engineering data for CBS®

BULLETIN T-1015

MEDUIM MU TRIODE-SHARP CUTOFF PENTODE

7731

CBS Type 7731 is a miniature medium-mu triode and sharp-cutoff pentode which is especially designed and tested for use in measurement test equipment, instrumentation, and other applications where extreme reliability, stable characteristics, and long life are required. The 7731 is a replacement for type 6U8 and superior performance is assured because of its improved construction, special tests, and tight minimum-maximum limits.

This electron tube has a continuous-wound coil heater which is superior to ordinary heaters both electrically and mechanically. Burn-outs are virtually eliminated, heater-cathode leakage is lower, and hum is lower. Further insurance of quality is provided by heater cycle testing.

Stable characteristics throughout life is a result of meticulous processing and selection of cathode sleeve material. Also each tube is subjected to a 48 hour burn-in period to obtain a more uniform level of performance when they are put into operational service.

An elaborate testing procedure is carried out on these tubes for confidence in their ultimate operation. There is a 100-hour early life assurance test, a special 1000-hour life test, and a 5000-hour informational life test.

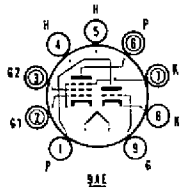
Additional mechanical features offered by CBS type 7731 include: gold plated base pins which prevent oxidation and improve base pin contact; precisely made and fitted parts in stronger structures for lower noise and microphonism; and electrical features include: life tested transconductance, low heater voltage transconductance test, and grid current test.

MECHANICAL DATA

Cathode, coated unipotential	
Bulb	T-6 1/2
Outline	JETEC 6-2
Base	Miniature 9-pin (E9-1)
Basing	9AE
Mounting position	Any

PIN CONNECTIONS

Pin 1: Triode Plate
Pin 2: Pentode Grid 1
Pin 3: Pentode Grid 2
Pin 4: Heater
Pin 5: Heater
Pin 6: Pentode Plate
Pin 7: Pentode Cathode, Grid 3, I.S.
Pin 8: Triode Cathode
Pin 9: Triode Grid



ELECTRICAL DATA

HEATER CHARACTERISTICS

Voltage, a-c or d-c	6.3±10%	volts
Current	450	ma
Peak heater-cathode voltage, max		
Heater negative to cathode	200	volts
Heater positive to cathode*	200	volts

*D-c component must not exceed 100 volts

DIRECT INTERELECTRODE CAPACITANCES

Triode Section

	No Shield	Shield♦	
Grid to plate: g1 to p	1.8	1.8	uuf
Input: g1 to k+h	2.5	2.5	uuf
Output: p to k+h	0.4	1.0	uuf
Heater to cathode: h to k	3.0	3.0	uuf

Pentode Section

Grid to plate: g1 to p, max	0.01	0.006	uuf
Input: g1 to k+h+g2+g3	5.0	5.0	uuf
Output: p to k+h+g2+g3	2.6	3.5	uuf
Heater to cathode: h to k	3.0	3.0	uuf

MAXIMUM RATINGS (Design maximum values)

	Triode	Pentode	
Plate voltage	330	330	volts
Grid 2 voltage, pentode		Rating Chart	
Grid 2 supply voltage		330	volts
Grid 1 voltage, positive d-c	0	0	volts
Plate dissipation	3.0	3.0	watts
Grid 2 dissipation		0.6	watts
Bulb Temperature	165		° C

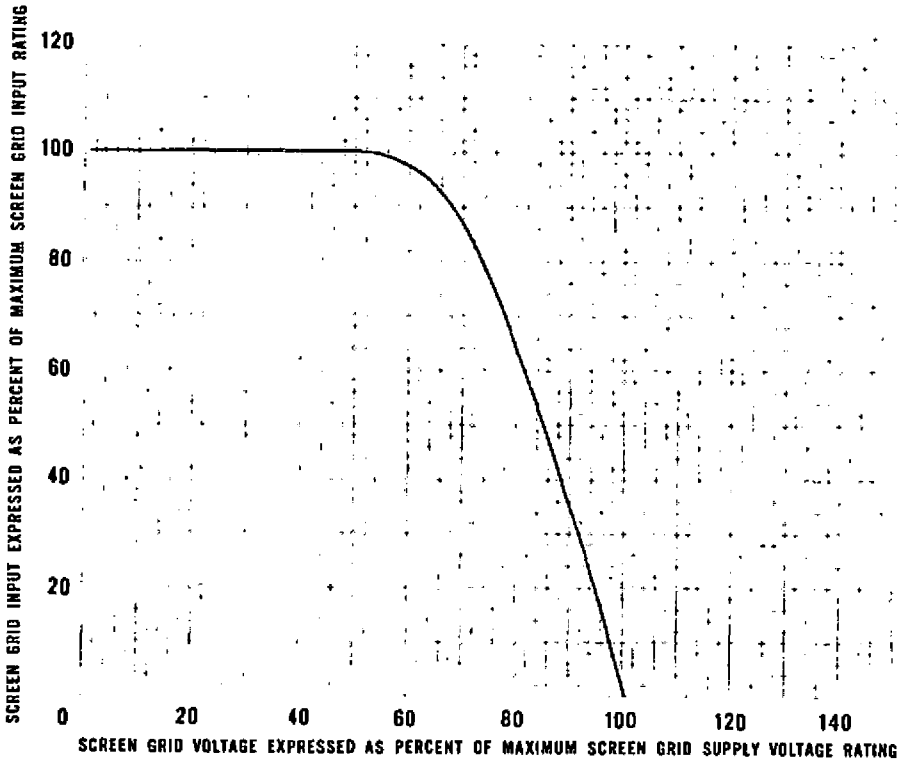
CHARACTERISTICS AND TYPICAL OPERATION

	Triode	Pentode	
Plate voltage	150	250	volts
Grid 2 (screen) voltage		110	volts
Cathode bias resistor	56	68	ohms
Plate resistance (approx.)	5000	400000	ohms
Transconductance	8500	5200	umhos
Amplification factor	40		
Plate current	18	10	ma
Grid 2 current		3.5	ma
Grid 1 voltage (approx.) for Ib = 10ua	-12	-10	volts

♦ JETEC shield 315 connected to cathode.

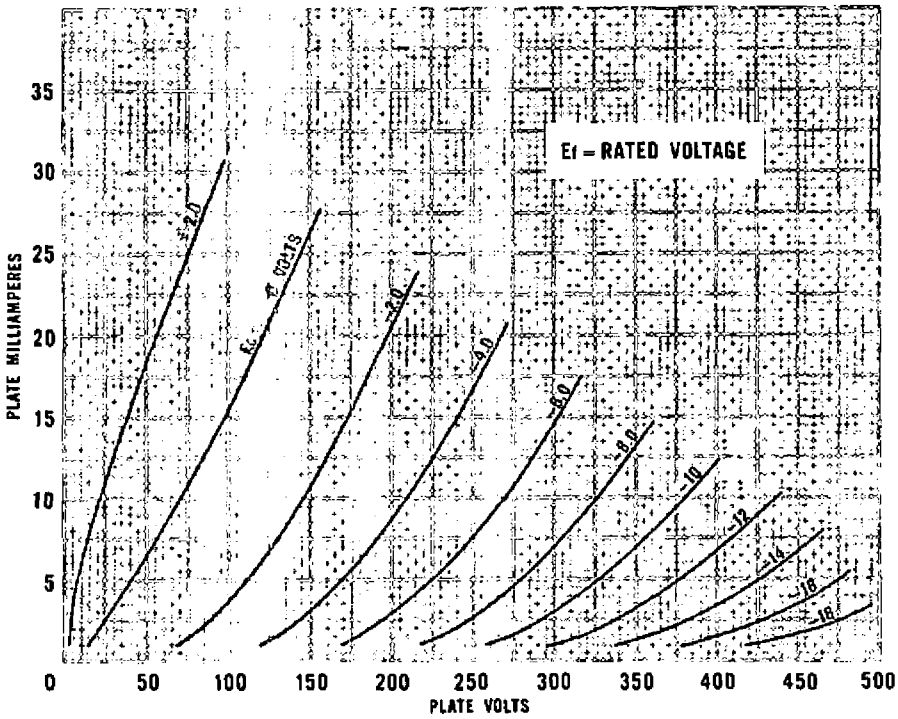
from JEDEC release #2870, July 4, 1960

SCREEN GRID RATING



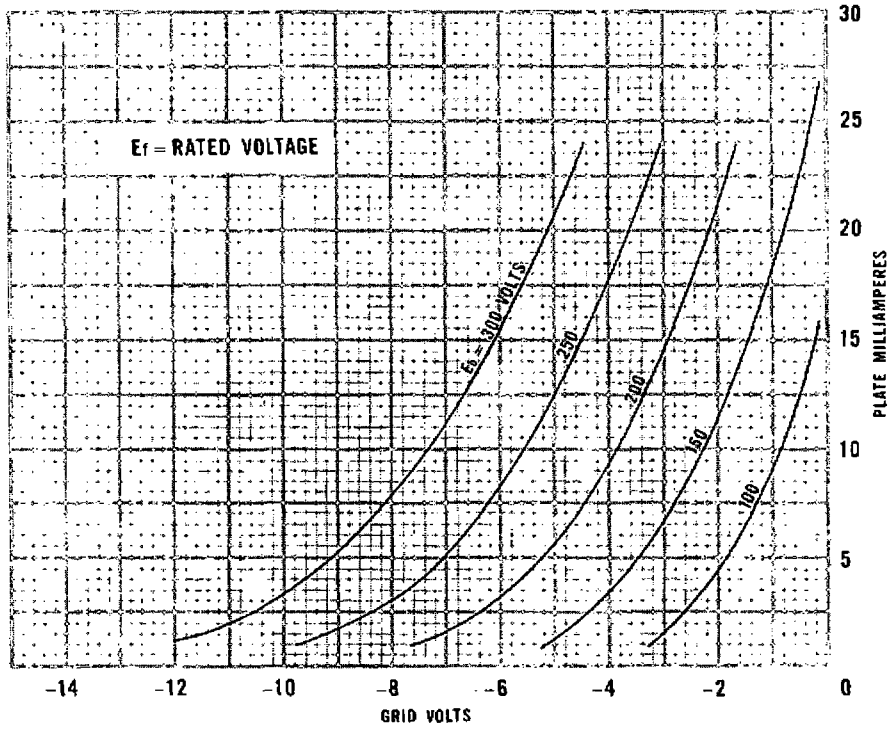
AVERAGE PLATE CHARACTERISTICS

TRIODE SECTION



AVERAGE TRANSFER CHARACTERISTICS

TRIODE SECTION



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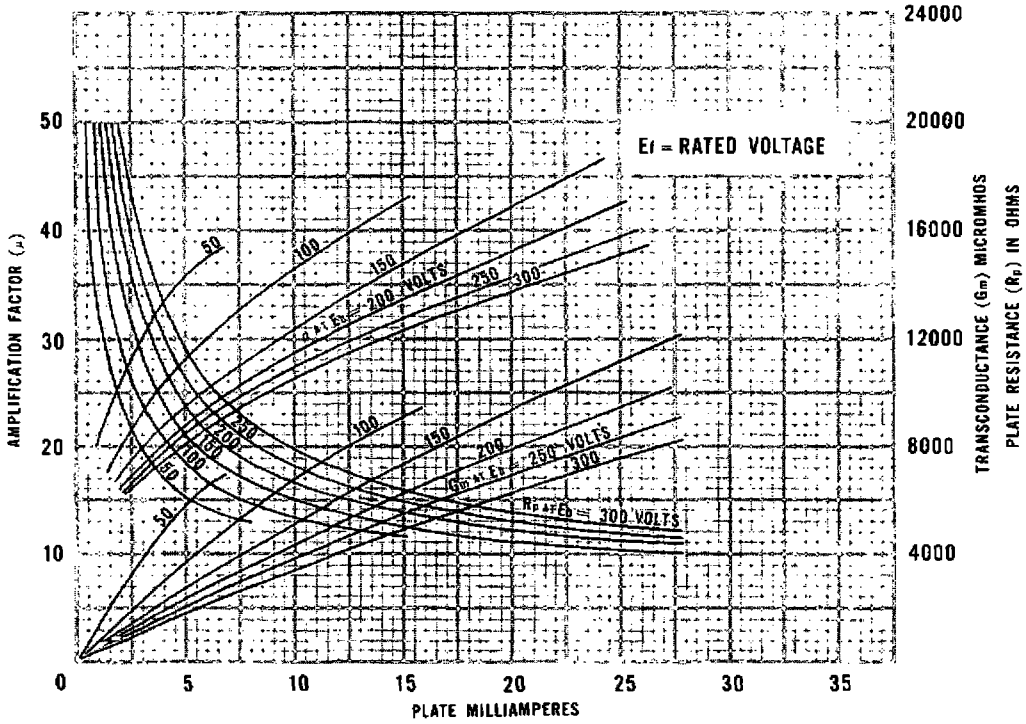
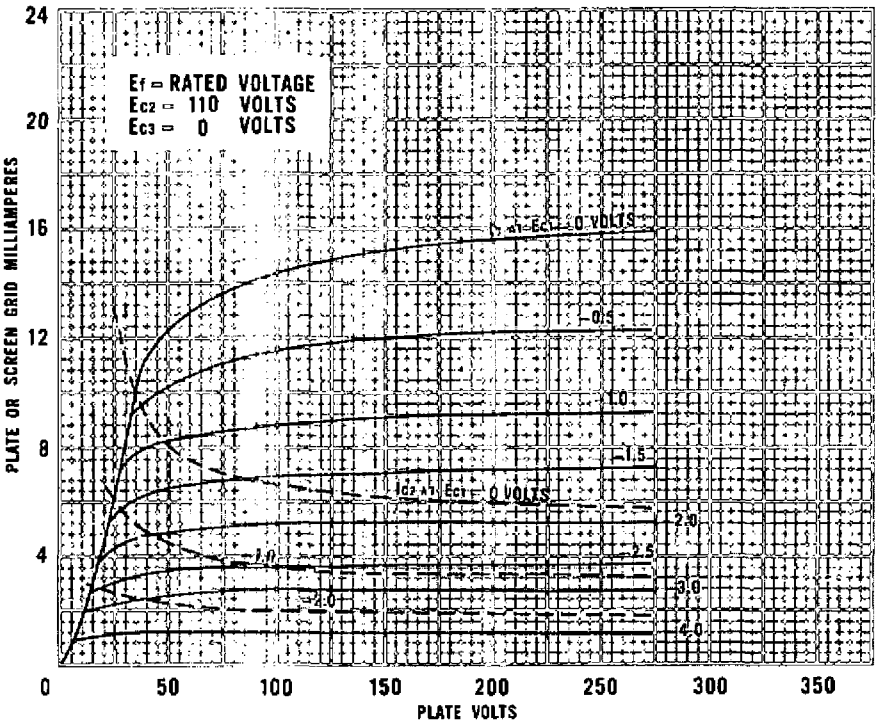
TRIODE SECTION



AVERAGE PLATE CHARACTERISTICS

PENTODE SECTION



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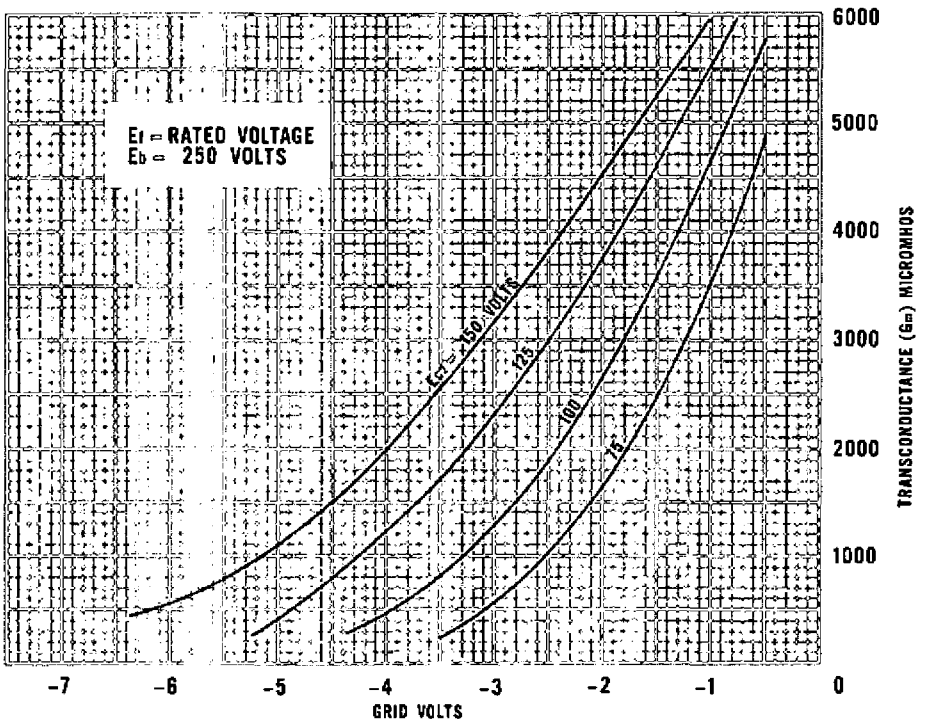

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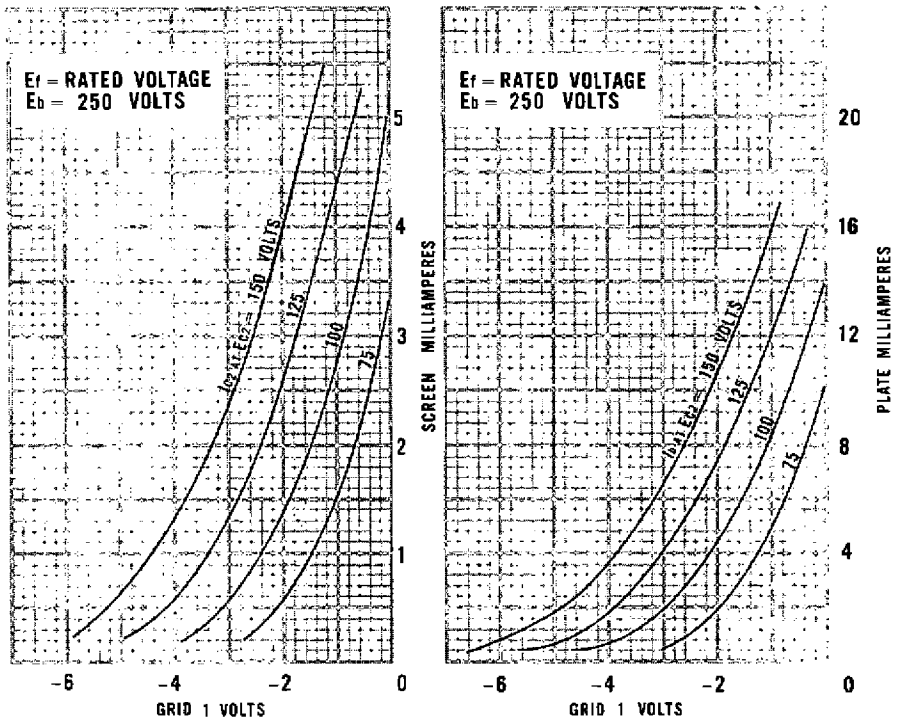
PENTODE SECTION



CUSTOMER ACCEPTANCE SPECIFICATION

Test Conditions

Eh=6.3V; Ebt=150Vdc; Ec1t=0Vdc
Rkt=56ohms; Ebp=250Vdc; Ec1p=0Vdc
Ec2p=110Vdc; Rkp=68ohms; Ehk=±200Vdc

Reference Note 2	AQL Note 1	Test [redacted]	Conditions	Sym.	Min.	Max.	Unit
4.7.5	0.4	Continuity & Shorts		---	---	---	---
4.10.8	2.5*	Heater Current		Ih	425	475	mA
4.10.4.1	1.0	Plate Current Pent.		Ibp	6.0	13.0	mAdc
4.10.4.3	2.5 [redacted]	Screen Current Pent.		Ic2p	2.0	5.0	mAdc
4.10.6.1	1.0	Grid Current Pent.	Ec1 = 0.5V	Ic1p	---	-0.7	uAdc
4.10.9	2.5 [redacted]	Transconductance Pent.	Note 3	Smp	4000	6400	umho
4.10.4.1	1.0	Plate Current CO Pent.	Ec1= -13Vdc, Rk=0	I2bp	---	50	uAdc
4.10.15	1.0	H-K Leakage Pent.	Ehk = ±200 Vdc	Ihkp	---	10	uAdc
4.10.14	2.5*	Capacitance Pent.		Cgpp	---	.02	uuf
				Cout p	1.4	3.8	uuf
				Cin p	4.0	6.0	uuf
4.10.4.1	1.0	Plate Current Triode		Ibt	12	25.0	mAdc
4.10.6.1	1.0	Grid Current Triode	Ec1 = -.5V	Ic1t	---	0.7	uAdc
4.10.9	2.5	Transconductance Triode	Note 3	Smt	6000	11000	umho
4.10.4.1	1.0	Plate Current CO Triode	Ec1= -15Vdc, Rk = 0	Ibt(2)	---	50	uAdc
4.10.15	1.0	Heater Cathode Leakage Triode	Ehk = ± 200 Vdc	Ihkt	---	10	uAdc
4.10.9	2.5*	Transconductance Pent.	Ef=5.7V, Note 3	ΔSmp	---	15	%
4.10.9	2.5*	Transconductance Triode	Ef=5.7V, Note 3	ΔSmt	---	15	%
4.10.6.1	2.5*	Grid Current (2) Pentode	Ef=7.0V, Rg1=100K Note 6	Icp(2)	---	1.0	uAdc
4.10.6.1	2.5*	Grid Current (2) Triode	Ef=7.0, Rg1=.5 meg Note 6	Ict(2)	---	1.0	uAdc
4.8	2.5*	Insulation of Electrodes Triode	E(g-all)= -100Vdc	R(g_1-all)	100	---	meg
			E(p-all)= -100Vdc	R(p-all)	100	---	meg
4.8	2.5*	Insulation of Electrodes Pentode	E(g_1-all)= -100Vdc	R(g_1-all)	100	---	meg
			E(p-all)= -100Vdc	R(p-all)	100	---	meg
4.10.14	2.5*	Capacitances Triode	Without Shield	Cgp	1.5	2.1	uuf
				Cin	1.5	3.5	uuf
				Cout	0.2	0.8	uuf

Reference	AQL	Test	Conditions	Sym.	Min.	Max.	Unit
4.10.3.1	2.5	RF Noise	Note 7	RFN	---	---	---
4.10.3.4	2.5	Noise and Microphonics Pentode	Eb=Ecc2=110Vdc, Rb=10K Rk=0, Ecc1= -2Vdc Ecal=30mV. Rg1=50K Note 9	M	---	---	---
		Noise & Microphonics Triode	Ebb=150Vdc, Rb=10K Rk=0, Ecc1= -1.0Vdc Rg1=50K, Ecal=30mV Note 9	M			
LIFE TESTS							
---	1.0 Code K	Early Life Assurance Test	Ef=6.3V, Ebp=250Vdc Ec2=110Vdc, Ebt=150Vdc Rg/t=100K, Rg/p=100K Rkp=68Ω, Rkt=56Ω, Ehkt= -200Vdc, Ehkp= -200Vdc Note 4	---	---	---	---
---	---	Early Life Assurance Test End Points	Shorts & Continuity	---	---	---	---
			Change in Transconductance (pentode) of Individual tubes	$\Delta \frac{Smp}{t}$		10	%
			Change in Transconductance (triode) of Individual tubes	$\Delta \frac{Smt}{t}$		10	%
4.11.5	---	Intermittent Life Test End Points 1000 Hours	Early Life Assurance Conditions Note 5				
4.11.4	---	Intermittent Life Test End Points 1000 Hours	Inoperatives	---	---	---	---
			Change in Transconductance (pentode) of Individual Tubes	$\Delta \frac{Smt}{t}$		20	%
			Change in Transconductance (triode) of Individual Tubes	$\Delta \frac{Smt}{t}$		20	%
			Grid Current Pent.	Ic(1)p	---	-1.0	uAdc
			Grid Current Triode	Ic(1)t	---	-1.0	uAdc
			Heater Cathode Leakage Pentode	Ihk	---	20	uAdc
			Insulation Resistance Triode	R	50	---	meg
			Insulation Resistance Pentode	R	50	---	meg
4.11.7	1.0	Heater Cycling Life Test	Ef=7.0V, Ehk_p= -200Vdc Ehk_t= -200Vdc, Cycle 1.0 min. on 4.0 min. off	---	---	48	hours
4.11.4	---	Heater Cycling Life Test End Points	Inoperatives	---	---	---	---
			Heater Cathode Leakage Pentode	Ihk_p	---	15	uAdc
			Heater Cathode Leakage Triode	Ihk_t	---	15	uAdc

TEST NOTES

Note 1: Lots of CBS Electronics tubes may be sampled using MIL-STD-105A sampling tables for the specified AQL. All characteristics, having similar AQL's shall be combined for sampling purposes with the exception of control test. Control test is indicated by an asterisk (*). The term AQL, as used on the specification, is defined in MIL-STD-105A, paragraph 4.1.

Note 2: References are paragraphs in MIL-E-1D specification, dated 31 March 1958.

Note 3: The cathode resistor shall be shunted with capacitive reactance not exceeding three (3) ohms 60 cycles.

Note 4: Early Life Assurance Test

a. Life test samples shall be selected from a lot at random in such a manner as to be representative of the lot. If such selection results in a sample containing tubes which are outside the initial specification limits for the relevant life test endpoint characteristics, such tubes shall be replaced by randomly selected acceptable tubes.

b. Serially mark all tubes of the sample.

c. Record reference characteristic measurements on the entire sample after a maximum operation of 15 minutes under specified voltage and current conditions.

d. The Early Life Assurance Test sample shall be operated at specified conditions or equivalent for 100 hours (± 4 hours) with the intermediate down period reading point at 20 hours (± 4 hours) and 2 hours (± 30 minutes). Intermittent or continuous operation may be employed.

e. A defective shall be defined as a tube having failed the shorts and continuity test or a tube having a change in referenced characteristic greater than that specified.

Note 5: 1000 Hour Intermittent Life Test

a. The sample size shall be 10 tubes and shall be selected from the first 10 lowest number tubes which have successfully passed the Early Life Assurance Test and meet the initial test endpoint characteristic.

b. Record the reference characteristic.

c. Place the sample on life test with the specified operating conditions for 1000 hours with the intermediate down period reading points at 250 ± 24 hours, 500 ± 24 hours and 750 ± 24 hours. The 100 hours of Early Life Assurance Test shall be part of the 1000 hours.

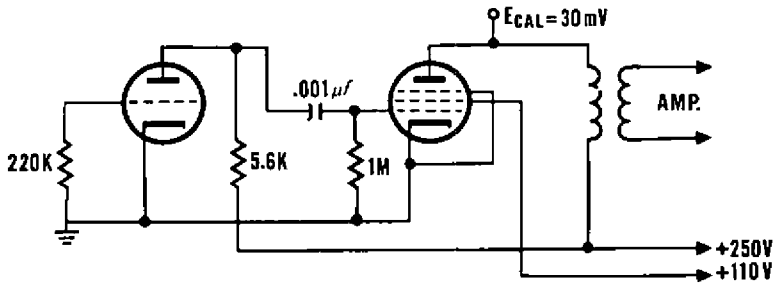
d. Acceptance criteria - The sample is acceptable if it has earned a total of 9000 tube hours. The total number of tube hours is the sum of the successful operating hours of each tube.

e. Quarterly, the life test sample shall be continued to 5000 hours with interim reading points at each 1000 hours. This test will be run to determine long life capabilities.

Note 6: Prior to this test, tubes to be preheated five (5) minutes at conditions indicated below. Test immediately after preheating.

	Eh V	Ec1 Vdc	Rk ohms	Rg1	Eb Vdc	Ec2 Vdc
Pentode:	7.0	0	68	100K	250	110
Triode:	7.0	0	56	.5 meg	150	---

Note 7:



Note 8: Test each section separately.

Note 9: The rejection level shall be set at the VU meter reading obtained during calibration.

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