	Mc
---	Spectrum measurements	VSWR = 1.5; Ib = 12.5 and 15.5 mAdc (see note 19)	---	---	---	---	---	---
4.16.3.7	RF bandwidth	F1; F3; F5	6.5	L6	BW	---	2.5	Mc
---	Minor lobes	F1; F3; F5	6.5	L6	Ratio	8	---	db
4.16.5	Pulling factor	(See note 22)	6.5	L6	ΔF	---	18	Mc
---	Backlash	F4 (see note 23)	6.5	L6	ΔF	---	10	Mc
4.16.3	Oscillation (2)	VSWR = 1.1 max except where noted	---	---	---	---	---	---
---	Magnetic field	No shunt	---	---	---	---	---	---
4.16.3.2	Heater-cathode warmup time	tk = 120 max at Ef = 6.3 V; Ef = 5.0 V for test	---	---	---	---	---	---
4.16.3.3	Pulse characteristics	tpc = 0.1 to 0.12 us; Du = 0.00033; trv = 0.07 max	---	---	---	---	---	---
4.16.3.4	Average anode current	4.7 mAdc	---	---	---	---	---	---
4.16.3.6	Power output	F3	6.5	L6	Po	13	---	W
---	Spectrum measurements	VSWR = 1.5; Ib = 4.1 and 5.1 mAdc (see note 19)	---	---	---	---	---	---
4.16.3.7	RF bandwidth	F1; F3; F5	6.5	L6	BW	---	20	Mc
---	Minor lobes	F1; F3; F5	6.5	L6	Ratio	8	---	db
4.16.7	Stability	Ib = 5.3 mAdc; F1; F3; F5; VSWR = 1.5 (see note 11)	6.5	L6	MP	---	1.0	%
	<u>Acceptance inspection, part 3 (life)</u>							
4.11 and 4.11.3.2	Intermittent life test	Group D; VSWR = 1.5 min cycled through λ_g in about 30 minutes; starting at 8,500 Mc the frequency will be increased in 100 Mc increments each 10 hours	---	---	---	250	---	Cycles

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PAR. NO.	TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	SYMBOL	LIMITS		UNIT
						Min	Max	
---	<u>Acceptance inspection, part 3 (life) - Contd</u>							
---	Life-test cycle	Condition Ib Ef Duration Standby 0 6.3 2 min Osc (2) 4.7 5.0 60 min Osc (3) 15.5 0 60 min Off 0 0 58 min	---	---	---	---	---	---
4.11.4	Life-test end point	(See note 24)	---	---	---	---	---	---
---	Backlash	Osc (1); F4 (see note 23)	---	---	ΔF	---	15	Mc
4.16.3.6	Power output	Osc (3); F1; F3; and F5	---	---	Po	36	---	W
4.16.7	Stability	Osc (2); Ib = 5.3 mAdc; F1; F3; and F5; VSWR = 1.5 (see note 11)	---	---	MP	---	2	%
4.16.7	Stability	Osc (3); Ib = 17.5 mAdc; F1; F3; and F5 (see note 11)	---	---	MP	---	2	%
4.16.3.7	RF bandwidth	Ib = 13.5 and 17.0 mAdc; F1; F3; F5 (see note 19)	---	---	BW	---	1.2	Mc
4.9.18 and 4.9.18.1.8	Container drop	Required						
5.	Preparation for delivery	(See note 25)						

NOTES:

1. For the assistance of designers of electronic equipment, the absolute ratings have been divided into two groups as follows:
 - a. Independent. These ratings must not be exceeded. They are limiting values beyond which the serviceability of any individual tube may be impaired.
 - b. Dependent. These ratings are interrelated, and it does not necessarily follow that combinations of limits can be attained simultaneously.

The tube manufacturer, through the appropriate service, should be consulted regarding details of application.
2. Frequency skipping or unstable operation may be encountered at some phase positions when the mismatch occurs at the end of a long line.
3. The temperature shall be measured at the point indicated on figure 1.
4. The heater voltage must be reduced during operation after the application of high voltage. For values of average power input greater than 150 watts, heater voltage shall be zero. For input powers less than 150 watts, the voltage shall be adjusted as recommended by manufacturer. Prior to application of high voltage, the heater voltage shall be 6.3 ±10 percent for a minimum of 2 minutes.
5. In handling and mounting the magnetron, care must be exercised to prevent demagnetization. Ferromagnetic materials or energized magnets shall not be brought within 2 inches of the tube.
6. Reasonable care shall be used in storage, installations, and use of the tube to avoid imparting vibration or shock in excess of the values for which the tube is designed to withstand.
7. The magnetron may be coupled directly to RG-51/U waveguide with a UG-52/AU 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 RG-51/U output of the magnetron to provide a straight section of RG-51/U waveguide through the coupling network.
8. Salt spray (corrosion), 4.9.8, is not applicable.

NOTES:
Cont'd

9.

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

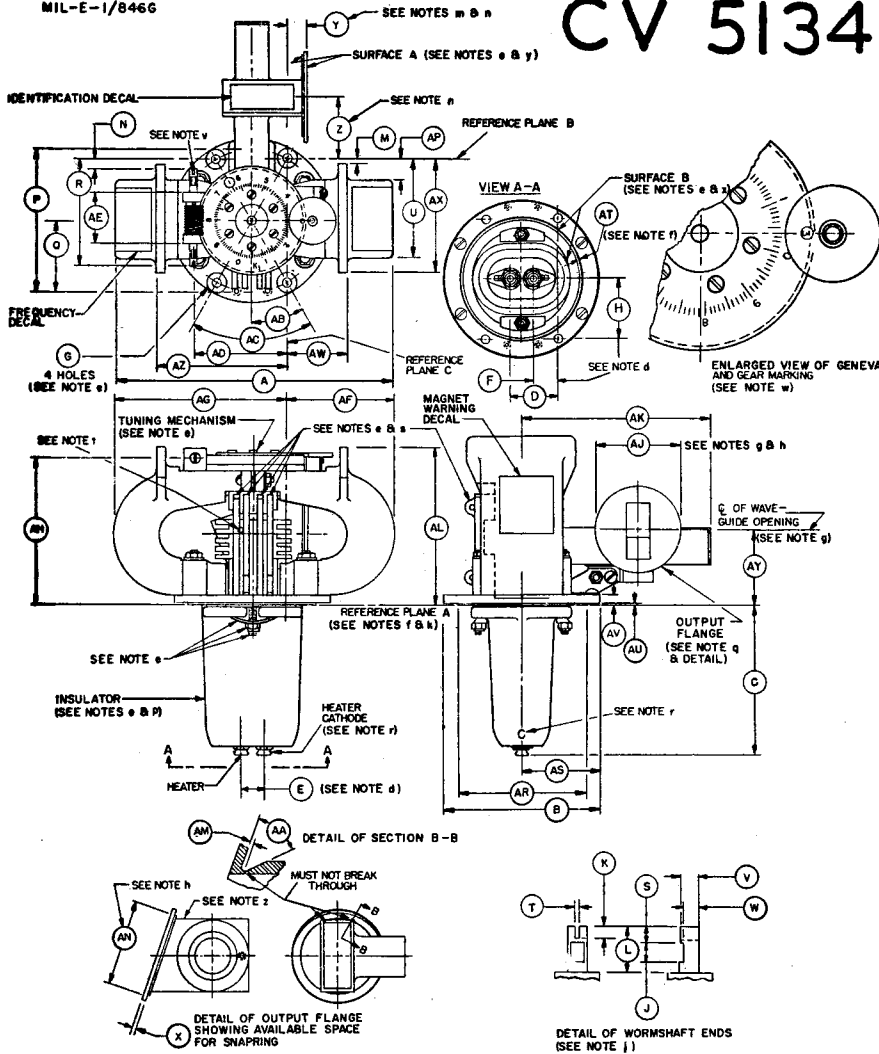
<u>Frequency</u>	<u>Marking</u>
8,500 $\frac{10}{10}$ Mc	F1
8,600 $\frac{10}{10}$ Mc	F2
9,000 $\frac{10}{10}$ Mc	F3
9,375 $\frac{13}{13}$ Mc	F4
9,600 $\frac{20}{20}$ Mc	F5.

These markings shall apply after thermal equilibrium under the Conditions of Osc (3) at an anode temperature of 80 $\frac{10}{10}$ ° C. These frequency ranges shall be obtained by rotating the tuning dial gear in a continuously clockwise direction.

10. All tests listed hereon shall be performed during qualification inspection; however, these 12 tests are normally performed during qualification inspection only.
11. Stability shall be measured with a VSWR adjusted to that phase determined by the tube manufacturer which produces maximum instability. 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 $\frac{1}{2}$ percent frequency range of the normal test frequency is 70 percent or less than that of a normal pulse.
12. With an air flow at standard atmospheric pressure of 25 cfm directed at the cooling fins from an orifice of 1-11/64 and 1-23/64 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 1/4 inch from the cooling fins.
13. The magnetron shall be vibrated in each of three mutually perpendicular planes with a frequency of 50 to 500 to 50 cycles per second during a 5-minute interval for each plane. The sinusoidal displacement shall be adjusted to maintain acceleration at 5 G.
14. The magnetron shall be mounted on a test plate and dropped 10 times on each of 3 mutually perpendicular planes parallel to the reference planes shown on figure 1. The shock pulse shall have a duration of approximately 11 milli-seconds as measured at the quarter amplitude points.
15. A cycle consists of two complete excursions each in opposite directions through the tuning range of the magnetrons. The tuning shaft shall be continuously driven at a speed of approximately 850 rpm. The tube 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 Mc to F5, 9,600 Mc.
17. With the tuning dial adjusted for a frequency of 9,000 Mc, an operating frequency of 9,600 Mc shall be obtained by rotating the tuning shaft 64 $\frac{12}{12}$ turns such that the large dial gear moves counterclockwise. A frequency of 8,500 Mc shall be attained by turning the shaft 47 $\frac{8}{8}$ turns in the opposite direction from the 9,000-Mc setting.
18. The AQL for the combined defectives for attributes in acceptance inspection, part 1 (production), excluding inoperatives and mechanical, shall be 1 percent.
19. The rf bandwidth and minor lobes shall be within the limits specified when a VSWR of 1.5 is introduced in the load at a distance no greater than 1/2 meter from the magnetron coupling flange, the phase being adjusted at a point to be determined by the tube manufacturer for the worst spectrum.
20. This test shall be performed at the conclusion of the holding period.
21. 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.
22. The pulling measurement shall be made at the frequency of maximum power output. This frequency to be determined by the tube manufacturer.
23. The frequency obtained by turning the tuning dial to a given setting in one direction shall be reproducible when returning to the same setting from the opposite direction to within the specified value.
24. The tube shall pass all applicable production and design tests at the end of the specified life, with the condition that the criteria for acceptance be modified in accordance with life-test end points listed.
25. Tubes shall be inclosed in a moisture-vaporproof barrier and prepared for domestic or overseas shipment, as specified in the contract or order, in accordance with Specification MIL-E-75/9. Rough handling (container drop) test (i) and container size D shall apply.
26. Referenced documents shall be of the issue in effect on the date of invitation for bids.

Preparing activity:
Navy - Bureau of Ships
(Project 5960-0789)
Custodians:
Army - Signal Corps
Navy - Bureau of Ships
Air Force

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WARNING
 MAINTAIN MINIMUM
 2 INCHES BETWEEN
 THIS MAGNET AND
 MAGNETIC MATERIALS
 MAGNETS, STEEL,
 TOOLS, PLATES, (ETC)

MAGNETIC WARNING DECAL

F5 _____
 F4 _____
 F3 _____
 F2 _____
 F1 _____

FREQUENCY DECAL

Figure 1. Outline drawing.

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DIM.	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	LIMITS	
			Min	Max
QUALIFICATION INSPECTION				
W	---	---	0.151	0.161
X	---	---	0.080	0.090
AU	---	---	0.023	0.039
AV	---	---	0.156	---
ACCEPTANCE INSPECTION, PART 1 (PRODUCTION)				
K			0.115	0.135
M			0.042	---
N			0.230	0.290
R			2.105	2.165
Y			0.261	0.301
Z			1.173	1.213
AD	> (See note c)	> I	1.954	1.984
AE			0.990	1.010
AH			2.834	2.874
AJ			1.743 dia	1.757 dia
AM			0.021	0.031
AN			1.438 dia	1.446 dia
AX			---	2.453
AY			1.542	1.582
ACCEPTANCE INSPECTION, PART 2 (DESIGN)				
A			---	5.938
B			3.219 dia	3.281 dia
C			2.921	3.047
E			0.490	0.510
G			0.190 dia	0.196 dia
J			0.188	0.203
L			0.428	0.448
P			2.869	2.881
S			0.141	0.156
T	> 6.5	> L6	0.040	0.045
U			---	2.188
V			0.187 dia	0.190 dia
AF			---	2.250
AG			---	3.688
AK			---	3.906
AL			---	3.281
AP			0.308	---
AR			2.620 dia	2.630 dia
AT			0.057	0.067
AW			---	1.344
AZ			---	2.781
NOMINAL DIMENSIONS (SEE NOTE b)				
D			0.969	
F			0.469	
H			1.245	
Q			1.438	
AA			45°	
AB			30°	
AC			60° 12'	
AS			1.625 R	

Figure 1. Outlines drawing. - (continued)

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NOTES:

- a. All dimensions in inches, unless otherwise specified.
- b. Dimensions without tolerances are for information and are not required for inspection purposes.
- c. The AQL for the combined mechanical defectives in acceptance inspection, part 1 (production), shall be 1 percent.
- d. Jacks shall be locking type as illustrated in Specification MIL-E-1. Jack holes shall lie within 0.023 radius of specified location. Centerlines of holes shall be perpendicular to mounting plate within 3°. Acceptance inspection, part 2 (design), required.
- e. All metal surfaces shall be painted within 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 7/32 radius of center of each hole G. Qualification inspection required. Paint may be omitted from back of output flange.
- f. With surface defined by dimension AT and reference plane A resting on a flat surface, a gage 0.010 thick and 1/8 wide shall not enter between surfaces at any point. Acceptance inspection, part 2 (design), required.
- g. Diameter AJ shall be concentric with waveguide opening within 0.010.
- h. Diameters AJ and AN shall be concentric within 0.005.
- j. A sleeve 0.195 inside diameter, 0.406 outside diameter, and 1.000 long shall pass over ends of shaft to face of worm bracket. Acceptance inspection, part 2 (design), required.
- k. Any part of assembly which extends below surface defined by reference plane A shall lie within 1-7/64 radius of true center of mounting plate.
- m. Tolerances include angular and lateral deviations.
- n. Defines relationship between surface A and mounting holes G.
- p. Insulator shall be Pyrex glass, or approved equivalent.
- q. Protective cover shall be provided for output flange. Waveguide opening shall be kept covered when tube is not in use.
- r. Common heater-cathode connection shall be identified by letter C.
- s. 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.
- t. Anode temperature shall be measured at this point.
- u. Frequency markings F1, F2, F4, and F5 correspond with the settings at 8,500, 8,600, 9,375, and 9,600, respectively.
- v. 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 2-1/2 inch-pounds shall be applied to the drive shaft. Gear and worm threads shall be free from any obstruction.
- w. 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±25 Mc under oscillation (3).
- x. Surface B shall provide hermetic seal with associated mounting surface.
- y. Surface A shall provide hermetic seal with waveguide.
- z. Section of waveguide RG-51/U.

Figure 1. Outline drawing. - (continued)

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