INCH-POUND

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SUPERSEDING
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30 September 1974 30/

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON
TYPE 7156A

This specification is approved for use by the Department of the Navy and is available 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: Pulsed, mechanically tunable frequency range 5,450 to 5,825 MHz, minimum peak power output 250 kw, integral magnet.

ABSOLUTE RATINGS:

Parameter: / Unit:	Ef V	Ib mA dc	ib a	Pi W	pi kw	tpc µs	epy kv	tk sec	Du ---
Maximum:	6.5	30	30	750	750	2.5	28	---	0.0012
Minimum:	--- 2/ 3/	---	---	---	---	---	---	180	---

ABSOLUTE RATINGS:

Parameter: / Unit:	VSWR ---	Tuner torque inch-ounce	Temperature Anode °C	Temperature Bushing °C	Pressurization output psia	Alt ft
Maximum:	1.5:1	200	120	270	35	10,000
Minimum:	--- 4/	--- 7/	--- 11/	--- 5/	12 6/	---

PHYSICAL CHARACTERISTICS:

Dimensions:	See figure 1.	Cathode:	Unipotential.
Mounting position:	Any.	Magnet:	27/
Mounting support:	See figure 1.	Weight:	35 pounds (15.876 kg) approx.
Coupling:		Handling:	28/
Input:	See figure 1.	Cooling:	Air cooled. 11/
Output:	See figure 1.		

TEST CONDITIONS: 1/ 14/

Parameter: / Unit:	Ef V	Ib mA dc	Du ---	tpc µs	VSWR ---	tk sec (min)
Maximum:	3/	21.5	0.0009	2.0 ± 0.30	1.1:1	180
Minimum:	3/	16	0.00063	0.23 ± 0.02	1.1:1	180

Frequency	
F	MHz
F1	5,450
F2	5,550
F3	5,660
F4	5,750
F5	5,825

See footnotes at the end of table I.

GENERAL:

Qualification - Required.
Shelf life: 1 year 24/

TABLE I. Testing and inspection.

Inspection	Method	Notes	Test	Conditions	Symbol	Limits Min	Limits Max	Unit
Qualification inspection								
Mechanical tuning	4223	---	1	F1 through F5	---	11	14	Turns
High-frequency vibration	1031	---	---	No voltages	---	---	---	---
Shock, specified pulse	1042	---	---	15 G; 11 ms	---	---	---	---
Direct interelectrode capacitances	4266	---	---		C	11	30	pF
Time jitter	4318	29/	2	F2 and F4	Δt	---	0.007	µs
Temperature coefficient	4027	5/ 21/	1	F1 and F5; T(anode) = 50°C to 120°C	$\Delta F/°C$	---	0.20	MHz/°C
Frequency change (warmup)	4302	5/ 8/	2	F4	ΔF	---	3	MHz
RF bandwidth	4308	22/	2	F2 and F4	BW	---	2.0/tpc	MHz
Minor lobe ratio	4308	17/ 29/	2	F2 and F4	SL	-7	---	dB
Rough handling test	1136	---	---		---	---	---	---
Conformance inspection, part 1		9/	---					
Pressurizing	4003	---	---	30 psia (min)	---	---	---	---
Heater current, nonoperating	4289	---	---	Ef = 5 V; tk = 180 sec (min)	If	4.5	5.4	A
Mechanical tuning range	4223	---	---		F	F1	F5	MHz
Warmup time	4303	3/	1, 2	Ef = 5 V	---	---	---	---
Pulse voltage	4306	12/ 13/ 25/	1	F1	epy	23	26	kv
Power output	4250	---	1 2	F1 and F5 F2 through F4	Po Po	225 157	--- 233	W W
RF bandwidth	4308	16/	1		BW	---	2.0/tpc	MHz
Stability	4315	19/ 20/ 19/ 26/	1 2	F1 and F5 F2 and F4	MP MP	--- ---	1.0 0.25	% %
Output power warmup time	4303	23/	2		Po	157	---	W

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Test	Conditions	Symbol	Limits Min	Limits Max	Unit
Conformance inspection, part 2								
Low-frequency vibration	1031	---	---	No voltages	---	---	---	---
Frequency change (warmup)	4302	5/ 8/	1	F5	ΔF	---	10	MHz
Electrode voltage (anode)	1261	15/	1		Δkv	---	-0, +2	kv
Frequency pulling figure	4310	18/	1	F5	ΔF	---	15	MHz
Tuner torque	4223	---	---	F1 through F5; T = 25°C	---	---	80	inch-ounce
Conformance inspection, part 3								
Life test	---	10/	1	Group D; cathode horizontal	t	70	---	cycles
Life test end points:	---							
Power output	4250	---	1		Po	180	---	W
		---	2		Po	120	---	W
RF bandwidth	4308	16/	1	F1 and F5	BW	---	2.2/tpc	MHz
Stability	4315	19/ 20/	1		MP	---	2	%
		19/ 26/	2	F2 and F4	MP	---	0.25	%

1/ The characteristics of the applied voltage pulse which will result in proper starting and oscillation of the magnetron, as measured into any tube, shall be as follows:

Long pulse (test condition (1))

(a) tpv = 2.25 μs ± 10 percent
(b) tsrv = 0.1 μs (min) to 0.3 μs (max)
(c) tfv = 0.65 μs nominal
(d) Ripple 3.5 percent (max)
(e) Pulse droop 5 percent (max)

Triple pulse (test condition (2))

(a) tpv = 0.35 μs ± 20 percent
(b) tsrv = 0.05 μs (min) to 0.15 μs (max)

For long pulse test purposes, modulator unit in accordance with Naval Ordnance System Command (Ord) No. 1857536, or equivalent shall be used. For triple pulse test purposes, the following modulator units shall be used, Ord. No's 1847960 and 2130769, or equivalents. Pulse spacing between each of the 0.23 μs detected rf pulses will be 1.0 ± 0.2 μs, measured from leading edge to leading edge at the 70 percent amplitude point. The rise and fall time shall be measured in accordance with method 4304. On the triple pulse group, this is applicable to the first leading edge (rise) and last trailing edge (fall).

2/ The maximum value specified herein is for a nonoscillating condition. Heater surge current shall not exceed 12 amperes.

3/ The heater voltage shall be reduced during operation after the application of high voltage. The following conditions shall be observed:

Conditions	Ef	Alternate operation
Test 1	2 V (for Ib = 21.5 mA)	Ef = 0V (for Ib = 24 mA and Du = 0.001)
Test 2	3.5 V ± 5 percent	

TABLE I. Testing and inspection - Continued.

4/ Frequency skipping or unstable operation may be encountered at some phase positions when the mismatch occurs at the end of a "long" line.

5/ The temperature shall be measured at the point shown on figure 1.

6/ The gas used in pressurization shall provide insulating properties at least equal to that of clean, dry air at the pressures specified herein.

7/ The minimum torque needed to override the tuner stop is 200 inch-ounces.

8/ With the tube operating under test condition (1), the frequency shall be allowed to reach thermal equilibrium at F5, or under test condition (2), the frequency shall be allowed to reach thermal equilibrium at F4. The tube shall then be allowed to cool at room ambient temperature for a minimum of 1 hour. Following the cooling period, the filament shall be preheated for 3 minutes, then high voltage applied to full value in 30 seconds maximum. Frequency measurements shall be made every 30 seconds for 2 minutes, then at 1 minute intervals until frequency stability is reached. The maximum frequency drift from high voltage application to stabilization shall be less than the value specified herein. Frequency stability shall occur within 15 minutes maximum. Stability is defined as the operating condition where the frequency does not vary more than 0.5 MHz within 15 minutes.

9/ Unless otherwise specified, the acceptance level for all tests listed under conformance inspection, part 1, shall be 1.0, inspection level II.

10/ The VSWR shall be 1.5. The interpretation of the value of the VSWR shall be as specified in method 4310. The standing-wave introducer shall be cycled continuously through a line length approximately a half wavelength long at an approximate rate of 4 cycles per hour. The application of operating voltages shall be in accordance with the following cycles:

(a) Cathode preheat: 3 minutes.

(b) Pulse voltage: 7 hours.

(c) Off: 57 minutes.

11/ Cooling requirements, where the ambient temperature does not exceed 50°C, shall be as follows. In no case shall the temperature of the anode exceed 120°C.

Average anode power input (watts)	Air flow (cfm)	Back pressure (inches of H_2O
0	2.5	.06
100	7.5	.16
200	10.0	.28
300	15.0	.44
400	19.5	.63
500	24.0	.87
600	29.0	1.13

12/ This test may be conducted only under one set of conditions within the limits for the test conditions specified herein.

13/ The rise time of the detected rf pulse (trrf) and the fall time of the detected rf pulse (tfrf) shall be measured between the 20 and 85 percent points. Pulse width shall be measured at the 50 percent level.

14/ The three detected rf pulses within each group shall be equal in height within 10 percent.

15/ The change in pulse voltage shall be measured as the frequency is increased from F1 to F5.

16/ The rf bandwidth shall be within the limits specified herein when a VSWR of 1.5 is introduced in the load at a distance not greater than 0.5 meter from the magnetron coupling flange, the phase being adjusted for maximum power output.

17/ The first adjacent side lobe shall be at least 7 dB below the main lobe, and each successive side lobe shall be lower than its preceding one. Measurements shall be limited to the first four side lobes each side of the main lobe, to a level not to exceed 25 dB below the level of the main lobe.

TABLE I. Testing and inspection - Continued.

18/ The pulling measurement shall be made in such a manner that thermal effects do not introduce appreciable errors.

19/ A missing pulse is defined as a pulse of test condition (1) or any one of the pulses in the pulse group of test condition (2) that:

(a) Has less than 70 percent of the energy content of a normal pulse, or

(b) Is at a frequency greater than plus or minus 5 MHz from the operating frequency. Missing pulses shall be counted during the last 3 minutes of a test interval not to exceed 6 minutes. During each 15 second interval in the 3-minute test time, there shall be no more than 125 missing pulses.

(c) In lieu of detecting individual pulses in test condition (2), a missing pulse detection level of 90 percent may be used as an alternative method if the energy of the three pulses is integrated as a group.

20/ This test shall be the first test after the holding period or the first test of the end-of-life measurements. After completing the heater-cathode warmup time, the 6-minute maximum stability test interval described in 19/ shall be started within 30 seconds after high voltage is applied. The modulator used for test shall have an inverse overload actuation sensitivity of 1-second short circuit. After the stability test has been completed, during the remainder of tests in test condition (1), no more than one overload actuation shall be allowed.

21/ Measurements of temperature and frequency shall be made after conditions of thermal equilibrium have been reached.

22/ Stability shall not be measured during this test.

23/ Leakage current shall be less than 2.0 mA dc and the power output greater than 157 W throughout the test. To measure leakage current and its relationship to power output, allow the tube to cool for a minimum of 1 hour. Operate the tube in the triple pulse, initially setting the current to 16 mA dc. Operate the tube for 1 hour. Maintain the line voltage constant. The leakage current is defined as the difference between the initial and final current.

24/ The magnetron shall have a shelf life of 1-year minimum. At any time during the shelf-life period, the tube shall be capable of being "snapped on" at normal operating voltages for both test conditions (1) and (2). The "snap on" test procedure and criteria shall be as defined in 20/ and 26/.

(a) Upon "snap-on" in test condition (1), the magnetron rf output shall not exhibit more than 250 consecutive missing pulses at any time, when operated in accordance with the requirements of test condition (1).

(b) Upon "snap-on" in test condition (2), the magnetron rf output shall not exhibit more than 30 consecutive missing pulse groups at any time, when operated in accordance with the requirements of test condition 2).

(c) A missing rf output is defined in 19/.

(d) The other missing pulse and stability requirements under test conditions (1) and (2) apply.

(e) At the end of this shelf-life period, the tube shall have an operational service life of 500 hours minimum. The missing pulse requirements specified herein shall be applicable throughout this service life.

25/ Excluding the leading edge and trailing edge of the detected rf pulse, the amplitude of the peak power shall not fall below 10 percent of the maximum value obtained during the pulse.

26/ This test shall be the first test after completion of conformance inspection, part 1, test condition (1). The following modulator units shall be used, Ord numbers 1847960 and 2130769. Input triggers and overload circuitry shall be as specified herein. "Normal" overload sensitivity referred to herein is incorporated in Ord assembly 1847960. The inverse overload circuits in each channel shall be provided with two actuation sensitivity controls, position (a) normal (30 consecutive pulses short-circuit) and position (b) 250 ms short circuit. With the sensitivity in position (b), and after the heater cathode warmup time, within 30 seconds maximum after high voltage is applied, the missing pulse test of 19/ shall be conducted. Upon completion of this test, the overload sensitivity shall be changed to position (a) and the remainder of test condition (2) tests completed. During the total test period with the overload sensitivity in position (a), there shall be no more than five overloads allowed. In addition, there shall be no overloads in the last 20 minutes of the test interval. The test interval may be extended until a satisfactory 20-minute period is obtained but the five overload criteria still applies.

TABLE I. Testing and inspection - Continued.

27/ In handling and mounting the magnetron, care shall be taken to prevent demagnetization. Ferro-magnetic materials shall not at any time be permitted to come closer than 8 inches from the magnet, except at the ends where the clearance may be 3 inches minimum. Energized magnets shall not at any time be permitted to come closer than 12 inches from the tube magnet.

28/ The packing shall be so designed as to provide a hand-carry inner container. The maximum dimensions of the container shall be 20 by 18 by 12 inches and the maximum weight shall be 12 pounds.

29/ This test shall also be performed after life-test end points.

30/ Marginal notations are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

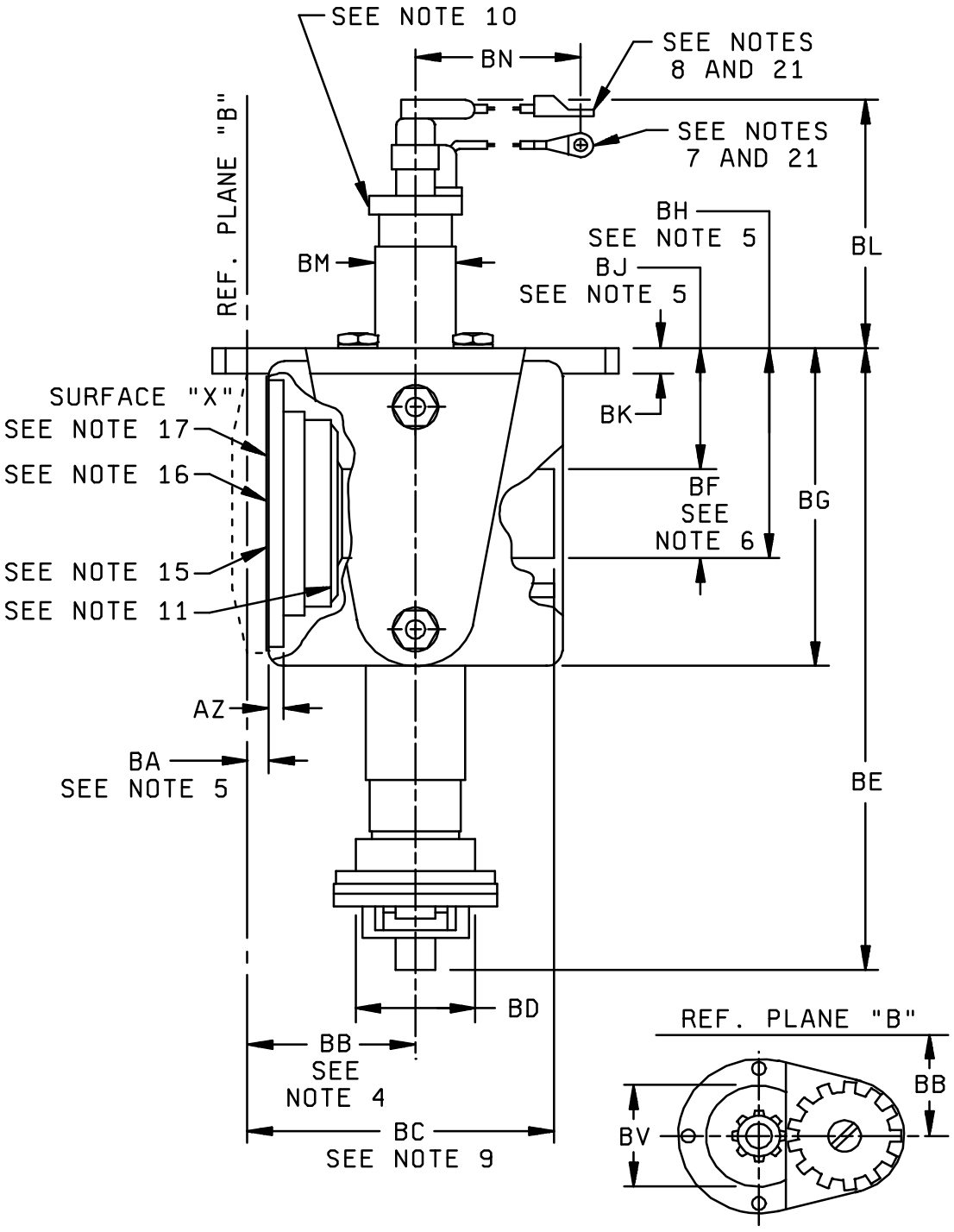

FIGURE 1. Outline drawing of electron tube type 7156A.

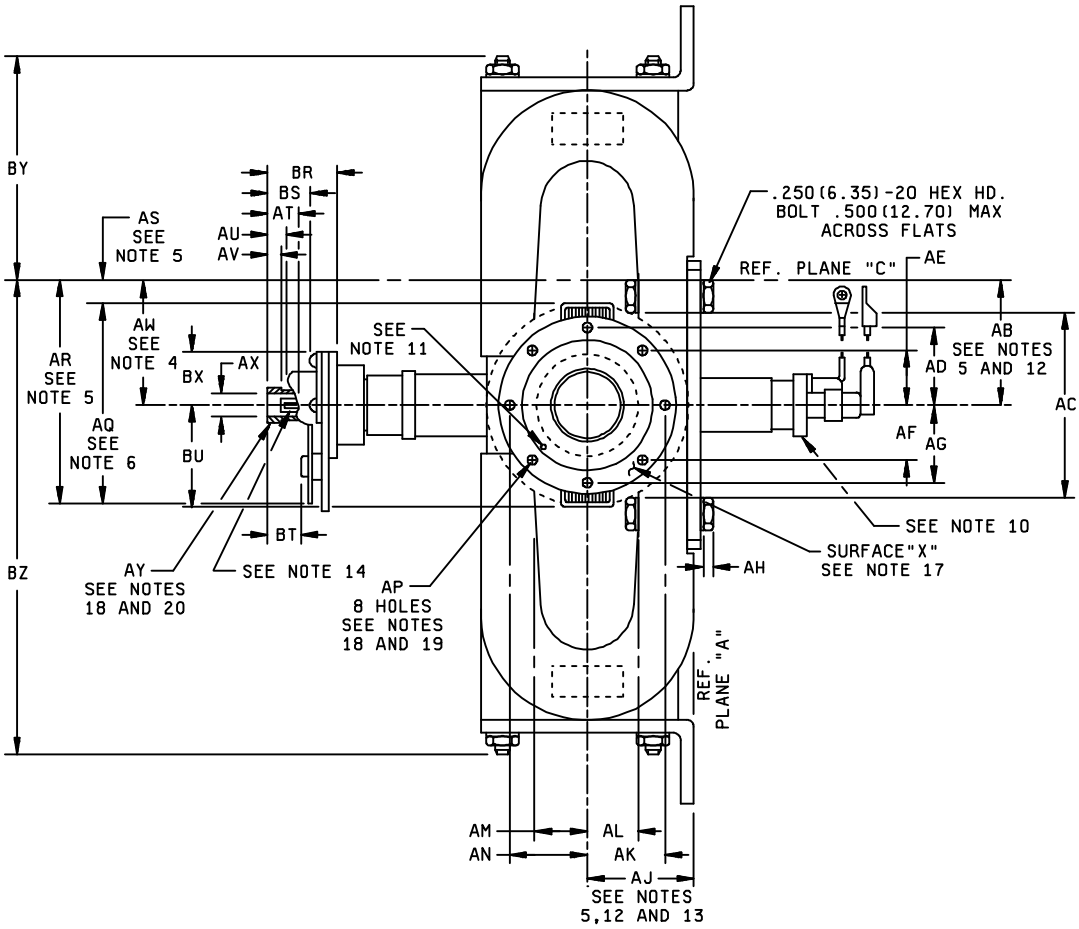

FIGURE 1. Outline drawing of electron tube type 7156A - Continued.

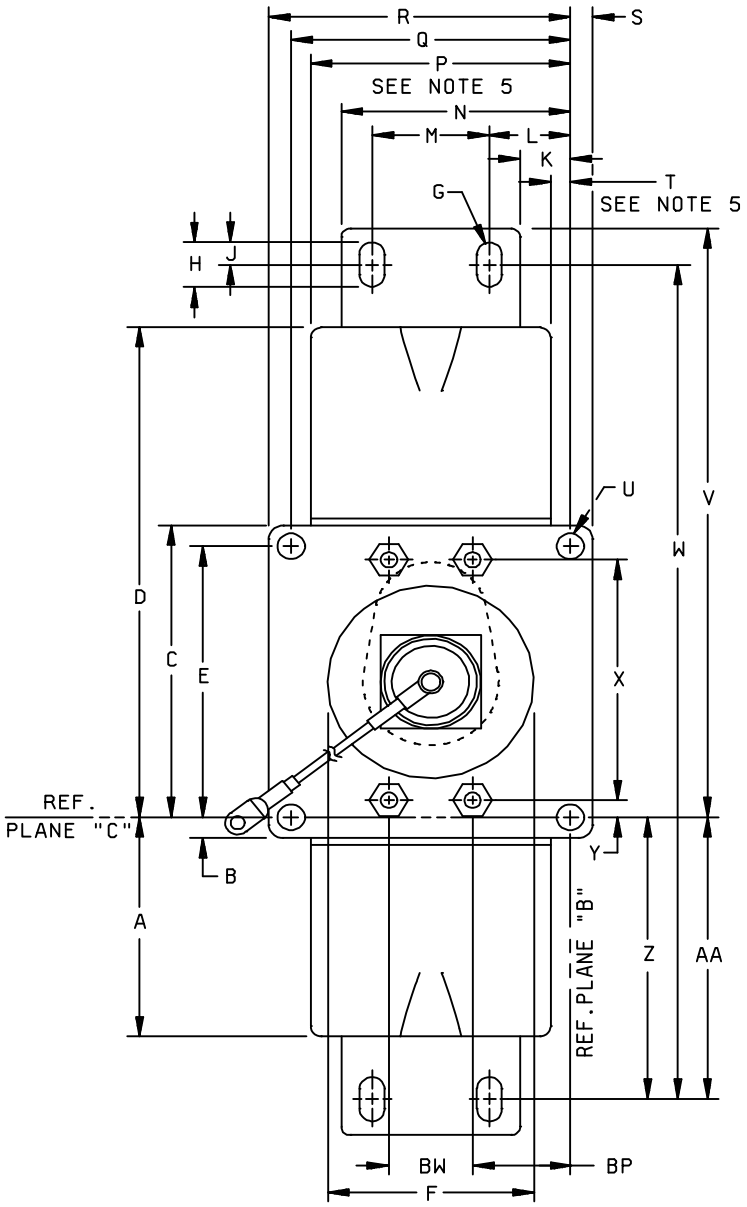

FIGURE 1. Outline drawing of electron tube type 7156A - Continued.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Qualification inspection				
BD	---	1.750	---	44.45
BM	---	1.250	---	31.75
BV	---	1.560	---	39.62
BU	---	2.330	---	59.18
BX	---	1.300	---	33.02
BY	---	4.750	---	120.65
BZ	---	9.875	---	250.83
Conformance inspection, part 1 9/				
U	.336	.352	8.53	8.94
V	---	11.250	---	285.75
W	15.070	15.570	328.77	395.47
Z	4.972	5.222	126.28	132.63
AA	---	6.125	---	155.57
AB	2.522	2.602	64.06	66.09
AJ	2.245	2.295	57.02	58.29
BA	.565	.585	14.35	14.86
BE	8.875	9.175	225.43	233.05
BL	---	3.625	---	92.08
Conformance inspection, part 2				
A	---	4.250	---	107.95
B	---	.340	---	8.64
C	---	5.460	---	138.68
D	---	9.375	---	238.13
E	5.115	5.135	129.92	130.43
F	---	3.532	---	89.71
G	.117	.197	4.50	5.00
H	.610	.640	15.49	16.26
J	.300	.325	7.62	8.26
K	.700	---	17.78	---
L	1.388	1.488	35.25	37.79
M	1.985	2.015	50.42	51.18
N	---	4.312	---	109.52
P	---	4.750	---	120.65
Q	4.865	4.885	123.57	124.08
R	---	5.205	---	132.21
S	---	.340	---	8.64
T	.218	---	5.54	---
AC	3.724	3.754	94.59	95.35
AD	1.615	1.635	41.02	41.53
AE	1.139	1.159	28.93	29.44
AF	1.139	1.159	28.93	29.44
AG	1.615	1.635	41.02	41.53

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
Conformance inspection, part 2				
AH	---	.375	---	9.53
AK	1.615	1.635	41.02	41.53
AL	1.139	1.159	28.93	29.44
AM	1.139	1.159	28.93	29.44
AN	1.615	1.635	41.02	41.53
AQ	4.120	4.180	104.65	106.17
AR	---	4.750	---	120.65
AS	.375	---	9.53	---
AT	.600	.654	15.24	16.61
AU	.464	.484	11.79	12.29
AV	.285	.345	7.24	8.76
AX	.435	.445	11.05	11.30
BC	---	4.500	---	114.30
BF	1.176	1.236	29.87	31.39
BG	---	4.750	---	120.65
BH	---	3.000	---	76.20
BJ	1.500	---	38.10	---
BR	---	1.450	---	36.83
BS	.672	---	17.07	---
BT	.625	---	15.88	---
Nominal				
X	4.500		114.30	
Y	.312		7.92	
AP	.190-32 UNF		4.83-32 UNF	
AW	2.563		65.10	
AY	.625-24 UNEF		15.88-24 UNEF	
AZ	.185		4.70	
BB	2.437		61.90	
BK	.250		6.35	
BN	10.000		254.00	
BP	1.750		44.45	
BW	1.375		34.93	

FIGURE 1. Outline drawing of electron tube type 7156A - Continued.

NOTES:

1. Reference plane “A” is defined as a plane passing along the face of the mounting plate.
2. Reference plane “B” is defined as a plane perpendicular to plane “A" passing through the center of holes as shown.
3. Reference plane “C” is defined as a plane mutually perpendicular to planes “A” and “B” passing through the center of the hole as shown.
4. Parts of this axis may deviate from centerline by .125 inch (3.18 mm).
5. Includes angular as well as lateral deviation.
6. This dimension applies to zone of radiator only.
7. Common heater - cathode connection.
8. Heater connection.
9. This dimension is from reference plane "B" to end of radiator.
10. Cathode support temperature shall be measured at point indicated.
11. Anode temperature shall be measured at point indicated.
12. Refers to the centerline of the waveguide as determined by centers of tapped holes.
13. Brackets shall be in same plane as top surface on mounting plate within .025 inch (0.64 mm).
14. Spline requirements:

    14° 30' pressure angle
    0.48 pitch
    12 teeth
    .250 inch (6.35 mm) pitch diameter.

15. Output flange shall be parallel to reference plane "B" within .025 inch (0.64 mm).
16. The glass portion of the output shall not extend beyond the flange.
17. All joints in waveguide assembly shall be such as to provide a hermetic seal at surface "X".
18. Pitch diameter shall accept class 2 "go" gauge only.
19. Minor diameter shall be not greater than .166 inch (4.22 mm).
20. Major diameter shall be not less than .614 inch (15.60 mm).
21. Clearance for .250 inch (6.35 mm) screw.

FIGURE 1. Outline drawing of electron tube type 7156A - Continued.

Custodians:
Navy - EC
DLA - CC

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

Preparing activity:
DLA - CC

(Project 5960-3547-04)