INCH-POUND

MIL-PRF-1/1728B
9 February 1998
SUPERSEDING
MIL-E-1/1728A
6 September 1979

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, POWER
TYPE 8904 *

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: Tetrode, ceramic-metal.
See figure 1.
Mounting position: Any.
Weight: 4 ounces (113.4 grams) nominal.

ABSOLUTE RATINGS:

Parameter: Unit:	Ef V ac 1/	F1 MHz	tk sec (min)	Eb V dc	Ec1 V dc	Ec2 V dc	Ehk V dc	Ib mA dc	Ic1 ma dc	Pg2 W	Pp W
Class AB1:	26.5 ±10%	110	60	2,500	---	400	±150	275	2.0	8.0	350
Class A:	26.5 ±10%	110	60	2,500	---	400	±150	400	---	8.0	350
Test conditions:	26.5	---	240	1,000	Adj	300	0	150	---	---	---

Parameter: Unit:	T (Anode core and seals) °C	Cooling 2/	Altitude Ft
Class AB1:	250	---	10,000
Class A:	250	---	10,000
Test conditions:	---	3/	---

See footnotes at end of table I.

GENERAL: Qualification - Required.

Special requirement: 19/

* Formerly designated type 8904/4CX350FJ.

TABLE I. Testing and inspection.

Inspection	Method	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 1		18/					
Electrode current (screen)	1256	---		Ic2	-7.0	+3.0	mA dc
Electrode voltage (grid)	1261	---	Eb = 2,200 V dc, Ec2 = 400 V dc; Ec1/Ib = 55 mA dc	Ec1	-19.0	-26.0	V dc
Total grid current	1266	4/	Eb = 2,500 V dc; Ib = 140 mA dc	Ic1	---	-25.0	μA dc
Primary grid emission (control)	1266	---	Pg1 = 0.5 W; t = 15; anode and screen grid floating	Isg1	---	-25.0	μA dc
Primary grid emission (screen)	1266	---	Ec1 = 0; t = 15; Pg2 = 8.0 W; anode floating	Isg2	---	-250.0	μA dc
Heater current	1301	---		If	0.50	0.81	Aac
Pulsing emission (1)	1231	5/ 6/	etd = eb = ec2 = ec1 = 400 v; Ef = 23.8 V ac	is	20	---	a
Pulsing emission (2)	1231	5/ 6/	eb = ec2 = ec1 = etd/is = 30 a	etd	---	400	v
Current division (long pulse)	1372	---	Eb = 500 V dc; Ec2 = 400 V dc; Ec1 = -100 V dc; prr = 11 ± 1 pps; tp = 4,500 μs (min); egk/ib = 850 ma	egk ic2	--- ---	+5.0 260	v ma
Interelement leakage resistance, cold	1366	---	Ef = 0 (30 minutes, min); Rs = 2.5 Meg; E = 100 V dc; g1 neg E = 500 V dc; g1 neg E = 500 V dc; g2 neg	--- Rg1k Rg1g2 Rg2p	--- 50 50 50	--- --- --- ---	--- Meg Meg Meg

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 2		---					
Direct-interelectrode capacitance	1331	---		Cgp Cin Cout	--- 20.0 5.6	0.038 24.0 6.2	pF pF pF
Heater-cathode leakage	1336	7/	Ehk = +150 V dc Ehk = -150 V dc	Ihk Ihk	--- ---	100 100	µA dc µA dc
Linear amplifier power output and distortion (procedure 2.2)	2204	8/	Eb = 2,200 V dc; Ec2 = 400 V dc; Ec1/Ibo = 55 mA dc; Eg1/Ib = 150 mA dc (max) (2 tone); R1 = 5,000 ± 100 ohms; Rg = 1,000 ohms (max); Anode tank: Q = 10 to 15; t = 180 (max); F = 2 to 10 MHz	Po 3rd IM 5th IM Ic1	250 -28 -31 ---	--- --- --- 50	W(PEP) dB dB µA dc
Conformance inspection, part 3							
Life test (1)	---	9/ 10/	Group C; linear amplifier power output and distortion (2-tone modulation); ΔIb = 55 mA dc	t	500	---	hrs
Life test (1) end points:	---						
Linear amplifier power output and distortion (procedure 2.2)	2204	---	Eb = 2,200 V dc; Ec2 = 400 V dc; Ec1/Ibo = 55 mA dc; eg1/Ib = 150 mA dc (max) (2 tone); R1 = 5,000 ± 100 ohms; Rg = 1,000 ohms (max); Anode tank: Q = 10 to 15; t = 180 (max); F = 2 to 10 MHz	Po 3rd IM 5th IM Ic1	240 -27 -30 ---	--- --- --- 100	W(PEP) dB dB µA dc
Primary grid emission (control)	1266	---	Pg1 = 0.5 W; t = 15; anode and screen grid floating	Isg1	---	-25	µA dc
Primary grid emission (screen)	1266	---	Ec1 = 0; Pg2 = 8.0 W; t = 15; anode floating	Isg2	---	-250	µA dc
Heater-cathode leakage	1336	7/	Ehk = +150 V dc; Ehk = - 150 V dc	Ihk Ihk	--- ---	100 100	µA dc µA dc

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 3 - Continued		---					
Interelement leakage resistance, cold	1366	---	Ef = 0 (30 minutes, min); Rs = 2.5 Meg;	---	---	---	---
			E = 100 V dc; g1 neg	Rg1k	20	---	Meg
			E = 500 V dc; g1 neg	Rg1g2	20	---	Meg
			E = 500 V dc; g2 neg	Rg2p	20	---	Meg
Life test (2)	---	---	Group C; heater standby; no voltages except Ef = 28.0 V ac	t	500	---	hrs
Life test (2) end points:	---						
Linear amplifier power output and distortion (procedure 2.2)	2204	---	Eb = 2,200 V dc; Ec2 = 400 V dc; Ec1/Ibo = 55 mA dc; eg1/Ib = 150 mA dc (max) (2 tone); R1 = 5,000 ± 100 ohms; Rg = 1,000 ohms (max); Anode tank: Q = 10 to 15; t = 180 (max); F = 2 to 10 MHz; Ef = 23.8 V ac	Po	200	---	W(PEP)
				Ic1	---	100	μA dc
Interelement leakage resistance, cold	1366	---	Ef = 0 (30 minutes, min); Rs = 2.5 Meg;	---	---	---	---
			E = 100 V dc; g1 neg	Rg1k	20	---	Meg
			E = 500 V dc; g1 neg	Rg1g2	20	---	Meg
			E = 500 V dc; g2 neg	Rg2p	20	---	Meg
Humidity	1011	11/ 16/	Ic1 = -30 μA dc (max) under post-test conditions	---	---	---	---
Vibration, mechanical	1032	12/ 17/	Ebb = 2,000 V dc; Ec1/Ib = 100 mA dc; Rp = 4,900 ohms; 10 G peak (min)	Ep	---	30	V ac
Shock, specified pulse	1042	13/ 17/	Eb = 2,000 V dc; Ec1 = -100 V dc; test condition A, except 90 G	---	---	---	---
Vibration, mechanical and shock end points:	---						
Electrode voltage (grid)	1261	---		Ec1	-19.0	-26.0	V dc
Total grid current	1266	---	Eb = 2,500 V dc; Ib = 140 mA dc	Ic1	---	-30.0	μA dc
Forced cooling	1143	11/ 14/ 17/	Eb = 2,000 V dc; Ec1/Ib = 175 mA dc; Ic1 = -30 μA dc (max) under post-test conditions	T (anode core)	---	250	°C
Coolan pressure drop versus coolant flow (forced air)	1155	1/ 5/ 17/	Eb = 2,000 V dc; Ec1/Ib = 175 mA dc	---	---	1.3	$In.H_2O$

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

1/ Maximum tube life may be obtained by adjusting the heater voltage (Ef) in accordance with application. The heater voltage (nominal and derated) shall be maintained within ±5 percent when consistent operation and extended life are factors.

2/ At an anode dissipation of 350 watts and an incoming air temperature of 50°C maximum, a minimum airflow of 7.8 cubic feet per minute (cfm) at sea level shall pass through the tube's anode cooler. At this flow rate of 7.8 cfm, the static pressure drop across the tube and socket shown on Drawing 246-JAN is approximately 1.2 inches (30.48 mm) of water. The pressure drop varies with the amount of escaping air and the shape and construction of the air director. Air cooling of the tube shall be increased with increased incoming air temperature or with increased altitude, or a combination of both. In all cases of operation, a socket which provides forced-air cooling of the base shall be used and maximum seal temperature ratings must not be exceeded. The airflow shall be applied before or simultaneously with electrode voltages, and may be removed simultaneously with them.

3/ In all electrical tests involving heater voltage, the socket shown on Drawing 246-JAN shall be used. Unless otherwise specified in the specific test conditions, forced-air cooling is permitted at the rate of 8.0 cfm maximum for the base and anode. A separate source may be used for the base and anode provided neither exceeds 8.0 cfm. Air under standard conditions of temperature and pressure shall be used, or appropriate corrections applied.

4/ This test shall be the first test performed at the conclusion of the holding period.

5/ The voltages applied to the plate and grids shall not exceed 450 volts. The applied voltage shall have a maximum pulse repetition rate (prr) such that the duty cycle (Du) shall not exceed 0.0002 (0.02 percent) based on the pulse length measured at 50 percent amplitude. The pulse duration (tp) shall not be less than 3 μs at 5 percent of the maximum value, and shall not exceed 2 μs at 50 percent amplitude.

6/ Method 1231: pulsing emission (1) or pulsing emission (2) may be performed alternately. However, only one of these tests shall be performed.

7/ Measurements shall be taken during an interval of 3 minutes immediately following the required warmup period.

8/ Prior to conducting this test, the tube under test (TUT) shall be operated in a static condition (Eb = 2,200 V dc; Ec2 = 400 V dc; Ec1/Ibo = 55 mA dc) for 3 minutes (minimum) to demonstrate that the Ibo value remains constant (i.e., Ibo = 55 ± 5 mA dc). The TUT shall be considered to fail this test if it exhibits instability after 5 minutes of testing. If there is a failure, reprocessing and retesting for stability shall be the only condition permitted for continuing this test.

9/ The following measurements shall be made prior to conducting life test (1): Method 1366 - interelement leakage resistance with 50 Meg (minimum) for each of the required measurements, and method 2204 - linear power output and distortion with limits and conditions as specified under conformance inspection, part 2.

10/ The following measurement shall be made prior to conducting life test (1): Method 1261 - electrode voltage (grid) with the value of Ec1 being read with an accuracy of ± 0.1 V dc and recorded. The TUT's operational stability shall be checked after 96 hours of life testing by repeating the electrode voltage (grid) test, observing the change in Ec1 from the initial reading, and the change in anode current (ΔIb) from the initial value of 55 mA dc. The ΔIb value shall not exceed ± 5.0 mA dc and allowable failures shall conform to the group C requirements. In the event of failure after double sampling, the life test lot shall be reprocessed before resubmitting a sample for life testing and the operational stability test.

11/ At the conclusion of this test, the TUT shall satisfy the requirements for the total grid current test (method 1266) specified herein under conformance inspection, part 1.

12/ The TUT shall be mounted in a resonance free jig and vibrated with sinusoidal excitation in each of the three mutually perpendicular axes. (The X-axis shall be defined as normal to a plane drawn through base pins numbered 3 and 7.)

Survey test: The TUT shall be vibrated for 60 seconds at the frequency which produces maximum vibration output noise voltage in each of the three positions. If at the end of 60 seconds, the vibration noise output is increasing, the vibration shall continue until there is no further increase. There shall be no indication of shorts during this test and the TUT output noise voltage shall not exceed the limit specified herein.

Cycling test: The frequency shall vary from 28 Hz to 750 Hz to 28 Hz with approximately logarithmic progression, and shall require 6 to 12 minutes to traverse the range, which shall constitute one cycle. The TUT shall be vibrated for one such cycle in each of the three axes.

TABLE I. Testing and inspection - Continued.

13/ The TUT shall be subjected to six shocks of the specified peak amplitude and duration in each of the three mutually perpendicular directions. Following the impact test, the TUT shall be rejected if it exhibits permanent shorts, or more than one temporary short during the test.

14/ The forced cooling test shall be conducted as follows: The base and anode of the TUT shall be cooled by applying an airflow of 7.8 cfm (maximum) from a single source using the infinite baffle system shown on figure 2, or equivalent. Air under standard conditions of temperature and pressure shall be used, or appropriate corrections applied. The anode core temperature shall not exceed the specified limits at the specified test conditions. Temperature shall be measured by means of a thermocouple embedded in the top of the core, adjacent to the cooler. This shall be done by drilling a small hole, shallow enough to prevent loss of TUT vacuum, placing the welded thermocouple junction therein, and then bending the edges of the hole to hold the thermocouple firmly in place. In all cases, good electrical continuity between the thermocouple and the metal area in close proximity shall be demonstrated prior to performing the cooling test.

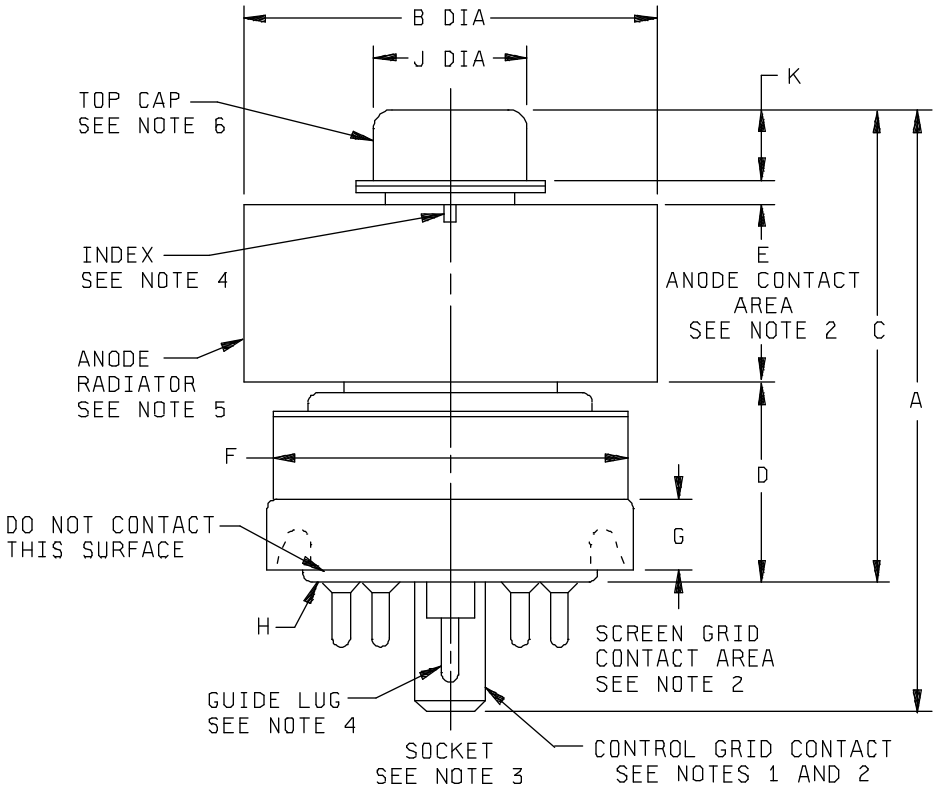
15/ This test shall be performed with the TUT operating under the conditions specified for the forced cooling test (see 14/), using the infinite baffle system shown on figure 2, or equivalent. The static pressure drop shall be measured across the TUT and socket.

16/ This test shall be performed during the initial production and once each succeeding 3-calendar months in which there is production. A regular double sampling plan shall be used, with the first sample of four tubes with an acceptance number of zero, and a second sample of four tubes with a combined acceptance number of one. In the event of failure, this test will be made as a part of conformance inspection, part 2, with an acceptance level of 6.5, inspection level S3. The regular “3-month” double sampling plan shall be reinstated after three consecutive samples have been accepted.

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

18/ The acceptance level for each test listed under conformance inspection, part 1, shall be 0.65, inspection level II.

19/ Reclaimed materials shall be utilized to the maximum extent possible as cited in MIL-STD-961 and MIL-STD-962 within the quality limits required by this document and to fulfill compliance with the Resource and Recovery Act of 1976 (Public Law 94-580 dated 21 October 1976).



Pin connections	
PIN	Element
1	g2
2	k
3	h
4	k
5	int con
6	k
7	h
8	k
center post	g1
radiator and cap	a
base ring	g2

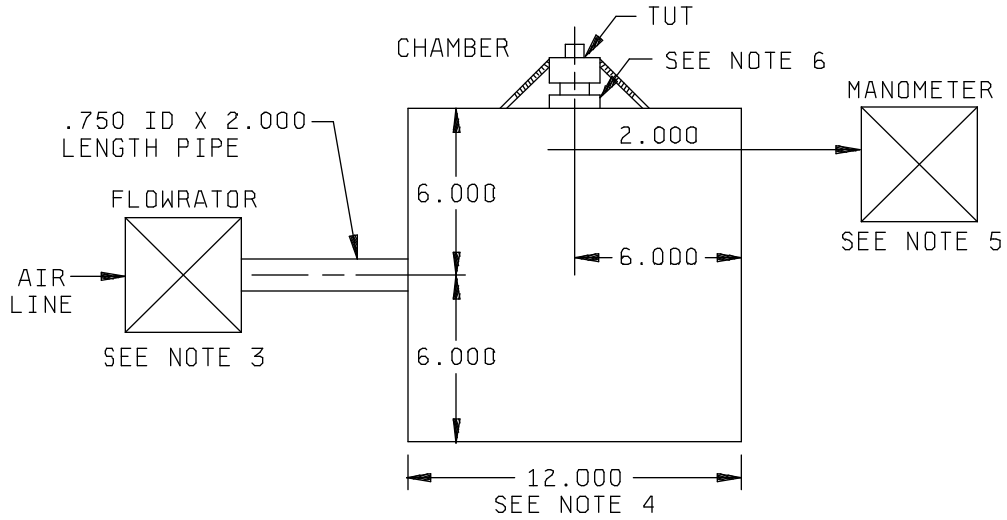
FIGURE 1. Outline drawing of electron tube type 8904.

Ltr	Dimensions			
	Millimeters		Inches	
	Min	Max	Min	Max
Conformance inspection, part 1				
A	59.03	62.59	2.324	2.464
C	45.97	48.51	1.810	1.910
Conformance inspection, part 3 (see 17/ of table I)				
B	40.89	41.66	1.610	1.640
D	19.05	20.57	0.750	0.810
E	18.03	20.07	0.710	0.790
F	---	35.71	---	1.406
G	4.75		0.187	
H	Base: B8-236 (see note 1)			
J	14.20	14.55	0.559	0.573
K	6.10		0.240	

NOTES:

1. Pin alignment shall be checked by means of gauge GB8-3. Dimensions of control-grid contact shall be inspected by means of gauges specified on Drawing 246-JAN and shall satisfy conformance inspection, part 2.
2. Alignment of anode, screen-grid, and control-grid contact surfaces shall be determined by means of gauge specified on Drawing 168-JAN. Conformance inspection, part 2, shall apply.
3. Air-system socket shall be as specified on Drawing 246-JAN, EIMAC SK-600, or equivalent.
4. Location of guide lug of control-grid contact shall be referenced by a notch or arrow on the anode radiator in position shown.
5. Anode clamping shall be confined to anode radiator.
6. Top cap outline optional provided it meets requirements of dimensions J and K.

FIGURE 1. Outline drawing of electron tube type 8904 - Continued.



Inches	mm
.750	19.05
2.000	50.80
6.000	152.40
12.000	304.80

NOTES:

1. Dimensions are in inches.
2. Metric equivalents are in parentheses.
3. Fisher Porter flowrator model B4-27-10/77, or equivalent.
4. 12 inch (304.80 mm) cube inside dimensions, compound sealed.
5. F. W. Dwyer manometer, 0 to 1 inch (25.40 mm) of water (Fisher Scientific Company 11-295-5 draft gauge), or equivalent.
6. Socket specified on drawing 246-JAN.

FIGURE 2. Baffle system.

Custodians:
Army - CR
Navy - EC
Air Force - 85

Preparing activity:
DLA - CC

(Project 5960-3476-04)

Review activities:
Army - AV, CE, CR4, MI, SM
Navy - AS, CG, MC, OS
Air Force - 11, 99