

Communications & Power Industries
beverly microwave division

88236

		APPROVAL		DOC NO.	SFD-313A
		TITLE		DEVICE TYPE	
		Test Specification		WRITER	A. Collins
				DATE	November 5, 1979
REV	LOCATION	ECO/DCO No.	DESCRIPTION	DATE	APPROVAL
I	Pages 14, 17	ECO 79-3888	Add and change for clarification for end users.	11/5/79	A.L.C. A.L. Collins
J	Pgs. 13 & 18	ECO 93-1312-01	Changes per ECO	3/2/94	J.G. J. Grifoni
K	3,4,9 & 10	ECO 94-0472	Changes per ECO	3/11/94	J.G. J. Grifoni
L	Pgs. 2, 4-7, 9-11, & 17	ECO 98-0962-01	Add Figure 2, make changes per ECO and Separate SFD-313 A and SFD-313B From SFD-313.	9/4/98	C.M.W. C.M. Walker
M	Page 4	ECO 98-1335	Change Heater Current from 21 to 22 Attach Page 1 to ECO.	12/1/98	R. M. R. Madore
N	Page 1	ECO 02-0006	Add maximum pulse width to ratings per ECO	1/28/02	R. J. M. R. Madore
P	Pgs. 10, 11, 12, 16 & 18	ECO 02-1210	Update ODs and dimensions per ECO.	1/21/03	A. C. T. Catalano
R	Pgs. 10 & 16	ECO 03-0456-01	Correct dimensions per ECO.	5/5/03	R. D. R. Davenport
T	Pgs. 10, 12, 18	ECO 03-0557	Add Dim to Figure 1a and support to Figure 1c per ECO.	5/23/03	M. E. D for A. Catalano
U	Pg. 12	ECO 03-0615	Change location of support on Figure 1c per ECO.	6/5/03	M. E. D. for A. Catalano

Latest revision changes are shaded.

ELECTRON TUBE, SFD-313 CEM COAXIAL MAGNETRON, PULSED

The provisions of the latest issue of MIL-PRF-1 apply to this specification.

DESCRIPTION: C-Band, tunable frequency, integral magnet, air cooled, 1,000 kW minimum peak power output.

ABSOLUTE MAXIMUM AND MINIMUM RATINGS:

INDEPENDENT Note 1

PARAMETER	If Surge	tk	VSWR	Tuner Torque	Body Temp	Input Bushing Temp	Pressurization	
							Input	Output
UNITS	a	sec		in-oz	°C	°C	psia	psia
MAXIMUM	50	---	1.5:1	200	115	270	30	60
MINIMUM	---	300	---	---	---	---	15	40
NOTES	25			2	3	3	4	16

DEPENDENT

PARAMETER	Ef	If	ib	Pi	pi	Du	tpc	prp	rrv
UNITS	V	A	a	W	kW	---	µsec	pps	kV/µsec
MAXIMUM	7.5	25	65	2500	2500	.0011	3.0	2500	100
MINIMUM	---	---	---	---	---	---	0.2	---	50
NOTES	5						6		7

MECHANICAL

- MOUNTING POSITION Any
- SUPPORT Mounting Flange, Note 27 (-1 after variant indicates threaded mounting holes)
- COOLING Forced Air - Note 8
- OUTLINE Figure 1
- MAGNET Note 9
- COUPLING WR 187, Notes 16, 21
- NET WEIGHT 57 pounds max

MIL-STD-1311	TEST	CONDITION	SYMBOL	LIMITS		UNITS
				MIN	MAX	
	General					
----	Marking	Figure 1	----	----	----	----
4.8.5	Holding Period	t = 48 hours	----	----	----	----
----	Dimensions	Figure 1	----	----	----	----
	<u>Qualification</u> <u>Approval Tests</u>	All variants; Notes 10, 19				
4004	Temperature Coefficient	Osc (2); TB - 60°C to 100°C; F = F3; Notes 3, 11	$\Delta F/\Delta T$	----	0.25	MHz/°C
1143	Air Cooling	Osc (2); TA = 25°C; F = F2; Notes 8, 12	ΔTB	----	65	°C
4003	Pressurization	45 psig min. output assembly; Note 15	----	----	----	----
----	Shock	G = 15; t = 11 ms; Notes 14, 22	----	----	----	----
----	Low Frequency Vibration	No voltage; F = 25 Hz; Notes 14, 29	----	----	----	----
----	High Frequency Vibration	No voltage; F = 50 Hz; Notes 14, 29	----	----	----	----
	<u>Oscillation (1)</u>					
----	Coupling	VSWR = 1.1 max except as noted; Notes 16, 21	----	----	----	----
4303	Heater-Cathode Warm-up Time	Ef = 5.0 V; tk = 300s; Note 5	----	----	----	----
4304	Pulse Characteristics	tpc = 0.25 μ s \pm 0.05 μ s; Du = 0.0004; rrv = 100 kV/ μ s min; Notes 6, 7	----	----	----	----
----	Average Anode Current	Ib = 24 mAdc				

MIL-STD-1311	TEST	CONDITION	SYMBOL	LIMITS		UNITS
				MIN	MAX	
4306	Pulse Voltage	Note 28	epy	33.5	37.5	kV
4250	Power Output	Notes 18, 28	Po	400	----	W
4308	Spectrum Measurements	Notes 17, 28				
	RF Bandwidth		BW	----	2/tpc	MHz
	Minor Lobe Ratio		SL		-9	dB
4315	Stability	Notes 20, 28	MP	----	1.0	%
	Special Testing	All variants; Notes 10, 19				
4551	Cycled Life Test	Osc (3); Notes 23	life	500	----	anode hours
				133	----	cycles
	Life Test End Points			Osc (3); Note 28		
4250	Power Output	Note 18	Po	800	----	W
4308	Spectrum Measurements	Note 17				
	RF Bandwidth		BW	----	2.5/tpc	MHz
	Minor Lobe Ratio		SL		-6	dB
4315	Stability	Note 20	MP	----	2.0	%
	<u>Quality Conformance Inspection, Part 1</u>					
1301	Heater Current	Ef = 5.0 V; tk = 300s min.	If		22	A
4223	Tuner Drive Torque	F0 to F4 Note 13	Torque	----	50.0	in-oz

MIL-STD-1311	TEST	CONDITION	SYMBOL	LIMITS		UNITS
				MIN	MAX	
	<u>Oscillation (2)</u>	All variants; Note 10				
----	Coupling	VSWR = 1.1 max. except as noted; Notes 16, 21	----	----	----	----
4303	Heater-Cathode Warm-Up	Ef = 5.0 V; tk = 300s; Note 5	----	----	----	----
4304	Pulse Characteristics	tpc = 1.0 μ s \pm 0.2 μ s; Du = 0.001; rrv = 100 kV/ μ s min; Notes 6, 7				
----	Average Anode Current	Ib = 60 mAdc	----	----	----	----
4306	Pulse Voltage	Note 28	epy	33.5	37.5	kV
4250	Power Output	Notes 18, 28	Po	1000	----	W
4308	Spectrum Measurements	Notes 17, 28				
	RF Bandwidth		BW	----	2/tpc	MHz
	Minor Lobe Ratio		SL		-9	dB
4315	Stability	Notes 20, 28	MP	----	1.0	%
4223	Tunable Frequency	Upper Limit Lower Limit	F F	F4+10 ----	---- F0-10	MHz MHz
	<u>Oscillation (3)</u>	Note 10				
----	Coupling	VSWR = 1.1 max. except as noted; Notes 16, 21	----	----	----	----
4303	Heater-Cathode	Ef = 5.0 V; tk = 300s; Note 5	----	----	----	----

MIL-STD-1311	TEST	CONDITION	SYMBOL	LIMITS		UNITS
				MIN	MAX	
4304	Pulse Characteristics	tpc = 2.0 μ s \pm 0.2 μ s; Du = 0.001; rrv = 100 kV/ μ s min; Notes 6,7	----	----	----	----
----	Average Anode Current	Ib = 60 mAdc	----	----	----	----
4306	Pulse Voltage	Note 28	epy	33.5	37.5	kV
4250	Power Output	Notes 18, 28	Po	1000	----	W
4308	Spectrum measurements	Notes 17, 28				
	RF bandwidth		BW	----	2/tpc	MHz
	Minor lobe ratio		SL		-9	dB
4315	Stability	Note 20, 28	MP	----	1.0	%
	<u>Quality Conformance</u> <u>Inspection Part 2</u>	Osc (3) Notes 10, 19 & 24				
4310	Pulling Factor	Note 28	Δ F	----	6	MHz
4311	Pushing Factor	Note 28	Δ F/ Δ ib	----	50	kHz/a
----	Power Ratio	Notes 18, 26	Pmax/ Pmin	----	1.15	Ratio

NOTES:

1. The requirements of paragraph 6.6 MIL-PRF-1F shall apply. For the assistance of designers of electronic equipment, the ratings have been divided into two groups as follows:
 - a. Independent (ratings which may be obtained simultaneously).
 - b. Dependent (ratings which are interrelated and may not necessarily be obtained simultaneously).
2. The tuner drive shall be capable of supplying a minimum of 50 inch-ounces of torque to the magnetron tuning shaft and shall never supply more than 200 inch-ounces of torque (including inertial effects) under stable conditions.
3. The temperature is to be measured at the point indicated on Figure 1.
4. The magnetron shall be capable of normal operation without electrical breakdown with the input bushing at normal atmospheric conditions.
5. Prior to the application of high voltage, the cathode shall be heated to the required initial operating temperature. This shall be done by applying 5.0 volts \pm 5 percent for 300 seconds minimum. On the application of anode voltage, the heater voltage must be reduced according to Fig. 2.
6. The characteristics of the applied pulse must be those which result in proper starting and oscillation. The rate of rise of the voltage pulse, the percentage of pulse voltage ripple, and the rate of pulse voltage fall are among the more important considerations. The tube manufacturer should be consulted regarding pulse characteristics as related to the specific application.
7. The rate of rise of voltage (rrv) shall be measured in accordance with MIL-PRF-1F method 4304 except that the steepest tangent to the leading edge of the voltage pulse shall be measured above the 70 percent amplitude point. Any capacitance used in the viewing (measuring) circuit shall not exceed 6 picofarads (pf).

NOTES: (continued)

8. The cooling required is partially determined by the total power input to the magnetron. The following table gives minimum air flow and back pressure values that are deemed necessary to limit the anode temperature to a maximum of 115°C at an ambient temperature of 50°C at sea level.

Total Magnetron Power Input (Watts)	Cooling Air Flow (Cu. Ft./min.)	Air Pressure at Entrance to Cooling System - (inches of water)
Standby condition	20	0.25
800	38	0.7
1200	42	0.8
1600	60	1.45
2000	95	3.1
2400	130	5.2

9. In handling and mounting the magnetron, care must be exercised to prevent demagnetization. Magnets and magnetic materials must not be permitted at any time closer than 12 inches from the tube axis. Supervisor should be consulted with regard to applications inconsistent with the above stated requirements.
10. The following code defines the test frequencies:
 $F_0 = 5400 \text{ MHz}; F_1 = 5450 \text{ MHz}; F_2 = 5650 \text{ MHz}; F_3 = 5825 \text{ MHz}; F_4 = 5900 \text{ MHz}$
11. Temperature measurements shall be made only after thermal equilibrium has been reached.
12. With specified air flow using a conduit which fits snugly to the cooling fins, the rise above ambient specified shall not be exceeded.
13. The tuning mechanism shall operate as specified over the entire frequency range.
14. Prior to and after completion of this test, the tube shall meet the requirements of Quality Conformance Inspection, Part 1, Oscillation (2).
15. The specified pressure shall be applied to the tube output. There shall be no leaks as evidenced by metered pressure fall off or by bubbles if the test is performed with the tube immersed in water. The time of the test shall be one (1) minute minimum.
16. A minimum value of 25 psig is required when using clean air with a -10°F dew point. Any other type of gas used for pressurization shall provide insulating properties consistent with this combination.
17. The radio frequency bandwidth and side lobes shall be within the limits specified when a VSWR of 1.5:1 minimum is introduced in the load and the phase is adjusted at the start of each measurement to produce maximum degradation.

NOTES: (continued)

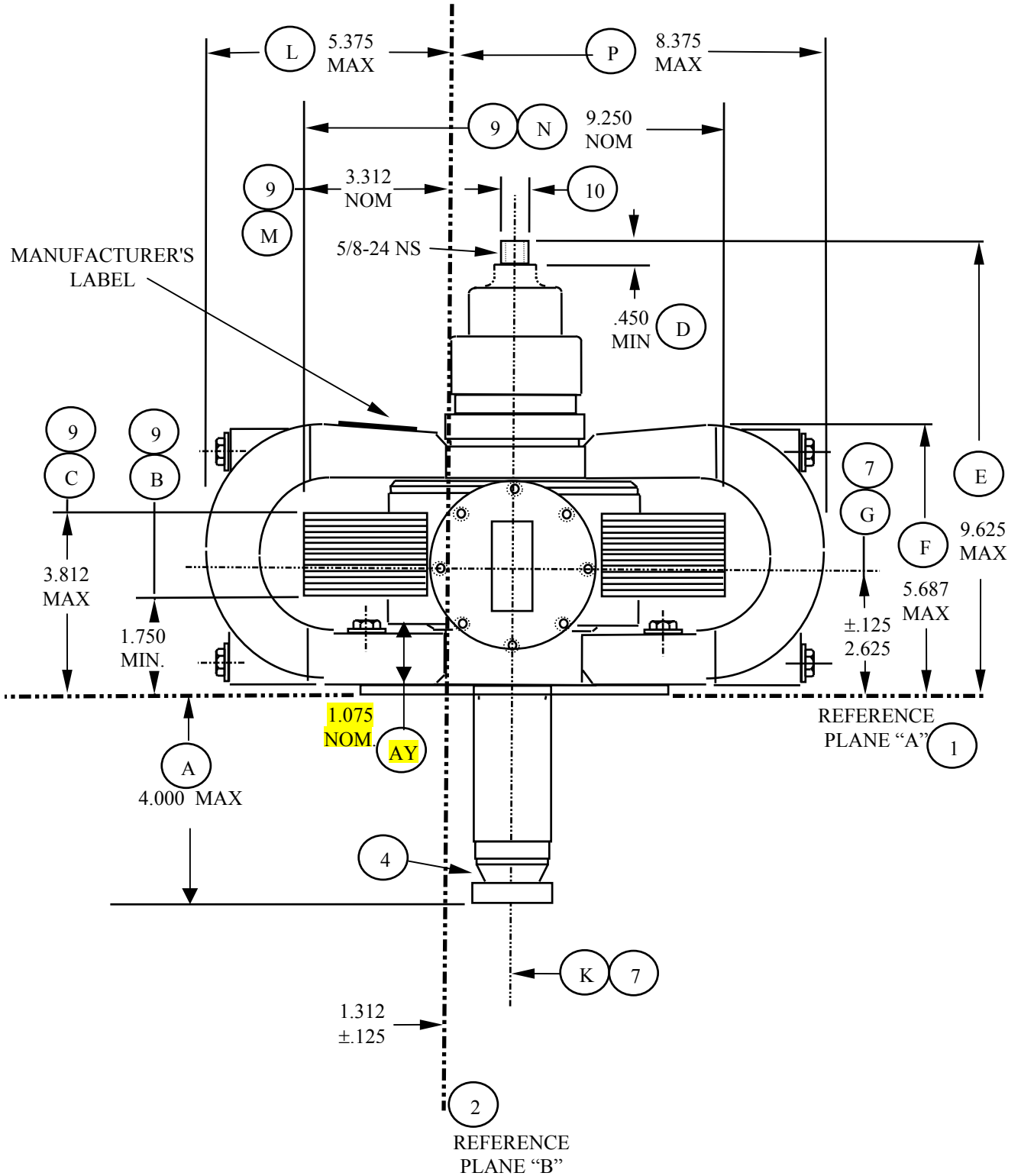
- 18. The minimum power output requirement must be satisfied over the specified frequency band.
- 19. Unless otherwise specified, all tests required by this specification shall be made under the following atmospheric conditions:
 - Temperature $25 \pm 10^{\circ}\text{C}$
 - Relative Humidity 90% or less
 - Barometric Pressure - Local Standard
- 20. 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. The missing pulses (MP) due to any causes, are considered to be missing if the RF energy is less than 70 percent of the normal energy level. The stability shall be measured when a VSWR of 1.5:1 minimum is introduced in that phase producing maximum instability.
- 21. The magnetron shall be coupled directly to a UG148B/U choke flange with eight holes drilled out to 7/32" diameter.
- 22. The tube shall be subjected to 18 impact shocks of 15 g, consisting of three shocks in opposite directions along each of three mutually perpendicular axes designated as planes A, B, and C, Figure 1, with each shock impulse having a time duration of 11 ± 1 milliseconds. The "g" value shall be within ± 10 percent when measured with a .2 to 250 Hz filter, and the maximum "g" shall occur at approximately 5-1/2 milliseconds.
- 23. The intermittent life test shall be conducted while the phase of 1.5:1 minimum VSWR is uniformly and continuously cycled through 360 electrical degrees with a time interval of approximately 30 minutes per cycle. Simultaneously the magnetron frequency, starting at F0, increasing to F4, then decreasing to F0 shall be changed approximately 100 megacycles increments each eight hours. A life test cycle is defined as follows:

<u>Condition</u>	<u>Ib (mA dc)</u>	<u>Ef (V)</u>	<u>Duration Minimum (minutes)</u>
Standby	0	5	5
Osc (3)	60	1.0	225
Off	0	0	10

This cycle to be repeated until the accumulated radiate time equals the specified life. The life test sampling plan shall be specified in the terms and conditions of the procurement contract.

NOTES: (continued)

24. The AQL for combined defectives for inspection by attributes in Quality Conformance Inspection, Part 1, excluding inoperatives, shall be 1.0 and the Inspection Level shall be II. For Quality Conformance Inspection, Part 2, the AQL shall be 6.5 and the Inspection Level S-3.
25. The internal impedance of the heater filament supply shall limit the surge current to the maximum specified.
26. The power shall be measured every 50 MHz from F0 to F4. All power readings shall be within specification. The ratio of any two adjacent readings shall not exceed the value specified.
27. Deleted.
28. This test is to be conducted at the following frequencies: F0, F2, and F4
29. The tube shall be mounted in a rigid fixture and vibrated with simple harmonic motion at a double amplitude (total excursion) of 0.080 in. \pm 0.005 in. The tube shall be vibrated in three axes for a period of one minute in each axis. The axes of vibration shall be perpendicular to planes A, B, and C as shown in Figure 1.



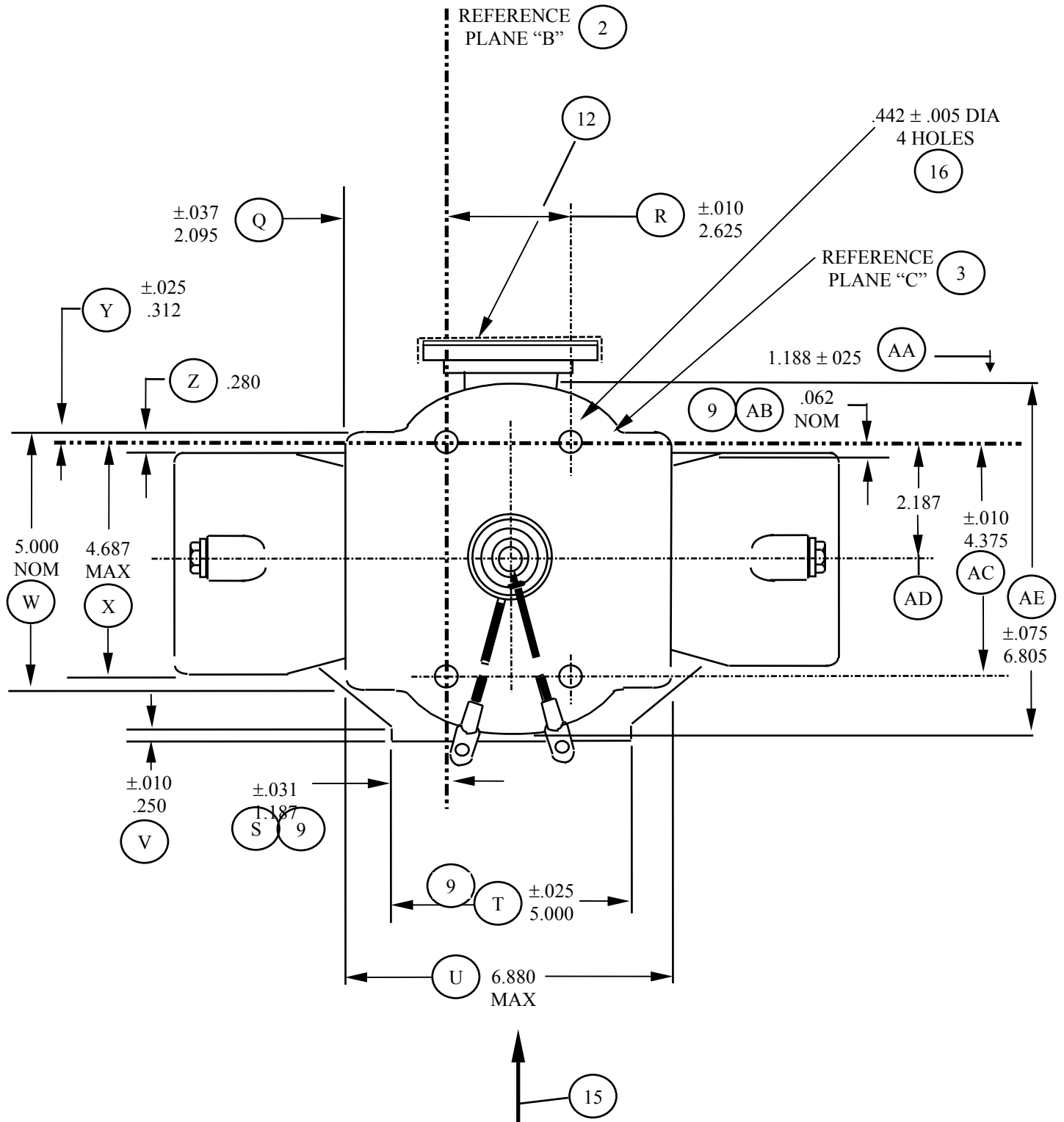


FIGURE 1b

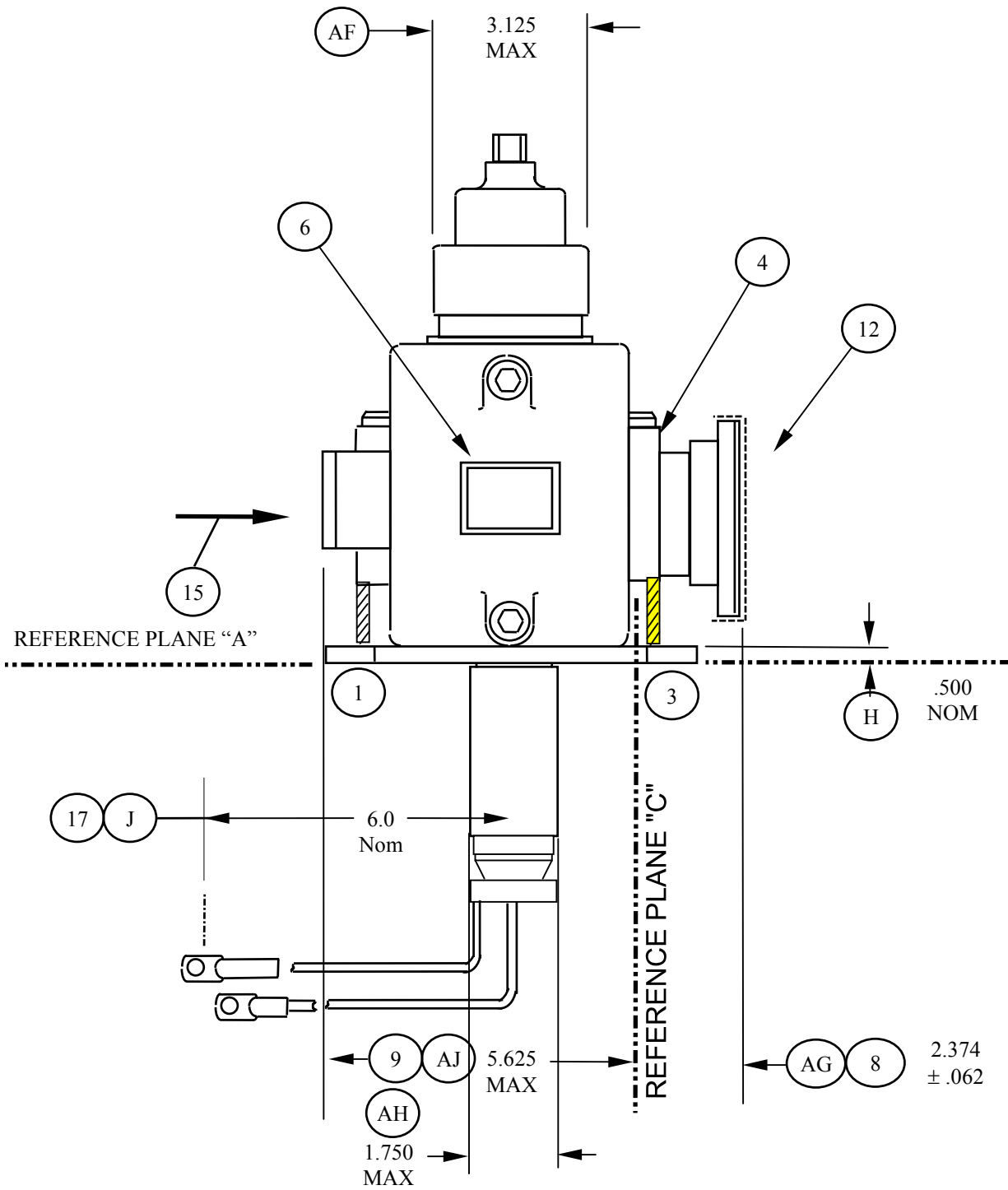
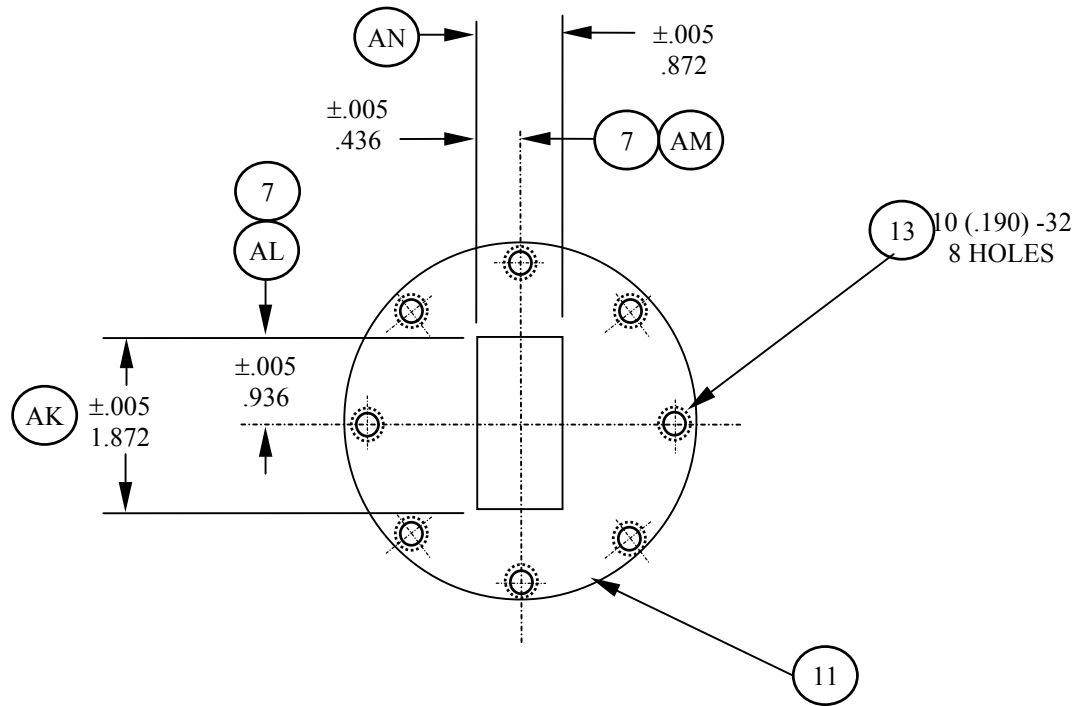
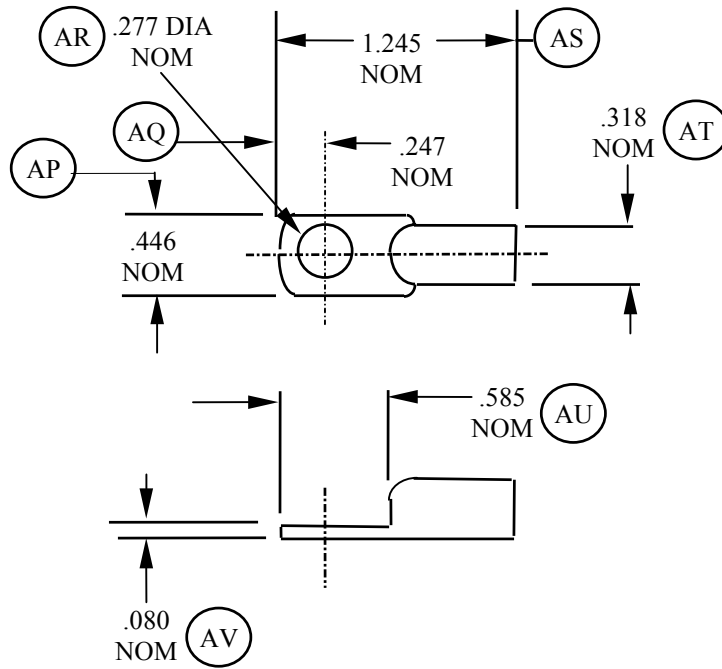


FIGURE 1c



DETAIL OF RECTANGULAR WAVEGUIDE OUTPUT FLANGE

FIGURE 1d



DETAIL OF TERMINAL LUG

FIGURE 1e

NOTES FOR FIGURE 1:

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 axis of the holes, as shown at reference plane "A".
3. Reference plane "C" is defined as a plane mutually perpendicular to planes "A" and "B" passing through the axis of the holes, as shown at reference plane "A".
4. Temperature measurements to be made at points indicated.
5. For vibration and shock testing, the axes of motion shall be perpendicular to reference planes "A" - "B" - "C".
6. **WARNING:** Maintain minimum clearance 12 inches between magnet and magnetic materials (magnets, steel tools, plates, etc.).
7. These dimensions refer to center line of the waveguide.
8. The output flange face to be parallel to plane "C" within .025.
9. This dimension refers to radiator fin size only.
10. Mates with S. S. White flexible shaft no. RY18-2 or equivalent.
11. Mates with modified waveguide flange UG-148B/U.
12. Protective closure.
13. A plane passing through the axis of the tapped holes shall be parallel with planes "A" and "B" within .050.
14. For pressurization of the output, an "O" ring can effect a hermetic seal to the face of the waveguide flange.
15. Indicates direction of anode cooling air flow.
16. Defined.
17. Lead with 1 inch long brown shrink tubing identifies common cathode lead.

DIMENSIONS				
LETTER	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
QUALIFICATION				
F		5.687		144.45
K	1.187	1.437	30.15	36.50
L		5.375		136.53
P		8.375		212.73
X		4.687		119.05
QUALITY CONFORMANCE INSPECTION (PART 1)				
A		4.000		101.60
B	1.750		44.45	
C		3.812		96.82
E		9.625		244.48
G	2.500	2.750	63.50	69.85
AC	4.365	4.385	110.87	111.38
AE	6.730	6.880	170.94	174.75
AG	2.312	2.436	58.72	61.87
AJ		5.625		142.88
DIMENSIONS				
INCHES		MILLIMETERS		

Figure 2

