

INCH POUND

MIL-PRF-1/507H
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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON, PULSE
TYPE 7452A

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: 16.0 GHz fixed frequency, 85 kw peak power output, integral 2-symmetrical-lobe magnet, air cooled.

OUTLINE AND DIMENSIONS: See figure 1 herein. Weight: 25 lbs., approx.

ABSOLUTE RATINGS: (note 1)

Parameter:	Ef	eb	if(surge)	tk	Anode T	VSWR	Cathode (bushing)T
Unit:	V	kv	a	sec	°C	ratio	°C
Maximum:	5.5	30	24	---	+125	1.5:1	+200
Minimum:	---	---	---	180	---	---	---
	(note 2, 3)		(note 3)		(note 4)		(note 4)

Parameter:	lb	ib	Pi	pi	Du	tpc	Pressurized (Output)
Unit:	mA dc	a	W	kw	---	µsec	psia
Maximum:	30	14	780	315	0.0028	0.6	45
Minimum:	---	10	---	---	---	---	14.7
						(note 5)	(notes 6, 7)

TEST CONDITIONS: (Notes 8, 9)								
Parameter:	Ef	lb	VSWR	Du	tpc	tfc	trv	F
Unit:	V	mA dc	ratio	---	µsec	µsec	µsec	GHz
Maximum:	4.8	26	1.1:1	---	0.275	0.15	0.14	16.160
Minimum:	---	22	---	0.00215	0.225	---	0.09	15.840
	(note 2)	(note 2)	(notes 7, 10)					

MOUNTING POSITION: Vertical (note 9)

INPUT CONNECTION: (See figure 1 herein)

OUTPUT CONNECTION: Waveguide choke coupling flange, modified UG-541/U (See figure 1 herein)

COOLING: Forced-air (See figure 1, note 14 herein)

MAGNET ISOLATION: (note 11)

MOUNTING PROVISION: (See figure 1, note 20, herein).

HANDLING-STRESS CAUTION: (note 12)

GENERAL:

Qualification: Not required.
Preproduction sample approval: Required; (note 13)
Dimensions: (See figure 1)
Marking: (notes 14, 15)
Packaging: (note 16)

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TABLE I. Testing and inspection.

Requirement or test	MIL-STD-1311 method	Conditions	Acceptance levels (see note 35)	Symbol	Limits		Units
					Min	Max	
<u>Conformance inspection, part 1</u>		(note 17)					
Visual-mechanical examination	---	See fig. 1	---	---	---	---	---
Pressurizing	4003	Air; 50 psia, min. Output assembly (note 18)	0.65	---	---	---	---
Heater current	4289	Ef = 4.8 V tk=180 sec., (min.) (note 3)	0.65	If	10.8	13.2	A
Oscillation (1)	---	VSWR = 1.1:1 max. (notes 1, 2, 8)	0.65	---	---	---	---
Heater-cathode warm-up time	4303	Ef = 4.8V tk = 180 sec (max.) Ef = 0.0V for test	---	---	---	---	---
Frequency	---	Anode T = +70° ±15°C (notes 4, 19)	---	F	15.840	16.160	GHz
Pulse characteristics	4304	(notes 20, 21)	---	---	---	---	---
Pulse voltage	4306	---	---	epy	22	26	kv
Average anode current	---	lb = 26 mA dc	---	---	---	---	---
Average power output	4250	---	---	Po	150	---	W
Spectrum measurement: RF bandwidth	4308	VSWR = 1.5:1 (note 22)	---	BW	---	8	MHz
Stability	4315	VSWR = 1.5:1 (note 23)	---	MP	---	0.75	%
<u>Conformance inspection, part 2</u>							
High-frequency vibration:	1031	No voltages (note 24)	6.5	---	---	---	---
RF bandwidth	4308	VSWR = 1.5 lb = 22-26 mA dc	---	BW	---	8	MHz
Frequency pulling factor	4310	(Osc. (1)) VSWR = 1.5:1, (note 25)	6.5	ΔF	---	25	MHz

See notes at end of Table I.

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TABLE I. Testing and inspection - Continued.

Requirement or test	MIL-STD-1311 method	Conditions	Acceptance levels (see note 35)	Symbol	Limits		Units
					Min	Max	
<u>Conformance inspection, part 2 - continued.</u>							
Frequency pushing factor	4311	(Osc.(1)) VSWR = 1.1:1 (max.) Swept: 22 to 26 mA dc at 50 Hz rate	6.5	ΔF	---	3.5	MHz/mA
<u>Conformance inspection, part 3</u>							
Cycling life	---	Group D (Osc.(1)) VSWR = 1.5:1, min. Cycle thru $\lambda/2$ ea. 15 minutes of oscillation (note 26)	---	N	175	---	cycles
Life-test end-points (Osc. (1)):	(4.6.2)	Aver. power output Pulse voltage Fixed tuned frequency RF bandwidth Stability Freq. drift, (note 27)	---	Po epy F BW MP ΔF	120 22 15.840 --- --- ---	--- 26 16.160 8 1.0 2	W kv GHz MHz % MHz/hr
<u>Periodic check,</u> (notes 28, 29, 30)							
Salt spray (corrosion)	1006		---	---	---	---	---
Humidity	1011		---	---	---	---	---
Shock	1042	Normal mounting. Test cond. A except G = 15 (peak) (note 31)	---	---	---	---	---
Input capacitance	4266	Heater to anode	---	C	10	20	pF
Temperature coefficient	4027	(Osc. (1)) VSWR = 1.1:1 Anode T = +55° to +85°C (note 4)	---	$\Delta F/^\circ C$	---	0.75	MHz/°C
Low-pressure	---	(Osc. (1)) VSWR = 1.5:1 Pressure = 522 mmHg (note 32)	---	---	---	---	---
Low-temperature operation	1026	Pre-test cooling = 60 minutes at -65°C (Osc.(1)); Stability test requirements; tk = 180 sec., max. (note 23)	---	MP	---	2.0	%

See notes at end of Table I.

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TABLE I. Testing and inspection - Continued.

Requirement or test	MIL-STD-1311 Method	Conditions	Symbol	Limits Min	Limits Max	Units
<u>Conformance inspection, part 3 - continued.</u>						
Frequency	---	(Osc.(1)) (notes 4, 19, 33)	F	15.840	16.160	GHz
Air cooling	---	(Osc.(1)) T _A = +25 °C P _i = 624 W ±10% Air flow = 40 cfm (note 34)	ΔT	---	+70	°C

NOTES:

- 1 Refer to MIL-PRF-1, section 3 definition of absolute ratings.
- 2 Prior to application of high voltage, the filament current applied should be between 10.8 and 13.2 amperes. The procedure should include, first, applying 4.8 volts for 180 seconds minimum to filament; then, upon application of anode voltage, the heater voltage should be reduced until the anode current is 26 mA dc.
- 3 The heater surge current should not be allowed to exceed 24 rms amperes.
- 4 Refer to figure 1, notes 12 and 21 herein for temperature-measurement point. Temperature shall be measured after thermal equilibrium has been reached.
- 5 The characteristics of the applied pulse must be those which result in proper starting and oscillation. The rate of pulse voltage rise, the percentage of pulse voltage ripple, and the rate of the pulse voltage fall are among the more important considerations. Negative post-pulse voltage oscillations may cause leakage current and noise. The established pulse characteristics (refer to Oscillation (1) pulse characteristics, herein) should be adhered to.
- 6 The gas used in pressurization shall provide insulating properties equal to or better than that of dry air at the pressure specified.
- 7 The waveguide must be pressurized at 14.7 psia, minimum, to prevent breakdown under matched conditions, VSWR = 1.1 maximum. Under mismatch conditions, VSWR = 1.5 maximum, the waveguide must be pressurized at 35 psia, minimum.
- 8 Unless otherwise specified for a particular test parameter (see testing program table herein), the cooling and pressurization requirements-data indicated herein shall be effective wherever applicable throughout the testing program.
- 9 The tube shall be mounted with the cathode vertical to within 15° deviation.
- 10 Output window shall be pressurized at 14.7 psia.
- 11 During handling, transportation, mounting, and use, care must be exercised to prevent demagnetization. Ferromagnetic materials should not be brought within 8 inches of the tube magnet, except at the ends where the clearance may be 3 inches. Energized magnets must not at any time be permitted to be closer than 12 inches from the tube magnet.
- 12 Care should be exercised during all handling for installation, storage, and use of the tube, to prevent greater shock or vibration than that of the values for which the tube is designed.

NOTES - Continued.

- 13 Preproduction Sample Approval in lieu of Qualification: Approval of preproduction sample, based upon preproduction sample inspection, shall replace Qualification requirements of MIL-PRF-1. Preproduction Sample tests, testing, sampling, and approval criteria shall correspond directly with all pertinent requirements in the specification as normally applicable to qualification of product.
 - a. Unless otherwise specified in the bid request or contract, preproduction tests will be performed after award of contract, at the manufacturer's plant. Approval of the preproduction sample is required prior to initial delivery of units on the contract. The fabrication of production units, prior to approval of the preproduction sample, shall be at the manufacturer's risk. Unless otherwise specified in the bid request or contract, the specimens shall become the property of the government and, upon approval, shall serve as a reference standard for the contracting officer and government inspector.
 - b. Requests for information regarding preproduction testing and approval of the product(s) covered herein should be referred to the Defense Supply Center Columbus, Code DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000, vqe.chief@dla.mil.
 - c. No Qualified Products List (QPL) entry will be undertaken for the product(s) covered herein as approval of design and performance of product will be based upon Preproduction Sample Approval.
 - d. In no manner shall the above requirements for Preproduction Sample Approval be construed as affecting requirements for production acceptance inspection of the product(s) covered herein.
- 14 Tube-designation marking shall be in accordance with MIL-PRF-1. If any specification requirements waiver has been granted, the product-identification marking shall consist of the tube type-number only.
- 15 Tube identification and tube serial number shall be marked in the most practical and most readily discernible location on the tube, relative to its normal mounted position (see Note 9, above).
- 16 Unless otherwise specified in contract or order, each tube shall, as a minimum protection against moisture and moisture vapor be sealed within a moisture-vaporproof barrier bag, or equivalent, normally acceptable under packaging requirements of MIL-DTL-75. Also each electron tube shall be furnished with a dust cover for protection of the output connector.
- 17 The Acceptance Level for the combined defectives for attributes in Conformance Inspection, Part 1, utilizes an accept on zero defect sampling plan in accordance with MIL-PRF-1, table III.
- 18 The tube shall be gasketed, and test made of the output assembly. The specified pressure shall be applied, and the tube immersed in water. The tube shall be rejected if evidence of continuous formation of air bubbles exists.
- 19 The frequency shall be within the limits specified when measured under the stipulated temperature condition(s) and in accordance with 4.9 (h) of MIL-STD-1311.
- 20 This test need be conducted under only one set of conditions within the limits presented for Oscillation(1) herein.
 - a. The characteristics of the applied pulse must be those that result in proper starting and oscillation. The rate of pulse voltage rise, the percentage of pulse voltage ripple, and the rate of pulse voltage fall are among the more important considerations. Negative post pulse voltage oscillation should be minimized to avoid leakage current and noise. Also, values of voltage and current fall time, spike, ripple, inverse voltage and post voltage oscillations should be minimized.
 - b. In instances where the pulse shape departs appreciably from the rectangular, an equivalent rectangular pulse with minimum departure areas shall be used for determination of pulse width and peak pulse current.
 - c. Any capacitance used in the viewing systems shall not exceed 6.0 pF.

NOTES - Continued

21 The pulse characteristics for Oscillation(1) test shall be as follows:

	Min	Max	Unit
tpc	0.225	0.275	μsec
tfc	---	0.15	μsec
trv	0.09	0.14	μsec
Ripple	---	±10	%
Inverse voltage	---	±20	%
Post pulse forward voltage	---	±5	%

22 The r-f bandwidth shall be within the limits specified when the specified VSWR is introduced in the load at a distance of approximately 0.25 meter from the magnetron, with the load phase adjusted for maximum spectrum degradation.

23 Stability shall be measured in terms of the average number of output pulses missing, expressed as a percentage of the number of input pulses applied during the period of observation. Output rf pulses are considered to be "missing" if, due to any causes, the average rf. pulse energy, within a ±1 percent frequency range of the normal operating frequency, is less than 70 percent of the energy level of a normal pulse. The percentage of missing pulses shall not exceed the amount specified, when measured in the last 3 minutes of a test interval not to exceed 6 minutes. Observation shall be made at the load phase position corresponding to maximum instability.

24 After subjection to Vibration test, each tube shall meet requirements for rf spectrum and stability in accordance with Oscillation (1) testing requirements herein.

25 The pulling measurement test shall be made in a manner such that thermal effects do not contribute appreciable error.

26 One Life test cycle shall consist of operation under the conditions of Osc (1) testing, as follows:

Ef	Ib	Period
Volts	mA dc	Minutes
4.8	0	3
0	26	120
0	0	27

a. The input power to the heater shall be snapped on at the beginning of each Life test cycle with a surge current of 24 to 26 amperes RMS.

b. The standing wave introducer shall be moved during the test so that operation is obtained for load phase positions corresponding to maximum power output, minimum power output, maximum frequency, and minimum frequency. If automatically driven, the standing wave introducer shall be cycled continuously through a line length approximately one-half wavelength long at a maximum rate of four cycles per hour; if manually moved, the standing wave introducer shall be cycled through the four load phase positions corresponding to maximum power, minimum power, maximum frequency, and minimum frequency at least once during the specified life of the tube, spending approximately equal periods of time in each phase position.

27 This test shall be performed in such a manner as to exclude thermal effects. The frequency drift shall not exceed the amount specified when averaged over each eight hour period during the minimum specified life, except during the first 24 hours. The frequency drift during the first 24 hours shall not exceed 6.0 MHz per hour when averaged over each eight hour period.

28 For periodic tests, sample tubes are to be selected at random intervals so that during only twelve-month period a minimum of two tubes shall have been successfully tested. In the event of failure of one or more tubes in a sample, these tests are to become a part of Conformance Inspection, part 2, until two successive lots have been successfully completed on these tests. After two successive lots have been successfully completed, the periodic tests shall then be eligible to be resumed on a twelve-month basis.

29 After subjection to all Periodic-check tests, the sample tube(s) shall meet the requirements of all tests in conformance inspection, part 1 herein.

NOTES - Continued.

30 Although all tests in Part 3, Periodic check, herein may be performed in any sequence, the sequence recommended is as follows:

- Air cooling
- Input capacitance
- Frequency
- Temperature coefficient
- Low pressure
- Low-temperature operation
- Shock
- Salt spray (corrosion)
- Humidity

However, at option of the manufacturer, the tube sample(s) may be subjected to the Part 3, Periodic Check tests herein in accordance with the following grouping plan (see c, below):

- a. The tube sample(s) shall be subjected first to all tests in Group 1, then to all tests in Group 2, and in the test sequence shown within each group. The requirements of Note 29 above shall be effective for performance immediately after the last test in each group.
- b.

<u>Group 1</u> Air cooling Input capacitance Low pressure Frequency Temperature coefficient	<u>Group 2</u> Low-temperature operation Shock Salt-spray (corrosion) Humidity
--	--

c. The above grouping plan is provided to relieve the need to repeat pre- and post-test end-point measurements (all tests of Conformance Inspection, part 1 herein) normally pertinent to individual tests such as Shock and Humidity.

- 31 The magnetron shall be mounted on a test plate and subjected to five half-sine shock pulses in each of three mutually perpendicular axes (a total of is shock pulse) parallel to the respective reference planes shown in Fig. 1 herein.
- 32 Under specified pressurization and with load phase varied through .5 λ g, (waveguide), minimum, there shall be no evidence of breakdown in input assembly.
- 33 The output frequency of the electron tube shall be within the specified limits when the anode-block temperature is varied from +55° to +85° C.
- 34 ΔT is the temperature rise of the anode above that of the coolant temperature at inlet of the cooling fins with the airflow as specified.
- 35 This specification sheet uses accept on zero defect sampling plan in accordance with MIL-PRF-1, table III.

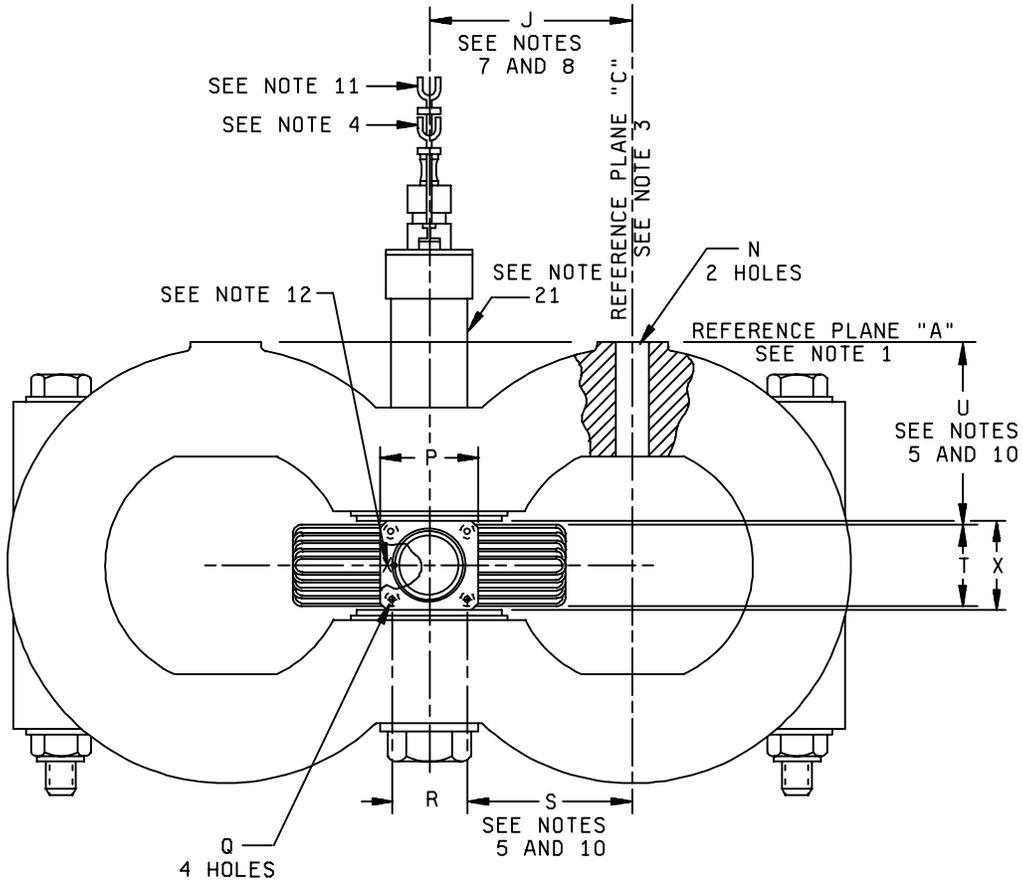


FIGURE 1. Outline and dimensions. (Front view).

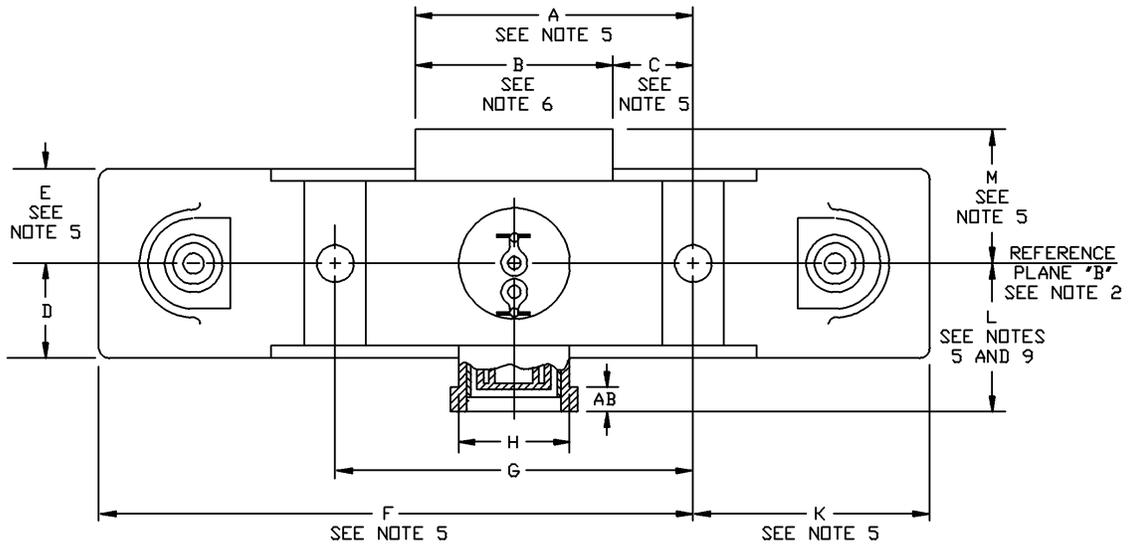


FIGURE 1. Outline and dimensions. - (Top view) - Continued.

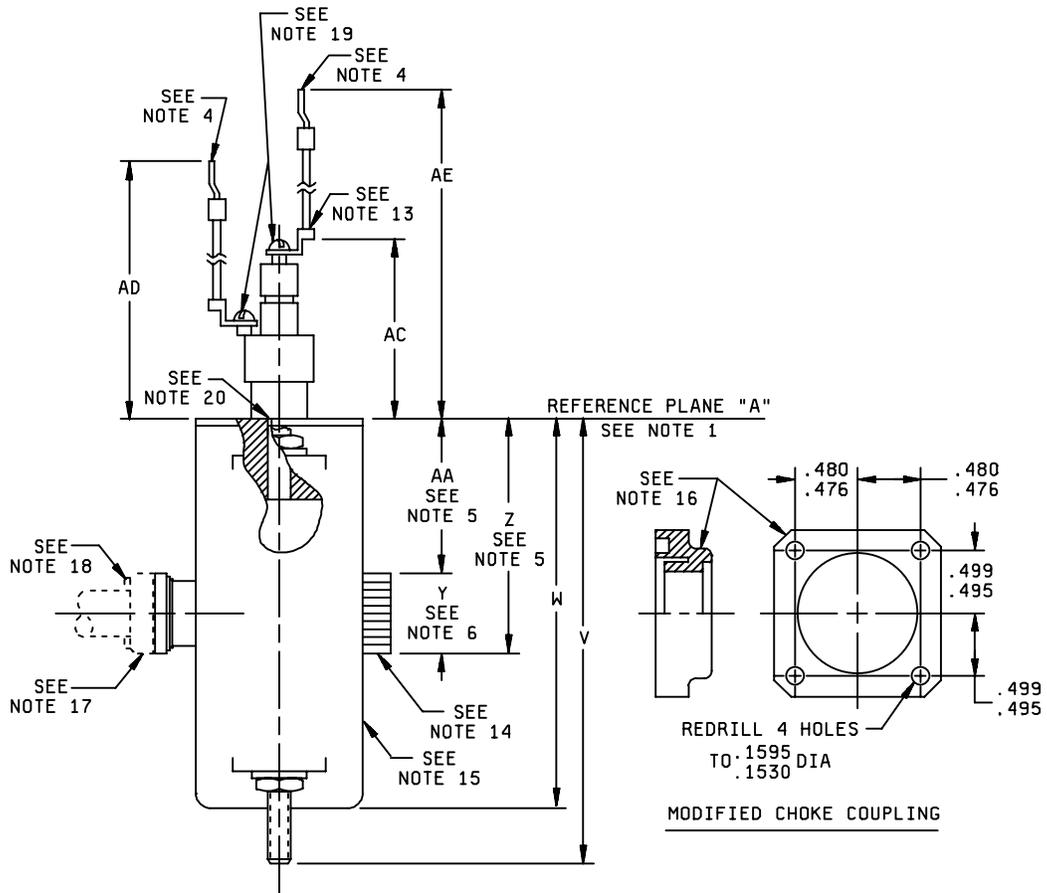


FIGURE 1 Outline and dimensions. - (Side view) - (Continued).

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Dimensions				
LTR	Inches		Millimeter	
	Min	Max	Min	Max
Conformance inspection, part 1				
F		8.875		225.42
K		3.625		92.08
L	1.870	1.970	47.50	50.04
Q	6-32 NC -2B			
R	.946	.966	24.03	24.54
S	2.077	2.217	52.76	56.31
T	.984	1.004	24.99	25.50
U	2.499	2.639	63.47	67.03
AC		3.312		84.12
AD	7.750	8.250	196.85	209.55
AE	7.250	7.750	184.15	196.85
Conformance inspection, part 3 (Periodic check)				
H		1.100		27.94
P	1.297	1.327	32.94	33.71
AB	.173	.203	4.39	5.16
X	1.297	1.327	32.94	33.71

Dimensions				
LTR	Inches		Millimeter	
	Min	Max	Min	Max
Conformance inspection, part 2				
A		4.281		108.74
B	2.930	3.070	74.42	77.98
C	.963		24.46	
D		1.625		41.275
E		1.625		41.275
J	2.625 NOM			
M		2.000		50.80
N	.469	.531	11.91	13.49
V		7.250		184.15
W		6.500		165.10
Y	.985	1.135	25.02	28.83
Z		3.780		96.01
AA	2.345		59.56	
G	5.178	5.322	131.52	135.18

FIGURE 1. Outline and dimensions - Continued.

NOTES:

- 1 Reference plane "A" is defined as a plane passing along the finished surface of the magnet.
- 2 Reference plane "B" is defined as a plane passing through the centers of the mounting holes, and perpendicular to reference plane "A".
- 3 Reference plane "C" is defined as a plane passing through the center of the mounting hole, and mutually perpendicular to reference planes "A" and "B".
- 4 Wire: No. 11 AWG, 7x6x30 AWG or equal.
Insulation: white silicone rubber, fiberglass tubing grade 4A1 or equal.
Lugs: Burndy spade lug YAVIO-T21F or equal; one lug painted brown to identify it as common heater-cathode connection, outer terminal.
- 5 Tolerance includes angular as well as lateral deviation(s).
- 6 These dimensions apply to radiator size only.
- 7 This dimension refers to centerline of tube.
- 8 Parts on this centerline may vary (displacement) by 0.125 in.
9. Surface of output flange to be parallel to reference plane "B" within 0.020 in.
- 10 Tube-to-tube variations shall be within the dimensional tolerances, but hole-to-hole variation on any single tube shall not vary more than .030-in. within the dimensional tolerances.
- 11 Heater connection.
- 12 Point at which temperature shall be measured on anode body.
- 13 Minimum distance from high-voltage to ground should be 1.500-in. through air, at normal atmospheric pressure.

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NOTES: - Continued

- 14 Anode cooling-fin inlet duct for supplying air to the tube cooling system must to insure delivery of air to the entire cross-section of the inlet, with minimum side leakage.
- 15 Anode must be grounded effectively, such as through the mounting holes.
- 16 Waveguide choke coupling flange, modified UG-541/U.
- 17 All joints of waveguide output assembly to be hermetically tight. "O"-ring silicone-rubber gasket, in accordance with MIL-DTL-3922/59 shall be used for test.
- 18 Four #6-32 screws required to attach waveguide choke to tube.
- 19 High-voltage terminals: Center terminal = heater, outer terminal = heater-cathode.
- 20 Mounting holes: Entire support and fastening of tube to be effective therein.
- 21 Point at which temperature shall be measured on cathode bushing.

Referenced documents. In addition to MIL-PRF-1, this document references the following:

MIL-DTL-75 MIL-STD-1311
MIL-DTL-3922/59

Changes from previous issue: The margins of this specification sheet are marked with vertical lines to indicate where changes were made from previous issue. Deleted table column locations are denoted using asterisks. 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 or the asterisk notations.

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(Project 5960-3703)

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