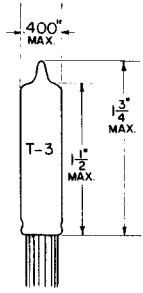
TUNG-SOL

PENTODE

SUBMINIATURE TYPE

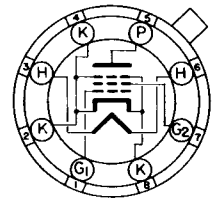


GLASS BULB

HEATER

AC OR DC

ANY MOUNTING POSITION



BOTTOM VIEW

SUBMINIATURE BUTTON
0.017" TINNED FLEXIBLE LEADS
8 PIN BASE

8DL

THE 5902 IS A HEATER-CATHODE TYPE BEAM PENTODE OF SUBMINIATURE CONSTRUCTION SUITABLE FOR SERVICE WHERE SEVERE CONDITIONS OF MECHANICAL SHOCK OR VIBRATION ARE ENCOUNTERED. IT IS DESIGNED FOR AUDIO POWER AMPLIFIER SERVICE IN EQUIPMENTS WITH LOW PLATE SUPPLY VOLTAGES, AND IS CAPABLE OF APPROXIMATELY ONE WATT OUTPUT IN THE AUDIO RANGE. THE FLEXIBLE LEADS MAY BE SOLDERED OR WELDED DIRECTLY TO THE TERMINALS OF CIRCUIT COMPONENTS WITHOUT THE USE OF SOCKETS. STANDARD SUBMINIATURE SOCKETS MAY BE USED BY CUTTING THE LEADS TO A SUITABLE LENGTH.

RATINGS

MECHANICAL

MAXIMUM IMPACT ACCELERATION (SHOCK TEST-NOTE 3)	450	G
MAXIMUM UNIFORM ACCELERATION (CENTRIFUGE TEST-NOTE 4)	1000	G
MAXIMUM VIBRATIONAL ACCELERATION (96 HR. FATIGUE TEST-NOTE 5)	2.5	G
MAXIMUM BULB TEMPERATURE	220	°C

RATINGS

AND NORMAL OPERATION

	MIL-E-1 SYMBOL	ABS. MIN.	NORM. TEST CONDITIONS NOTE 7	NORMAL OPERATION NOTE 6	ABS. MAX.	MIL-E-1 UNITS
HEATER VOLTAGE (NOTE 8)	Ef:	6.0	6.3	6.3	6.6	VOLTS
PLATE VOLTAGE	Eb:	---	110	110	165	Vdc
GRID #1 VOLTAGE	Ec1:	-55	0	0	0	Vdc
GRID #2 VOLTAGE	Ec2:	---	110	110	155	Vdc
PLATE DISSIPATION	Pp:	---	---	3.3	4.1	W
GRID #2 DISSIPATION	Pg2:	---	---	0.24	0.3	W
GRID #1 CIRCUIT RESISTANCE	Rg1:	---	---	---	0.55	MEG.
HEATER-CATHODE VOLTAGE	Ehk:	-200	---	---	+200	VOLTS
CATHODE CURRENT	Ik:	---	---	---	50	mAdc
CATHODE RESISTANCE	Rk:	---	270	270	---	OHMS
PLATE CURRENT (1):	Ib(1):	---	---	30	---	mAdc
GRID #2 CURRENT	Ic2:	---	---	2.2	---	mAdc
TRANSCONDUCTANCE (1)	Sm(1):	---	---	4200	---	μMHOS
PLATE RESISTANCE	rp:	---	---	0.015	---	MEG.

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1]

TEST	AQL %	MIL-E-1 SYMBOL	MIN	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 1	COMBINED AQL=1.0% EXCLUDING MECH. AND INOPERATIVES								
HEATER CURRENT:	0.65	If:	420	432	450	468	480	36	mA
HEATER-CATHODE LEAKAGE: Ehk=-100 Vdc									
Ehk=+100 Vdc	0.65	Ihk:	---	---	---	---	15	---	μAdc
GRID CURRENT:									
Rg1=1.0 MEG.	0.65	Ic(1):	---	---	---	---	-1.0	---	μAdc
PLATE CURRENT (1):	0.65	Ib(1):	23.0	27.0	30.0	33.0	37.0	8.0	mAdc
PLATE CURRENT (2):									
Ec1=-40 Vdc	0.65	Ib(2):	---	---	---	---	100	---	μAdc
POWER OUTPUT (1):									
Esig=6.4 Vac;									
Rp=3000 OHMS	0.65	Po(1):	0.75	---	---	---	---	---	W
CONTINUITY AND SHORTS: (INOPERATIVES):	0.4	---	---	---	---	---	---	---	---
MECHANICAL:									
ENVELOPE (8-4)	---	---	---	---	---	---	---	---	---
MEASUREMENTS ACCEPTANCE TESTS PART 2									
INSULATION OF ELECTRODES:									
Ef=6.3 V									
Eg1-all=-100 Vdc	2.5	Rg1-all:	50	---	---	---	---	---	MEG.
Ep-all=-300 Vdc	2.5	Rp-all:	50	---	---	---	---	---	MEG.
SCREEN CURRENT:	2.5	Ic2:	0	---	2.2	---	4.0	---	mAdc
TRANSCONDUCTANCE (1):	2.5	Sm(1):	3500	3850	4200	4550	4900	950	μMHOS
GRID EMISSION:									
Rg=0.47meg; Rk=220 OHMS; Ef=7.5 V; PREHEAT 5 MINUTES AT Ec1=0; TEST AT Ec1=-40 Vdc	2.5	Ic(2):	---	---	---	---	-2.0	---	μAdc
POWER OUTPUT (2):									
Ef=5.7 V; Esig=6.4 Vac;									
Rp=3000 OHMS.(NOTE 9)	2.5	Δ_{Ef} Po (2):	---	---	---	---	15	---	PERCENT
AF NOISE:									
Esig=150 mVac; Ec2= 110 Vdc; Ec1=-8.7 Vdc; Rg1=0.5 meg.; Rg2= 0.01 meg.; Rp=2000 OHMS;									
Rk=0; Cg2 =4 μf	2.5	EB:	---	---	---	---	17	---	VU
PLATE RESISTANCE:	6.5	rp:	0.01	---	---	---	---	---	MEG.
CAPACITANCE:		Cgp:	---	---	---	---	0.20	---	μμf
CAPACITANCE: (NOTE 2)	6.5	Cin:	5.5	---	6.5	---	7.5	---	μμf
CAPACITANCE:		Cout:	6.5	---	7.5	---	8.5	---	μμf
LOW PRESSURE VOLTAGE BREAKDOWN:									
PRESSURE =55±5 mm Hg; VOLTAGE = 300 Vac	6.5	---	---	---	---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	AQL %	MIL-E-1 SYMBOL	MIN.	LAL	BOG	UAL	MAX	ALD	MIL-E-1 UNITS
MEASUREMENTS ACCEPTANCE TESTS PART 2 cont'd.									
COMBINED AQL =1.0% EXCLUDING MECH. AND INOPERATIVES									
VIBRATION (1) NO VOLTAGES: f VARIABLE FROM 10-50 cps; G max = 10; FIXED AMPLITUDE 0.040 INCH: POST SHOCK AND FATIGUE TEST END POINTS APPLY	---	---	---	---	---	---	---	---	---
VIBRATION (2): F =40cps; G=15; Rp= 2000 OHMS	2.5	Ep:	---	---	---	---	100	---	mVac
DEGRADATION RATE ACCEPTANCE TESTS									
SUBMINIATURE LEAK FATIGUE:	2.5	---	4.0	---	---	---	---	---	arcs
SHOCK: Ehk=+100 Vdc; Rg=0.1 MEG.; HAMMER ANGLE= 30° (NOTE 3)	20	---	---	---	---	---	---	---	---
FATIGUE: 96 HOURS; G= 2.5; FIXED FREQUENCY; F =25 min., 60 max. (NOTE 5)	6.5	---	---	---	---	---	---	---	---
POST SHOCK AND FATIGUE TEST END POINTS: VIBRATION (2): F = 40 cps; G =15; Rp= 2000 OHMS	---	Ep:	---	---	---	---	300	---	mVac
HEATER-CATHODE LEAKAGE: Ehk=-100 Vdc Ehk =± 100 Vdc	---	Ihk:	---	---	---	---	20	---	PERCENT
CHANGE IN POWER OUTPUT (1) OF INDIVIDUAL TUBES:	---	Δ_tPo(1):	---	---	---	---	40	---	μAdc
GLASS STRAIN (THERMAL SHOCK):	6.5	---	---	---	---	---	---	---	---
ACCEPTANCE LIFE TESTS									
HEATER CYCLING LIFE TEST: Ef =7.0 V; Eb=Ec1=Ec2= 0 V; 1 MIN ON, 4 MIN. OFF; Ehk = 140 Vac	2.5	---	2000	---	---	---	---	---	CYCLES
HEATER CYCLING LIFE TEST END POINTS: HEATER-CATHODE LEAKAGE: Ehk=-100 Vdc Ehk =±100 Vdc	---	Ihk:	---	---	---	---	40	---	μAdc

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] - cont'd.

TEST	ALLOWABLE DEFECTS PER CHARACTERISTIC 1st SAMPLE	ALLOWABLE DEFECTS PER CHARACTERISTIC COMBINED SAMPLES	AQL %	MIL-E-1 SYMBOL	MIN.	MAX	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS							
1 HOUR STABILITY LIFE TEST: TA = ROOM; Eb=Ec2= 100 Vdc; Ehk=+200 Vdc; 220 OHMS			---	---	---	---	---
1 HOUR STABILITY LIFE TEST END POINTS: CHANGE IN POWER OUTPUT (1) OF INDIVIDUAL TUBES: (TYPICAL SAMPLES SIZE = 50 TUBES)			1.0	Δ_t Po(1):	---	10	PERCENT
100 HOUR SURVIVAL RATE LIFE TEST: TA= ROOM; Eb=Ec2= 100 Vdc;Ehk=+200 Vdc; Rg= 0.47 MEG. Rk =220 OHMS			---	---	---	---	---
100 HOUR SURVIVAL RATE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE = 200 TUBES)			---	---	---	---	---
INOPERATIVES:			0.65	---	---	---	---
POWER OUTPUT (1):			1.0	Po(1):	0.65	---	W
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST: T BULB =220° C; Eb =Ec2 = 100 Vdc; Ehk =+200 Vdc; Rg =0.47 MEG.; Rk = 220 OHMS			---	---	---	---	---
500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST END POINTS: (TYPICAL SAMPLE SIZE= 20 TUBES 1st SAMPLE; 40 TUBES 2nd SAMPLE)			---	---	---	---	---
INOPERATIVES:	1	3	---	---	---	---	---
HEATER CURRENT:	2	5	---	If:	414	492	mA
HEATER-CATHODE LEAKAGE: Ehk=-100 Vdc; Ehk=±100 Vdc	2	5	---	Ihk:	---	60	μAdc
GRID CURRENT (1):	1	3	---	Ic(1)±	---	-2.0	μAdc
POWER OUTPUT (1) CHANGE OF INDIVIDUAL TUBES FROM INITIAL:	1	3	---	Δ_tPo(1):	---	20	PERCENT
POWER OUTPUT (1) AVERAGE CHANGE:	---	---	---	Ave.Δ_tPo(1):	---	15	PERCENT
INSULATION OF ELECTRODES:							
g-all	2	5	---	Rg1-all:	25	---	MEG.
p-all			---	Rp-all:	25	---	MEG.
POWER OUTPUT (2) (NOTE 9)	2	5	---	Δ_{Ef} Po(2):	---	15	PERCENT
TOTAL DEFECTIVES:	4	8	---	---	---	---	---

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CHARACTERISTICS AND QUALITY CONTROL TESTS[1] cont'd.

TEST	ALLOWABLE DEF. PER CHARACTERISTIC 1st SAMPLE	ALLOWABLE DEF. PER CHARACTERISTIC COMBINED SAMPLES	AQL %	MIL-E-1 SYMBOL	MIN.	MAX.	MIL-E-1 UNITS
ACCEPTANCE LIFE TESTS - cont'd.							
1000 HOUR HIGH TEMPERATURE INFORMATION LIFE TEST: T BULB=220°C; Eb= Ec2=100 Vdc; Ehk=+ 200 Vdc; Rg=0.47 MEG ; Rk =220 OHMS	---	---	---	---	---	---	---
1000 HOUR HIGH TEMPERATURE INFORMATION LIFE TEST END POINTS: READ FOR SAME CHARACTERISTICS AS FOR 500 HOUR INTERMITTENT HIGH TEMPERATURE LIFE TEST. LIMITS NOT ESTABLISHED.	---	---	---	---	---	---	---

NOTE 1: CHARACTERISTICS, QUALITY CONTROL TEST PROCEDURES, AND INSPECTION LEVELS ARE MADE ACCORDING TO THE APPROPRIATE PARAGRAPHS OF MIL-E-1 "INSPECTION INSTRUCTIONS FOR ELECTRON TUBES," AND MIL-STD-105A.

NOTE 2: WITH A CYLINDRICAL SHIELD (0.405"I.D.-1 7/8" LONG) CONNECTED TO CATHODE LEADS.

NOTE 3: TEST CONDITIONS AND ACCEPTANCE CRITERIA PER SHOCK TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

NOTE 4: CENTRIFUGE TEST WITH FORCES APPLIED IN ANY DIRECTION.

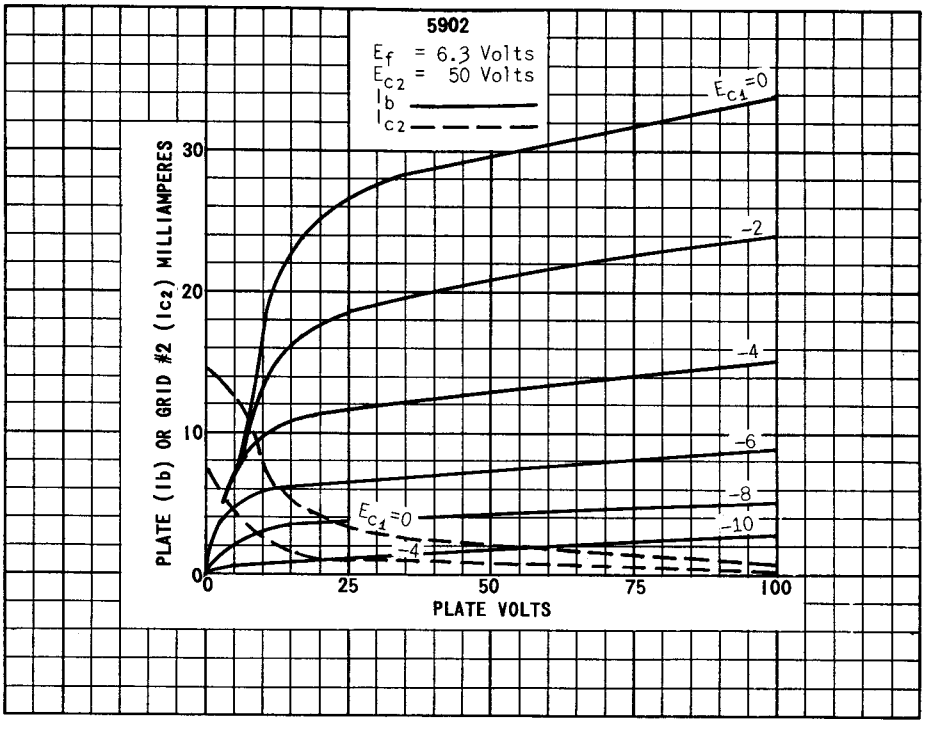
NOTE 5: TEST CONDITIONS AND ACCEPTANCE CRITERIA PER FATIGUE TEST PROCEDURES OF MIL-E-1 BASIC SPECIFICATIONS.

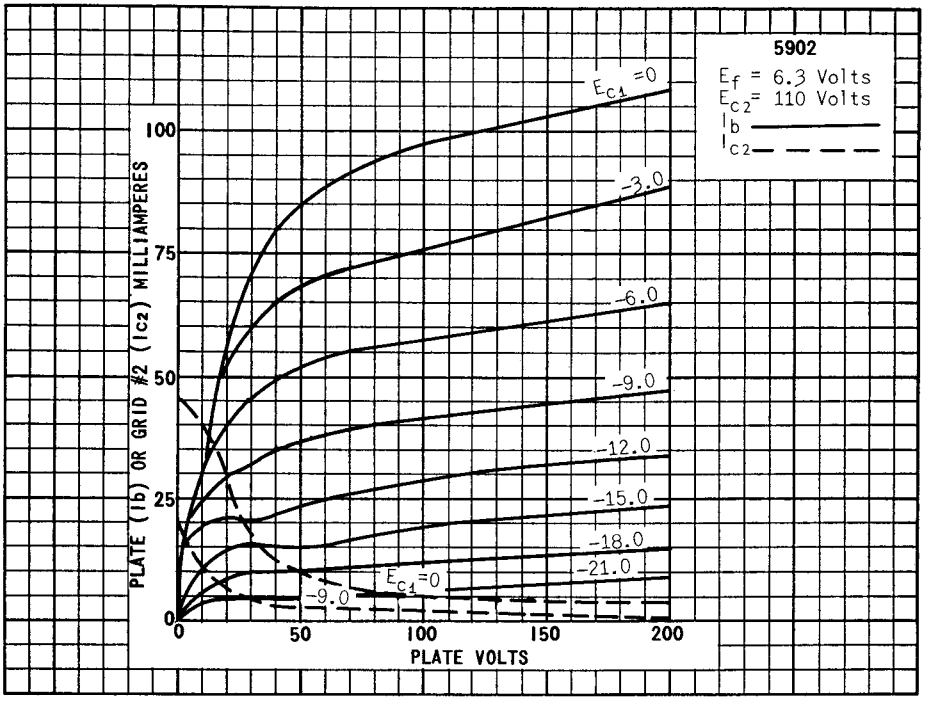
NOTE 6: THESE NORMAL VALUES REPRESENT CONDITIONS AT WHICH CONTROL OF RELIABILITY MAY BE EXPECTED.

NOTE 7: THESE NORMAL TEST CONDITIONS ARE USED FOR ALL CHARACTERISTIC TESTS UNLESS OTHERWISE STATED UNDER THE INDIVIDUAL TEST ITEM.

NOTE 8 FOR MOST APPLICATIONS THE PERFORMANCE WILL NOT BE ADVERSELY AFFECTED BY ±5% HEATER VOLTAGE VARIATION, BUT WHEN THE APPLICATION CAN PROVIDE A CLOSER CONTROL OF HEATER VOLTAGE, AN IMPROVEMENT IN RELIABILITY WILL BE REALIZED.

NOTE 9: CHANGE OF POWER OUTPUT FOR INDIVIDUAL TUBES FROM THAT VALUE MEASURED AT Ef= 6.3 V TO THAT VALUE MEASURED AT Ef=5.7V.


5902
E_f = 6.3 Volts
E_{c2} = 50 Volts
I_b
I_{c2}
E_{c1}=0
-2
-4
-6
-8
-10
E_{c1}=0
-4
PLATE (I_b) OR GRID #2 (I_{c2}) MILLIAMPERES
0
10
20
30
0
25
50
75
100
PLATE VOLTS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E_f = 6.3 Volts
E_{c2} = 110 Volts
I_b
I_{c2}
E_{c1}=0
-3.0
-6.0
-9.0
-12.0
-15.0
-18.0
-21.0
E_{c1}=0
-9.0
PLATE (I_b) OR GRID #2 (I_{c2}) MILLIAMPERES
0
25
50
75
100
0
50
100
150
200
PLATE VOLTS