

INCH-POUND

MIL-PRF-1/1729C
 27 February 1998
 SUPERSEDING
 MIL-E-1/1729B
 12 November 1976

PERFORMANCE SPECIFICATION SHEET
 ELECTRON TUBE, NEGATIVE GRID (MICROWAVE)
 TYPE 8538B 17/

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: Triode, planar, ceramic and metal construction.
 See figures 1 and 1A.
 Mounting position: Any.
 Weight: 0.7 ounce (20 grams) nominal.

ABSOLUTE RATINGS:

Parameter:	F	E _f	E _b	ep _y	E _c	ib	lb	ic	tp	Du
Unit:	GHz	V <u>1/ 11/</u>	kV dc	kv	V dc <u>3/</u>	a <u>2/</u>	mA dc	a	μs	---
Maximum:										
Anode pulsed osc or amp:	3.0	6.3 ±5%	---	10	-300	5.0	---	2.5	6.0	0.0033
Grid pulsed osc or amp:	3.0	6.3 ±5%	8.0	---	-300	5.0	---	2.5	6.0	0.0033
Test conditions:	---	6.3	1.0	---	Adj	---	100	---	---	---

ABOLUTE RATINGS:

Parameter:	P _p	P _g	tk	TE	T (anode shank)	Barometric pressure, reduced	Cooling
Unit:	W	W	sec (min)	°C <u>4/</u>	°C <u>4/</u>	mmHg <u>5/</u>	--- <u>4/</u>
Maximum:							
Anode pulsed osc or amp:	100	1.5	60	250	250	35	Conduction and convection
Grid pulsed osc or amp:	100	1.5	60	250	250	35	Conduction and convection
Test conditions	---	---	300	---	---	---	<u>6/</u>

See footnotes at end of table I.

GENERAL:

Qualifications: Required. 19/

TABLE I. Testing and inspection.

Inspection	Method	Conditions	Acceptance level	Inspection level or code	Symbol	Limits		Unit
						Min	Max	
<u>Conformance inspection, part 1 7/</u>								
Insulation of electrodes	1211	Eb = Ek = 0; Ec = -500 V dc	0.65	II	R	50	---	Meg
Electrode voltage (1) (grid)	1261		0.65	II	Ec	-2.0	-7.0	V dc
Total grid current	1266		0.65	II	Ic	---	-8.0	μ A dc
Pulsing emission	1231	(eb = ec)/is = 10.0 a; tp = 1 to 3 μ s; prr = 600 (max)	0.65	II	etd	---	180	v
Heater current	1301		0.65	II	If	1.2	1.4	A
High-voltage holdoff 9/	---	Ebb = 10 kV dc; Ec = -150 V dc (max); 10 k Ω (max) anode circuit resistance	0.65	II	Ib	---	1.0	mA dc
<u>Conformance inspection, part 2</u>								
Electrode voltage (2) (grid)	1261	Eb = 1.0 kV dc; Ec/Ib = 1.0 mA dc	---	---	Eco	---	-16	V dc
Direct-interelectrode capacitance 8/	1331	No voltages applied (ground cathode connection); use fixture in accordance with DSCC Drawing No. D72000	---	---	{ Cin Cgp Cout	{ 8.5 1.30 ---	{ 11.0 1.55 0.06	{ pF pF pF
Power gain (pulse)	---	Grounded grid; Ef = 5.8 V; pd = 300 w (peak); F = 1,030 \pm 5 MHz; Ec = -70 V dc (min); Eb = 5.0 kV dc; tp = 0.5 to 2.0 μ s; Du = 0.001 (max)	---	---	po	2.2	---	kW

See footnotes at end of table.

TABLE I. Testing and inspection - Continued.

Inspection	Method	Conditions	Acceptance level	Inspection level or code	Symbol	Limits		Unit
						Min	Max	
<u>Conformance inspection, part 3</u>								
Life test <u>10/</u>	---	Group C; $E_f = 6.3 \pm 0.1$ V; heater standby; $t = 500$ hours	---	---	---	---	---	---
Life-test end point: <u>10/</u>	---		---	---	Δi_b ΔC_{gp}	---	25 0.15	% pF
Sweep-frequency vibration <u>8/ 12/ 13/</u>	---	F = 55 to 500 Hz; accel = 10 G (peak); Ebb = 400 V dc; R _p = 10,000 ohms, E _c /I _b = 10 mA	---	---	E _p	---	250	mV ac
Shock, specified pulse <u>13/ 14/</u>	1042	Condition A; no voltages	---	---	---	---	---	---
Torque <u>8/ 13/ 18/</u>	---	No voltages applied	---	---	---	---	---	---
Shock and torque - test end point:	---							
Total grid current	1266		---	---	I _c	---	-10	μA dc
Barometric pressure, reduced <u>15/</u>	1002	Pressure = 35 mmHg (max); voltage = 2.0 kV ac	---	---	---	---	---	---

- 1/ The transit-time heating effect of the cathode may require compensation by a reduction in heater voltage after dynamic operation of the tubes has started. The back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. There is an optimum heater voltage which will maintain the cathode at the correct operating temperature for a particular set of operating conditions. A maximum variation of ± 5 percent from optimum is permitted. No reduction in heater voltage is required up to and including 500 MHz.
- 2/ The regulation or series-anode-supply impedance, or both, shall limit the instantaneous peak current, with the tube considered as a short circuit, to a maximum of 10 times the specified maximum current rating.
- 3/ The maximum instantaneous peak grid-cathode voltage shall be within the range of +175 to -750 volts.
- 4/ Sufficient conduction, convection, and force-air cooling shall be provided to limit the envelope and anode shank temperatures to the specified maximum value under all operating conditions. Reliability will be seriously impaired if this maximum is exceeded. Where emphasis is placed on long and reliable life, lower temperatures shall be used. To insure proper cooling, the tube shall be sufficiently tightened into the heat sink (15 to 20 inch-pounds). The maximum torque, however, shall not exceed 20 inch-pounds.
- 5/ Operation at this altitude is possible in a suitably designed circuit.
- 6/ Sufficient conduction, convection, and forced-air cooling may be used in all electrical tests involving application of heater voltage to maintain the anode shank and seal temperatures within the specified maximum values.
- 7/ All tests listed under conformance inspection, part 1, shall be performed at the conclusion of the holding period.
- 8/ Other tube contact configurations may be used provided the tube contact area remains unchanged and the socket, jig, or cavity gives equal performance. Mounting of the socket, jig, or cavity may be at the option of the manufacturer.

TABLE I. Testing and inspection - Continued.

- 9/ After heater warmup, and using the circuit of figure 2, the anode voltage shall be raised slowly to 10 kV dc. Intermittent arcing may occur as the anode voltage is increased, but more than 5 arcs shall be cause for rejection. The voltage shall be held at the 10 kV dc level for 1 minute; if any arcs occur during this time, or I_b exceeds the specified limit of 1.0 mA dc, the tube shall be rejected. If any arcs occur during this period the TUT shall be held at the 10 kV dc level for an additional 2 minutes and if no additional arc occurs (and I_b does not exceed the specified limit of 1.0 mA dc), then the TUT shall be accepted.
- 10/ At zero hours of life test, measure and record C_{gp} , and establish the drive conditions necessary to obtain a peak anode current (i_b) of 3 amps (minimum) with an anode voltage of 2.0 kV dc and a bias of -40 V dc. The pulse width of the modulator shall be 2 μ s (minimum) and the duty cycle shall be 0.0025 (maximum). At the conclusion of the life test, measure C_{gp} and calculate ΔC_{gp} , and with the drive level determined at zero hours, check the peak anode current and calculate Δi_b .
- 11/ Where emphasis is placed on long and reliable life, the filament voltage can safely be lowered to 6.0 volts, provided the line voltage is regulated better than ± 2 percent.
- 12/ The tube shall be suitably mounted (e.g., epoxy encapsulated) and vibrated with simple harmonic motion. The peak acceleration over the frequency range shall be within ± 20 percent of the reference acceleration at 100 Hz. The frequency shall vary from 55 to 500 Hz and return to 55 Hz with approximately logarithmic progression and shall require from 4 to 6 minutes to traverse the range. Each tube shall be vibrated for 30 minutes in the X and Y axes, except that if the cumulative result of tests on 50 or more tubes shows more than 75 percent of the tubes have higher output voltages in one position, subsequent measurements need to be taken only in the position giving the higher reading. The voltages specified shall be applied during vibration. The value of the alternating voltage, E_p , produced across the resistor, R_p , as a result of vibration shall be measured with a device having the ability to measure, with an error of less than 10 percent, the rms value of a sine wave of voltage at all frequencies from 20 to 20,000 Hz.
- 13/ This test shall be performed during the initial production and once each succeeding 12-calendar month period in which there is production. A regular double sampling plan shall be used, with the first sample of three tubes having an acceptance number of zero, and a second sample of three tubes having a combined acceptance number of one. In the event of failure, the test shall be made as a part of conformance inspection, part 2, inspection level S3, with an acceptance level of 6.5. The regular "12 calendar month" double sampling plan shall be reinstated after three consecutive samples have been accepted.
- 14/ The tube shall be suitably mounted (e.g., epoxy encapsulation). Each tube shall be subjected to a total of 15 shocks; 5 shocks in each plane +X, +Z, and -Z in any sequence.
- 15/ Voltage shall be 60 Hz ac applied between the anode and grid. No other voltages shall be applied. There shall be no evidence of failure as indicated by arc-over. Perform test on 10 tubes selected from the first production lot of each year. If more than one tube fails, the test shall become part of conformance inspection, part 2, with an acceptance level of 6.5, inspection level S3. After three consecutive successful submissions, the test shall revert to a 10-tube annual test. This is not a destructive test.
- 16/ Test shall be conducted in a cavity assembly in accordance with the following Hazeltine Corporation drawings, or equivalent:
- | | |
|----------|------------------------------|
| 114329-5 | Final output cavity assembly |
| 114277-7 | RF filter assembly |
| 114612 | Connector (matching stub) |
| 330620 | Power divider (SMA"") |

A 0.47 μ F cathode bypass capacitor shall be employed.

(Copies of the above drawings may be obtained from Hazeltine Corporation, Greenlawn, NY 11740 at no cost.)

TABLE I. Testing and inspection - Continued.

17/ This type will replace the following:

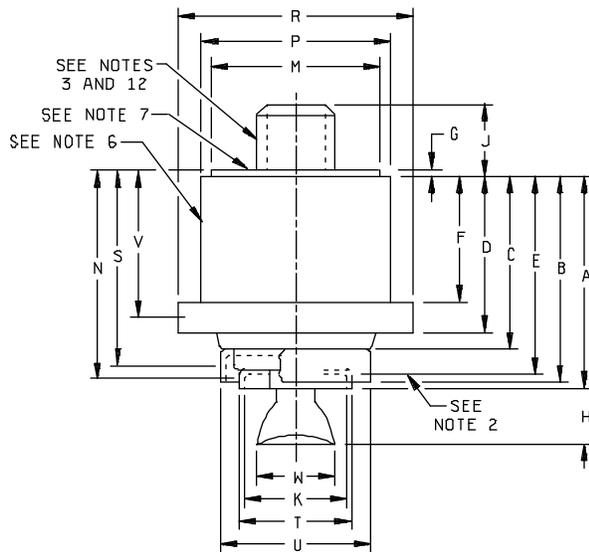
Type or part number

8538A and Y-564
ML8538 and Hazeltine P/N 910633
8933 (EIMAC)

18/ The torque test shall be performed as follows:

- a. A torque of 15 inch-pounds shall be applied at right angles to the tube axis between the anode and cathode, without shock.
- b. A torque of 20 inch-pounds shall be applied at right angles to the tube axis between the anode and grid, without shock.

19/ Compatibility testing is required in addition to the requirements stated herein. A sample of 10 tubes shall be subjected to compatibility testing in the Receiver Transmitter RT-868A/APX-76(V), or in RT-1026/TPX-46(V), where it shall be demonstrated that pulse train droop does not exceed 1.0 dB when used with a pulse train of 37 pulses 0.5 μ s wide spaced at 2 μ s. Droop shall be defined as that power difference between pulses with maximum power and minimum power respectively. There shall be no evidence of a sudden amplitude change or "step" during the pulse train.



Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
Conformance inspection, part 2					
A	.845	.909	21.46	23.09	
B	.825	.875	20.96	22.22	
D	.640	.669	16.26	16.99	
F	.520	.537	13.21	13.64	
K	.410	.425	10.41	10.80	
R	.935	.950	23.75	24.13	1, 8
T	.440	.460	11.18	11.68	1, 4
U	.595	.607	15.11	15.42	1, 9
Conformance inspection, part 3					11
C	.702	.740	17.83	18.80	
E	.782	.837	19.86	21.26	
G	.022	.040	0.56	1.02	
H	---	.250	---	6.35	
J	.240	.275	6.10	6.98	
M	.565	.580	14.35	14.73	
P	.775	.785	19.68	19.94	
W	---	.313	---	7.95	
Reference dimensions					10
N	0.815		20.70		1, 4, 12
S	0.778		19.76		1, 9, 12
V	0.598		15.19		1, 8, 12

NOTES:

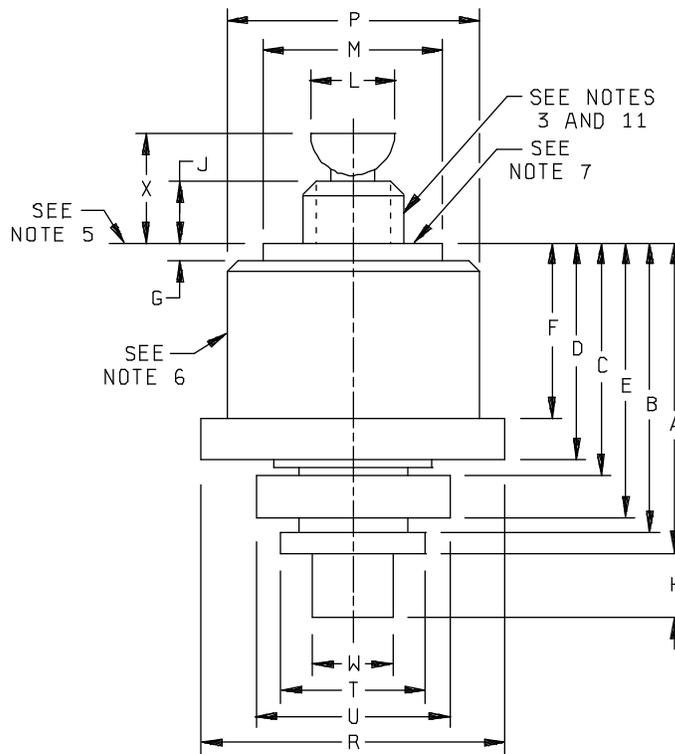
1. Total indicated runout (TIR) of contact surfaces shall be gauged from centerline of reference and shall be as follows:

Contact surface	TIR (max)	Reference
Grid	0.015	Anode
Cathode	0.015	Anode
Heater	0.015	Anode

- See outline. Alternate heater-contact surface. Heater contact can be made to the bottom of the heater terminal-cup by means of a coil spring having a maximum coil OD of .390 inch (9.91 mm) and a minimum coil ID of .320 inch (8.13 mm), or some similar device.
- See outline. Anode, .3125-24 UNF-2A thread.
- Heater-contact surface.
- See outline. Reference surface. The tube shall be stopped only by this surface when screwed in the socket.
- See outline. Insulating envelope. Do not clamp or locate on this surface.
- See outline. Anode flange is for electrical contact; stud is for heat transfer and anode temperature measurement.
- Grid-contact surface.
- Cathode- or heater-contact surface.
- Dimensions in electrode contact areas table are for socket design purposes and are not intended for inspection purposes.
- These dimensions shall be checked on 10 tubes per month when in continuous production. Failure of more than one tube to meet tolerances for any dimension shall cause that dimension to become, for all lots in process, part of conformance inspection, part 2.
- Silver plated 30 milligrams per square inch (msi) minimum plus gold strike.

FIGURE 1. Outline drawing of electron tube type 8538B.

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Ltr	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
Conformance inspection, part 2					
A	---	.960	---	24.38	
B	---	.895	---	22.73	
C	.702	.740	17.83	18.80	
D	.655	.684	16.64	17.37	
E	.825	.875	20.96	22.23	
F	.537	.554	13.64	14.07	
R	.935	.950	23.75	24.13	1, 8, 11
T	.440	.460	11.18	11.68	1, 4, 11
U	.595	.607	15.11	15.42	1, 9, 11
W	.235	.265	5.97	6.73	1, 4, 11
Conformance inspection, part 3					10
G	---	.055	---	1.40	
H	---	.200	---	5.08	
J	.150	.190	3.81	4.83	
L	---	.260	---	6.60	
M	.545	.570	13.84	14.48	
P	.775	.785	19.68	19.94	
X	---	.340	---	8.64	

FIGURE 1A. Alternate outline drawing of electronic tube type 8538B.

NOTES:

- Total indicated runout (TIR) of contact surfaces shall be gauged from centerline of reference and shall be as follows:

Contact surface	TIR (max)	Reference
Grid	.020 (0.51)	For all TIR measurements, the reference is the anode thread pitch diameter -----see note 2
Cathode	.020 (0.51)	
Heater	.020 (0.51)	

- The TIR measurement shall be made using gauge in accordance with figure 3 to attach to the tube anode and reference the pitch diameter of the threads.
- See outline. Anode, .3125-24 UNF-2A thread.
- Heater-contact surface.
- See outline. Reference surface. The tube shall be stopped only by this surface when screwed in the socket.
- See outline. Insulating envelope. Do not clamp or locate on this surface.
- See outline. Anode flange is for electrical contact; stud is for heat transfer and anode temperature adjustment.
- Grid-contact surface.
- Cathode- or heater-contact surface.
- These dimensions shall be checked on 10 tubes per month when in continuous production. Failure of more than one tube to meet tolerances for any dimension shall cause heat dimension to become, for all lots in process, part of conformance inspection, part 2.
- Silver plated 30 milligrams per square inch (msi) minimum plus gold strike.

FIGURE 1A. Alternate outline drawing of electron tube type 8538B - Continued.

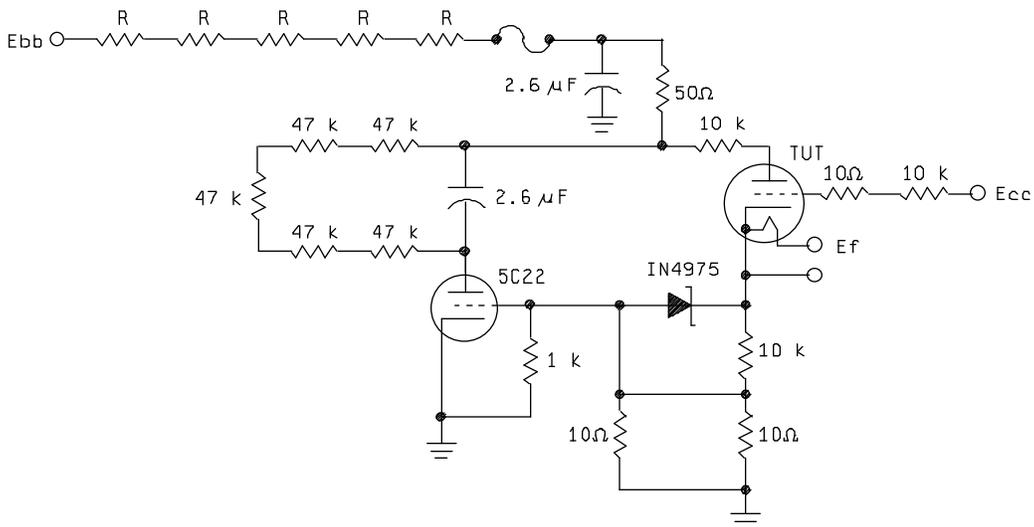
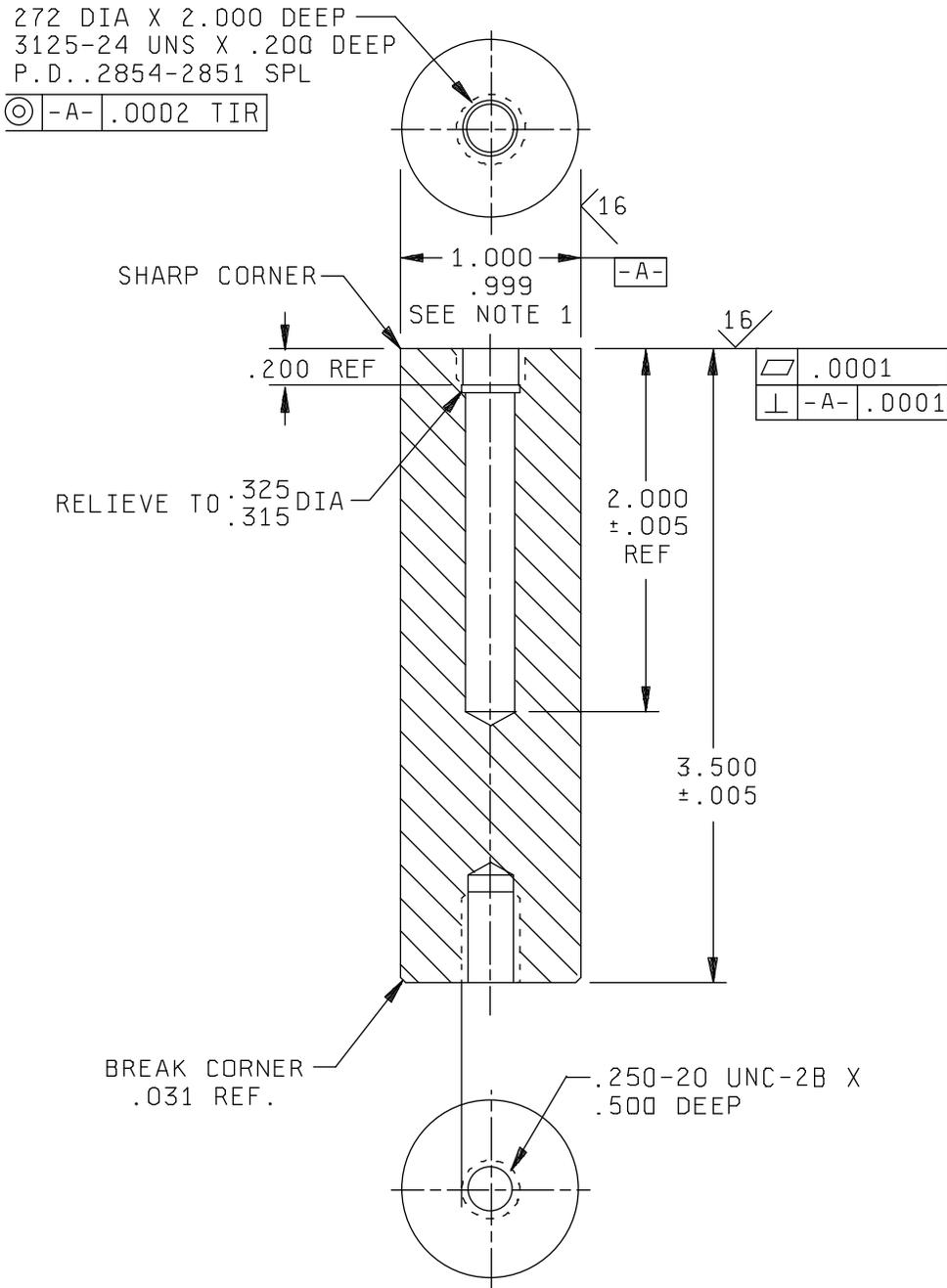


FIGURE 2. High voltage test circuit.



Inches	mm
.0001	0.00
.0002	0.00
.0003	0.01
.005	0.13
.031	0.79
.200	5.08
.272	6.91
.315	8.00
.325	8.26
.500	12.70
.999	25.37
1.000	25.40
2.000	50.80
3.500	88.90

NOTES:

1. Overall diameter taper .0001 maximum.
2. This arbor, or equivalent, to be used to check concentricity of grid and cathode contact surfaces with reference to anode pitch diameter (P.D.).

FIGURE 3. Check fixture arbor.

Custodians:

Army - CR
Navy - EC
Air Force - 85

Review activities:

Army - AR
Navy - AS, CG, MC, OS, SH
Air Force - 11, 17, 99

Preparing activity:

DLA - CC

Project 5960-3476-05)