INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MICROWAVE (NEGATIVE GRID)
TYPE 7698

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-metal.
See figure 1.
Mounting position: Any.
Weight: 1.8 ounces (48 grams) nominal.

ABSOLUTE RATINGS:

Parameter:	F	Ef	Eb	epy	Ec	ib	Ib	ic	tp	Du
Unit:	GHz	V	V dc	kv	V dc	a	mA dc	a	μs	---
Maximum:										
Anode pulsed (Osc or amp)	3.0	6.3 ±5% 1/ 12/	---	3.5	-150	5 2/	---	2.5	3.5	0.0025
Grid pulsed (Osc or amp)	3.0	6.3 ±5% 1/ 12/	2,000	---	-150	5 2/	---	2.5	3.5	0.0025
Test conditions:	---	6.3	600	---	Adj	---	25	---	---	---

ABSOLUTE RATINGS:

Parameter:	Pp	Pg	tk	TE	T(anode shank)	Barometric pressure reduced	Cooling
Unit:	W	W	sec (min)	°C	°C	mmHg	---
Maximum:							
Anode pulsed (Osc or amp)	10	2 3/	60	250 4/	250 4/	35 5/	4/
Grid pulsed (Osc or amp)	10	2 3/	60	250 4/	250 4/	35 5/	4/
Test conditions:	---	---	300	---	---	---	6/

See footnotes at end of table I.

GENERAL:
Qualification: Required.

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	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 1		7/					
Insulation of electrodes	1211	---	Eb = Ek = 0; Ec = -500 V dc	R	50	---	MegΩ
Power oscillation (pulse)	1236	8/ 9/	F = 3.0 GHz (min); epy = 3.5 kv; Ec = -1.5 V (min); Rg/Ib = 12 mA dc (max); Ef = 5.8 V	Po	6.0	---	W
Electrode voltage (1) (grid)	1261	6/		Ec	-4.5	-9.5	V dc
Total grid current	1266	6/		Ic	---	-2.0	μA dc
Pulsing emission	1231	---	eb = ec = etd/is = 10 a; tp = 3 μs (max); prr = 600 (max)	etd	---	180	v
Heater current	1301	---		If	1.20	1.40	A
Conformance inspection, part 2							
Direct-interelectrode capacitance	1331	9/	No voltages applied; use fixture in accordance with Drawing 158-JAN	Cgk Cpg Cpk	7.00 2.10 ---	9.00 2.40 0.06	pF pF pF
Resonance	---	9/ 11/	No voltages applied	---	---	---	---
Electrode voltage (2) (grid)	1261	---	Ec/Ib = 1.0 mA dc; Eb = 1,000 V dc	Eco	---	-30	V dc
Power gain	---	13/	F = 1,100 ± 50 MHz; Ebb = 2,200 V dc (min); Ecc = -50 V dc; tp = 3 μs (min); Du = 0.002 (min); pd = 400 w	po	1.8	---	kW

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method MIL-STD-1311	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 3							
Life test	---	10/	Group C; t = 500 hours; filament standby; Ef = 6.3 V ac	---	---	---	---
Life-test end point	---	10/		Δib	---	25	%
Variable-frequency vibration	---	9/ 14/ 15/	55 to 500 Hz at 10 G peak; Ec/Ib = 10 mA dc; Rp = 10,000 ohms; Ebb = 300 V dc	Ep	---	250	mV ac
Torque	---	9/ 15/ 16/	No voltages applied	---	---	---	---
Shock	---	9/ 15/ 17/	60 G peak (min); 11 $\pm$ 2 ms; no voltages applied	---	---	---	---
Torque-and shock test end point:	---						
Total grid current	1266	---		Ic	---	-10	μA dc
Barometric pressure, reduced	1002	15/ 18/	Pressure = 35 mmHg (max); voltage = 2,000 V ac; TA = 30°C $\pm$ 10°C	---	---	---	---

1/ The transit time heating effect of the cathode shall be compensated by a reduction in heater voltage after dynamic operation of the tubes 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 which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of $\pm$5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz.

2/ 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.

3/ The maximum instantaneous peak grid-cathode voltage shall be within the range of +250 to -750 volts.

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

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

TABLE I. Testing and inspection - Continued.

6/ Sufficient conduction, convection, and forced-air cooling shall be used in all electrical tests involving application of heater voltage to maintain the anode shank and seal temperatures within the specified maximum values.

7/ All tests listed under conformance inspection, part 1, shall be performed at the conclusion of the holding period.

8/ The applied voltage pulse shape 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 (max), tf = 0.7 μs (max). 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. The oscillator output coupling and the grid or cathode resistor may be adjusted for maximum power output.

9/ Other tube contact configuration 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.

10/ 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 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 is 25 percent.

11/ Grid-anode resonance: Test in cavity in accordance with Drawing 278-JAN. Cavity shall resonate at 1,354 ± 2 MHz with tuning lug 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 ± 2.0 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 capacitance, the tube under test (TUT) shall be represented by a point within a parallelogram whose four corners are located by the following points:

Point	Capacitance (pF)		Frequency (MHz)	
	C-gp	C-gk	F-gp	F-gk
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

12/ Where emphasis is placed on long and reliable life, the filament voltage can safely be lowered to 6.0 volts, provided the line voltage is regulated better than ± 2 percent.

13/ Test shall be conducted in a power amplifier cavity as shown on figure 2. Driving power is defined as the net power delivered to the amplifier 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.

TABLE I. Testing and inspection - Continued.

14/ The TUT shall be mounted in a 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 approximately 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 tests on 50 or more tubes of a construction show that more than 75 percent of the tubes have higher output voltages in one position, subsequent measurements need be taken only in the axis giving the higher reading. 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 of 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 vibrational 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.

15/ This test shall be performed during the initial production and once each succeeding 12-calendar month period in which there is production. A regular double sampling plan shall be used, with the first sample of three tubes having an acceptance number of zero, and a second sample of three tubes having a combined acceptance number of one. In the event of failure, the test shall be made as a part of conformance inspection, part 2, inspection level S3, with an acceptance level of 6.5. The regular “12 calendar month” double sampling plan shall be reinstated after three consecutive samples have been accepted.

16/ The torque test shall be performed as follows:

a. The TUT shall be held securely at the cathode connection. 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 .109 inch (2.78 mm) ± .016 inch (0.40 mm) from the cathode end of the tube. An approved equivalent method may be used. The heater cup shall not loosen or short circuit on 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.

17/ 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 Y, +Z, -Z in any sequence as shown on figure 1.

18/ Voltage shall be 60 Hz ac applied between anode and grid. No other voltages shall be applied. There shall be no evidence of failure as indicated by arc-over

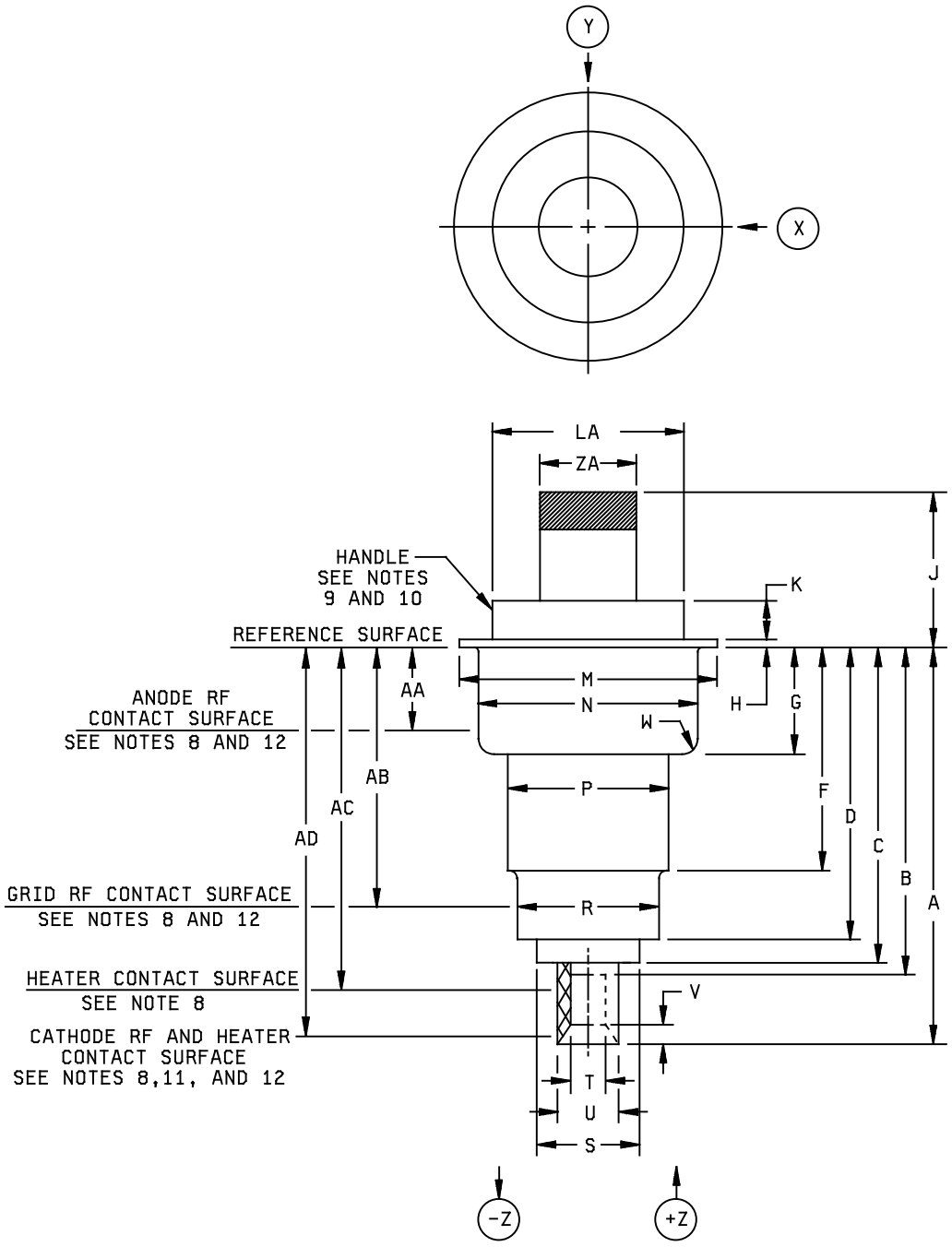


FIGURE 1. Outline drawing of electron tube type 7698.

Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
Conformance inspection, part 2					
A	1.815	1.875	46.10	47.62	
B	---	1.534	---	38.96	
C	---	1.475	---	37.46	
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	5, 13
R	.655	.665	16.64	16.89	5, 13
T	.213	.223	5.41	5.66	6, 13
U	.315	.325	8.00	8.26	5, 6, 13
Conformance inspection, part 3					7
H	---	.040	---	1.02	
K	---	.185	---	4.79	
M	1.180	1.195	29.97	30.35	
P	.752	.792	19.10	20.12	
S	---	.545	---	13.84	
V	---	.086	---	2.18	
W	---	.100	---	2.54	
LA	.840	.860	21.34	21.84	
ZA	.427	.447	10.85	11.35	
Electrode contact areas					14
AA	.035	.361	0.89	9.17	1, 5
AB	1.185	1.265	30.10	32.13	2, 5
AC	1.534	1.728	38.96	43.89	3, 6
AD	1.475	1.815	37.46	46.10	4, 5, 6

FIGURE 1. Outline drawing of electron tube type 7698 - Continued.

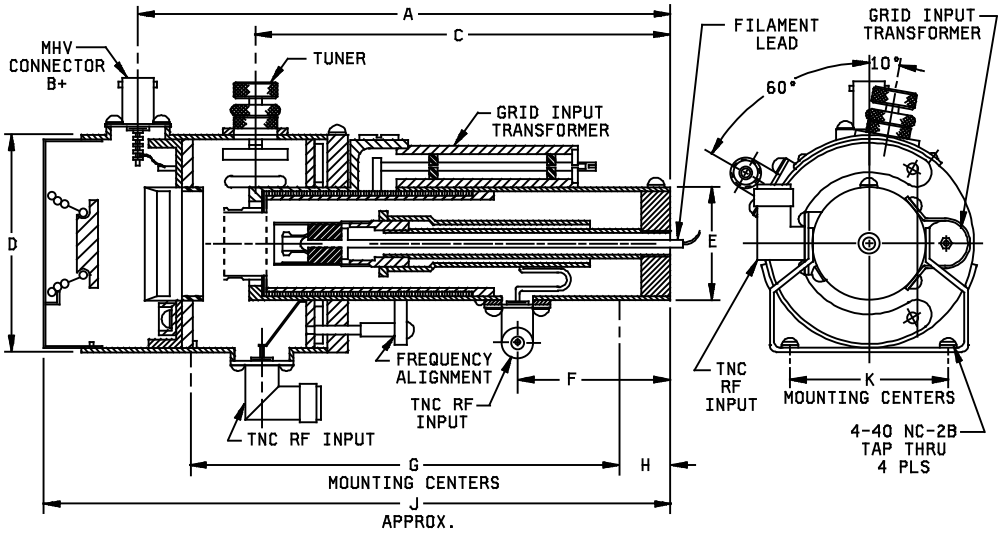
NOTES:

1. Anode rf contact surface and reference dimension for eccentricity measures.
2. Grid rf contact surface and reference dimension for eccentricity measurements.
3. Heater contact surface and reference dimensions for eccentricity measurements.
4. Heater and cathode rf contact surface and reference dimensions for eccentricity measurements.
5. The total indicated runout of the anode and grid contact surface with respect to the cathode contact surface shall not exceed .020 inch (0.51 mm).
6. The total indicated runout of the cathode contact surface with respect to the heater contact surface shall not exceed .012 inch (0.30 mm).
7. These dimensions shall be tested on 10 tubes per month when in continuous productions. 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.
8. Silver plated 30 MSI minimum.
9. Plating not required over radiator or handle support of copper, aluminum, or approved equivalent.
10. This surface shall be used for measurement of anode shank temperature.
11. Inner edge of heater and outer edge of cathode rf connections shall be free from burrs and sharp edges. Insulation material between heater and heater-cathode shall be securely affixed.
12. Total indicated runout (T.I.R.) of contact surfaces shall be gauged from center line of reference and shall be as follows. Note 7 shall apply.

Contact surface	T.I.R. (maximum)	Reference
Anode	.020	Cathode
Grid	.020	Cathode
Heater	.012	Cathode

13. Diameters N, R, T, and U shall apply throughout entire contact areas as defined by dimensions AA, AB, AC, and AD, respectively.
14. Dimensions in electrode contact areas table are for socket design purposes and are not intended for inspection purposes.

FIGURE 1. Outline drawing of electron tube type 7698 - Continued.



	Dimensions	
Ltr	Inches	Millimeters
A	5.72	145.29
C	4.56	115.82
D	2.50 O. D.	63.50 O. D.
E	1.25 O. D.	31.75 O. D.
F	1.56	39.62
G	4.72	119.89
H	.62	15.75
J	6.97	177.04
K	1.88	47.75

NOTE: All dimensions are for reference only.

FIGURE 2. Pulse amplifier cavity.

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

MIL-STD-1311
Drawing 158-JAN
Drawing 276-JAN
Drawing 277-JAN
Drawing 278-JAN
Drawing 279-JAN
Drawing 280-JAN
Drawing 283-JAN

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

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