INCH-POUND

MIL-PRF-1/1753C
17 April 2014
SUPERSEDING
MIL-PRF-1/1753B
18 July 2002

PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, MAGNETRON
TYPE DOD-031 *

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 7,800 to 8,500 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
				(body)	(input bushing)	(input)	(output)	
Unit:	W	kW	----	°C	°C	psia	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:	28/
Mounting position:	Any	Cathode:	Unipotential
Mounting support:	Flange	Magnet isolation:	See note 8 and 8/
Coupling:	WR-112 (figure 1) 24/25/	Weight:	14.5 pounds
		Cooling:	Forced air 9/

* Replaces Varian type number VMX-1136.

Frequency
F1 = 7,800 MHz F2 = 8,100 MHz F3 = 8,500 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	---- 7	0.5 ----	160 ----	---- 0.00125	---- 18.75	1.1:1 ----	115 ----	---- F1,F2,F3
Minimum	---- 5/	0.3	90 6/ 7/	----	----	----	55 (Note 5)	----

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	---- 7	0.9 ----	160 ----	---- 0.00125	---- 18.75	1.1:1 ----	115 ----	---- F1,F2,F3
Minimum	---- 5/	0.7	90 6/ 7/	----	----	----	55 (Note 5)	----

GENERAL:

Qualification - Required.

Holding period = 48 hours minimum.

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

Service-life guarantee in lieu of life-testing shall be forwarded and subject to approval from the qualifying activity.

TABLE I. Testing and inspection.

Inspection	Method MIL-STD-1311	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
Qualification inspection		26/						
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	in.-oz
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	8520 ----	---- 7780	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	----	0.025	MHz/a

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method MIL-STD-1311	Notes	Test	Conditions	Symbol	Limits		Unit
						Min	Max	
Conformance inspection, part 3								
Life test		29/, 30/	1, 2	Group D; VSWR = 1.5 cycled through λg every 15 minutes (approximately)		1250 1500	--- ---	hours cycles
Life-test end points:		2/						
Power output	4250		2		Po	70	---	W
RF bandwidth	4308	21/	1, 2		BW	---	2.5/tpc	MHz
Minor lobes	4308	21/	1, 2		Ratio	6	---	dB
Stability	4315	17/	2		MP	---	0.5	%

1/ 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:

$$Ef = 13.75 \left(1 - \frac{Pi}{675}\right) \pm 5 \text{ percent; for Pi = 0 to 370 watts, where Pi = epy x Ib.}$$

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. 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 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 be 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 non-vibrating 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 conformance inspection part 1.

TABLE I. Testing and inspection - Continued.

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 pulses shall be 0.25 percent when measured as stated in note 17/, except the load shall be matched.

21/ 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. 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 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 effects 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 5/	25.0
Test condition 2 5/	25.0
Off	7.5

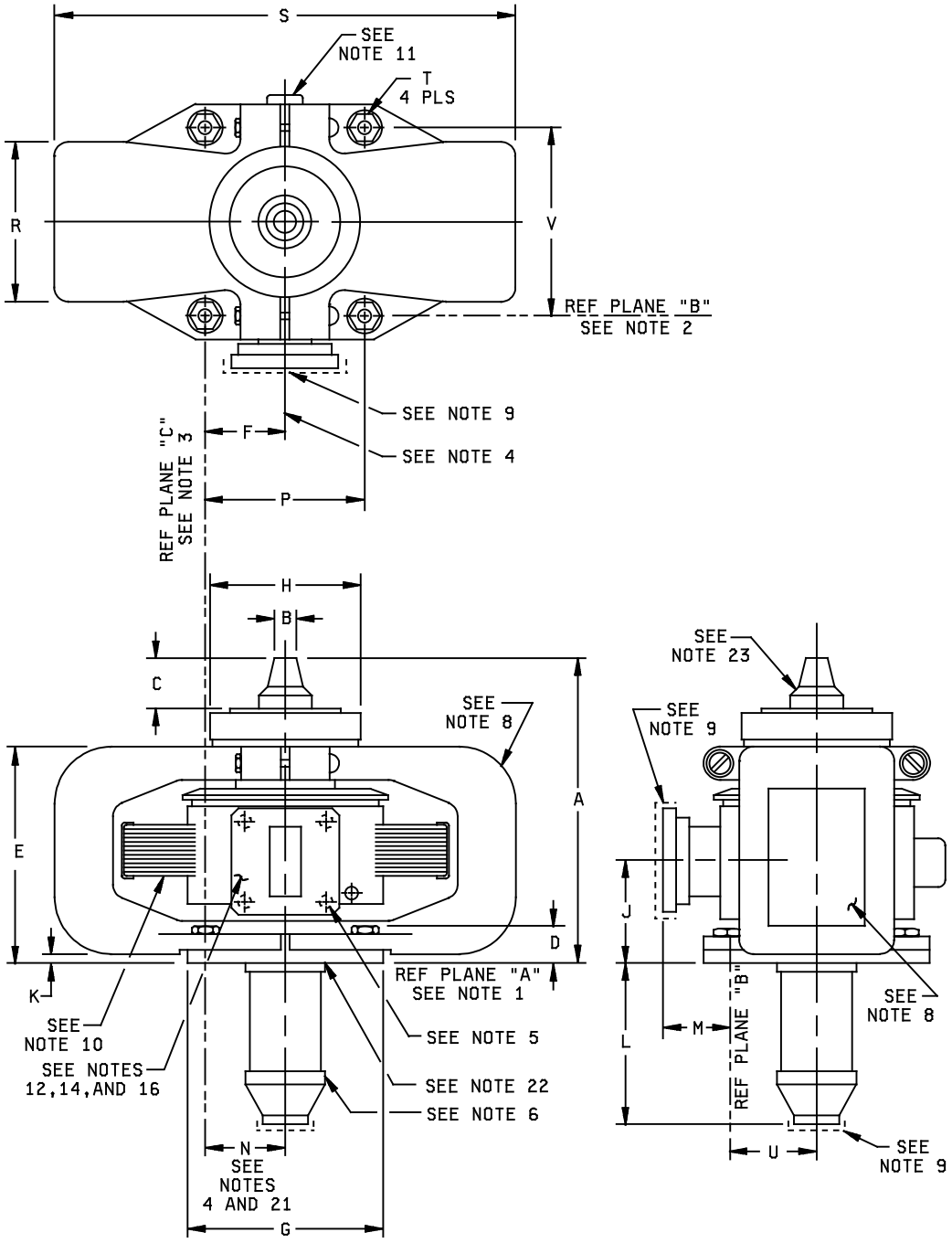
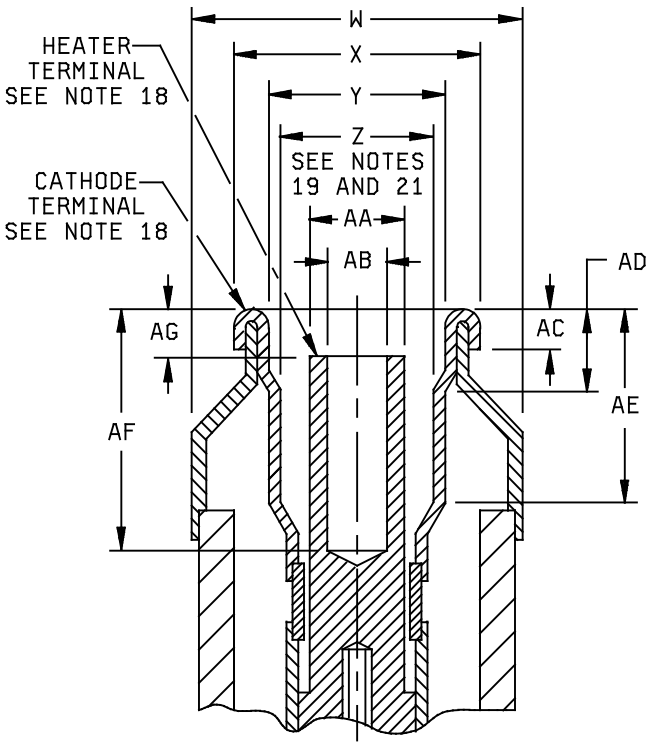
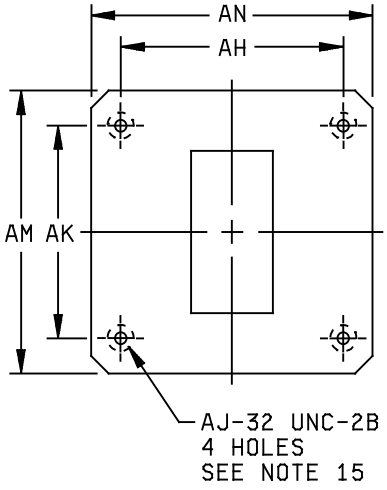


FIGURE 1. Outline drawing of electron tube type DOD-031.



DETAIL OF INPUT CONNECTION



DETAIL OF OUTPUT FLANGE

Ltr	Dimensions			
	Millimeters		Inches	
Inspection				
	Min	Max	Min	Max
G	95.76	98.30	3.770	3.870
N	36.30	38.63	1.429	1.521
S		210.82		8.300
U	36.93	39.27	1.454	1.546
Y	15.32	15.67	.603	.617
AD		3.96		.156
AE		14.27		.562
AH	37.34	37.59	1.470	1.478
AK	34.24	34.44	1.348	1.356
Conformance inspection, part 1				
F	36.30	38.63	1.429	1.521
J	45.42	47.75	1.788	1.880
K	6.35		.250	
L	65.05	69.77	2.561	2.747
M	30.18	33.32	1.188	1.312
P	74.68	75.18	2.940	2.960
V	75.95	76.45	2.990	3.010
X	20.96	21.29	.825	.838
AM	47.24	48.01	1.860	1.890
AN	47.24	48.01	1.860	1.890
Conformance inspection, part 2				
T	7.01	7.26	.276	.286
W	26.97	28.55	1.062	1.124
Z	13.51	13.84	.532	.545
AA	5.94	6.76	.234	.266
AB	4.17	4.42	.164	.174
AC	2.92	3.43	.115	.135
AF	19.05		.750	
AG	3.18	4.75	.125	.187
Nominal				
A	151.13		5.950	
B	11.10		.437	
C	20.83		.820	
D	20.83		.820	
E	95.25		3.750	
H	50.80		2.000	
R	68.25		2.687	
AJ	4.17		.164	

FIGURE 1. Outline drawing of electron tube type DOD-031 - 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 per MIL-DTL-3922/59. (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 14.
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-031 - Continued.

Referenced documents. In addition to MIL-PRF-1, this specification sheet references:
MIL-STD-1311 MIL-STD-202 MIL-HDBK-2036 MIL-DTL-3922/59 A-A-55549

The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. 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 and relationship to the last previous issue.

Custodians:
Army – CR
Navy - EC
Air Force - 85
DLA - CC

Review
Navy - AS, OS

Preparing activity:
DLA - CC

(Project 5960-2013-048)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil/.