INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, KLYSTRON
TYPE 8493

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 MIL-PRF-1.

DESCRIPTION: Pulsed amplifier, control grid modulated, self-focused, tunable frequency range 900 to 1,215 MHz.

ABSOLUTE RATINGS:

Parameter: Unit:	Ef V	Ec V	Eb kV	egy v	ib a	Pi W	pd w	Pd W	po kw	Po W
Maximum: Minimum:	4.6 3.8	-50 -250	20 ---	450 ---	10 ---	2,300 ---	500 ---	80 ---	25 ---	600 ---

Parameter: Unit:	Pg W	prr pairs/sec	Du ---	T °C
Maximum: Minimum:	5 ---	3,700 ---	0.025 ---	150 --- (Figure 1, ref. T1 through T5)

PHYSICAL CHARACTERISTICS:

Dimensions:	See figure 1	Cooling:	Forced-air 2/
Mounting:	1/	Weight::	30 pounds (approximate)
Temperature reference:	See figure 1	Marking:	See figure 1
Output and input connectors	See figure 1	Initial start-up:	5/

TEST CONDITIONS:

Parameter: Unit:	Ef V	Ec V	Eb kV	egy v	Pi W	pd w	po kw
Tolerance:	--- 4.2	--- -125	--- 12.5	±55 365	max 1,840	--- 30	min 11.5
Notes:	3/	4/	5/	6/ 7/	---	11/	8/ 9/

TEST CONDITIONS:

Parameter: Unit:	Du ---	prr pair/sec	F MHz
Tolerance:	0.025 ---	±90 3,600	--- F1 and F3
Notes:	---	---	10/

Frequency	
F	MHz
F1	960
F2	1,100
F3	1,215

See footnotes at end of table I.

GENERAL:

Qualification: Not Required.

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

AMSC N/A
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FSC 5960

TABLE I. Testing and inspection.

Inspection	Method MIL-STD-1311	Notes	Conditions	Symbol	Limits		Unit
					Min	Max	
Conformance inspection, part 1							
Heater current	1301	3/	Ef = 4.2 V	If	30	38	A
Electrode current (anode)	1256	7/	egy = 365 v	ib	---	4.5	A
Power level (output)	4250	7/ 8/ 9/ 10/		po	11.5	---	kw
Electrode current (cutoff)	1256	---	egy = 0	Ib	---	1.0	ma
Cathode emission	4214	12/ 13/		Δib/ib	---	10	%
Conformance inspection, part 2							
Direct-interelectrode capacitance	4266	---	Connect shell to cathode	Cgk	---	150	pF
Spectrum	---	16/		Spec 1 Spec 2	-43 -53	--- ---	dB dB
Torque test, rf output connector	---	---	No voltages	---	200	---	inch/pound
Open-short circuit test	---	9/		---	---	---	---
Power level (pulse droop)	4250	14/		---	---	2	%
Conformance inspection, part 3							
Life test	---	17/	Group D; tp = 10 µs (rectangular) Psi = 1,300 W	t	1,000	---	hours
Life test end-points:	---						
Power level (output) Cathode emission	4250 4214	7/ 11/ 13/ 17/		po Δib/ib	10.5 ---	--- 10	kw %
First Article Inspection							
Power level (harmonic)	4250	18/		po	---	-50	dB
Amplifier insertion loss	4257	15/	egy = 0 ib = 0	po po	--- ---	10 -3	µw dBm
Warmup time	4303	---	tk = 6 minutes (max) t = 10 seconds	--- po	--- 11.5	--- ---	--- 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	
First Article Inspection Continued							
Temperature coefficient	4027	20/	F = F2; TA = -65°C to +65°V	ΔF/ΔT	---	+0.015 -0.021	MHz/°C MHz/°C
Shock, specified pulse	1042	21/ 22/	Test condition J, except 6.5 ms	---	---	---	---
Nonoperation vibration	1031	23/	No voltages	ΔF	---	0.5	MHz
Operation vibration	1031	19/		$\frac{\Delta V(\max)}{V(\max)}$	---	3.0	%
Permanence of marking	1105	---		---	---	---	---

1/ The tube described herein shall be designed to be mounted in any position using the four .375 inch (9.53 mm) diameter threaded inserts on the collector end plate and a suitable strap around the mounting bracket shown on figure 1.

2/ The tube under test (TUT) shall be cooled at sea level pressure with 18 psia per minute of 0.0730 pounds per cubic foot density at a pressure drop not greater than 2.0 inches of water.

3/ The TUT shall stabilize within the limits specified herein after a 5 minute (maximum) preheating period.

4/ The TUT shall not be operated without a negative-grid bias when the beam voltage has been applied. The TUT shall be protected from this condition by overload circuits included in the high voltage circuits. The output of the dc beam supply shall be followed by a series resistor approximately 10 ohms to prevent serious surges of beam current through the tube.

5/ The following procedure shall be followed for all new tubes and tubes which have not been operated during the preceding 3-month period.

a. Reduce the grid drive voltage to zero (do not change the bias voltage from its normal -125 V setting).

b. Turn on main power and apply rated filament and 125 V bias voltage for 15 minutes.

c. Apply a beam voltage of 7 kv for 15 minutes.

d. Increase the grid drive from zero to a value which gives 10 ma of average beam current.

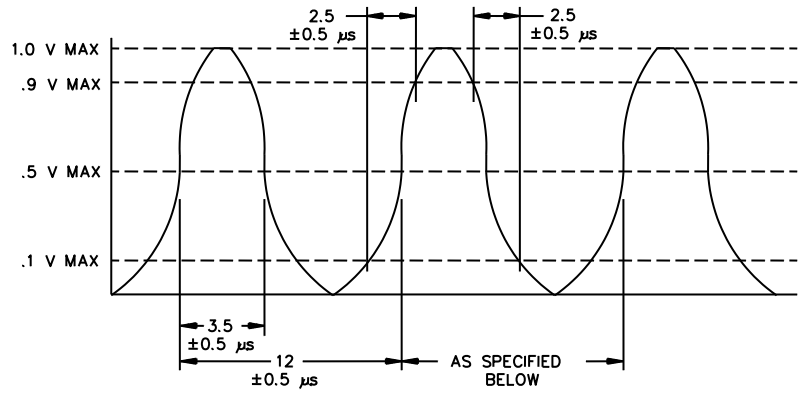
e. Apply the rated beam voltage and increase the grid drive to 60 mA average beam current. Continue to increase the grid drive to values which provide 10 mA beam current increases every 5 minutes until the current reaches 90 mA and operates at 90 mA for 5 minutes.

The tube is not considered to be properly aged and ready to be placed into service.

6/ The control grid shall be driven with a shaped pulsed pair which has a peak amplitude as specified herein with reference to the negative bias voltage (total grid swing).

TABLE I. Testing and inspection - Continued.

7/ The eg pulse shall be of such shape as to provide rf output voltages which conform to the following diagram:



a. The eg pulses shall be composed of pairs spaced 12.0 ±0.5 microseconds between centers. The repetition rate shall be 3,600 ± 90 pairs per second.

b. The tube shall not oscillate with the input line disconnected and the input and output resonators tuned to the same frequency provided that the middle resonator is detuned by one turn of one tuning nut from resonance.

c. The output of the grid modulator can be loaded with a shunt impedance, if necessary, to obtain the proper waveform to drive the TUT grid.

8/ The TUT shall deliver the rated power specified herein into a transformer adjusted load which has a VSWR of 1.5:1, or less.

9/ The TUT nor its output coupling shall be damaged if the TUT output connector is open, short circuited, or terminated in any resistance or reactance or combination thereof between the limits of open and short circuit when the TUT is tuned in equipment in accordance with instructions supplied by the tube supplier.

10/ A tuning curve shall be supplied with each tube. The frequency of each resonator can be set approximately by adjusting the tuning ring spacing of each resonator according to the tuning charts. Tuning rings shall be parallel with one turn of a tuning nut after final adjustment. When adjusted to any operating frequency in the range from F1 to F3 in accordance with the individual cold tuning charts, and when supplied with rf drive over the range of nominal frequency ±0.5 MHz, the tube will deliver a minimum rf output power of 30 watts into a 50-ohm resistive load.

11/ The rf drive shall be applied to the input resonator of the TUT. The rf drive may be either pulsed or cw. When a rectangular pulse drive is used, synchronization shall be provided to allow the control-grid pulse to appear in time phase with rf pulse. The rf drive pulse shall be free from frequency modulation which would prevent testing the tubes to the performance limits indicated.

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

13/ With the TUT operating, the filament voltage shall be decreased from 4.5 to 3.8 volts. The percentage change in anode current shall be within the limits specified herein.

14/ After account has been taken of existing differences in the amplitude of adjoining eg pulses, and correction made for the 5:4 power relationship between the output voltage pulse amplitude and droop in Eb, there shall be in addition not more than 2 percent difference between the maximum amplitude pulse and the minimum amplitude pulse in a group of 24 successive pulses. These 24 pulses may be evenly spaced in a total interval not exceeding 330 microseconds. One tube per month shall be tested with no failures per lot.

15/ With the TUT operating under specified test conditions, removal of the grid pulse potential shall reduce the radiated rf and the transmitted output to the maximum specified. In the absence of beam current and for any condition of tuning, the maximum level of radiated rf or the transmitted output is specified with respect to the rf drive power.

TABLE I. Testing and inspection - Continued.

16/ Spectrum test:

a. The requirements of b. shall be met under the following conditions: (1) a suitable grid drive pulse such as shown on figure 2; (2) an output voltage pulse of 3.5 µs when measured at half amplitude; (3) a peak drive voltage set at a point in the range 365 ± 55 volts with reference to the bias level of -125 volts dc; (4) the input and center cavities suitably detuned as described in the spectrum check; and (5) peak power output of at least 11.5 kw.

b. The frequency spectrum of the output rf pulses shall be such that the energy in each 500 kHz wide band, centered ±800 kHz from the center frequency shall be greater than 43 dB down from the energy in the 500 kHz band centered on the carrier frequency; further, the energy in each 500 kHz wide band, centered ± 2 MHz from the center frequency shall be greater than 53 dB down from the energy in the 500 kHz band centered on the carrier frequency.

17/ The beam current shall be measured at 0, 24, 48, 250 and 500 hours. Power output shall be measured only at 0, 48, 250, and 500 hours. Average power may be adjusted by means of variable pulse repetition rate and grid voltage.

18/ The second harmonic of the fundamental drive frequency shall be below the limit specified herein when the output of the tube is examined under Po conditions by spectrum analyzer techniques at the drive frequencies of F1, F2, and F3.

19/ The tube shall be vibrated at 15 and 135 Hz for 3 minutes at each frequency. The vibration level shall be 2.5 G"s and shall be applied in the Z-direction. Before and after this test, the TUT shall satisfy the requirements of conformance inspection, part 1.

20/ The TUT shall be installed in a temperature chamber with external rf connections provided from each cavity. The body temperature coefficient is measured by tuning each tube cavity to resonate with the modulated output of a signal source operating at the specified frequency. Absorption of each cavity and a monitoring frequency meter are viewed superimposed on an oscilloscope presentation of the mode. The frequency of each cavity is measured at room ambient temperature and at the specific temperature extremes. The temperature coefficient $\frac{\Delta F}{\Delta T}$ shall be within the specified limit.

21/ The TUT shall be shocked with 3 shock pulses in each of the +X, +Y, and +Z axes of the tube. The TUT shall then satisfy the requirements of the conformance inspection, part 1, power output test.

22/ The TUT shall be mounted in a shock-mounted rack resonant at 35 ±5 Hz at normal vibration amplitude (less than 0.100 displacement). This platform shall exhibit these frequency characteristics in all directions of applied shock. The deflection characteristics of this shock-mounted rack shall be the same as, or similar to, that of Barry Corporation Shock Mounts, Type C-2080-T6-SB, or equivalent.

23/ The resonant frequency of each resonator shall be set at F2 ±2 MHz by "cold test" methods. After vibration, the cold resonant frequency of the respective resonators shall be within the limits specified herein of the original setting.

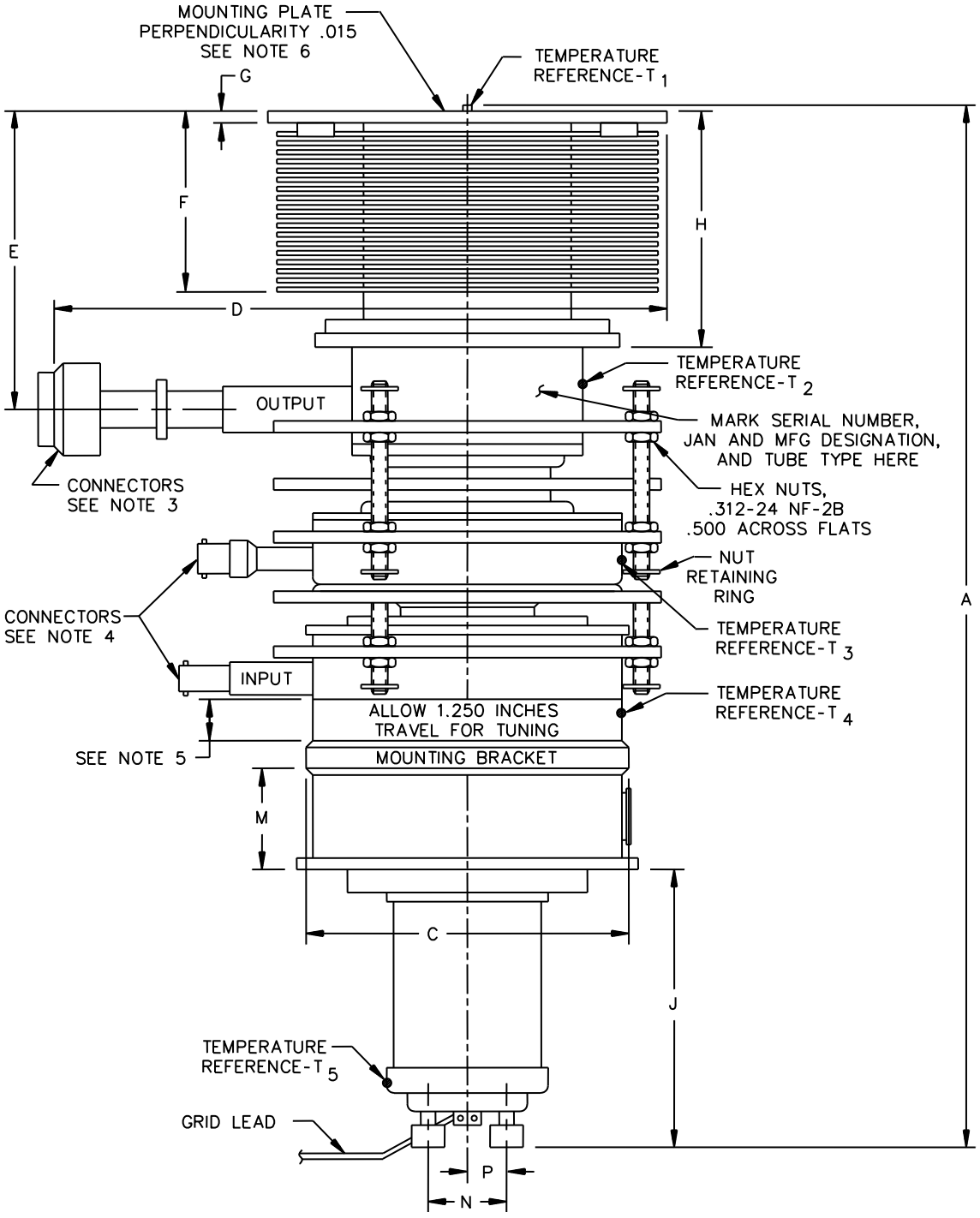


FIGURE 1. Outline drawing of electron tube type 8493.

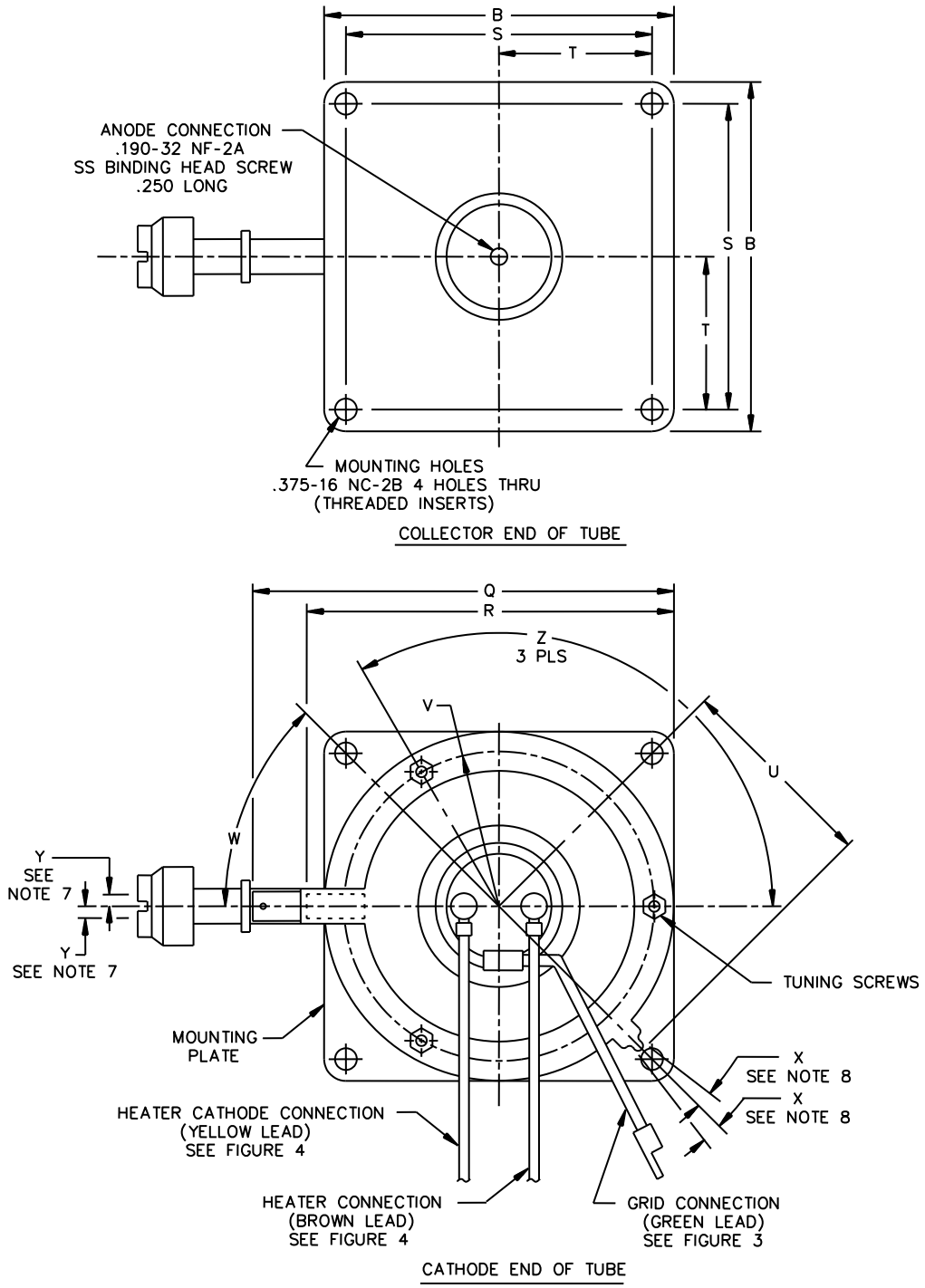


FIGURE 1. Outline drawing of electron tube type 8493 - Continued.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
First Article Inspection				
E	4.600	4.850	116.84	123.19
G	.172	.203	4.36	5.16
M	1.563	1.688	39.70	42.88
Q	---	9.000	---	228.60
R	---	7.750	---	196.85
S	5.719	5.781	145.15	146.73
U	---	4.250	---	107.95
W	43.5°		46.5°	
Conformance inspection, part 2				
A	17.250	19.000	438.15	482.60
B	6.844	6.906	173.84	175.41
C	5.344	5.406	135.74	137.31
D	10.000	10.250	254.00	260.35
F	2.625	2.875	66.67	73.03
H	3.375	3.438	85.73	87.33
J	---	4.565	---	115.95
N	1.188	1.313	30.17	33.35
T	2.844	2.906	72.23	73.81
V	3.024	3.039	76.81	77.19
Y	---		2°	
Z	115°		125°	
Nominal dimensions (see note 2)				
P	.625		15.87	
X	5°		5°	

NOTES:
1. Metric equivalents (to the nearest 0.01 mm) are given for general information only.
2. Dimensions without tolerances are for information only and are not required for inspection purposes.
3. Output connector shall mate with connector UG-1126/U.
4. Connectors shall mate with Plug M39012/16-0001.
5. Provision shall be made for 1.250 inch (31.75 mm) tuning travel.
6. Axis of tube shall be perpendicular to collector end-plate within .015 inch (0.38 mm) for every inch, assuming parallel tuning.
7. Allowable deviation of connectors from true position on centerline.
8. Allowable deviation of seal-off tip from true position on centerline through mounting holes as shown.
9. Pictorial configuration is for reference purposes only.
10. Tuning screws should be free and clear of all paint.

FIGURE 1. Outline drawing of electron tube type 8493 - Continued.

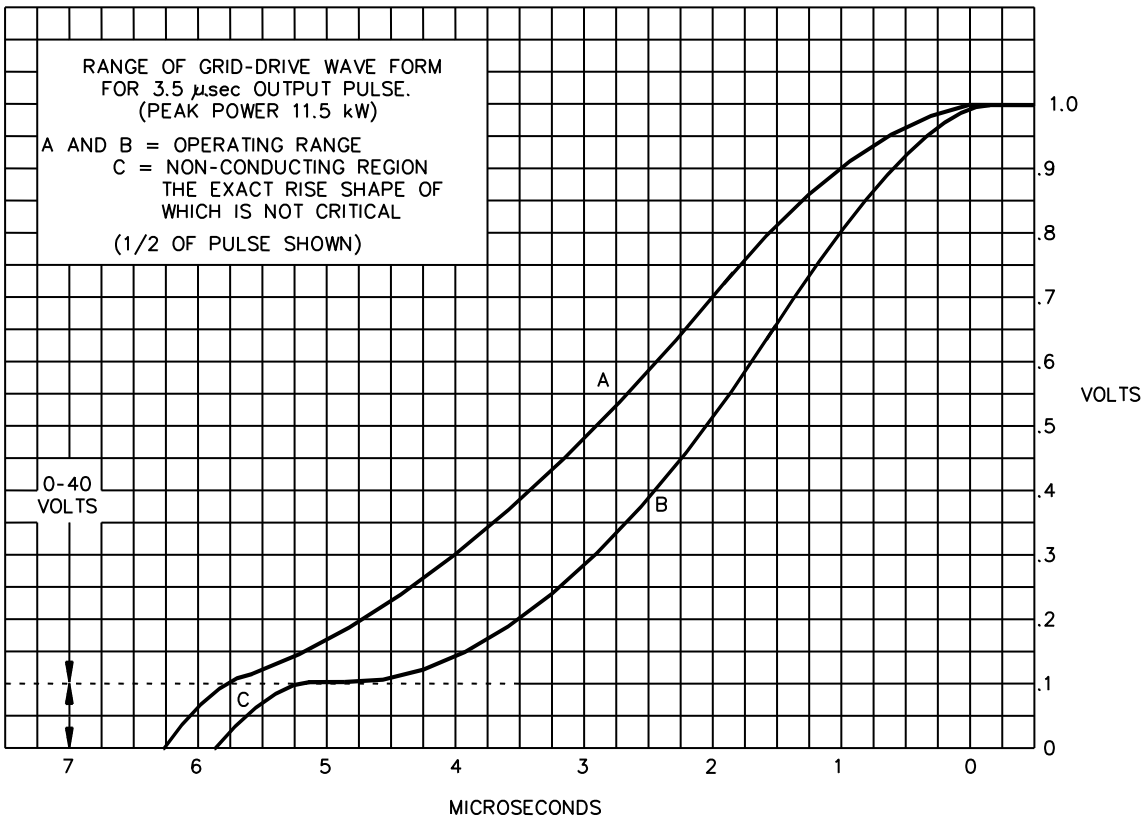


FIGURE 2. Range of grid-drive waveform.

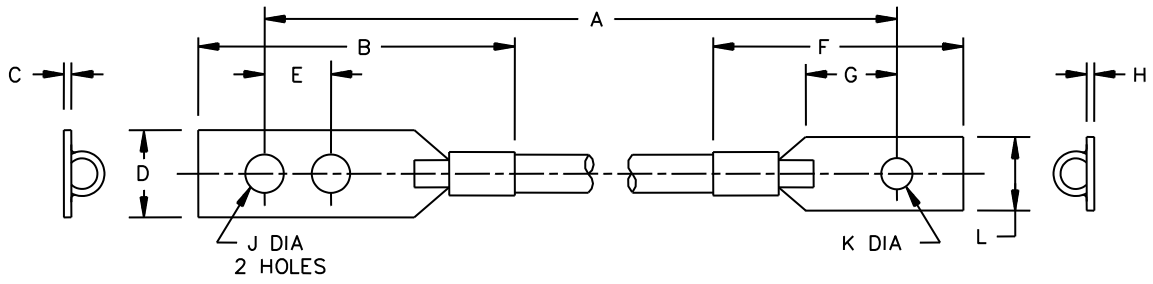


FIGURE 3. Grid lead assembly.

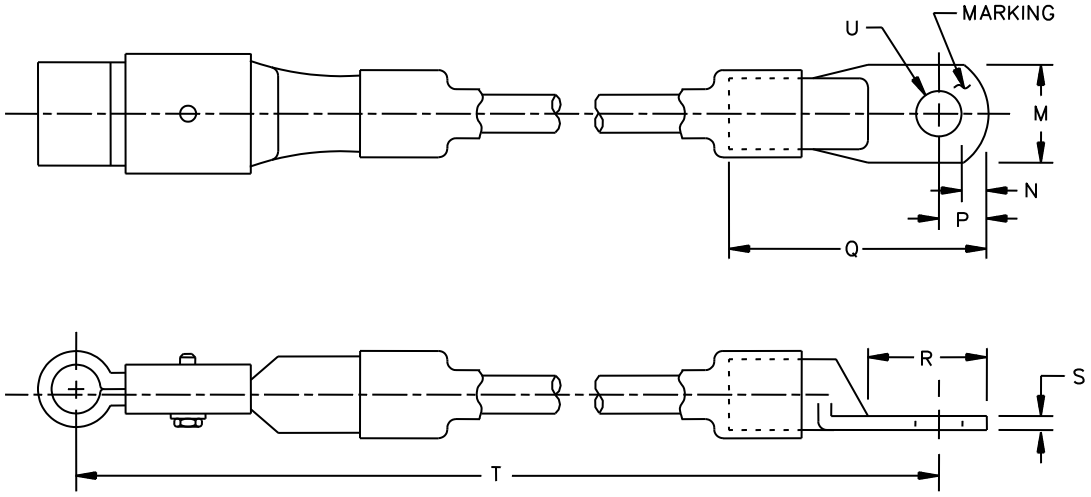


FIGURE 4. Heater and cathode lead assembly.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
First Article Inspection				
A	6.437	6.687	163.50	169.85
C	.025	.035	0.63	0.89
D	.370	.380	9.40	9.65
E	.305	.315	7.75	8.00
G	.296	---	7.52	---
J	.193 DIA	.203 DIA	4.90 DIA	5.16 DIA
K	.143 DIA	.152 DIA	3.63 DIA	3.86 DIA
L	.232	.312	5.89	7.92
M	.433	442	11.00	11.23
N	.120	.130	3.05	3.30
P	.245	.255	6.22	6.48
Q	1.214	1.224	30.84	31.09
R	.589	.599	14.96	15.21
T	7.218	7.406	183.29	188.11
U	.255	.265	6.48	6.73
Reference dimensions				
B	1.310		33.33	
F	.875		22.22	
H	.030		0.76	
S	.060		1.52	

Marking	
Heater	Cathode
H	HK

NOTES:
1. Dimensions are in inches.
2. Metric equivalents (to the nearest 0.01 mm) are given for general information only.

FIGURE 4. Heater and cathode lead assembly - Continued.

Referenced 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 lines 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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