SYLVANIA engineering data service 5987

MECHANICAL DATA

Bulb	T-3
Base	E8-10, Subminiature Button Flexible Leads
Outline	JETEC 3-4
Basing	8DM
Cathode	Coated Unipotential
Mounting Position	Any

RATINGS[1] (Absolute Maximum)

Impact Acceleration	450 G
Uniform Acceleration	1000 G
Fatigue (Vibrational Acceleration for Extended Periods)	2.5 G
Bulb Temperature	220° C
Altitude[2]	80000 Ft.

ELECTRICAL DATA

HEATER CHARACTERISTICS

	Min.	Bogey	Max.
Heater Voltage[3]	6.0	6.3	6.6 V
Heater Current		450	mA

DIRECT INTERELECTRODE CAPACITANCES

	Shielded[4]	Unshielded
Grid to Plate	3.0	3.2 μμf
Input	3.2	2.8 μμf
Output	4.6	1.5 μμf

RATINGS[1 & 5] (Absolute Maximum)

Plate Voltage	165 Vdc
Peak Plate Forward Voltage	330 v
Plate Current	50 mAdc
Plate Dissipation	4.0 W
Heater-Cathode Voltage	
Heater Positive with Respect to Cathode	200 v
Heater Negative with Respect to Cathode	200 v

CHARACTERISTICS

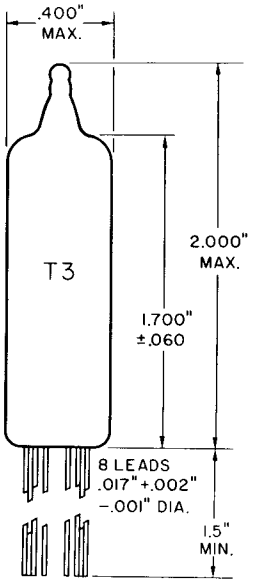
Plate Voltage	100 Vdc
Grid Voltage	−18 Vdc
Plate Current	9.0 mAdc
Transconductance	1850 μmhos
Amplification Factor	4.1

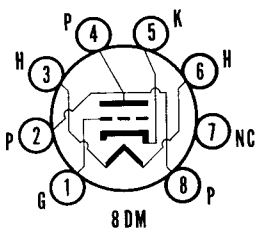
NOTES:

1. *Limitations beyond which normal tube performance and tube life may be impaired.*
2. *If altitude rating is exceeded, reduction of instantaneous voltages (Ef excluded) may be required.*
3. *Tube life and reliability of performance are directly related to the degree of regulation of the heater voltage to its center-rated value of 6.3 volts.*
4. *External shield of 0.405 inch inside diameter connected to cathode.*
5. *Values shown are as registered with RETMA.*

QUICK REFERENCE DATA

The Premium Subminiature Type 5987 is a low-mu, high perveance, power triode designed for use as a control tube in servo circuits. It is intended for operation under conditions of severe shock, vibration, high temperature and high altitude. The Sylvania Type 5987 is manufactured and inspected to meet the applicable specifications for reliable operation.





SYLVANIA ELECTRIC PRODUCTS INC.

RADIO TUBE DIVISION
EMPORIUM, PA.

Prepared and Released By The
TECHNICAL PUBLICATIONS SECTION
EMPORIUM, PENNSYLVANIA

FEBRUARY 1957

ACCEPTANCE CRITERIA

Test Conditions

Heater Voltage	6.3 V	Grid Voltage	
Plate Voltage	100 Vdc	Negative Value	18 Vdc
		Heater-Cathode Voltage MIL-E-1 Par. 3.2.2.1	0 V

For the purposes of inspection, use applicable reliable paragraphs of MIL-E-1 and Inspection Instructions for Electron Tubes.

MIL-E-1 Ref.	Test	Limits Min.	Limits Bogey	Limits Max.	Units
Production Tests					
4.10.8	Heater Current:	420	450	480	mA
4.10.6.1	Grid Current:	0	—	-0.8	μAdc
4.10.4.1	Plate Current:	6.8	9.0	11.2	mAdc
4.10.9	Transconductance (1): Sm	1480	1850	2220	μmhos
Special Design Tests					
4.9.5.3	Subminiature Lead Fatigue:	4	—	—	arcs
4.9.19.2	Vibration: Ep F = 40 cps; G = 15; Rp = 2000 Ohms	—	—	75	mVac
4.10.15	Heater-Cathode Leakage: Ehk = +100 Vdc Ehk = -100 Vdc	 0 0	 — —	 15 15	 μAdc μAdc
4.8	Insulation of Electrodes: Egk = 100 Vdc; Ef = 6.3 V	 100	 —	 —	 Meg
4.10.3.2	AF Noise: Pn Rp = 10,000 Ohms; Esig = 70 mVac	 —	 —	 14	 VU
Design Tests					
4.10.9	Transconductance (2): Sm Ef = 5.7 V	 1300	 —	 —	 μmhos
4.10.11.1	Amplification Factor:	3.6	4.1	4.6	
4.10.14	Capacitance: No Shield Cgp No Shield Cin No Shield Cout	 2.5 2.2 1.2	 3.2 2.8 1.5	 3.9 3.4 1.8	 μμf μμf μμf
Degradation Tests					
4.9.20.5	Shock: Hammer Angle = 30°	 —	 —	 —	
4.9.20.6	Fatigue: Note 1 F = 60 cps; G = 2.5	 —	 —	 —	
- - - -	Post Shock and Fatigue Test End Points: Vibration Heater-Cathode Leakage Transconductance (1) Sm	 — 0 1250	 — — —	 200 40 —	 mVac μAdc μmhos
Acceptance Life Tests					
- - - -	Heater Cycling Life Test: Note 2 Ef = 7.0 V; Eb = Ec = O V	 2500	 —	 —	 Cycles
4.11.5	Intermittent Life Test (1): Note 3 Rg = 0.47 Meg; Eb = 150 Vdc; Ec = O V; Rk = 1100 Ohms; Ehk = 140 Vac; TA = Room	 500	 —	 —	 Hours

ACCEPTANCE CRITERIA (Continued)

MIL-E-1 Ref.	Test	Limits Min.	Bogey	Max.	Units
	Acceptance Life Tests (Continued)				
4.11.4	Intermittent Life Test End Point (1):				
	Transconductance (1) Sm	1250	—	—	μmhos
	Grid Current	0	—	-1.5	μAdc
	Heater-Cathode Leakage	0	—	60	μAdc
	Insulation of Electrodes				
	Rg-all	50	—	—	Meg
	Rp-all	50	—	—	Meg

ACCEPTANCE CRITERIA NOTES:

1: Acceptance sampling procedure shall be in accordance with the shock test sampling procedure of the Inspection Instructions for Electron Tubes.

2: The regulation of the heater voltage supply shall be not more than 3.0 percent. This test shall be made on a lot by lot basis. A cycle consists of operating the heater with the voltage "on" for one minute and "off" for four minutes. A heater-cathode voltage of 140 Vac rms shall be applied. The sample size for the cycling test shall be ten tubes from each lot. In case of failures, it shall be permissible at the manufacturer's discretion to select a second sample of 15 tubes and base the percent of life on both the first and second sample, or 25 tubes. The life of each tube shall be based on the number of heater cycles completed without a defect. The number of cycles completed on any tube shall be determined by adding to the number of cycles at the last satisfactory observation 50% of the cycles between the last satisfactory observation and the observed failure point or 10% of the total number of cycles, whichever is the lesser. A failure or defect shall consist of an open heater, or heater-cathode short. The minimum percent life requirement of a test shall be 95% and shall be calculated as follows:

$$\%\ \text{life at 2500 cycles} = \frac{\text{sum of cycles completed without failures}}{2500 \times \text{number of tubes}} \times 100$$

3: At the conclusion of the 500 hour life test, the average life of the life test sample shall be not less than 475 hours. Life test sample size shall be 10 tubes. Provision for release of tubes prior to completion of life test on a reduced basis as specified in 4.3.1.3 Inspection Instructions for Electron Tubes shall not apply.

APPLICATION DATA

The Premium Subminiature Type 5987 is a high perveance, low mu audio power-triode characterized by long life and stable operation under conditions of severe shock, vibration, high altitude and high temperature.

The 5987 is designed primarily for use as a control tube in servo systems and may be used with alternating voltage supplies. In this application, precautions should be taken to insure against poor tube and circuit reliability. In addition to causing forward currents which may be in excess of the cathode capabilities, abnormal positive plate voltage results in an appreciable increase in secondary emission. Likewise, presence of the negative half cycle encourages primary emission by the plate. Investigations have shown that the control grid is the collector for back emitted electrons. Consequently, a negative voltage, dependent upon the back emission current magnitude and value of grid circuit resistance, will be developed on the grid and may be of a value sufficient to influence circuit performance.

The effects of back emission can be minimized by (1) employing a low value grid resistor, (2) inserting series diodes, such as the Sylvania 5641, in the plate circuits. This makes it nearly impossible for current to flow in the reverse direction. (3) Operate the tubes conservatively with respect to supply voltage, peak currents, element dissipation and bulb temperature. Back emission approximates an exponential curve with increasing plate voltage swing and plate dissipation. For further discussion the reader is referred to the general section of this manual or "Effects of AC Plate Voltages on Tube Performance", Sylvania Engineering Information Service, Vol. 1, No. 10, May 1954.

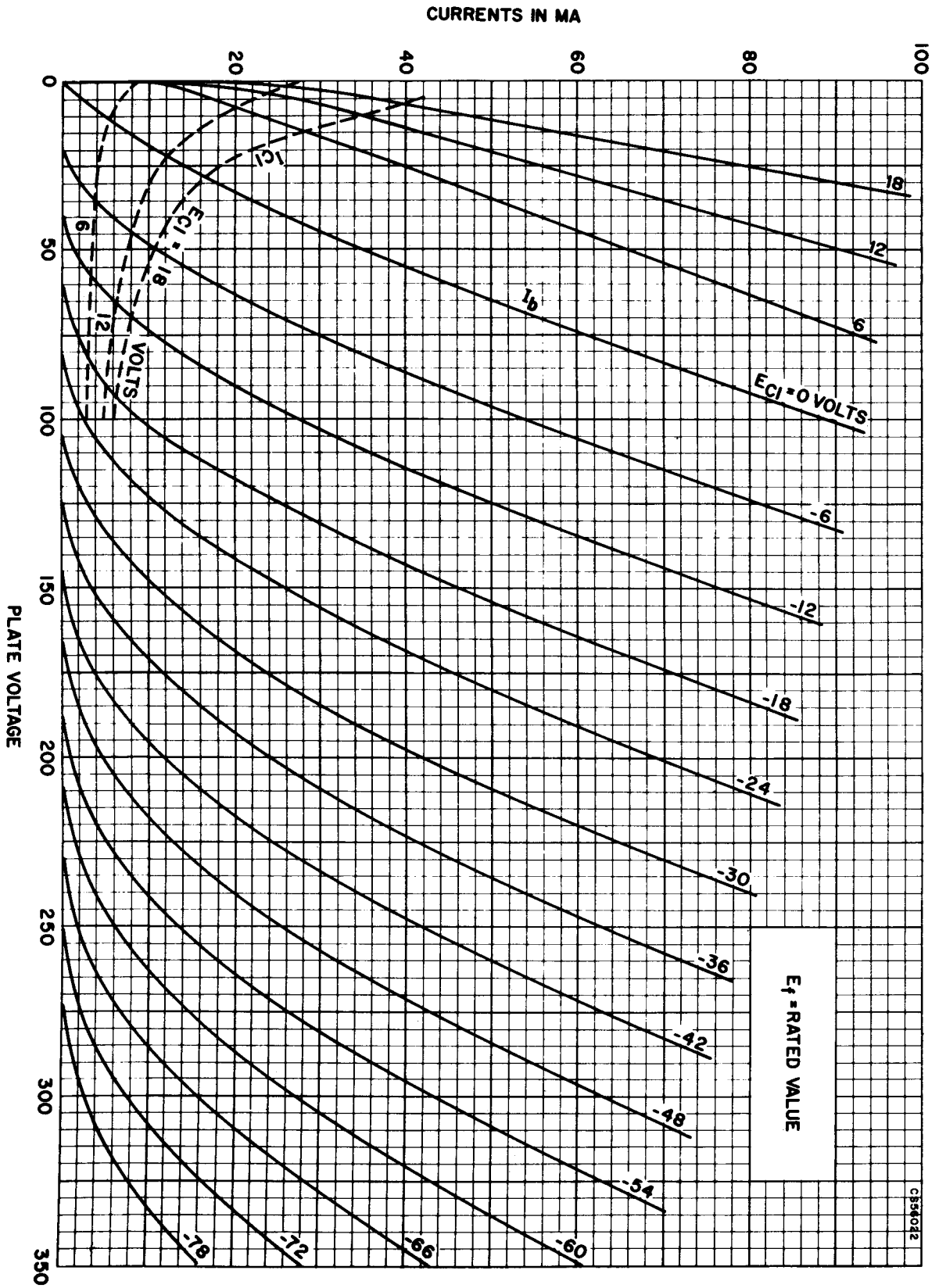
To insure correlation with actual field conditions and thereby enhance equipment reliability, vibrational noise output is controlled by the "white noise test" as shown in the acceptance criteria. Briefly, this test consists of subjecting the tube to a white noise vibration spectrum covering the frequency band of 100 to 5000 cps at a rms level of 2.3 g's per octave. Limits are shown for both peak and rms output. A further discussion of the white noise vibrational test is included in the frontal section of this manual.

Life expectancy is described by the life tests, specified on the attached pages and/or individual MIL-E-1 specifications. The actual life expectancy of the tube in an operating circuit is affected by both the operating and environmental conditions involved. Likewise, the life tests specified indicate performance under certain operating criteria to a set of specified end points. Performance at conditions other than those specified can usually be estimated only roughly as giving better or poorer life expectancy. For further discussion of life expectancy, reference should be made to the frontal section of this manual.

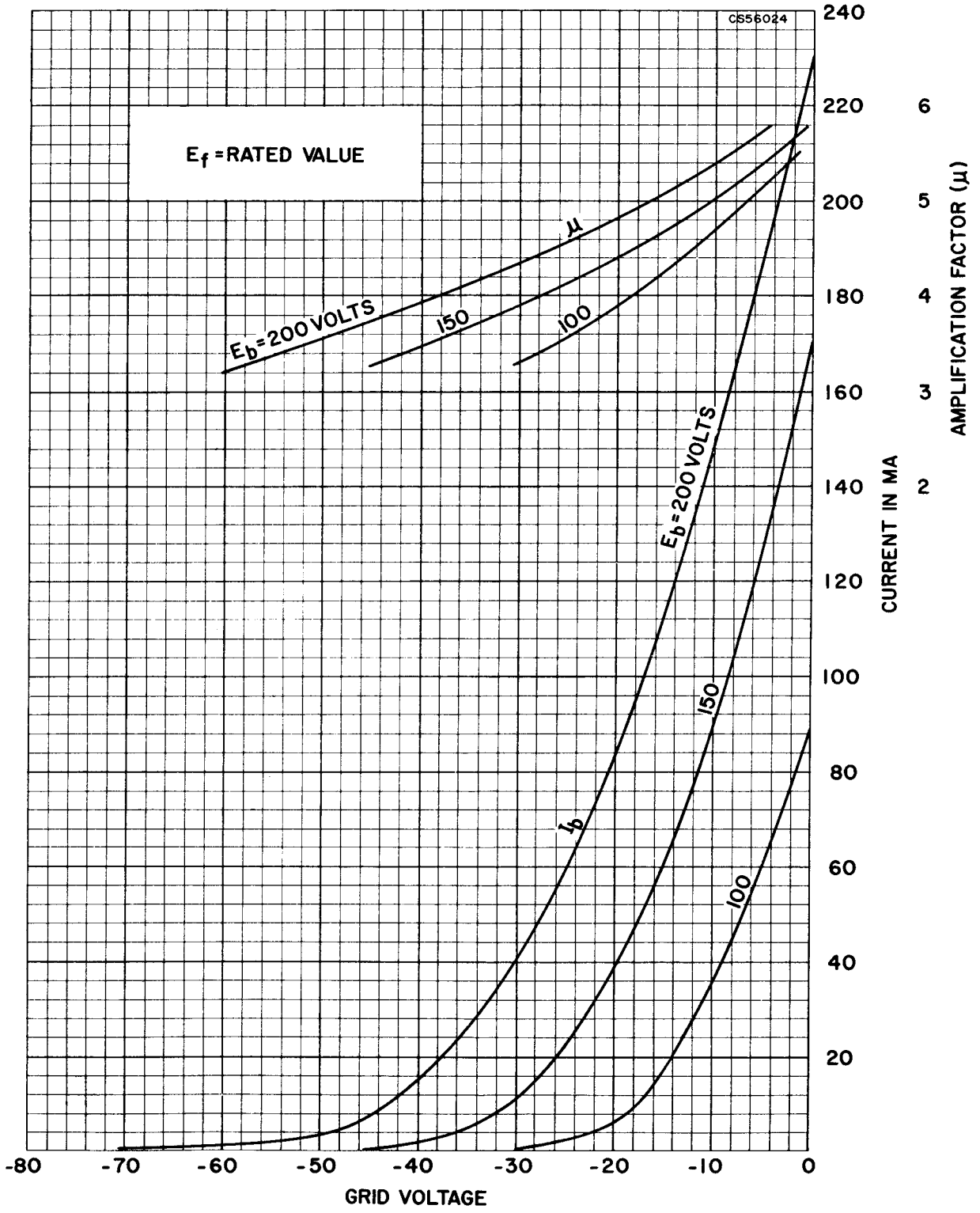
To insure optimum performance in pulse applications this type is subjected to a pulse emission test as shown in the accompanying data. The tube must, under the specified pulse operating conditions, deliver a minimum specified current. A further discussion of this test is included in the general section of this manual.

When operated under conditions common to on-off control applications the tube exhibits freedom from the development of interface resistance. The heater-cathode construction is designed to withstand intermittent operation.

AVERAGE PLATE CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS



AVERAGE TRANSFER CHARACTERISTICS