INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, POWER
TYPE 8167

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, metal-ceramic.

See figure 1.

Mounting position: Any.

Weight: 4 ounces (105.4 grams) nominal.

ABSOLUTE RATINGS: F = 500 MHz.

Parameter:	Ef	Eb	Ec1	Ec2	Ib	Ehk	Pg1	Pg2
Unit:	V ac 1/	V dc	V dc	V dc	mA dc	V dc	W	W
Maximum:								
Class C Telep:	6.0 ± 5%	1,500	-250	300	200	±150	2	12
Class C Teleg:	6.0 ± 5%	2,000	-250	300	250	±150	2	12
Class AB1:	6.0 ± 5%	2,500	---	400	250	±150	2	12
Test conditions:	6.0	1,000	Adj	300	150	---	---	---

ABSOLUTE RATINGS: F = 500 MHz.

Parameter:	Pp	T(seal and anode core)	tk	Cooling	Barometric pressure, reduced
Unit:	W	°C	sec (min)	2/	mmHg (min)
Maximum:					
Class C Telep:	200	250	30	---	141 ± 5
Class C Teleg:	300	250	30	---	141 ± 5
Class AB1:	300	250	30	---	141 ± 5
Test conditions:	---	---	120	3/	---

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							
Electrode current (screen)	1256	---		Ic2	---	-5.0 +3.0	mA dc
Total grid current	1266	4/	Eb = 2,000 V dc	Ic1	---	-15	μA dc
Electrode voltage (grid)	1261	---		Ec1	-32.0	-45.0	V dc
Primary-grid emission (control)	1266	---	Ic1 = 70 mA dc; t = 15 seconds; anode and g2 floating	Isg1	---	-25	μA dc
Primary-grid emission (screen)	1266	---	Ec1 = 0; t = 15 seconds; Ic2 = 100 mA dc; anode floating	Isg2	---	-250	μA dc

Pulse emission (1)	2212	5/	Eb = Ec2 = 250 V dc;
			Ec1 = -100 V dc;
			egk/ik = 1.5 a;
			Ef = 5.4 V ac;
			tp = 4,500 μs (min);
			prr = 11 ± 1;
			tr = tf = 25 μs;
			slope = 0.5 percent;
			ripple = 0.1 percent
				Δik	---	200	ma

Current division (method A)	1372	---	Eb = Ec2 = 250 V dc; Ec1 = -100 V dc; egk/Ib = 1.0 a; tp = 4,500 μs (min); prr = 11 ± 1	egk ic1 ic2	8.0 --- ---	18.0 250 250	v ma ma
Conformance inspection, part 2							
Heater current	1301	---		If	2.6	3.1	A ac
Stability	---	---	Eb = 2,000 V dc; Ec1/Ib = 150 mA dc at t = 0; read ΔIb at t = 120 seconds	ΔIb	---	10	mA dc
Interelement leakage resistance, cold	1366	13/	Rs = 2.5 MegΩ; E = 100 V dc, g1 negative	Rg1k	50	---	MegΩ
			E = 500 V dc, g2 positive;	Rg1g2	50	---	MegΩ
			E = 500 V dc, p positive	Rg2p	50	---	MegΩ

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 2 – Continued							
Direct-interelectrode capacitance (ground cathode connection)	1331	---	Test in fixture in accordance with DESC Drawing 67001, or equivalent	Cgp Cin Cout	--- 25.0 3.5	0.06 33.0 4.5	pF pF pF
Heater-cathode leakage	1336	---	Ehk = +250 V dc; Ehk = -250 V dc	Ihk Ihk	--- ---	150 150	μA dc μA dc
Pulse emission (2)	2212	5/	Pulse emission (1), except Ef = 6.0 V ac	Δik	---	100	ma
RF useful output power	2214	---	Class C amplifier; F = 450 to 500 MHz; Eb = 2,000 V dc; Ec1 = -90 V dc; Ec2 = 250 to 300 V dc; Ic1 = 25 mA dc (max); Eg1/Ib = 250 mA dc; Ef = 5.0V ac; circuit and cavity in accordance with Drawing 285-JAN, or equivalent	Po	225	---	W
Conformance inspection, part 3							
Vibration (noise)	---	6/ 7/	Ef = 6.0 V (ac or dc); Ebb = 2,500 V dc; Ec2 = 350 V dc; Rp = 4,900 ohms; Ec1/Ib = 100 mA dc; accel = 20 G peak (min); F = 100 to 750 Hz, ascending sweep only	Ep	---	20	V ac
Vibration (noise) end points:	---						
Total grid current	1266	---		Ic1	---	-20	μA dc
Electrode voltage (grid)	1261	---		Ec1	-32.0	-45.0	V dc
Long duration shock	---	6/ 8/	Eb = 2,000 V dc; Ec2 = 350 V dc; Ec1 = -150 V dc; shock = 11 ± 2 ms; accel = 90 G peak (min); total impacts = 18	---	---	---	---

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 - Continued							
Long duration shock end points:	---						
Total grid current	1266	---		Ic1	---	-20	μA dc
Electrode voltage (grid)	1261	---		Ec1	-32.0	-45.0	V dc
Linear amplifier power output and distortion	2204	6/	Eb = 2,000 V dc; Ec2 = 350 V dc;	Po	225	---	W (useful)
			Ec1/Ibo = 125 mA dc;	3rd IM	-25	---	dB
			Eg1/Ib = 250 mA dc 1 tone;	5th IM	-30	---	dB
			$R\ell$ = 4,150 ± 150 ohms; Rg = 1,000 ohms (max); F = 2 to 10 MHz; anode tank Q = 10 to 15				
Life test (5)	---	10/	Group C; linear amplifier power output and distortion; t = 500 hours	Po (initial)	225	---	W (useful)
Life test (5) end points:	---						
Interelement leakage resistance, cold	1366	13/		Rg1k	10	---	MegΩ
				Rg1g2	10	---	MegΩ
				Rg2p	15	---	MegΩ
Linear amplifier power output and distortion	2204	---		Po	210	---	W (useful)
Life test (5)	---	10/	t = 500 hours	3rd IM	-24	---	dB
				5th IM	-29	---	dB
				Po	210	---	W (useful)
				ΔIb	---	35	mA dc
Life test (2)	---	---	Group C; Ef = 6.6 V ac; Ec1 = Ec2 = Eb = 0; t = 500 hours	---	---	---	---
Life-test (2) end points:	---						
Interelement leakage resistance, cold	1366	13/		Rg1k	10	---	MegΩ
				Rg1g2	10	---	MegΩ
				Rg2p	15	---	MegΩ
Life test (4)	---	11/	Group C; Ec1 = -100 V dc; g2 and p floating; t = 200 hours	---	---	---	---

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 - Continued							
Life-test (4) end points:	---						
Heater current	1301	---		If	2.6	3.1	A ac
Heater-cathode leakage	1336	---	Ehk = +250 V dc	Ihk	---	150	µA dc
			Ehk = -250 V dc	Ihk	---	150	µA dc
Pressure drop	1155	9/	Airflow = 5.0 cfm (min)	---	---	0.4	Inch H_2O
Cooling	---	9/ 12/	Eb = 2,000 V dc; Ec1= 0;	T(anode core)	---	250	°C
			Ec2/Ib = 150 mA dc; airflow = 5.0 cfm (max)	T(anode seal)	---	225	°C
				T(base seal)	---	225	°C
Humidity	1011	9/		---	---	---	---
Humidity test end point:	---						
Total grid current	1266	---		Ic1	---	-20	µA dc
Life-test (1)	---	9/	RF useful power output; t = 500 hours	---	---	---	---
Life-test (1) end points:	---						
Pulse emission (2)	2212	---		∆ik	---	100	ma
Primary grid emission (control)	1266	---		Isg1	---	-25	µA dc
Primary grid emission (screen)	1266	---		Isg2	---	-250	µA dc
Heater-cathode leakage	1336	---	Ehk = +250 V dc	Ihk	---	150	µA dc
			Ehk = -250 V dc	Ihk	---	150	µA dc
RF useful power output	2214	---		Po	180	---	W
Life test (3)	---	9/	Ebb = 1,000 V dc; Ec2 = 250 V dc; Ec1/Ib = 50 mA dc; Eg1/Ib = 100 mA dc; Rp = 1,000 ohms; TA = 200°C (min); F = 1 kHz (min); t = 100 hours	---	---	---	---
Life-test (3) end points:	---						
Pulse emission (2)	2212	---		∆ik	---	100	ma
Total grid current	1266	---		Ic1	---	-20	µA dc

See footnotes at top of next page.

TABLE I. Testing and inspection - Continued.

1/ At frequencies above approximately 200 MHz, it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode after dynamic operation of the tube has started. This back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. Particular care should be used in the selection of stable circuit components and in final tuning of high-frequency circuits as off-resonance operation, even to a small degree, may result in marked and undesirable increase in cathode temperature. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for any particular set of operating conditions. A maximum variation of ± 5 percent from optimum is permitted. For straight-through, Class C CW amplifier operation, the following heater operation voltages are indicated:

Frequency (MHz)	Ef (V ac)
201 to 300	5.75
301 to 400	5.50
401 to 500	5.00

2/ When the tube is operated at 100 percent of maximum rated anode dissipation at an incoming air temperature of 25°C maximum, a minimum airflow of 5.0 cfm at sea level shall pass through the anode cooler. If the socket EIMAC SK-710 and chimney SK-606, or equivalents, are used, an incoming airflow of 5.0 cfm to the lower end of the socket is required. At this flow of 5.0 cfm, the static pressure drop directly across the tube and socket (with chimney installed) is approximately 0.4 inch of water. This pressure drop varies with the amount of escaping air and with the shape and construction of the air director (chimney). The airflow rating applies at bias voltages of less than 100 volts and frequencies less than 500 MHz. Air cooling of the tube should be increased with increased negative grid bias, increased incoming air temperature, increased frequency of operation, or a combination. In all cases of operation, a socket which provides forced-air cooling of the base shall be used, and maximum seal and anode core temperature ratings shall not be exceeded. Airflow must be applied before or simultaneously with electrode voltages, and may be removed simultaneously with them. In cases where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

3/ Unless otherwise specified herein, in all electrical tests involving application of heater voltage, forced-air cooling of the tube is allowed at the rate of 5.0 cfm for the base and anode. The tube should be operated in an air-system socket (EIMAC SK-710 socket, with EIMAC SK-606 chimney, or equivalents). Standard temperature and pressure conditions shall apply.

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

5/ Pulse emission (1) and (2) are taken at the voltage conditions specified. For the basic test circuit, see test method 1372, figure 1372-1.

6/ Testing shall be performed every three months, with sampling as follows:

n1 = 4 c1 = 0

The listed tests shall be considered as nondestructive except in case of failure. In case of a sample failure, that test shall become conformance inspection, part 2, acceptance level 6.5 of MIL-PRF-1 Table III, for three consecutive successful submissions, at which time the test may revert to the quarterly basis.

7/ The fixture described in Drawing 284-JAN shall be used to hold the tube in the manner indicated. The test circuit shown on figure 3 shall be used, but tubes found to electrically oscillate for causes other than vibration shall not be tested nor rejected on this test. Each tube under test shall be subjected to one sweep cycle in each of the three axes X, Y, and Z. One sweep cycle (100 to 750 Hz, ascending only) shall be covered in 6 to 12 minutes. Each tube shall be vibrated for 60 seconds at the frequency which gives the maximum vibration output voltage in each of the three positions. If at the end of 60 seconds the vibration output is increasing, the vibration shall be continued until there is no further increase for 60 seconds. The tubes shall not show noise voltage output in excess of the maximum limit specified, except one intermittent short per tube shall be allowable during this test. The tube shall show no intermittent or tap shorts after the test. In addition to reading noise voltage output with a VTVM, such as an HP400D 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 (100 to 750 Hz) 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. The frequency at the extremes of the sweep shall be read with an accuracy of ± 1 percent.

TABLE I. Testing and inspection - Continued.

8/ The fixture described in Drawing 284-JAN shall be used to hold the tube in the manner indicated. The tube shall be subjected to the specified acceleration in the X, Y, and Z axes, with six 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 duration measured at the zero-axis level.

9/ This test shall be performed during the initial production and then annually thereafter. Sample shall consist of three tubes with an acceptance number of zero. In the event of a failure, the test will be made as a part of conformance inspection, part 2, acceptance level 6.5 of MIL-PRF-1 Table III . The annual sampling plan shall be reinstated after three consecutive samples have been accepted.

10/ During the performance of life-test (5), the rf grid driving voltage and the bias voltage shall be monitored and held constant. The bias voltage shall be adjusted to produce the specified value of Ibo and the rf drive shall be adjusted to produce the specified anode current of 250 mA dc during an initial adjustment period not to exceed 4 hours. In no case shall the grid be driven positive with respect to the cathode as indicated by a grid current of 50 μA dc maximum. At the conclusion of the life-test period, the change (ΔIb) in the anode current from the initial value of 250 mA dc, and the power output (Po), both being read in the life-test equipment itself, shall be read and the tube shall meet the listed requirements for these parameters. Prior to the performance of life-test (5), the tube shall have met the requirements of the linear amplifier power output and distortion test.

11/ Heater voltage shall be cycled approximately 2.0 minutes "on" and 4.0 minutes "off". No grid-cathode shorts are permitted during or after life test. For qualification, data on a sample of 10 tubes shall be submitted.

12/ The tube shall be mounted in an air-system socket (EIMAC SK-710, with SK-606 chimney, or equivalents) arranged so that the entire airflow passes through the anode cooler, with air flowing in a base-to-anode direction. Air under standard conditions of temperature and pressure shall be used, or appropriate correction applied. Temperatures shall be measured by means of thermocouples, located as follows:

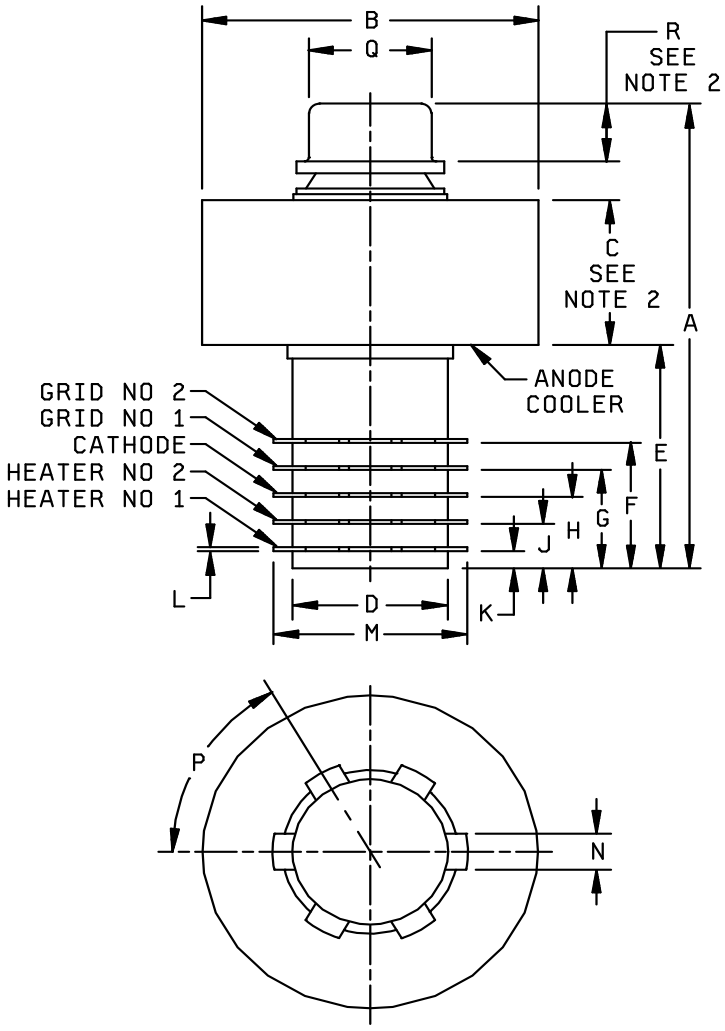
Anode core. The thermocouple shall be embedded in the top of the anode core, adjacent to the cooler, by means of drilling a small hole, shallow enough so that the tube vacuum shall not be lost, placing the welded thermocouple junction therein, and then peening the edges of the hole so as to hold the thermocouple firmly in place.

Anode seal. The thermocouple shall be attached, by any suitable means, to the base of the anode in the immediate vicinity of the junction of the screen-grid/anode insulating dielectric material with the anode.

Base seal. The thermocouple shall be attached, by any suitable means, to the screen-grid contact where it joins the insulating dielectric material.

In all cases, good electrical continuity between the thermocouple and the metal area in close proximity shall be demonstrated before the cooling test is performed.

13/ Measurement with General Radio Megohmeter Model 1862C, or equivalent. Unused elements are to be left floating.

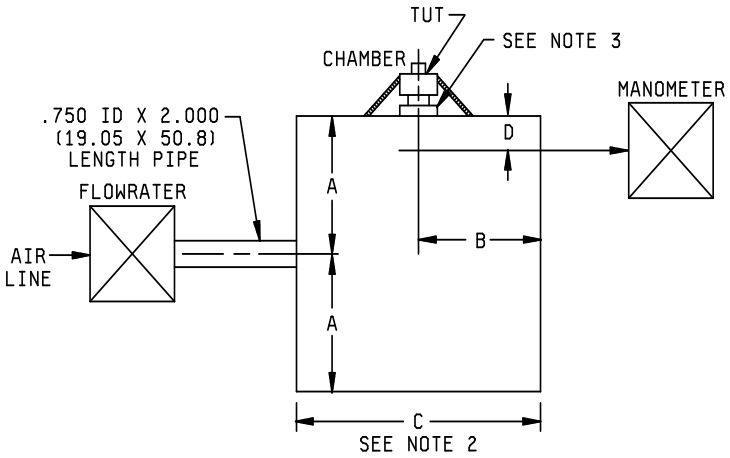


Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
A	2.300	2.500	58.42	63.50
D	.740	.770	18.80	19.56
F	.602	.642	15.29	16.31
G	.470	.500	11.94	12.70
H	.329	.359	8.36	9.12
J	.193	.213	4.90	5.41
K	.050	.072	1.27	1.83
L	.010	.020	0.25	0.51
M	.936	.956	23.77	24.28
Conformance inspection, part 3 (see note 1)				
B	1.610	1.640	40.89	41.66
C	.710	.790	18.03	20.07
E	1.133	1.195	28.78	30.35
N	.170	.185	4.32	4.70
Q	.559	.573	14.20	14.55
R	.240	---	6.10	---
Reference dimension				
P	60°			

NOTES:
1. Dimensions shall be checked during the initial production and annually thereafter. A sampling plan shall be used, with 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, acceptance level 6.5 of MIL-PRF-1 Table III. Annual sampling plan may be reinstated after three consecutive samples have been accepted.

2. Available anode contact surfaces.

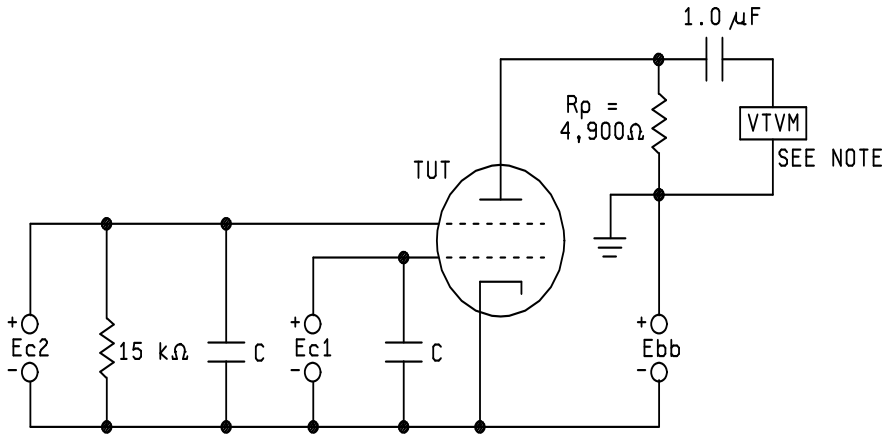
FIGURE 1. Outline drawing of electron tube type 8167.



Ltr	Dimension			
	Inches		Millimeters	
	Min	Max	Min	Max
A	5.95	6.05	151.1	153.7
B	5.95	6.05	151.1	153.7
C	11.95	12.05	303.5	306.1
D	1.95	2.05	49.5	52.1

NOTES:
1. Tabulated dimensions are in inches with metric equivalents based upon 1.00 inch = 25.4 mm.
2. 12.00 inch (304.8 mm) cube inside dimension shall be free of air leaks.
3. Socket shall be EIMAC SK-710, or equivalent.

FIGURE 2. Baffle system.



NOTE: Hewlett-Packard Type 400-D, or equivalent.

FIGURE 3. Vibration noise test circuit.

Referenced documents. In addition to MIL-PRF-1, this specification sheet sheet references MIL-STD-1311, Drawing 285-JAN, DESC Drawing 67001, and Drawing 284-JAN.

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