

INCH-POUND

MIL-PRF-1/1648D
w/AMENDMENT 1
27 March 2024
SUPERSEDING
MIL-PRF-1/1648D
23 September 2014

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, POWER

TYPE 8660

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

Requirements for acquiring the electron tube described
herein shall consist of this document and [MIL-PRF-1](#).

DESCRIPTION: Tetrode, ceramic-metal.

See figure 2.

Mounting position: Any.

Weight: 27 ounces (765.5 grams) nominal.

ABSOLUTE RATINGS: F = 110 MHz.

Parameter:	Ef	Eb	Ec1	Ec2	Ib	Pg1	Pg2	Pp	Anode core and seal T	tk	Cooling
Unit:	V ac	V dc	V dc	V dc	mA dc	W	W	W	°C	sec (min)	--- <u>1/</u>
C. teleg:	6.0 ± 5%	3,000	-250	350	750	1.0	12	1,500	250	180	---
Class B or AB:	6.0 ± 5%	3,000	---	400	900	1.0	12	1,500	250	180	---
Test conditions:	6.0	2,000	Adj	300	250	---	---	---	---	300	<u>2/</u>

See footnotes at end of table I.

GENERAL:

Qualification - Required.

AMSC N/A

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FSC 5960



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TABLE I. Testing and inspection.

Inspection	MIL-STD-1311 method	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
<u>Conformance inspection, part 1</u>							
Heater current	1301	---		I _f	9	11	A ac
Electrode voltage (grid)	1261	---		E _{c1}	-48	-62	V dc
Electrode current (screen)	1256	---		I _{c2}	0	-10	mA dc
Primary grid emission (control)	1266	<u>9/</u>	E _{c1} /P _{g1} = 1.0 W; p = g ₂ = k = 0 V dc; E _{avg} (reverse) = 25 V; t = 60	I _{sg1}	---	-10	μA dc
Primary grid emission (screen)	1266	<u>9/</u>	E _{c2} /P _{g2} = 12 W; p = g ₁ = k = 0 V dc; E _{avg} (reverse) = 50 V; t = 60	I _{sg2}	---	-25	μA dc
Ion current	---	<u>3/</u>	E _b = -67.5 V dc; E _{c2} = 300 V dc; E _{c1} /I _{c2} = 20 mA dc	I _z	---	10	μA dc
Linear amplifier power output and distortion	2204	<u>7/</u>	Class AB amplifier; E _b = 2,900 V dc; E _{c2} = 225 V dc; E _{c1} /I _{bo} = 300 mA dc; E _{g1} /I _b = 700 mA dc; R _ℓ = 2,200 ± 100 ohms; R _g = 1,000 ohms (max); anode loaded tank; Q = 10 to 15	P _o 3rd IM 5th IM	1,000 -35 -40	--- --- ---	W dB dB
<u>Conformance inspection, part 2</u>							
Direct-interelectrode capacitance (grounded cathode connection)	1331	---		C _{gp} C _{in} C _{out}	--- 75.0 10.8	0.03 88.0 12.8	pF pF pF
Current division	1372	---	E _b = 500 V dc; E _{c2} = 325 V dc; E _{c1} = -200 V dc; e _{gk} /I _b = 3.0 a	e _{gk} i _{c1} i _{c2}	--- --- ---	20 50 300	v mA mA

See footnotes at end of table.

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TABLE I. Testing and inspection - Continued.

Inspection	MIL-STD-1311 Method	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
<u>Conformance inspection, part 3</u>							
Life test	---	8/	Group C; linear amplifier power output and distortion; except $E_{g1}/P_o = 1,100$ W (useful); $t = 500$ hours	---	---	---	---
Life test end point: Linear amplifier power output and distortion	2204	---		P_o 3rd IM 5th IM	1,000 -33 -38	--- --- ---	W (useful) dB dB
Vibration (noise)	---	4/ 5/	$E_{bb} = 2,500$ V dc; $E_{c2} = 400$ V dc; $E_{c1}/I_b = 250$ mA dc; $E_f = 6.0$ V ac or V dc; $R_p = 1,000$ ohms; Accel = 10 G peak (min); $F = 28$ to 500 Hz; ascending sweep only	E_p	---	30	V ac
Vibration (noise) end point: Electrode voltage (grid)	1261	---		E_{c1}	-48.0	-62.0	V dc
Shock, specified pulse (long duration)	---	4/ 6/	$E_b = 2,000$ V dc; $E_{c2} = 400$ V dc; $E_{c1} = -200$ V dc; Shock = 11 ± 2 ms; Accel = 50 G peak (min); total impacts = 9	---	---	---	---
Shock, specified pulse (long duration) end point: Electrode voltage (grid)	1261	---		E_{c1}	-48.0	-62.0	V dc
Stability	---	4/ 7/	$E_b = 2,900$ V dc; $E_{c2} = 225$ V dc; $E_{c1}/I_{bo} = 300$ mA dc; $t = 90$	ΔI_b	---	30	mA dc

See footnotes at top of next page.

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TABLE I. Testing and inspection - Continued.

- 1/ In all cases of operation, force-air cooling is required and the maximum temperature ratings should not be exceeded. An air-system socket, such as the EIMAC SK-800 series, and air director (chimney) SK-806, or equivalents, shall be used. The cooling table is based on operation of the tube in an SK-800B socket with SK-806 chimney, with air flowing in a base-to-anode direction, with cooling air at 50°C maximum, and for operation at frequencies below 30 MHz. Additional air cooling may be required at higher frequencies. Airflow must be applied before or simultaneously with electrode voltages (including the heater), and may be removed simultaneously with them. When long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

Anode dissipation (W)	Sea level		10,000 feet	
	Airflow (cfm)	Approx press drop (In•H ₂ O)	Airflow (cfm)	Approx press drop (In•H ₂ O)
500	7.5	0.04	11	0.06
1,000	17.5	0.23	24	0.21
1,500	34	0.60	45	0.80

- 2/ In all electrical tests involving application of heater voltage, the use of an air-system socket and chimney is allowable, and forced-air cooling is permitted in order to maintain temperatures within the allowable maximum.
- 3/ This test shall be the first performed after the holding period. The tube shall be connected as an ion gauge, with the specified potentials applied, and the highest initial reading shall be taken as the test value. Ion current is read with a microammeter in series with the negative anode lead. Except for Ef, all voltages shall be applied simultaneously, with an automatic current regulator controlling Ic2 to the value specified.
- 4/ This test shall be performed yearly. A regular sampling plan shall be used, with the sample of three tubes with an acceptance number of zero. In the event of failure, the test will be made as a part of conformance inspection, part 2 (see 10/). The regular yearly sampling plan may be reinstated after three consecutive samples have been accepted.
- 5/ Each tube under test (TUT) shall be subjected to one sweep cycle in each of the three axes, X, Y, and Z. One sweep (28 to 500 Hz, ascending only) shall be covered in 6 to 15 minutes. The specified voltages shall be applied during the test, using the basic circuit shown on figure 3. Tubes found to electrically oscillate for causes other than vibration shall not be tested nor rejected on this test. Each tube shall be vibrated for 60 seconds at the frequency which gives the maximum vibration (noise) output voltage in each of the three axes. If at the end of the 60 seconds, the vibration output voltage is increasing, the vibration shall be continued until there is no further increase. The tubes shall not show noise voltage output in excess of the maximum limit specified, except one intermittent short shall be allowable during this test. In addition to reading noise voltage on the specified VTVM, or equivalent, a permanent recording shall be made using a good quality recorder to produce a plot of noise voltage versus frequency. Noise voltage amplifiers used with the recorder shall have a ± 1 dB frequency response over the range to be measured and the overall recording equipment shall be capable of fast response in order to show sharp noise voltage spikes resulting from internal tube resonances or other phenomenon. Prominent noise peaks indicated on the recording shall be individually investigated by fixed-frequency operation, and the 60-second operation shall be made at the frequency of highest noise as so selected.
- 6/ Each TUT shall be subjected to the specified acceleration in the X, Y, and Z axes, with three shocks in each axis. Tubes showing any permanent shorts, or more than one temporary short during the test, shall be rejected. The applied shock shall be an approximate half-sine wave motion with the duration measured at the zero-axis level.
- 7/ When the stability test is performed, the same sample of tubes shall be used for the stability test and the linear amplifier power output and IM distortion test, with the stability test performed first. The same test circuit shall be used for both tests. The absolute value of the 3rd IM shall never be greater than the absolute value of the 5th IM.

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TABLE I. Testing and inspection - Continued.

- 8/ The life test shall be considered as destructive. All voltage and current meters shall be calibrated for ± 2 percent accuracy or better as installed in the equipment. The circuit used need not be identical to that used for the linear amplifier power output and IM distortion test. Prior to the performance of the life test, the tubes used shall have met the requirements of the linear amplifier power output and IM distortion test.
- 9/ The test circuit of figure 1 shall be used. The input voltage shall be varied to obtain the average inverse voltage and the resistor R shall be varied to obtain and maintain the forward power for the specified time. All unused tube elements shall be grounded. The wattmeter shall be capable of reading over the range from dc to at least 600 Hz. Loading of the transformer is permissible.
- 10/ This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.

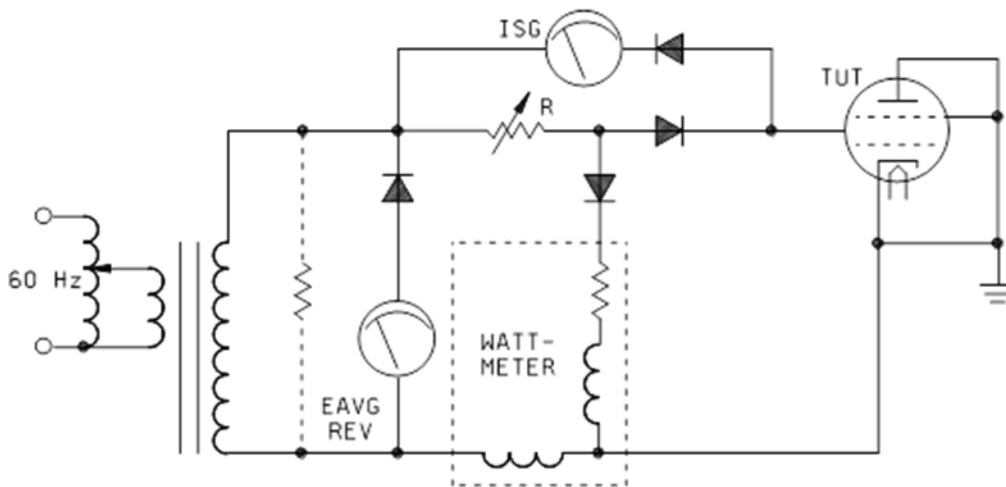
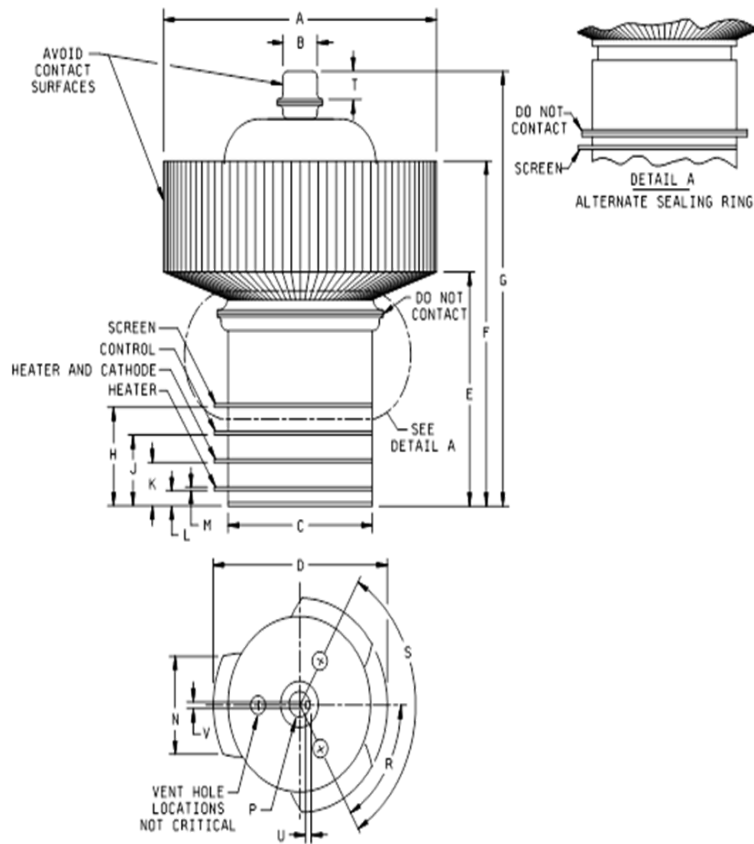


FIGURE 1. Test circuit.

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Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
C	1.870	1.900	47.50	48.26
G	4.600	4.800	116.84	121.92
H	.965	.988	24.51	25.10
J	.690	.710	17.53	18.03
K	.415	.435	10.54	11.05
L	.140	.165	3.56	4.19
M	.020	.030	0.51	0.76
P	.314	.326	7.98	8.28
U	.025	.048	0.64	1.22
V	.045	.070	1.14	1.78
Conformance inspection, part 3				
(see note 2)				
A	3.335	3.365	84.71	85.47
B	.807	.817	20.50	20.75
D	2.250	2.300	57.15	58.42
E	2.195	2.380	55.75	60.45
F	3.410	3.550	86.61	90.17
N	.700	.800	17.78	20.32
R	55°	65°	55°	65°
S	115°	125°	115°	125°
T	.470	.530	11.94	13.46

NOTES:

1. Dimensions H, J, K, L, and M shall be maintained within .100 inch (2.54 mm) from the outer peripheral edge of the contact tabs.
2. Dimensions shall be checked yearly. A regular sampling plan shall be used, with the sample of three tubes with an acceptance number of zero (see 10/). In the event of failure, the test will be made as a part of conformance inspection, part 2 (see 10/). The regular yearly sampling plan may be reinstated after three consecutive samples have been accepted.

FIGURE 2. Outline drawing of electron tube type 8660.

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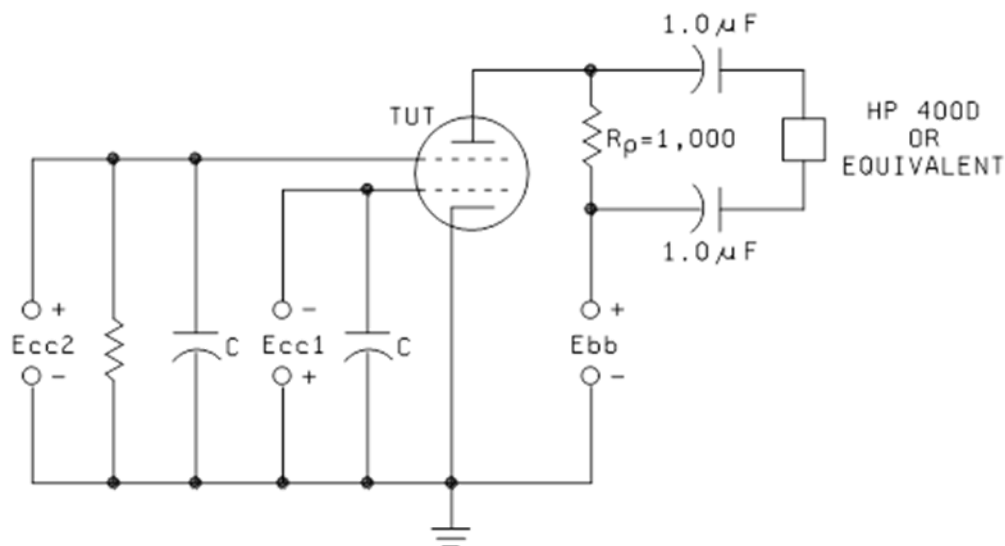


FIGURE 3. Basic circuit for use in vibration (noise) test.

Reference documents. In addition to [MIL-PRF-1](#), this specification sheet references [MIL-STD-1311](#).

Amendment notations. The margins of this specification sheet are marked with vertical line to indicate modifications generated by this amendment. 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.

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