

MILITARY SPECIFICATION SHEET
 ELECTRON TUBE, RECEIVING
 TYPE 5687WB ^{1/}

The complete requirements for procuring the electron tube described herein shall consist of this document and the latest issue of Specification MIL-E-1.

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

- ⓐ This specification sheet includes test requirements necessary to assure a process average (4-lot sum) acceptable failure rate (AFR) of 1.1 percent per 1,000 hours with a 5.0 percent producer's risk and a reject failure rate (RFR) of 5.2 percent per 1,000 hours with a 90 percent consumer confidence. Notable improvement in reliability may be achieved when this tube is operated under conditions of reduced stress. Failure rate adjustment charts and associated data published in MIL-HDBK-217 should be consulted to determine the failure rate level applicable to operating conditions selected.

DESCRIPTION: Double triode, miniature, low Mu

Outline	---	6-2 (EIA)	ⓐ
Base	---	E9-1	
Envelope	---	T6-1/2	
Cathode	---	Coated unipotential	
Base connections:			
Pin No.	---	1	2
Element	---	2a	2g
		2k	h
		h	h
		1k	1g
		hct	1a

ABSOLUTE-MAXIMUM RATINGS:

Normal	Ef	Eb	Ec	Ehk	Rg/g	Ic/g	Ik/k	Pp/p	TE	Alt
Parameter:	V	Vdc	Vdc	v	Meg	mAdc	mAdc	W	°C	ft
Unit:										
Maximum:	6.6	330	0, -200	135	0.1	6.0	65	3.75	225	(see note 3)
	13.2	---	---	---	(see note 1)	---	---	(see note 2)	---	---
Minimum:	6.0	---	---	---	---	---	---	---	---	---
	12.0	---	---	---	---	---	---	---	---	---

TEST CONDITIONS (1): 12.6 120 -2 0 --- --- --- --- --- ---

Pulse service	Ef	Eb	Ec	eb	egk	ehk	Pg/g	Pp/p	Ik/k	Du	tp	Prr
Parameter:	V	Vdc	Vdc	v	v	v	W	W	ma	%	μs	
Unit:												
Maximum:	6.6	330	---	660	50, -100	100	0.1	4.0				
	13.2	---	---	---	---	---	---	---				
Minimum:	6.0	---	---	---	---	---	---	---				
	12.0	---	---	---	---	---	---	---				

[See figure 1]

TEST CONDITIONS (2): 12.6 300 -40 --- 40 --- --- --- --- 1.0 10 1,000

GENERAL:

Qualification - Required (see note 4)

Reliable tube

^{1/} Formerly tube type 5687WA

ⓐ denotes changes

5687WB

METHOD	REQUIREMENT OR TEST	CONDITIONS	AQL PERCENT DEFECTIVE	INSP LEVEL OR CODE	SYMBOL	LIMITS						UNIT
						MIN	LAL	BOSEY	UAL	MAX	ALD	
	<u>Quality conformance inspection, part 1 (see note 5)</u>											
1256	Electrode current (1) (anode)	Test condition (1) (see note 6)	---	---	Ib	---	33	36	39	---	7	mAdc
1256	Electrode current (1) (anode)	Test condition (1) (see notes 6 and 7)	0.4	II	Ib	27	---	---	---	45	---	mAdc
1266	Total grid current	Test condition (1) (see notes 6 and 7)	0.4	II	Ic	0	---	---	---	-1.5	---	μ Adc
1301	Heater current		---	---	II	---	425	440	455	---	25	mA
1301	Heater current		0.4	II	II	410	---	---	---	470	---	mA
1306	Transconductance (1)	See note 6	---	---	Sm	---	10500	11500	12500	---	2500	μ mhos
1306	Transconductance (1)	See note 6	0.4	II	Sm	8500	---	---	---	14500	---	μ mhos
1336	Heater-cathode leakage	See note 6	0.4	II	Ihk	---	---	---	---	30	---	μ Adc
1201	Short and discontinuity detection		0.4	II	---	---	---	---	---	---	---	---
	<u>Quality conformance inspection, part 2 (see note 5)</u>											
1211	Insulation of electrodes	E(g to all) = -300 V E(a to all) = -500 V (see note 5)	2.5	I	R	100	---	---	---	---	---	Meg
1031	Low-frequency vibration	F = 40 Hz; 10 G; Rp = 2,000 ohms (see note 6)	6.5	Code H	Ep	---	---	---	---	100	---	mVac
Ⓒ2201	Noise and microphonics	Ebb = 300 Vdc; Ec = 0; Esig = 70 mVac; Rk = 680 ohms; Rg = 1.0 Meg; Rp = 2,000 ohms (see note 8)	2.5	I	---	---	---	---	---	---	---	---
1256	Electrode current (2) (anode)	Test condition (1); Ec = -20 Vdc (see note 6)	2.5	I	Ib	---	---	---	---	6.0	---	mAdc
1256	Electrode current (3) (anode)	Test condition (1); Ec = -25 Vdc (see note 6)	2.5	I	Ib	---	---	---	---	1.0	---	mAdc
1266	Grid emission	Ef = 14.0 V; Eb = 300 Vdc; Ec = -25 Vdc (see notes 6 and 10)	2.5	I	Is	0	---	---	---	-5.0	---	μ Adc
1296	Pulse current (1) (cathode)	Test condition (2); Rk/k = 1.0 ohm (see notes 6 and 11)	2.5	Code H	Ik	900	---	---	---	---	---	ma

METHOD	REQUIREMENT OR TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSP LEVEL OR CODE	SYMBOL	LIMITS					UNIT	
						MIN	LAL	BOGEY	DAL	MAX		ALD
<u>Quality conformance inspection, part 2</u> (see note 5) -Continued												
1296	Pulse current (2) (cathode)	Test condition (2); E _f = 12.0 V; R _k /k = 1.0 ohm (see notes 6 and 11)	6.5	Code H	Ik	800	---	---	---	---	---	ma
1306	Transconductance (2)	E _f = 11.4 V (see note 6)	2.5	I	ΔS _m E _f	---	---	---	---	15	---	%
1316	Amplification factor	See note 6	2.5	I	Mu	16	---	18.5	---	21	---	---
1331	Direct-interelectrode capacitance	No shield (see note 6) No shield (see note 6) No shield (triode No. 1) No shield (triode No. 2) No shield (see note 6)	6.5	Code E	C _{gp}	2.8	---	4.0	---	5.2	---	pF
					C _{in}	2.8	---	4.0	---	5.2	---	pF
					C _{out}	0.42	---	0.60	---	0.78	---	pF
					C _{out}	0.34	---	0.50	---	0.66	---	pF
					Chk	---	---	---	---	9.7	---	pF
1231	Emission current (anode)	E _{pp} = 195 Vac; E _c = 0; R _k /I _b = 10.5 mAdc (see note 12)	2.5	I	I _s	---	---	---	---	25	---	μAdc
1121	Base strain	See note 13	---	---	---	---	---	---	---	---	---	---
2126	Glass strain		2.5	I	---	---	---	---	---	---	---	---
1041	Shock	450 G; E _{hk} = 100 Vdc (see note 14)	---	---	---	---	---	---	---	---	---	---
1031	Vibration fatigue	2.5 G; F = 25 (min), 60 (max); fixed frequency	6.5	See note 15	---	---	---	---	---	---	---	---
---	Post-shock and vibration-fatigue test end points	Low-frequency vibration	---	---	Ep	---	---	---	---	150	---	mVac
Heater-cathode leakage		---	---	I _{hk}	---	---	---	---	50	---	μAdc	
Transconductance (1)		---	---	S _m	6500	---	---	---	---	---	---	μmbos
Total grid current		---	---	I _c	---	---	---	---	---	-3.0	---	μAdc
ⓐ1105	Permanence of marking		---	---	---	---	---	---	---	---	---	---
METHOD	REQUIREMENT OR TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS				UNIT		
<u>Quality conformance inspection, part 3</u> (see note 16)												
ⓐ1506	Heater-cycling life	E _f = 7.5 V; 1 min "on," 4 min "off;" E _{hk} = 135 Vdc; E _b = E _c = 0 (see note 22)	1.0	S4		---	---	---	---	---	---	
	Life-test end point (heater cycling)	Heater-cathode leakage			I _{hk}	---	---	---	---	30	μAdc	
ⓐ1516	Stability life	E _c = 0; R _k /k = 88 ohms; E _{hk} = 135 Vdc; R _g /g = 1.0 Meg; TA = room	1.0			---	---	---	---	---	---	

METHOD	REQUIREMENT OR TEST	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS		UNIT
						MIN	MAX	
	<u>Quality conformance inspection, part 3</u> (see note 16) -Continued							
---	Life-test end point (stability) (2 and 20 hours)	Change in transconductance (1) of individual tubes	---	---	ΔS_{m_t}	---	10	%
1521	Survival-rate life	Stability life test, or equivalent conditions	---	II	---	---	---	---
---	Life-test end points (survival rate) (100 hours)	Short and discontinuity detection Transconductance (1)	0.65 1.0	II II	---	---	---	---
1501	Intermittent life	Test condition (1); stability life test; TE = 225° C (min) (see notes 17, 18, and 19)	---	---	---	---	---	---
---	Life-test end points (intermittent) (1,000 hours)	Inoperatives Total grid current Heater current Change in transconductance (1) of individual tubes Transconductance (2)	---	---	---	---	---	---
		Heater-cathode leakage Insulation of electrodes E (g to all) = -300 V E (a to all) = -500 V	---	---	I_c I_f ΔS_{m_t} $\Delta S_{m_{E_f}}$ I_{hk}	0 400 ---	-2.5 480 25 30	μA_{dc} mA % %
1501	Intermittent life (pulse)	Test condition (2); Rb/p = 50 ohms (see notes 19, 20, and 21)	---	---	R	25	---	Meg
---	Life-test end points (intermittent pulse) (1,000 hours)	Inoperatives Pulse cathode current (1)	---	---	ik	750	---	ma

NOTES:

1. This value is for operation under fixed-bias conditions. With cathode bias, Rg/g may be 1.0 megohm maximum.
2. Pp/p on one section may be as great as 4.2 watts maximum providing that the total for both sections does not exceed 7.5 watts.
3. See "Reduced pressure (altitude) rating", and altitude, maximum peak voltage.

Ⓒ 4. For qualification, "Life-test data" shall apply with the following exception:

	Quantity	Acceptance No.
Intermittent life test of any sampling plan selected from MIL-STD-105 that assures a RFR of 5.2 percent (Pa = 10 percent) or less	128	3

NOTES: -Continued

5. Sampling procedure shall be in accordance with MIL-STD-105, with sample size determined by lot size, except the minimum sample size shall be as specified below. Use the AQL and inspection level specified for each individual test item to determine the minimum sample size code letter. The maximum lot tolerance percent defectives (LTPD), specified below, is for purposes of information and is defined as the percent defective in the lot for which the probability of acceptance is 0.10 as obtained from the operating characteristic curves in MIL-STD-105.

<u>AQL</u> <u>(percent defective)</u>	<u>Inspection</u> <u>level</u>	<u>Maximum</u> <u>LTPD</u>	<u>Minimum</u> <u>sample size code</u>
0.4	II	2.7	L
2.5	I	12.9	H

6. Test each section separately.
This test to be performed at the conclusion of the holding period.
8. Tie 1k to 2k; 1g to 2g; and 1a to 2a.
9. The tube described by this TSS is a substitute for tube type 5687WA, MIL-E-1/779F.
10. Prior to this test, tubes shall be preheated a minimum of 5 minutes with all sections operating at the conditions indicated below. Test at specified conditions within 3 seconds after preheating. The 3-minute test shall not be permitted. Grid emission shall be the last test performed on the sample selected for the grid-emission test.

Ef	Eb	Ecl	Rk/k	Rg/g
V	Vdc	Vdc	Ohms	Meg
14.0	120	-2	0	1.0

11. The positive portion of the grid pulse shall be a square wave meeting pulse shape requirement of method 1296, and, in addition, the maximum amplitude shall occur within the first 20 percent of tp. The pulse shall be applied to the grid by means of a driving circuit which produces the specified peak pulse voltage directly at the grid terminal with respect to cathode. Grid resistance, not exceeding 50 ohms may be inserted to prevent oscillation, provided readjustment of grid drive is made to maintain the specified pulse amplitude directly at the grid terminal. Peak currents shall be measured by means of a high impedance oscilloscope, or equivalent device, connected across a cathode resistor of 1.0 ± 0.01 ohm. The specified limit refers to the maximum of pulse amplitude.
12. Test each unit separately with test voltages applied to opposite section. Tie grids to negative end of individual Rk through individual 100-ohm resistors. Adjust individual Rk for specified forward anode current ± 5 percent as measured on the forward half cycles of anode voltage. After a minimum of 5 minutes operation as above, measure reverse anode current on the reverse half cycles of anode voltage. See figure 2.
13. Acceptance sampling procedure shall be in accordance with "Base-strain test, miniature, sampling (method 1121), except that data covered in "Acceptance and rejection criteria" shall be modified as follows:
- Accepted if not more than one defective for class "A," "B," or "C" defects, respectively (see method 1121), or if not more than a total of two defectives are found in the sample.
 - Rejected if two or more defectives for class "A," "B," or "C" defects, respectively, or if a total of three or more defectives are found in the sample.

NOTES: -Continued

- 14. A grid resistor of 0.1 megohm shall be added; however, this resistor shall not be used when a thyatron-type short indicator is employed.
- 15. This test shall be conducted on the initial lot and thereafter on a lot approximately every 6 months. When one lot has passed, the 6-month rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes. MIL-STD-105, sample size code letter E, shall apply.
- 16. Life testing.
 - (a) A lot submitted after failure to meet the requirements of any life test shall be subjected to all quality conformance inspection tests, parts 1 and 2, except visual and mechanical, including dimensions, capacitance, vibration, shock, vibration fatigue, base strain, and glass strain tests.
 - (b) Accidental breakage of not more than one tube shall be allowed in the life-test sample for any life test. In the event that one life-test tube is accidentally broken, acceptability of the life-test sample shall be based upon the remaining tubes in the sample provided the broken tube was not known to be defective.

Envelope temperature (TE) requirements, when measured in accordance with the temperature by conduction-band measurement (method 1226), will be satisfied if a tube having bogey Ib (± 5 percent) under normal test conditions, is determined to operate at or above minimum specified temperature at any position in the life-test rack.

The life-test acceptance criteria shall be as follows:

	Sample size	Acceptance number	Prerelease number	AFR	RFR
Single lot (n)	32		0	1.1	
Process qualification (4-lot moving sum) (4n)	128	3	-	1.1	5.2
Tightened inspection	50	1	-	0.7	7.8

The intermittent life test shall be conducted for 1,000 hours under the specified conditions. Acceptance of product under this specification is twofold. First, the production process shall be under control as indicated by compliance with the 4-lot moving sum acceptance procedure. Second, each lot shall meet the acceptance requirements for a single lot. The life-test procedure shall be as follows:

- (a) Select the life-test sample from the lot at random in such a manner as to be representative of the lot. If such selection results in the sample containing tubes which are outside the specified initial limits for the endpoint characteristics, such tubes shall be replaced by acceptable tubes.

NOTES: -Continued

① 19. -Continued

- (b) Process acceptance is established and based upon the sum of failures from a total sample size equivalent to four single lot samples (4n). This total sample may, at the option of the manufacturer, be taken from one production lot or from two to four consecutive lots. If the sample size for a single production lot is greater than n, but less than 4n, the first n tubes of the sample shall be considered the sample for acceptance of this lot and the single lot acceptance number shall apply. If the sample size is 4n, from a given lot, this lot shall be accepted or rejected on the basis of the acceptance numbers for the 4-lot moving sum. Only the results of the first test on each lot shall be considered in establishing and maintaining the process acceptance. Reprocessed sample results shall not be included in the 4-lot moving sum. When first establishing the process acceptance to this specification, the current previously tested, consecutive life tests may be accumulated to establish the sample size required for the 4-lot moving sum (4n). In maintaining the 4n sample size, the first serially numbered tubes in any given sample may be used to maintain the required total number of tubes.
- (c) After process acceptance is established each lot shall be accepted or rejected in accordance with acceptance and prerelease numbers. Prerelease shall be made only on the basis of 4 consecutive lots.
- (d) The loss of process acceptance shall result when the acceptance number for the 4-lot moving sum is exceeded for the current 4 consecutive lots. All life tests, including failed life tests, are to be included in the 4-lot moving sum evaluation except those excluded under the provisions of (i) below. The loss of process acceptance shall also result when a production discontinuity of more than 13 weeks occurs. If the process acceptance is lost, it shall be reestablished as required in (b) above before shipment of product may resume.
- (e) In the event of failure of a single lot sample, the lot may be resubmitted under this specification providing the following condition is met: Reprocess the entire lot and submit a reprocessed life test using the tightened inspection as specified. A lot shall be resubmitted only once for acceptance.
- (f) The current lot may be prereleased at 500 hours if the following criteria are met:
- (1) The number of defectives in the 4-lot moving sum does not exceed the specified acceptance numbers at 1,000 hours.
 - (2) No lot in the last four completed lots has been rejected at 1,000 hours.
 - (3) None of the interim uncompleted lots has been rejected using 1,000 hour limits.
 - (4) The number of defectives in the current lot does not exceed the specified prerelease numbers at 500 hours.
- (g) The life-test sample shall be read at the following times:
- 0 hours
- $500 + \frac{48}{24}$ hours (only when prerelease is desired)
- $1,000 + \frac{48}{24}$ hours

Additional reading periods may be used at the discretion of the manufacturer but no sample shall be discontinued before completion of $1,000 + 48, -24$ hours. Records shall be kept by the manufacturer on all samples representing lots produced to this specification and shall be made available to the Government on request.

NOTES: -Continued

① 19. -Continued

- (h) During the testing period required to establish "process acceptance" individual lots may be shipped provided the single lot sampling plan applied to such lots assures a RFR of 5.2 percent, or less, with a 90 percent consumer confidence. The supplier has the option of selecting any sampling plan from the lot quality (LQ) tables of MIL-STD-105 which provide an LQ of 5.2 percent or less ($P_a = .10$). The sampling plan shall be selected prior to placing samples from the individual lot on test. In the event the lot fails to meet RFR of 5.2 percent but meets the single lot criteria RFR of 12.2 percent, the lot shall not be shipped until testing from subsequent lots assures process acceptance. After the selection of a sample, no further samples shall be drawn from the lot for life testing under this plan.
- (i) The results of inspection of products manufactured or tested under conditions not typical of usual production or test may be excluded from the 4-lot moving sum provided evidence is presented to establish that the product was manufactured or tested under abnormal conditions. Data that merely appear unreasonable or abnormal are not a sufficient basis for exclusion of such data; there shall be a sound technical reason established before exclusion of the data is approved. Records shall be kept on excluded samples and made available to the Government on request. Approval for exclusion of lots from the 4-lot moving sum shall be obtained, in writing, from the procuring activity.
20. The intermittent pulse life-test sample shall consist of 20 tubes and not more than 1 tube failure shall be permitted. In the event of rejection of the first sample due to failure of more than 1 tube, a second sample of 20 tubes shall be selected from the lot. Acceptance shall then be based upon the combined first and second samples. The total tube failures from the combined first and second samples shall not exceed two. A life-test defect is defined as a tube which becomes inoperable or which fails to meet the life-test end-point limits as specified on the tube specification sheet. The intermittent pulse life test shall be read at 0, $2 \pm 1/2$, 20 ± 4 , 100 ± 16 , 500 ± 48 , and $1,000 \pm 48$ hours.
21. The positive portion of the grid pulse shall be a rectangular wave meeting pulse shape requirement of method 1296. The pulse shall be applied to the grid by means of a driving circuit which produces the specified peak pulse voltage directly at the grid terminal with respect to the cathode. Grid resistance not exceeding 50 ohms may be inserted to prevent oscillation, provided readjustment of grid drive is made to maintain the specified pulse amplitude directly at the grid terminal. The pulse width, t_p , shall be $10 \pm 2 \mu s$, and the duty factor, 0.9 percent to 1.1 percent. Self-excited life-test circuitry is permissible, provided any additional anode voltage drops during the time of the pulse are compensated for by increasing Ebb. No fixed Ecl need be applied under self-excited conditions.
22. Operate heaters in parallel.

Custodians:

Army - EL
 Navy - EC
 Air Force - 85

Preparing activity:

Navy - EC

(Project 5960-2211-32)

Review activities:

Army - EL, MU, MI
 Navy - SH
 Air Force - 11, 85
 DSA - ES

User activities:

Army - ME
 Navy - AS, OS, MC, CG
 Air Force - 19

