INCH-POUND

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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, NEGATIVE GRID (MICROWAVE)

TYPE 7815 *

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 (51 gm) nominal.

ABSOLUTE RATINGS:

Parameter:	F1	Ef	Eb	epy	Ec	ib	Ib	ic	tp	Du	Pp
Unit:	MHz	V	V dc	kv	V dc	a	mA dc	a	µs	---	W
Maximum:		1/				2/					
Anode pulsed (Osc or amp)	3,000	6.0 ±5%	---	3.5	-150	3.0	---	1.8	3.5	0.0025	10
Grid pulsed (Osc or amp)	3,000	6.0 ±5%	2,000	---	-150	3.0	---	1.8	3.5	0.0025	10
Test conditions:	---	6.0	600	---	Adj	---	25	---	---	---	---

ABSOLUTE RATINGS:

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

See footnotes at end of table I.

GENERAL:

Qualification: Required.

* See 7/

TABLE I. Testing and inspection.

Inspection	Method MIL-STD-1311	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 1		8/					
Insulation of electrodes	1211		Eb = Ek = 0; Ec = -500 V dc	R	50	---	MegΩ
Electrode voltage (1) (grid)	1261	---		Ec	-2.5	-7.5	V dc
Total grid current	1266	---		Ic	---	-2.0	µA dc
Pulsing emission	1231	---	eb = ec = etd/is = 6.0 a; tp = 3 µs (max); prr = 600 (max)	etd	---	160	v
Heater current	1301	---		If	0.90	1.05	A
Conformance inspection, part 2		9/					
Resonance test	---	10/	No voltages	---	---	---	---
Electrode voltage (2) (grid)	1261	11/	Eb = 1,000 V dc; Ec/Ib = 1.0 mA dc	Ec	---	-25	V dc
Direct-interelectrode capacitance	1331	---	No voltages; use fixture in accordance with Drawing 158-JAN	Cin Cgp Cout	5.6 1.85 ---	7.0 2.10 0.035	pF pF pF
Power oscillation (pulse)	1236	12/	F = 3,000 MHz (min); epy = 3.5 kv; Ec = -1.5 V dc (min); Rg/Ib = 7.5 mA dc (max); Ic = 4.5 mA dc (max); Ef = 5.8 V	Po	4.0	---	W (useful)
Power gain	---	13/	F = 1,100 ± 50 MHz; Ebb = 2,200 V dc; Ecc = -45 V dc; tp = 3 µs (min); Du = 0.002 (min); pd = 400 w (peak)	G	6	---	dB

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	---	14/	Group B; Ef = 6.0 V; Filament standby	---	---	---	---
Life-test end point (500 hours)	---	14/		Δib	---	25	%
Variable-frequency vibration	1031	9/ 15/ 16/ 17/	F = 55 to 500 Hz; Accel = 10 G (peak); Ebb = 300 V dc; Rp = 10,000 ohms; Ec/Ib = 10 mA dc	Ep	---	250	mV ac
Torque	---	9/ 15/ 16/ 18/	No voltages	---	---	---	---
Torque-test end point	---	---					
Total grid current	1266	---		Ic	---	-10	µA dc
Shock, specified pulse	1042	15/ 16/	Condition A; no voltages; use fixture in accordance with Drawing 280-JAN	---	---	---	---
Shock, specified pulse-test end point	---	---					
Total grid current	1266			Ic	---	-10	µA dc
Barometric pressure, reduced	1002	19/	Pressure = 35 mmHg (max); voltage = 1,800 V ac; TA = 30°C ± 10°C	---	---	---	---

1/ The transit-time heating effect of the cathode may require compensation 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 which 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.

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, 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 will be seriously impaired if this maximum is exceeded. Where emphasis is placed on long and reliable life, lower temperatures should be used.

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

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

TABLE I. Testing and inspection - Continued.

7/ Tube type 7815R was deleted from this TSS in the E revision; use the latest revision of MIL-PRF-1/1702, tube type 8745.

8/ All tests listed under conformance inspection, part 1 shall be performed at the conclusion of the holding period. The acceptance level for each test shall be 0.65 (see 21/).

9/ 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.

10/ Grid-anode resonance: Test cavity in accordance with Drawing 278-JAN. Cavity shall resonate at 1,354 ± 2.0 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 ± 2.0 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	1.85	5.6	1,980	1,790
2	1.85	5.6	2,010	1,820
3	2.10	7.0	1,910	1,740
4	2.10	7.0	1,940	1,770

11/ This test may be performed with the following alternate conditions: Eb = 600 V dc; Ec/Ib = 1.0 mA dc. The limit for Ec shall then be -15.0 V dc maximum.

12/ 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 maximum, and tf = 0.7 µs maximum. The pulse repetition rate (prr) 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.

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 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.

14/ At zero hours, establish the drive conditions necessary to obtain 2.0 amperes peak anode current with an anode voltage of 1,000 V dc and a bias voltage of -40 V dc and Ef = 6.0 V. 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 is 25 percent. Group B shall apply except that it shall be permissible to represent a lot not to exceed one month's production with a sample of 12 tubes, with an accept on zero sampling:

$n_1 = 12$ $c_1 = 0$

This is a destructive test.

15/ This test is nondestructive except in case of failure.

TABLE I. Testing and inspection - Continued.

16/ This test shall be performed during the initial production and once each succeeding 12-calendar month period in which there is production. An accept on zero defect sampling plan shall be used, with sample of three tubes having an acceptance number of zero. In the event of failure, the test shall be made as a part of conformance inspection, part 2, with an acceptance level of 6.5 (see 21/). The "12 calendar month" sampling plan shall be reinstated after three consecutive samples have been accepted.

17/ 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 axis, subsequent measurements need be taken only in the axis giving the higher reading. 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.

18/ 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.

19/ Voltage 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. Perform test on 10 tubes selected from the first production lot of each year. If one tube or more fails, the test shall become part of conformance inspection, part 2 with acceptance level of 6.5 (see 21/). After three consecutive successful submissions the test shall revert to a 10-tube annual test. This is not a destructive test.

20/ Revision letters are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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

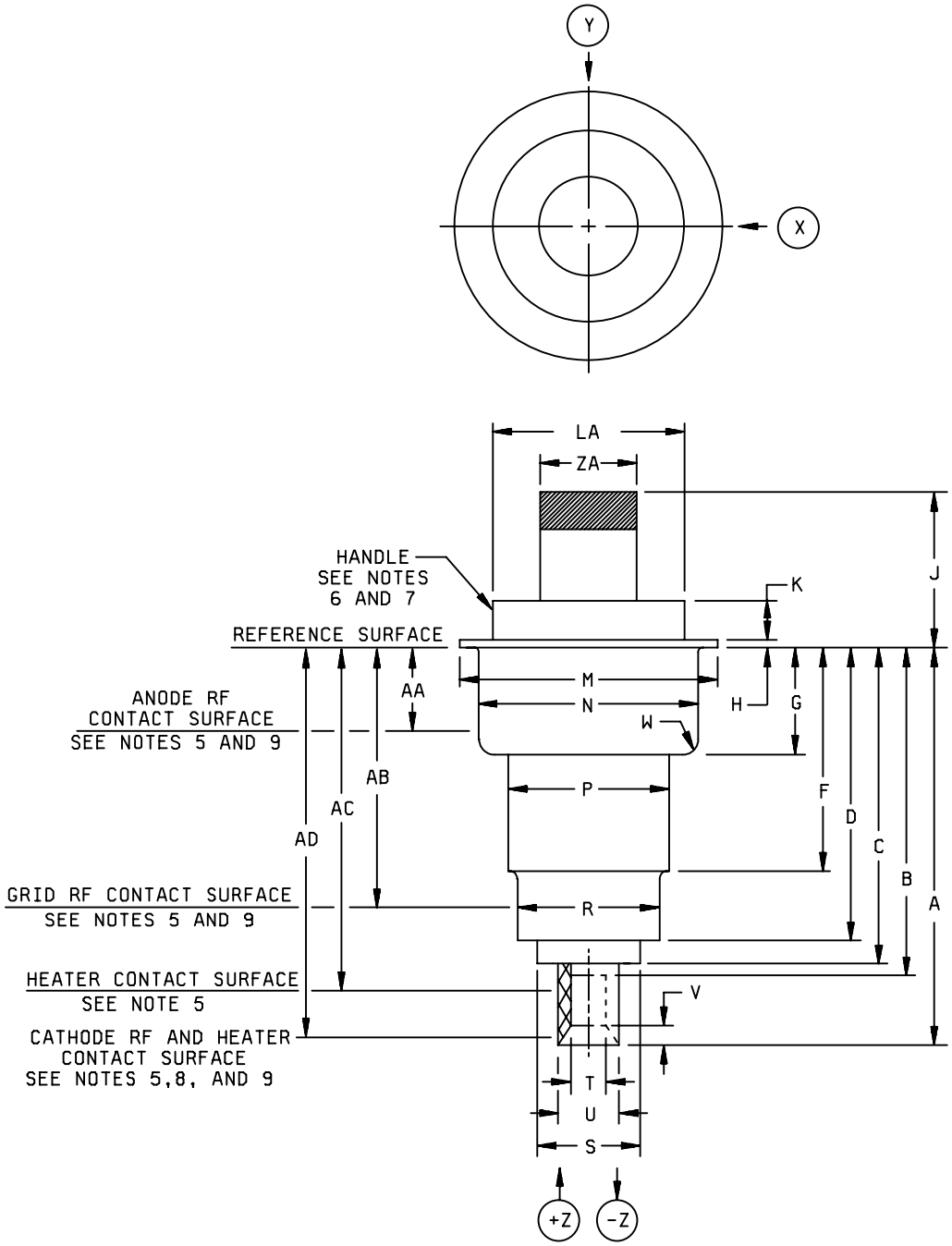


FIGURE 1. Outline drawing of electron tube type 7815.

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	2, 10
R	.655	.665	16.64	16.89	2, 10
T	.213	.223	5.41	5.66	3, 10
U	.315	.325	8.00	8.26	2, 3, 10
Conformance inspection, part 3					4
H	---	.040	---	1.02	
K	---	.185	---	4.70	
LA	.840	.860	21.34	21.84	
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	
Z	.427	.447	10.85	11.35	
Electrode contact areas					1, 11
AA	.035	.361	0.89	9.17	2
AB	1.185	1.265	30.10	32.13	2
AC	1.534	1.728	38.96	43.89	3
AD	1.475	1.815	37.46	46.10	2, 3

FIGURE 1. Outline drawing of electron tube type 7815 - Continued.

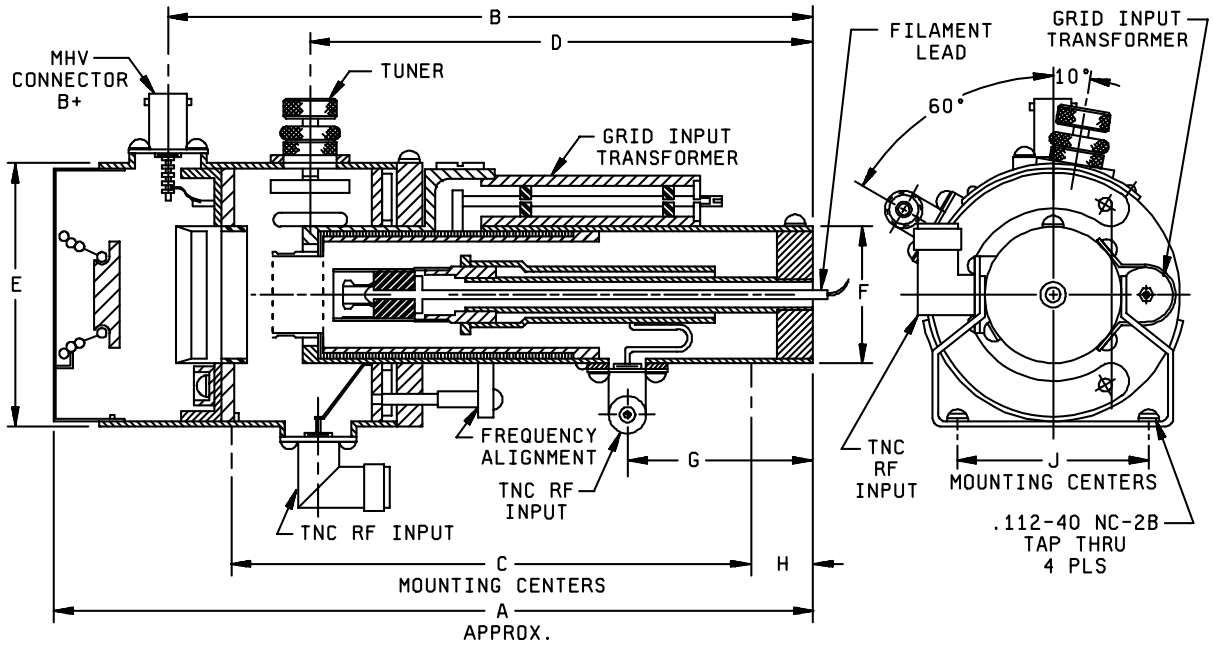
NOTES:

1. Electrode contact surfaces and reference dimensions for eccentricity measurements.
2. 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).
3. The total indicated runout of the cathode contact surface with respect to the heater contact surface shall not exceed .012 inch (0.30 mm).
4. 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.
5. Silver plated 30 MSI minimum. Note 4 shall apply.
6. Plating not required over handle support of copper, aluminum, or approved equivalent.
7. This surface shall be used for measurement of anode shank temperature.
8. Inner edge of heater and outer edge of cathode RF connection shall be free from burrs and sharp edges.
9. Total indicated runout (TIR) of contact surfaces shall be gauged from centerline of reference and shall be as follows. Note 4 shall apply.

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

10. Diameters N, R, T, and U shall apply throughout entire contact areas as defined by dimensions AA, AB, AC, and AD respectively.
11. 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 7815 - Continued.



Ltr	Dimensions	
	Inches	Millimeters
A	6.969	177.01
B	5.719	145.26
C	4.719	119.86
D	4.562	115.87
E	2.500 O. D.	63.50 O. D.
F	1.250 O. D.	31.75 O. D.
G	1.562	39.67
H	.625	15.88
J	1.875	47.63

NOTE: All dimensions are for reference only.

FIGURE 2. Pulse amplifier cavity.

NOTES

Referenced documents. In addition to MIL-PRF-1, this specification sheet sheet references MIL-STD-1311, MIL-PRF-1/1702, Drawing 158-JAN, Drawing 159-JAN, Drawing 276-JAN, Drawing 277-JAN, Drawing 278-JAN, Drawing 279-JAN, Drawing 280-JAN, and Drawing 283-JAN.

Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. 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 and relationship to the previous issue.

Custodian:
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5960-3734)

Review activities:
Navy - AS, CG, MC, OS

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