INCH-POUND
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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, NEGATIVE GRID (MICROWAVE) TYPE 7211

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: Triode, planar, ceramic and metal.
See figure 1.
Mounting position: Any.
Weight: 2.5 ounces nominal.

ABSOLUTE RATINGS:

Parameter: Unit:	F1 MHz	Ef V 1/	Eb V dc	eb v	epy kv	Ec V dc	Ik mA dc	Ib mA dc	ib a	Ic mA dc	ic a
Maximum:											
CW osc or amp:	2,500	6.3 ±5%	1,000	---	---	-150	190	---	---	45	---
Anode mod CW osc or amp:	2,500	6.3 ±5%	---	1,200 2/	---	-150	190	---	---	45	---
Anode pulsed osc or amp:	3,000	6.3 ±5%	---	---	3.5	-150	---	---	5.0 3/	---	2.5
Grid pulsed osc or amp:	3,000	6.3 ±5%	2,500	---	---	-150	---	---	5.0 3/	---	2.5
Test condition:	---	6.3	1,000	---	---	Adj	---	100	---	---	---

Parameter: Unit:	tp µs	Du ---	Pp W	Pg W 4/	tk sec (min)	TE °C 5/	T (anode shank) °C (see 5/ and note 5 of figure 1)	Cooling --- 8/	Barometric pressure, reduced mmHg 6/
Maximum:									
CW osc or amp:	---	---	100	2.0	60 25/	250	250	---	35
Anode mod CW osc or amp:	---	---	100	2.0	60	250	250	---	35
Anode pulsed osc or amp:	6.0	0.0033	100	2.0	60	250	250	---	---
Grid pulsed osc or amp:	6.0	0.0033	100	2.0	60	250	250	---	35
Test condition:	---	---	---	---	300	---	---	9/	---

GENERAL:

Qualification - Required.

Holding period (MIL-STD-1311) t = 72 hours.

This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.

TABLE I. Testing and inspection.

Inspection	Method MIL-STD-1311	Conditions	Symbol	Limits		Unit
				Min	Max	
Conformance inspection, part 1						
Heater current	1301		If	1.20	1.40	A
Electrode (1) voltage (grid)	1261	10/	Ec	-6.0	-12.0	V dc
Total grid current	1266	7/ 10/	Ic	---	-8.0	μA dc
Insulation of electrodes	1211	Eb = Ek = 0; Ec = -500 V dc	R	50	---	MegΩ
Pulsing emission	1231	prr = 600 pps (max) tp = 3 μs (max); eb = ec = etd/is = 10 a	etd	---	180	v
Current division	1372	Eb = 160 V dc; Ec = -10 V dc to -150 V dc egk/ib = 500 mA	egk ic	10.0 130	18.0 270	v mA
Conformance inspection, part 2						
Electrode (2) voltage (grid)	1261	Ec/Ib = 1.0 mA dc	Ec	---	-30	V dc
Direct-interelectrode capacitance	1331	Use fixture in accordance with Drawing 158-JAN 11/	Cin Cgp Cout	7.00 2.10 ---	9.00 2.40 0.06	pF pF pF
Resonance	---	No voltage applied 11/ 12/	---	---	---	---
Power oscillation	1236	F = 2,500 MHz (min); Ef = 5.0 V; Ib = 140 mA dc 11/ 13/	Po	18	---	W (useful)
Power oscillation (pulse)	1236	F = 3,000 MHz (min); epy = 3.5 kv; Ec = -1.5 V (min); Ef = 5.8 V; Rg/Ib = 12 mA dc 11/ 14/	Po	6.0	---	W (useful)
Power gain (pulse)	---	F = 1,100 ± 50 MHz; Ebb = 2,200 V dc; Ecc = -50 V dc; tp = 3 μs (min); Du = 0.002 (min); pd = 400 w 15/	po	1.8	---	kw

See footnotes at end of table I.

TABLE I. Testing and inspection - Continued.

Inspection	Method MIL-STD-1311	Conditions	Symbol	Limits		Unit
				Min	Max	
Conformance inspection, part 2 - Continued						
Power gain (CW)	---	F = 700 MHz (min); Eb = 630 V dc; Ef = 5.6 V; Pd = 4.0 Watts; Rg/Ic = 40 mA dc (max); Ik = 140 mA dc (max) 11/ 23/	Po	38.0	---	W (useful)
Grid distortion	---	11/ 24/	ΔF	---	+2.0 -11.0	MHz
Conformance inspection, part 3						
Life-test (1) provisions	---	Group B; Ef = 6.3 V ac; filament standby 21/	t	500	---	hrs
Life-test (1) end point	---	21/	Δib	---	25	%
Life-test (2) provisions	---	Group C; heater cycling; 2 minutes on Ef = 6.3 V; 5 minutes off Ef = 0 V; no other voltages applied.	Cycles	1,000	---	---
Life-test (2) end points	---	Heater current	If	1.15	1.45	A
Periodic-check tests						
Variable-frequency vibration	1032	F = 55 to 500 to 55 Hz; accel = 10 G peak (min); Ec/Ib = 10 mA dc; Rp = 10,000 ohms; Ebb = 300 V dc 11/ 16/ 17/	Ep	---	250	mV ac
Torque	---	No voltages applied 11/ 16/ 18/	---	---	---	---
Torque test end point	---	Total grid current	Ic	---	-10	μA dc
Shock	1042	Condition A; method 213; MIL-STD-202 11/ 16/ 19/	---	---	---	----
Shock-test end point	---	Total grid current	Ic	---	-10	μA dc
Barometric pressure, reduced	---	Pressure = 35 mmHg (max); voltage = 2,000 V ac; TA = 30°C ± 10°C 16/ 20/	---	---	---	---

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

1/ The transit time heating effect of the cathode shall be compensated for by a reduction in heater voltage after dynamic operation of the tube has started. The back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage that will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ± 5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz. Where emphasis is placed on long and reliable life, the heater voltage can safely be lowered to 6.0 volts, providing the line voltage is regulated to ± 2 percent or better.

2/ 1,200 volts is at the crest of the audio wave.

3/ The regulation, or series anode supply impedance, or both, shall limit the instantaneous peak current, with the tube considered as a short circuit, to a maximum of 10 times the specified maximum current rating.

4/ The maximum instantaneous peak grid voltage for CW ratings shall be within the range of +30 to -400 volts. The maximum instantaneous peak grid voltage for grid-pulse conditions shall be within the range of +250 to -750 volts.

5/ Sufficient conduction, convection, and forced-air cooling shall be provided to limit the envelope and anode shank temperatures to the specified maximum value under all operating conditions. Reliability shall be seriously impaired if this maximum is exceeded. Where emphasis is placed on long and reliable life, lower temperatures shall be maintained.

6/ Operation at this altitude is possible in a suitably designed circuit.

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

8/ Sufficient conduction or convection cooling, or both, shall be provided for all seals to limit temperatures in accordance with 5/. For anode cooling, an airflow of 12.5 cfm minimum should be supplied at sea level with air at 25°C maximum, directed with a cowl as shown on Drawing 157-JAN. Where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

9/ In all electrical tests involving application of heater voltage, sufficient conduction or convection cooling, or both, may be provided for all seals to limit temperatures. Unless otherwise specified, an airflow of 12.5 cfm maximum (at sea level, with air at 25°C) may be supplied for anode cooling. The use of the cowl as shown on Drawing 157-JAN is permissible.

10/ Airflow through the anode radiator shall be between 3.5 and 4.0 cfm with the cowl as shown on Drawing 157-JAN. The grid current shall be measured not less than 5 minutes after the anode dissipation has been set at 100 watts.

11/ Other tube contact configurations may be used provided the tube contact area remains unchanged and the socket, jig, or cavity gives equal performance. Mounting of the socket, jig, or cavity may be at the option of the manufacturer.

TABLE I. Testing and inspection - Continued.

12/ Grid-anode resonance. Test in cavity in accordance with Drawing 278-JAN. Cavity shall resonate at 1,354 ± 2 MHz with tuning slug in accordance with Drawing 277-JAN at TA = 25°C ± 5°C.

Grid-cathode resonance. Test in cavity in accordance with Drawing 283-JAN. Cavity shall resonate at 1,719 ± 2 MHz with tuning slug in accordance with Drawing 277-JAN at TA = 25°C ± 5°C.

When plotted on graphs of resonant frequency versus grid-anode capacitance and resonant frequency versus grid-cathode (input) capacitance, the tube under test (TUT) shall be represented by a point within a parallelogram whose four corners are located by the following points:

Points	Capacitance (pF)		Frequency (MHz)	
	Cgp	Cgk	Fgp	Fgk
1	2.10	7.0	1,935	1,765
2	2.10	7.0	1,965	1,795
3	2.40	9.0	1,870	1,725
4	2.40	9.0	1,900	1,755

13/ Test to be made in cavity in accordance with Drawing 160-JAN. The cavity shall be connected to a load with a VSWR less than 1.5/1. The oscillator output coupling and the grid or cathode resistor, or both, may be adjusted for maximum power output.

14/ The applied voltage pulse shall be measured with a noninductive resistor of 1,150 ohms ± 2 percent inserted in place of the tube. The pulse shape shall be: tp = 3.0 μs ± 10 percent, tr = 0.4 μs maximum, and tf = 0.7 μs maximum. The pulse repetition rate shall be adjusted so that Du = 0.0025 ± 5 percent with the above measured pulse length. Test in cavity in accordance with Drawing 279-JAN. The cavity shall be connected to a load with a VSWR less than 1.5/1. The oscillator output coupling and the grid or cathode resistor may be adjusted for maximum power output.

15/ Test to be conducted in power amplifier cavity as shown on Fidelitone Microwave Inc., Drawing JVM-D9819, or equivalent. Driving power is defined as the net power delivered to the amplifier cavity input terminals and the reflected power shall be subtracted from the incident power to obtain the net driving power. The output tuning shall be adjusted for maximum power output.

16/ This test shall be performed during the initial production and once each succeeding 12-calendar month period in which there is production. In the event of failure, the test shall be made as a part of conformance inspection, part 2. The regular “12 calendar month” sampling plan shall be reinstated after three consecutive samples have been accepted.

17/ The tube shall be mounted in the socket in accordance with Drawing 276-JAN and vibrated with simple harmonic motion. The peak acceleration over the frequency range shall be within ± 20 percent of the reference acceleration at 100 Hz. The frequency shall vary from 55 to 500 Hz and return to 55 Hz with approximate logarithmic progression and shall require 4 minutes minimum, 6 minutes maximum, to traverse the range. Each tube shall be vibrated for 30 minutes in each axis X and Z except that if the cumulative result of test on 50 or more tubes of a construction show that more than 75 percent of the tubes have a higher output voltage in one axis, subsequent measurements need to be taken only in the axis giving the higher readings. The voltages specified herein shall be applied to the tube during vibration. The value of the alternating voltage Ep, produced across the resistor Rp as a result of vibration, shall be measured with a suitable device. This device shall have an appropriate voltage range and shall have the ability to measure, with an error less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 20,000 Hz. The value of the vibration output, Ep, shall not exceed the limit specified herein at any point in the sweep frequency range during the last complete cycle of cycling vibration.

TABLE I. Testing and inspection - Continued.

18/ The torque test shall be performed as follows:

a. The tube shall be held securely at the cathode connections. A force of 5 pounds shall be applied to the heater cup without perceptible shock. This test may be made by applying the force at right angles to the inside of the cup at a point 7/64-inch (2.77 mm) ± 1/64-inch (0.41 mm) from the cathode end of the tube. An approved equivalent method may be used. The heater cup shall not loosen or short circuit to the cathode connection. This part of the test shall not be required if the space between the heater cup and the cathode sleeve is completely filled with insulating material.

b. A torque of 15 inch-pounds shall be applied between anode and cathode without shock.

c. A torque of 40 inch-pounds shall be applied between anode and grid without shock.

d. A torque of 30 inch-pounds shall be applied, both clockwise and counter-clockwise, between the anode cooler and the anode contact surface, with no resulting loosening of the cooler or damage to the tube.

19/ Test in jig made in accordance with Drawing 280-JAN. Each tube shall be subjected to a total of 15 shocks; that is, 5 shocks in each axis X, Y, and Z, in any sequence. The applied shock wave shall be of approximate half-sine configuration, with duration measured at the zero-axis level.

20/ The voltage E shall be 60 Hz ac applied between the anode and grid. No other voltages shall be applied. There shall be no evidence of failure as indicated by arc-over.

21/ At zero hours, establish the drive conditions necessary to obtain 3.0 amperes peak anode current with an anode voltage of 1,000 V dc and a bias voltage of -40 V dc. The pulse width of the modulator shall be 2 μs minimum and the duty cycle shall be 0.0025 maximum. With the drive level determined at zero hours, check the anode current at the end of life. The maximum allowable drop in anode current (Δib) is 25 percent. Group B shall apply except it shall be permissible to represent a lot not to exceed one month's production with a sample of 12 tubes. No failures are allowed.

22/ Superseding USAF AFLC Drawing 67B1800, Revision B, dated 31 July 1967.

23/ Test in a cavity in accordance with applicable part of Canadian Marconi Co. rf power amplifier 407-057, or equivalent. The cavity shall be connected to a 50-ohm load with a VSWR less than 1.5 to 1. The oscillator output coupling and the grid or cathode resistor may be adjusted for maximum power output. Driving power is defined as the net power delivered to the amplifier cavity input terminals, and the reflected power shall be subtracted from the incident power to obtain the net driving power. The amplifier output tuning may be adjusted for maximum power output.

24/ The test shall be made in accordance with Drawing 281-JAN. Calibrate the circuit adjusting the cavity until the frequency of resonance is 1,980 ± 25 MHz at room temperature with a tube which meets the resonance test requirements. In the grid distortion test the frequency shall first be measured with Ef = 6.3 volts and then the grid dissipation increased to 2 watts with Eb = -150 V dc. The change in frequency shall not be greater than the limit specified herein. Cooling air at room temperature may be used.

25/ In CW oscillator or amplifier service, the anode voltage (Eb) and grid voltage (Ec) may be applied simultaneously with heater voltage (Ef) if Eb does not exceed 650 V dc.

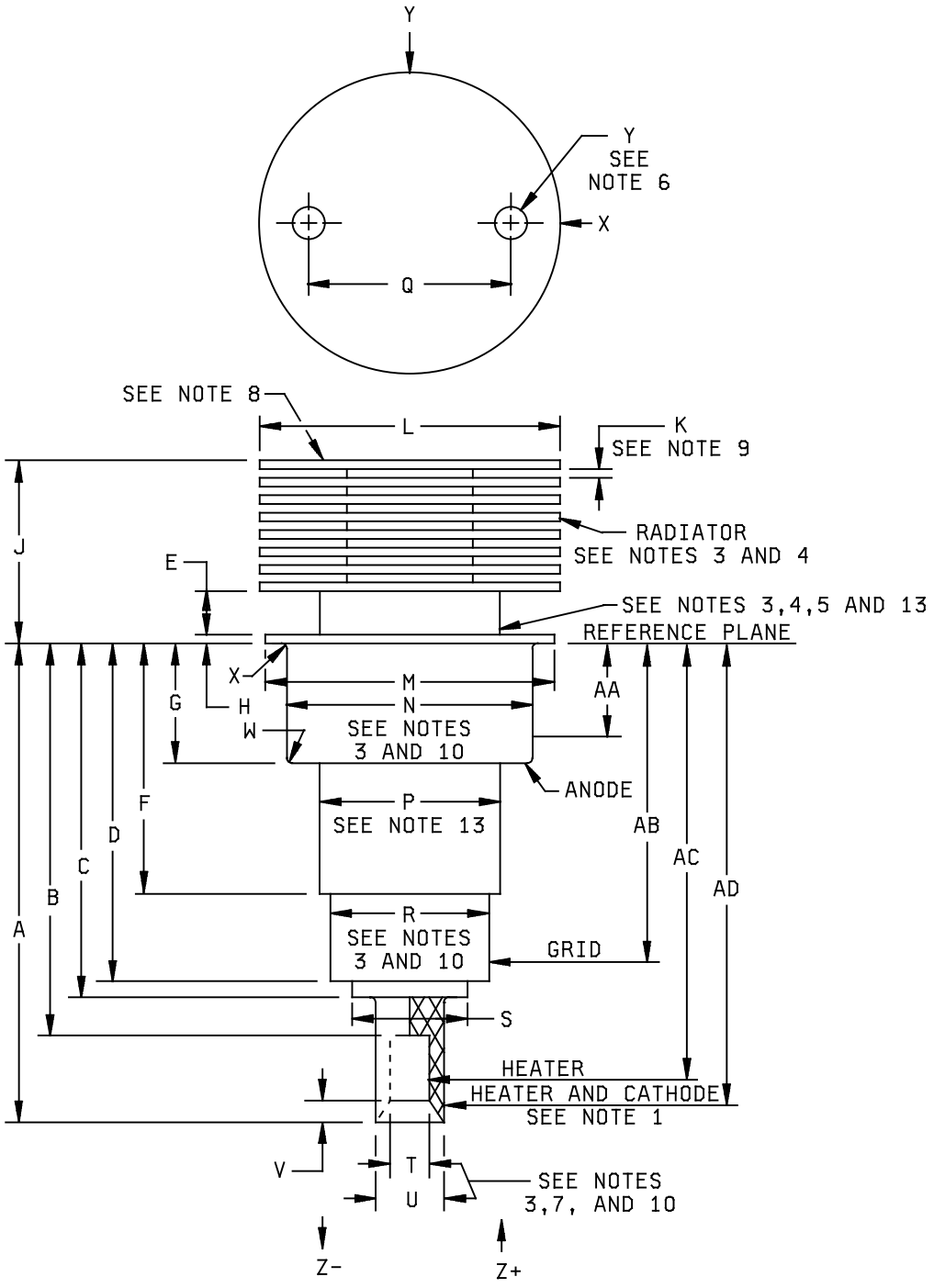

FIGURE 1. Outline drawing of electron tube type 7211.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
A	1.815	1.875	46.10	47.63
B	---	1.534	---	38.96
C	---	1.475	---	37.47
D	1.289	1.329	32.74	33.76
F	.970	1.010	24.64	25.65
G	.462	.477	11.73	12.12
J	.766	.826	19.46	20.98
N	1.025	1.035	26.04	26.29
R	.655	.665	16.64	16.89
T	.213	.223	5.41	5.66
U	.315	.325	8.00	8.26
Conformance inspection, part 3 (periodic check) (see note 2)				
E	.125	.185	3.18	4.70
H	---	.040	---	1.02
K	.025	.046	0.64	1.17
L	1.234	1.264	31.34	32.11
M	1.180	1.195	29.97	30.35
P	.772	.792	19.61	20.12
Q	.650	.850	16.51	21.59
S	---	.545	---	13.84
V	---	0.086	---	2.18
W	---	.100 RAD	---	2.54 RAD
X	---	035 RAD	---	0.89 RAD
Y	.105	.145	2.67	3.68
Electrode contact areas (see note 12)				
AA	.035	.361	0.89	9.17
AB	1.185	1.265	30.10	32.13
AC	1.534	1.728	38.96	43.89
AD	1.475	1.815	37.47	46.10

NOTES:

1. Insulation material between heater and heater-cathode shall be securely affixed.
2. These dimensions shall be tested on 10 tubes per month when in continuous production. Failure of more than one tube to meet tolerances for any dimension shall cause that dimension to become, for all lots in process, part of conformance inspection, part 2.
3. Silver plated 30 MSI minimum. Note 2 shall apply.
4. Plating not required over radiator and radiator support of copper, aluminum, or approved equivalent.
5. This surface shall be used for measurement of anode shank temperature.
6. Holes for tube extractor through top fin only.
7. Inner edge of heater and outer edge of cathode rf connection shall be free from burrs and sharp edges.

FIGURE 1. Outline drawing of electron tube type 7211 - Continued.

NOTES: - Continued.

8. This fin shall withstand a 6-inch drop test without loosening and without distortion as judged by ability to maintain dimension K. Note 2 shall apply.
9. Distortion of fins permissible provided distance between adjacent fins at any point on circumference meets tolerances for dimension K.
10. Eccentricity of contact surfaces shall be gauged from center line of reference and shall be as follows: Note 2 shall apply.

Contact surface	TIR maximum	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

11. Diameters N, R, T, and U shall apply throughout entire contact areas as defined by dimensions AA, AB, AC, and AD, respectively.
12. Dimensions in electrode contact areas table are for socket design purposes and are not intended for inspection purposes.
13. This surface shall not be used for clamping or locating.

FIGURE 1. Outline drawing of electron tube type 7211 - Continued.

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

MIL-STD-1311	Drawing 278-JAN
MIL-STD-202	Drawing 279-JAN
Drawing 157-JAN	Drawing 280-JAN
Drawing 158-JAN	Drawing 281-JAN
Drawing 160-JAN	Drawing 283-JAN
Drawing 276-JAN	Drawing JVM-D9819
Drawing 277-JAN	

NOTE: To obtain copies of JAN drawings, please send a request via email to TubesAmps@dla.mil.

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Review activities:
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