INCH-POUND

MIL-PRF-1/1755B
18 July 2002
SUPERSEDING
MIL-PRF-1/1755A
30 April 1994

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON
TYPE DOD-033 *

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: Coaxial, tunable frequency 14,000 to 15,200 MHz, pulsed, integral magnet, 85 kW rated peak power output.

ABSOLUTE RATINGS:

Parameter:	Ef	if(surge)	If	tk	tpc	rrv	Tuner torque	ib
Unit:	V	a	A	sec	µs	kV/µs	inch-ounce	a
Maximum	15	12	3.6	----	2.0	160	75	20
Minimum	----	----	----	150	0.2	90	----	12
	5/ 15/				6/	7/	3/	----

ABSOLUTE RATINGS:

Parameter:	Pi	pi	VSWR	Temperature		Pressurization		Du
Unit:	W	kW	----	(body) ºC	(input bushing) ºC	(input) psia	(output) psia	----
Maximum	370	370	1.5:1	125	165	45	45	0.00125
Minimum	----	----	----	-55	-55	15	15	
				(Note 5)	(Note 6)	4/		

ABSOLUTE RATINGS:

Dimensions:	See figure 1	Marking:	See note 28
Mounting position:	Any	Cathode:	Unipotential
Mounting support:	Flange	Magnet isolation:	8/
Coupling:	WR-62 (figure 1) 24/ 25/	Weight:	16 pounds
		Cooling:	Forced air 9/

* Replaces Varian type number VMU-1134.

Frequency
F1 = 14,000 MHz F2 = 14,700 MHz F3 = 15,200 MHz

TEST CONDITION (1): 24/ 25/

Parameter: Unit:	Ef V	tpc µs	rrv kV/µs	Du ----	Ib mA dc	VSWR ----	T (body) ºC	F Freq
Maximum Minimum	---- 5 ---- 5/	0.5 ---- 0.3	160 ---- 90 6/ 7/	---- 0.00125 ----	---- 18.75 ----	1.1:1 ---- ----	115 ---- 55 (Note 5)	---- F1,F2,F3 ----

TEST CONDITION (2): 24/ 25/

Parameter: Unit:	Ef V	tpc µs	rrv kV/µs	Du ----	Ib mA dc	VSWR ----	T (body) ºC	F Freq
Maximum Minimum	---- 5 ---- 5/	0.9 ---- 0.7	160 ---- 90 6/ 7/	---- 0.00125 ----	---- 18.75 ----	1.1:1 ---- ----	115 ---- 55 (Note 5)	---- F1,F2,F3 ----

GENERAL:

Qualification - Required.

TABLE I. Testing and inspection.

Inspection	Method	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
Qualification inspection								
Forced cooling	1143	5., 9/	2		ΔT	----	90	ºC
Temperature coefficient	4027	5., 10/	2	T = 55º to 115ºC; F = F2	ΔF/ΔT	----	0.25	MHz/ºC
Shock, specified pulse	1042	11/		Condition K; no voltages	----	----	----	----
Vibration, mechanical	1032	12/,26	2	F = F2	----	----	----	----
Random vibration (operation)	----	18/,20	2	F = F2; MIL-STD-202, method 214	----			
Thermal shock	----	19/						
Salt water immersion	----	16/	----		----	----	----	----
Conformance inspection, part 1		1/						
Pressurizing	4003	22/,23	----	45 psia minimum input and output assemblies	----	----	----	----
Heater current	1301	----	----	Ef = 13.75 V; tk = 150 sec (min)	If	----	3.3	A
Operating torque or force	4223	----	----	TA = 20ºC ± 5ºC (nonoperating)	Torque	----	35	inch-ounce
Cathode warmup time	4303	5/	1/, 2/		----	----	----	----
Pulse characteristics	4304	6,7	1/, 2/	rrv = 160 kV/µs (min)	----	----	----	----
RF bandwidth	4308	21	1/, 2/		BW	----	2.0/tpc	MHz
Minor lobes	4308	21	1/, 2/		Ratio	9	----	dB
Mechanical tuning range	4223	13,14	1/	Upper limit Lower limit	F F	15,220 ----	---- 13,980	MHz MHz
Pulse voltage	4306	----	2/		epy	16.5	19.5	kV
Stability	4315	17	2/		MP	----	0.25	MHz
Power output	4250	----	2/		Po	87	132	W
Conformance inspection, part 2								
Frequency pulling figure	4310	----	2/	F2	ΔF	----	8	MHz
Frequency pushing figure	4311	27	2/	ib = 15 to 19 a; F = F2	ΔF/Δib	----	0.300	MHz

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
Conformance inspection, part 3								
Life test 29/ 30/		29/, 30/	1, 2	Group D; VSWR = 1.5 cycled through λg every 15 minutes (approximately)		1,250 1,500	--- ---	hours cycles
Life-test end points: 2/		2/						
Power output	4250		2		Po	70	---	W
RF bandwidth 21/	4308	21/	1, 2		BW	---	2.5/tpc	MHz
Minor lobes 21/	4308	21/	1, 2		Ratio	6	---	dB
Stability 17/	4315	17/	2		MP	---	0.5	%

1/ Unless otherwise specified, the acceptance level for all tests listed under conformance inspection, part 1, shall be accept on zero failures.

2/ If during life test, the tube does not meet the specified limits, it shall be recycled for an additional five cycles. At such time, the tests shall be repeated. The tube will be considered satisfactory if it passes the second test.

3/ The tuning mechanism shall be capable of withstanding a static torque of 75 inch-ounce at the ends of its travel.

4/ The tube shall be capable of normal operation without electrical breakdown with the input bushing in air 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 13.75 volts ±5 percent for 150 seconds, minimum. On the application of anode voltage, the heater voltage shall be reduced in accordance with the following schedule:

$$Ef = 13.75 \left(1 - \frac{Pi}{530}\right) \pm 5 \text{ percent; for Pi = 0 to 370 watts; where Pi = epy x Ib.}$$

6/ The characteristics of the applied pulse shall 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 most important considerations.

7/ The rate of voltage (rrv) shall be expressed in kilovolts per microsecond (kV/μs) defined by the steepest tangent to the leading edge of the voltage pulse above the 70 percent amplitude point amplitude point. Any capacitance used in the viewing (measuring) circuit shall not exceed 6 picofarads (pF).

8/ In handling and mounting the magnetron, care shall be exercised to prevent demagnetization. See figure 1. The use of magnetic inspection tools is prohibited.

9/ With a total airflow of approximately 20 cfm at approximately 760 mmHg, 25ºC divided equally and directed through the cooling fins toward the body of the tube from two ducts placed 0.750 inch (19.05 mm) maximum from cooling fins, the specified rise above ambient temperature shall not be exceeded.

10/ Temperature measurements shall be made only after thermal equilibrium has been reached. The frequency shall be measured at the extremes of any 30ºC temperature difference in the specified temperature range.

11/ The tube shall be subjected to five shocks of the specified peak amplitude and duration in each of three mutually perpendicular directions. Following impact tests, the tube shall show no mechanical failure and shall meet the power output and pulse voltage requirements of conformance inspection, part 1.

TABLE I. Testing and inspection - Continued.

12/ The tube shall be mounted in a resonance free jig and vibrated with sinusoidal excitation in each of three mutually perpendicular planes through the following amplitudes:

20 to 100 Hz	10 G (or 0.1 inch D.A. max)
100 to 500 Hz	3 G

Cycling test: The frequency shall vary from 5 to 500 to 5 Hz with approximately logarithmic progression, and shall require approximately 30 minutes to traverse the range. This constitutes one cycle. The TUT shall be vibrated for one such cycle in each of the three planes.

Resonance test: Mechanical resonant frequencies of the tube shall be determined during the cycling test.

Vibration test schedule (times shown refer to one axis)

Type	Room temperature
Resonance	30 minutes
Cycling	30 minutes

13/ The frequency range F1 to F3 shall be traversed by a tuning shaft rotation of 5 ± .5 turns.

14/ Operation outside the upper and lower frequency limit is not recommended since permanent tube damage may result.

15/ CAUTION: It is important when supplying a dc input to the filament of this tube that the heater terminal be operated negative in polarity with respect to the heater cathode terminal. Failure to observe this precaution may result in permanent damage to the tube.

16/ The tube shall be mounted such that the high-voltage bushing is covered and the waveguide output is sealed. The assembly shall be placed in a 5 percent solution of salt and water for a period of 24 hours. At the end of 24 hours the tube shall be removed from the solution, washed with clean water and dried with an air hose. The tuner knob and upper tuner assembly will be removed so that the tuner surfaces may be inspected for the presence of water. Upon completion of the inspection (assuming no water was found within the tuner) the tube shall be reassembled and operated to meet the power output test requirements of quality conformance inspection, part 1.

17/ 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 me missing if the rf energy is less than 70 percent of the normal energy level. The stability shall be measured when VSWR of 1.5:1 minimum is introduced in the load and the phase is adjusted at the start of each measurement interval to produce maximum instability. The missing pulse count shall be performed over a 3-minute test interval.

18/ The spectrum of the tube rf output, while under random vibration, shall be displayed on a spectrum analyzer. Adjust spectrum analyzer such that all pulses can be seen on the display. the rf bandwidth shall be greater than the prf. the sweep rate shall be adjusted so that it is in the range of 4 to 10 times 1/prf. The display shall be set for 2 MHz per division. A reference spectrum shall be photographed at the beginning and end of the vibration period (a nonvibrating spectrum) to monitor drifts in the transmit frequency and bandwidth. Ten photographs will be taken at approximately equal intervals throughout the 20-minute vibration period per axis. An acceptable bandwidth is defined as the 6 dB amplitude bandwidth of the reference spectrum, plus 6 MHz. No more than 5 percent of the reference spectrum amplitude may be outside the acceptable bandwidth. Following completion of the random vibration test, the tube shall meet the power output test requirements of quality conformance inspection part 1.

19/ The tube shall be mounted such that the high-voltage bushing is shielded and the waveguide output is connected to a length of waveguide. The mounting plate shall have a thermal mass equal to 5 pounds of aluminum.

The tube shall be operated until thermal equilibrium is reached and the body temperature is at least 90ºC. All power and cooling shall be removed. After a period of no greater than 2 minutes, the tube shall be immersed in water at 4ºC and left for a period of 3 minutes. This test shall be repeated 3 times. During immersion water shall not be allowed to enter the waveguide nor touch the high-voltage bushing.

20/ The vibration amplitude shall be 0.0125 g^2/Hz, 10 Hz to 2 kHz. The maximum number of missing pulsed shall be 0.25 percent when measured as stated in note 17, except the load shall be matched.

TABLE I. Testing and inspection - Continued.

21/ The radio frequency bandwidth and side lobes shall be within the limits specified with 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. A satisfactory spectrum is one whose slope does not change sign more than once for power levels greater than 6 dB below its peak.

22/ The seal formed by clamping the tube mounting plate against a suitable tube test fixture shall be hermetically tight for 1 minute minimum with the specified air pressure applied so as to surround the entire input bushing below the mounting plate.

23/ The seal formed by clamping the tube output flange against a suitable tube test fixture shall be hermetically tight for 1 minute minimum with the specified air pressure applied internally to the test fixture.

24/ The tube shall be coupled directly to M3922/59-007 choke flange modified so that mounting holes provide clearance for No. 8 bolts.

25/ The modulator shall be such that energy per pulse delivered to the tube, if arcing occurs, shall not greatly exceed the normal energy per pulse. The tube heater shall be protected against arcing by use of a connector that places a minimum of 4,000 pF across the heater directly at the input terminals.

26/ At the completion of this test, the tube shall meet the power output and pulse voltage requirements of quality conformance inspection, part 1.

27/ The pushing factor shall be measure in steps of at least 4 amperes each and no value shall exceed the limits specified herein. The peak current through the tube shall alternately be the limits as specified under this test condition. These tests shall be run to exclude the affects of thermal drift and frequency instability not due to pushing.

28/ In addition to regular markings the tuner dial settings for the following frequencies shall be marked on the tube. The accuracy of these settings shall be ±5 MHz at the start of life under conditions of test condition (2) with the anode temperature approximately 80ºC as measured at the point specified on figure 1 when tuning is performed in the order of increasing the frequency.

Frequency code	Dial setting
F1	----
F2	----
F3	----

29/ Starting at F1 and increasing to F3, then decreasing to F1, the frequency of the tube will be changed in 200 MHz increments (approximately) after each 50 hours (approximately) of high-voltage operation. The duration of the switching interval between test conditions 1 and 2 shall not exceed 5 seconds. The following cycle shall be used for life test:

Condition	Duration (minutes)
Standby	2.5
Test condition 1 (see note 5)	25.0
Test condition 2 (see note 5)	25.0
Off	7.5

30/ Service-life guarantee is acceptable in lieu of life test if specifically authorized by contract.

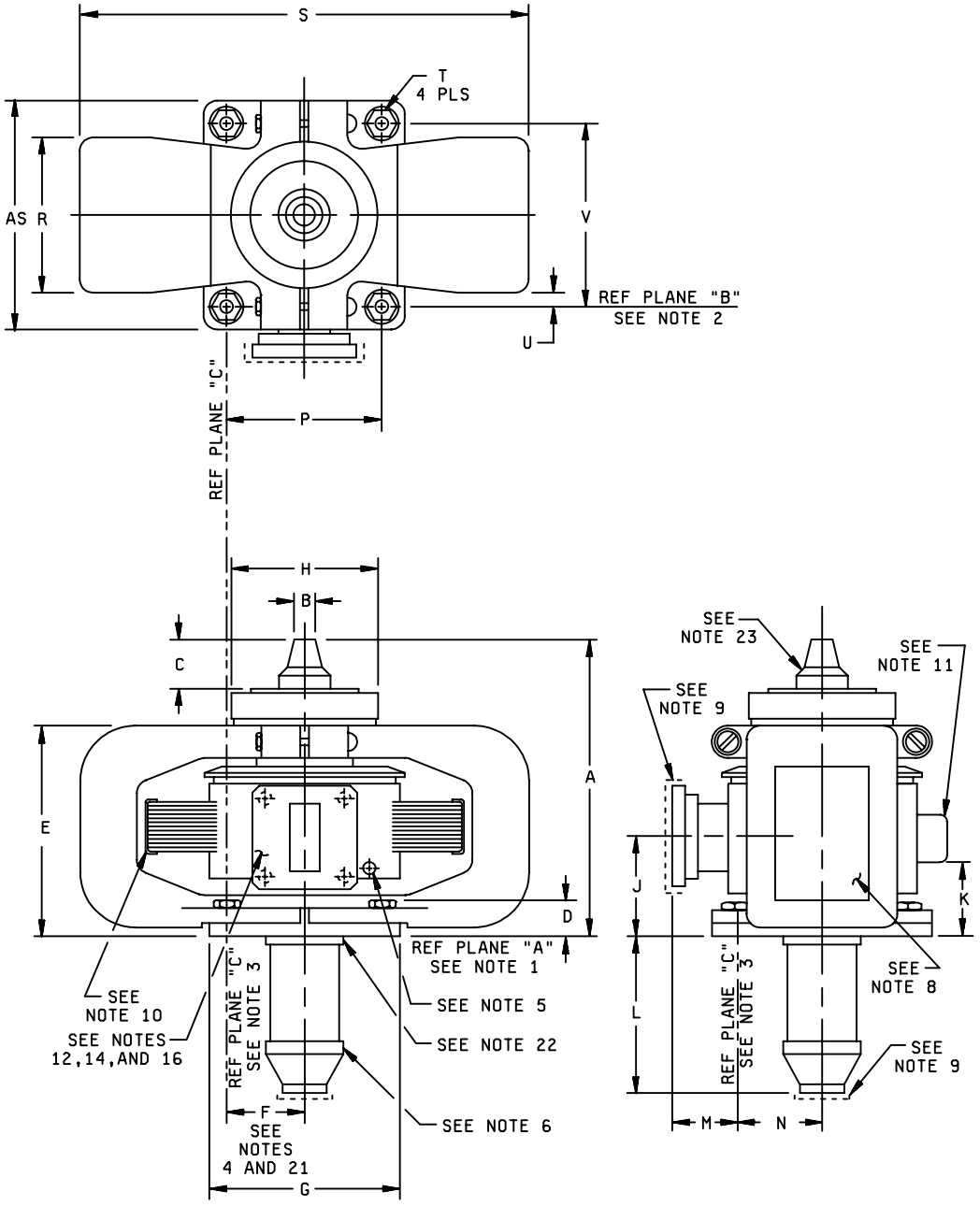
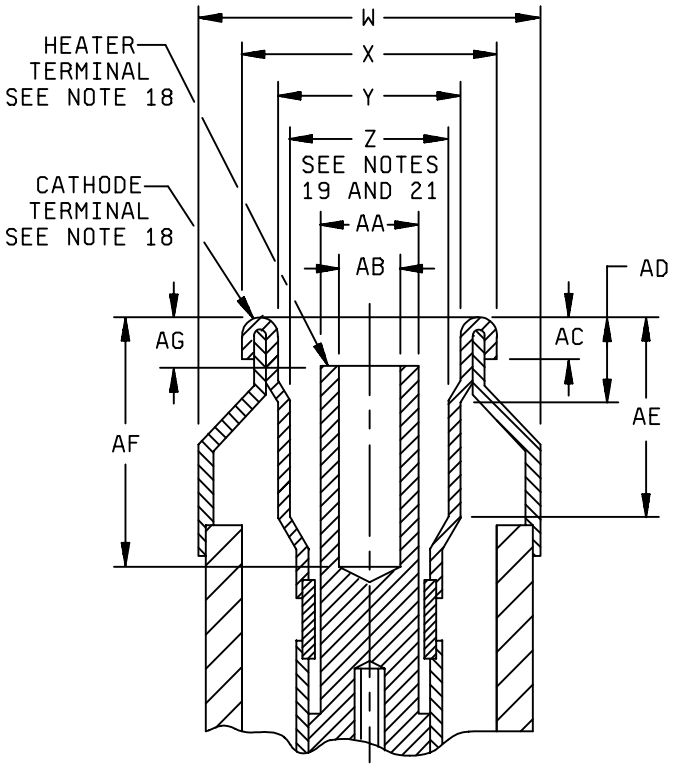
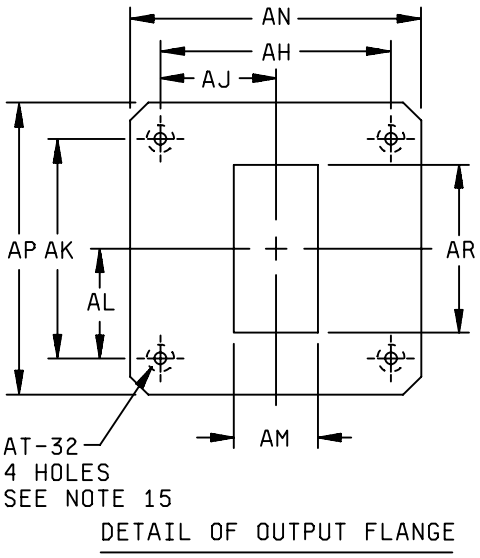


FIGURE 1. Outline drawing of electron tube type DOD-033.





Ltr	Dimensions			
	Millimeters		Inches	
Qualification inspection				
	Min	Max	Min	Max
E	----	98.81	----	3.890
N	37.34	38.86	1.470	1.530
U	3.48	----	.137	----
Y	15.32	15.67	.603	.617
AC	2.92	3.43	.115	.135
AD	----	3.96	----	.156
AE	----	14.27	----	.562
AH	24.18	24.38	.952	.960
AJ	12.09	12.19	.476	.480
AK	25.17	25.38	.991	.999
AL	12.59	12.69	.4955	.4995
AM	7.85	7.95	.309	.313
AN	----	34.11	----	1.343
AP	----	34.11	----	1.343
AR	15.75	15.85	.620	.624
Conformance inspection, part 1				
F	30.48	33.02	1.200	1.300
J	49.00	51.33	1.929	2.021
M	11.89	15.04	.468	.592
P	63.25	63.75	2.490	2.510
S	----	228.60	----	9.000
V	75.95	76.45	2.990	3.010
Conformance inspection, part 2				
D	14.35	17.40	.565	.685
K	39.24	40.77	1.545	1.605
L	----	71.07	----	2.798
T	6.86	7.37	.270	.290
W	26.97	28.55	1.062	1.124
X	20.96	21.29	.825	.838
Z	13.51	13.84	.532	.545
AA	5.94	6.76	.234	.266
AB	4.17	4.42	.164	.174
AF	19.05	----	.750	----
AG	3.18	4.75	.125	.187
Nominal				
A	139.95		5.510	
B	11.10		.437	
C	20.83		.820	
G	88.90		3.500	
H	58.73		2.312	
R	68.25		2.687	
AS	95.25		3.750	
AT	3.51		.138	

FIGURE 1. Outline drawing of electron tube type DOD-033 - 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 axis of the holes, as shown at reference plane "A".
3. Reference plane "C" is defined as a plan mutually perpendicular to planes "A" and "B" passing through the axis of the holes, as shown at reference plane "A".
4. Includes angular as well as lateral deviations.
5. Body temperature to be measured at this point. The magnetron serviceability will not be impaired with a screw inserted or removed from this threaded hole.
6. Input bushing temperature to be measured at this point.
7. For vibration and shock testing, the planes of testing shall be reference planes "A" - "B" - "C".
8. Warning: Maintain minimum clearance 4 inches between magnet and magnetic materials (magnets, steel tools, plates, etc.). Use no magnetic inspection tools.
9. Protective closure. To be removed before magnetron is used, and attached when the tube is not in use.
10. The inner laminations of the cooling fins are not painted. However, there may be an overspray of the protective paint.
11. Indicates direction of body cooling airflow.
12. Mates with modified choke flange, M3922/59-007. (Clearance instead of threaded holes).
13. With the tube mounted on the test fixture and with the specified air pressure applied so as to surround the entire input terminal beyond the tube mounting plate, the entire magnetron and fixture are to be submerged in water. No bubbles are allowed in a one minute interval.
14. With the tube output flange clamped against a modified choke flange (M3922/59-007), and using a gasket per A-A-55549, and with the specified air pressure applied to the interior of the waveguide submerge entire magnetron and fixture in water. No bubbles are allowed in a one minute interval.
15. A plane passing through the axis of two threaded holes perpendicular to the face of the output flange must be parallel to planes "A" and "C" within .030.
16. The face of the waveguide flange shall be flat within .010 total indicator reading. The surface of this flange shall be of such a quality that a hermetic type seal can be effected. See note s.
17. Input connection mates with Jettron Products Inc., East Hanover, NJ Connectors Cat. No. 90-006 and 90-030, or equivalent.
18. Heater terminal and cathode terminal shall be concentric within .010.
19. This diameter applies for the length from AE to AD.
20. This face has a satin type (smooth, dull) finish of approximately 63 micro-inches. (Galvanic couples for this material are listed in MIL-HDBK-2036).
21. These dimensions apply to the axis of diameter "Z".
22. This identifies a north pole. Refer to MIL-STD-1311, method 1367.
23. It is recommended that the tuner knob be replaced after salt water immersion. Care should be taken to note the number setting indicated on the dial before removal of the knob. This dial number shall be set on the replacement knob prior to installing in the time shaft.

FIGURE 1. Outline drawing of electron tube type DOD-033 - Continued.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Review activities:
Navy - AS, OS

Preparing activity:
DLA - CC

(Project 5960-3589)