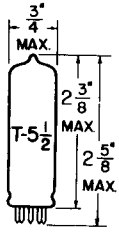
TUNG-SOL

FULL-WAVE RECTIFIER

MINIATURE TYPE



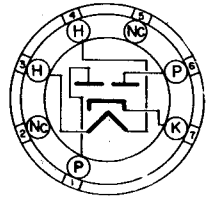
GLASS BULB
5-3

COATED UNIPOTENTIAL CATHODE

HEATER

6.3 VOLTS 0.60 AMP.

ANY MOUNTING POSITION



BOTTOM VIEW
MINIATURE BUTTON
7 PIN BASE
5BS

THE 6X4WA IS A FULL-WAVE RECTIFIER INTENDED FOR COMMERCIAL AND INDUSTRIAL APPLICATIONS WHERE A HIGH DEGREE OF RELIABILITY IS REQUIRED. IT IS CHARACTERIZED BY LONG LIFE AND STABLE PERFORMANCE UNDER CONDITIONS OF SEVERE VIBRATION, SHOCK, HIGH TEMPERATURE AND HIGH ALTITUDE.

DURABILITY CHARACTERISTICS

IMPACT ACCELERATION (1 MSEC DURATION) (MAX.)	450	G
FATIGUE (VIBRATIONAL ACCELERATION FOR EXTENDED PERIODS)(MAX.)	2.5	G

RATINGS[A]

ABSOLUTE MAXIMUM

HEATER VOLTAGE[B]	6.3±10%	VOLTS
AC PLATE SUPPLY VOLTAGE, RMS (EACH PLATE)	SEE RATING CHART 1	
STEADY STATE PEAK PLATE CURRENT, RATING CHART 2 (EACH PLATE)	220	MA.
TRANSIENT PEAK PLATE CURRENT, RATING CHART 3 (EACH PLATE)[D]	1.6	AMP.
DC OUTPUT CURRENT (EACH PLATE)	SEE RATING CHART 1	
HEATER-CATHODE VOLTAGE:		
HEATER NEGATIVE WITH RESPECT TO CATHODE TOTAL DC AND PEAK	450	VOLTS
HEATER POSITIVE WITH RESPECT TO CATHODE TOTAL DC AND PEAK	100	VOLTS
BULB TEMPERATURE	165	°C
ALTITUDE[C]	SEE RATING CHART 4	

CHARACTERISTICS[E]

FULL-WAVE RECTIFIER-CAPACITOR INPUT

AC PLATE SUPPLY VOLTAGE PER PLATE	400	VAC
FILTER INPUT CAPACITOR	8	μf
LOAD RESISTOR	8200	OHMS
DC OUTPUT CURRENT	55	MADC
DC OUTPUT VOLTAGE AT FILTER INPUT (APPROX.)	435	VDC
TUBE VOLTAGE DROP[E] I_b = 50 MA EACH PLATE	22	VOLTS

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NOTES

[A] LIMITATIONS BEYOND WHICH NORMAL TUBE PERFORMANCE AND TUBE LIFE MAY BE IMPAIRED.

[B] IF ALTITUDE RATING IS EXCEEDED, REDUCTION OF INSTANTANEOUS VOLTAGES (Ef EXCLUDED) MAY BE REQUIRED.

[C] TUBE LIFE AND RELIABILITY OF PERFORMANCE ARE DIRECTLY RELATED TO THE DEGREE OF REGULATION OF THE HEATER VOLTAGE TO ITS CENTER-RATED VALUE.

[D] IF CAPACITOR INPUT CIRCUITS ARE TO BE USED, PROTECT THE CIRCUITS AGAINST THE POSSIBILITY OF HOT-SWITCHING AND DO NOT EXCEED A MAXIMUM PEAK CURRENT VALUE OF 1.6 AMPERE DURING THE INITIAL CYCLES OF THE HOT-SWITCHING TRANSIENT.

[E] TEST CONDITIONS ONLY.

INTERPRETATION OF RATING CHARTS

RATING CHARTS 1, 2 AND 3 REPRESENT BOUNDARY CONDITIONS BEYOND WHICH OPERATION IS NOT PERMITTED. WITH THE AID OF SIMPLE LABORATORY MEASUREMENTS AND THE USE OF THE THREE CHARTS, ANY APPLICATION MAY BE ANALYZED FOR PROPER RECTIFIER TYPE OPERATION.

THE BOUNDARIES OF RATING CHART 1 ARE BASED ON LIMITS OF SUPPLY VOLTAGE, PLATE DISSIPATION AND OUTPUT CURRENT. THESE BOUNDARIES DIFFER, DEPENDING UPON THE TYPE OF FILTER USED. WITH CAPACITOR INPUT, OPERATION IS CONFINED TO THE AREA BOUNDED BY FAEDG WHILE FOR CHOKE INPUT, THE ENTIRE AREA BOUNDED BY FABCG MAY BE USED.

THE BOUNDARY OF RATING CHART 2 DEFINES THE LIMIT OF STEADY-STATE PEAK CURRENT. OPERATION WITHIN THE BOUNDARY IS PERMITTED.

RATING CHART 3 DEFINES THE MINIMUM VALUE OF EFFECTIVE PLATE SUPPLY RESISTANCE, PER PLATE, FOR ANY GIVEN PLATE VOLTAGE SUPPLY WHICH WILL ASSURE THAT THE SURGE CURRENTS ARE WITHIN A SAFE VALUE.

$$Rs = N^2Rpri + Rsec + Ra$$

WHERE: N - VOLTAGE STEP UP RATIO OF PLATE TRANSFORMER:

$$N = \frac{N\ Secondary}{N\ Primary} \quad \text{for half-wave}$$

$$N = \frac{N\ Secondary}{2N\ Primary} \quad \text{for full-wave}$$

Rpri - DC RESISTANCE OF TRANSFORMER PRIMARY.

Rsec - AVERAGE DC RESISTANCE OF TRANSFORMER SECONDARY PER SECTION.

Ra - ADDED SERIES RESISTANCE.

FOR ANY APPLICATION, EACH CHART SHOULD BE CONSULTED. ON ALL CHARTS THE POINTS OF OPERATION SHOULD FALL WITHIN THE PROPER BOUNDARIES.

PLATE SUPPLY VOLTAGES ARE MEASURED WITH THE RECTIFIER TUBE NON-CONDUCTING, I.E., WITH THE TRANSFORMER UNLOADED. THIS UNLOADED VOLTAGE IS USED WITH CALCULATING RECTIFICATION EFFICIENCY.

THE RECTIFICATION EFFICIENCY IS DEFINED AS:

$$\frac{\text{DC OUTPUT VOLTAGE}}{\text{(UNLOADED RMS SUPPLY VOLTAGE PER PLATE)}}$$

THE DC OUTPUT VOLTAGE IS MEASURED AT THE INPUT TO THE FILTER

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ACCEPTANCE CRITERIA

TEST CONDITIONS:

HEATER VOLTAGE	6.3	VOLTS
PLATE SUPPLY VOLTAGE PER PLATE	400	VAC
LOAD RESISTANCE	8200	OHMS
LOAD CAPACITANCE	8	μf

FOR THE PURPOSE OF INSPECTION, USE APPLICABLE RELIABLE PARAGRAPHS OF MIL-E-1 AND INSPECTION INSTRUCTIONS FOR ELECTRON TUBES.

MEASUREMENTS ACCEPTANCE TESTS:	MIL-E-1 REF.	AQL %	LIMITS MIN.	LIMITS BOG.	LIMITS MAX.	UNITS
HEATER CURRENT:	4.10.8	1.0	540	600	660	MA.
HEATER-CATHODE LEAKAGE:						
Ehk=-450 Vdc	4.10.15	0.65	---	---	75	μAdc
OPERATION: NOTE 5 Io						
Ehk=Eo+ 117 Vac	4.10.13	0.65	51	55	---	mAdc
EMISSION (1): NOTE 2, Is						
Eb = 50 Vdc	4.10.1.1	1.0	100	---	---	mAdc
CONTINUITY AND SHORTS:						
NOTE 7	----	0.4	---	---	---	
MECHANICAL: ENVELOPE (6-5)	4.9.1	---	---	---	---	
INSULATION OF ELECTRODES:	4.8	2.5	---	---	---	
NOTE 2 Ep-all=-500 Vdc,						
Rp-all		---	100	---	---	MEG.
EMISSION (2): Is						
Ef =5.5 V; Eb=50 Vdc	4.10.1.1	2.5	90	---	---	mAdc
LOW PRESSURE VOLTAGE BREAKDOWN:						
PRESSURE =140±5 mm Hg;						
VOLTAGE = 980 Vac	4.9.12.1	6.5	---	---	---	
VIBRATION (1):						
NO VOLTAGES; F=40 cps; g=10	4.9.19.1	6.5	---	---	---	
DEGRADATION RATE ACCEPTANCE TESTS - NOTE 3						
SHOCK:						
HAMMER ANGLE =30° (450 G,						
1 msec DURATION); Epp/p=						
0 V; Ef = 6.3 V	4.9.20.5	20	---	---	---	
FATIGUE:						
G= 2.5; FIXED FREQUENCY;						
F = 25 cps min.; 60 max.	4.9.20.6	6.5	96	---	---	HOURS
POST SHOCK AND FATIGUE TEST						
END POINTS:						
HEATER-CATHODE LEAKAGE,						
Ehk=-450 Vdc	----	---	---	---	150	μAdc
OPERATION, Io; NOTE 5		---	48	---	---	mAdc
GLASS STRAIN	----	---	---	---	---	

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ACCEPTANCE CRITERIA

ACCEPTANCE LIFE TESTS. NOTE 3	MIL-E-1 REF.	AQL %	ALLOWABLE DEF. PER CHARACT. 1st SAMP.	ALLOWABLE DEF. PER CHARACT. COMB. SAMP.	LIMITS MIN.	LIMITS MAX.	UNITS
HEATER CYCLING LIFE TEST (2000 CYCLES MIN.) Ef =7.5V; 1 min. on, 1 min. off; Ehk=+100 Vdc; Epp/p = O V	4.11.7	---	---	---	---	---	
HEATER CYCLING LIFE TEST END POINTS							
HEATER-CATHODE LEAKAGE, Ehk =-450 Vdc	4.11.4	---	---	---	---	150	μAdc
SURVIVAL RATE LIFE TEST: NOTES 6 & 8							
Ef = 6.3 V; Epp/p=400 Vac; RL = 8200 OHMS; EL =8 μf; TA = Room	4.11.3.1	---	---	---	100	---	HOURS
SURVIVAL RATE LIFE TEST END POINTS:	4.11.4						
INOPERATIVE (NOTE 1)		0.65	---	---	---	---	
EMISSION (1):		1.0	---	---	51	---	mAdc
INTERMITTENT LIFE TEST: NOTES 4 & 6							
SURVIVAL RATE LIFE TEST CONDITIONS: T ENVELOPE =+165°C min.; 1000 HOUR REQUIREMENTS DO NOT APPLY	4.11.3.1	---	---	---	500	---	HOURS
INTERMITTENT LIFE TEST END POINTS: (500 HOURS)	4.11.4						
INOPERATIVE (NOTE 1)		---	1	3	---	---	
OPERATION - CHANGE OF INDIVIDUALS Δ Io		---	1	3	---	8.5	PERCENT
HEATER CURRENT		---	1	3	540	670	mA
HEATER-CATHODE LEAKAGE		---	1	3	---	---	
Ehk =-450 Vdc		---	---	---	---	90	μAdc
TOTAL DEFECTIVES		---	2	5	---	---	

ACCEPTANCE CRITERIA NOTES

1. AN INOPERATIVE IS DEFINED AS A TUBE HAVING ONE OR MORE OF THE FOLLOWING DEFECTS: DISCONTINUITY OR SHORT (REF. NOTE 7 EXCEPT TUBES SHALL NOT BE TAPPED:) AIR LEAKS (REF. MIL E-1, PAR. 4.7.6).

2. TEST EACH SECTION SEPARATELY.

3. TUBES SUBJECTED TO THE FOLLOWING DESTRUCTIVE TESTS ARE NOT TO BE ACCEPTED UNDER THIS SPECIFICATION.

4.9.20.5	SHOCK
4.9.20.6	FATIGUE
4.11.7	HEATER CYCLING LIFE TEST
4.11.3.1	INTERMITTENT LIFE TEST

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ACCEPTANCE CRITERIA NOTES – cont'd.

4. ENVELOPE TEMPERATURE IS DEFINED AS THE HIGHEST TEMPERATURE INDICATED WHEN USING A THERMOCOUPLE OF #40 BS OR SMALLER DIAMETER ELEMENTS WELDED TO A RING OF 0.025 INCH DIAMETER PHOSPHOR BRONZE PLACED IN CONTACT WITH THE ENVELOPE. ENVELOPE TEMPERATURE REQUIREMENT WILL BE SATISFIED IF A TUBE, HAVING BOGEY Ib (±5%) UNDER NORMAL TEST CONDITIONS, IS DETERMINED TO OPERATE AT MAXIMUM SPECIFIED TEMPERATURE AT ANY POSITION ON THE LIFE TEST RACK.

5. IN A FULL-WAVE CIRCUIT, ADJUST Zp/p SO THAT A BOGEY TUBE GIVES Io = 55 mAdc. A BOGEY TUBE HAS A TUBE DROP Etd = 22 Vdc AT Is = 50 mAdc PER PLATE.

6. IN A FULL-WAVE TEST CIRCUIT, THE VALUES SPECIFIED FOR RL & CL MAY BE CONSIDERED APPROXIMATE AND SHALL BE ADJUSTED INITIALLY TO GIVE NOT LESS THAN Io =55 mAdc AND Ib =200 MA PER PLATE WITH A BOGEY TUBE. Ehk=Eo +117 Vac.

7. ALL TUBES SHALL BE TESTED FOR CONTINUITY OF ALL CIRCUITS, INCLUDING DUPLICATE PIN CONNECTIONS TO THE SAME ELECTRODE; FOR SHORTS BETWEEN ANY OF THE TUBE ELEMENTS OR BETWEEN THE ELEMENTS AND THE NO-CONNECTION BASE PINS; AND FOR AIR LEAKS.

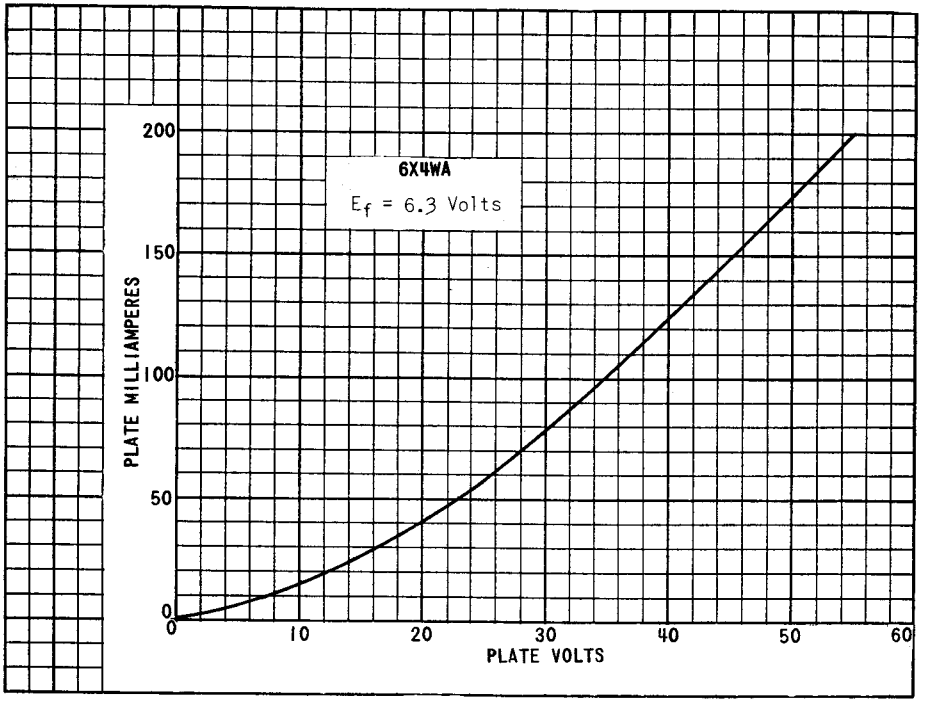
   TESTS FOR SHORTS SHALL BE PERFORMED USING AN AUTOMATIC TAPPER DESIGNED AND ADJUSTED TO DELIVER AN IMPULSE OF APPROXIMATELY ONE-HALF SINE WAVE OF 300±50 μSEC DURATION (MEASURED 10% FROM THE BASE OF THE TUBE UNDER TEST) AND HAVING A PEAK ACCELERATION OF 85 G'S AS MEASURED WITH A GULTON A-305 ACCELEROMETER AND KA-1 KIT. THE SHORTS DETECTING EQUIPMENT SHALL BE A DC DEVICE CAPABLE OF DETECTING AS SHORTS INTERELEMENT RESISTANCES WHICH PERSIST FOR A PERIOD OF TIME IN EXCESS OF THAT DETERMINED BY A CURVE OF RESISTANCE VERSUS TIME DURATION PASSING THROUGH THE FOLLOWING POINTS: 600,000 OHMS – CONSTANT VALUE (PERMANENT SHORT); 500,000 OHMS – 500 μsec; 100,000 OHMS – 100 μsec; AND 1,000 OHMS – 60 μsec.

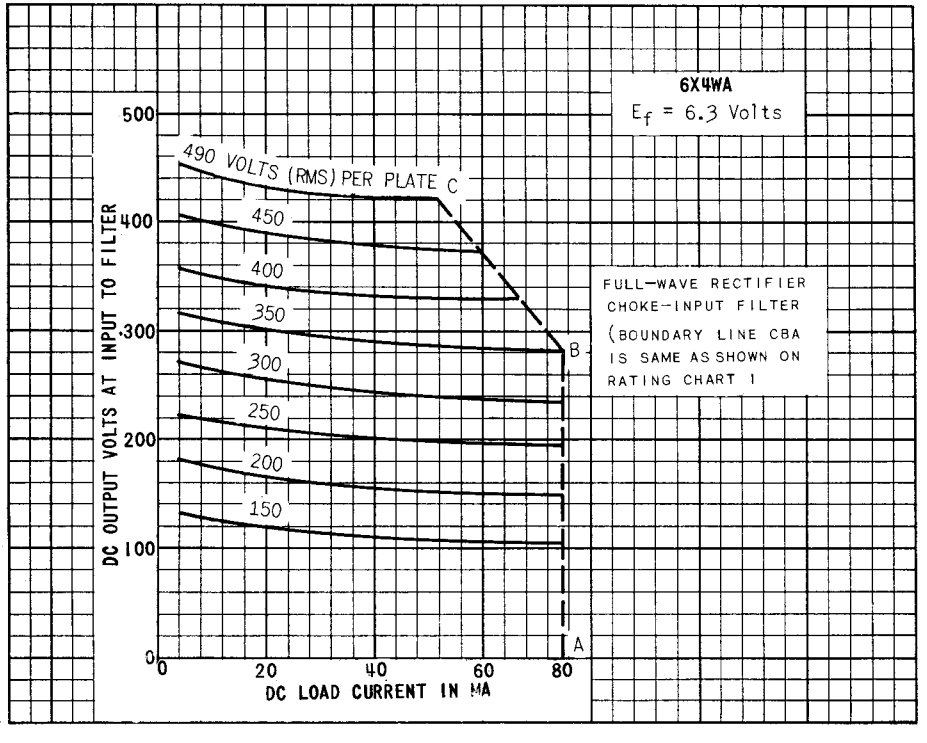
   THE TUBE UNDER TEST SHALL BE CONNECTED TO THE SHORTS TEST EQUIPMENT WITH ELEMENTS IN SEQUENCE FOR SINGLE SECTION TUBES BUT LIKE ELEMENTS IN THE SECTIONS OF A MULTISECTION TUBE MAY BE PARALLELED, PROVIDING THE MECHANICAL ASSEMBLY OF THE TUBE STRUCTURE IS SUCH THAT THE POSSIBILITY OF A SHORT DUE TO SECTION CROSS JUMPERS IS REMOTE.

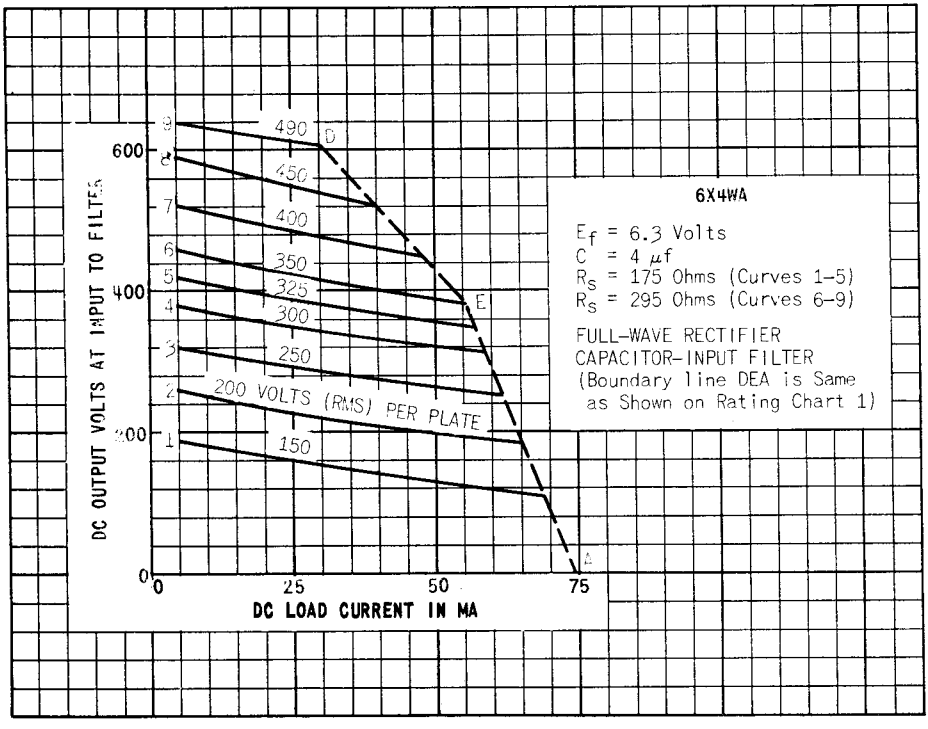
   TUBES HAVING PERMANENT SHORTS, OPENS AND AIR LEAKS SHALL BE REJECTED ON THE FIRST TEST. IF REJECTED FOR TAP-SHORT OR OPEN OCCURS ON FIRST SERIES OF TAPS REPEAT TAPPING CYCLE THREE TIMES. REJECT TUBE AS INOPERABLE IF REJECT OCCURS AT ANY TIME DURING THE THREE REPEAT TEST, OTHERWISE ACCEPT.

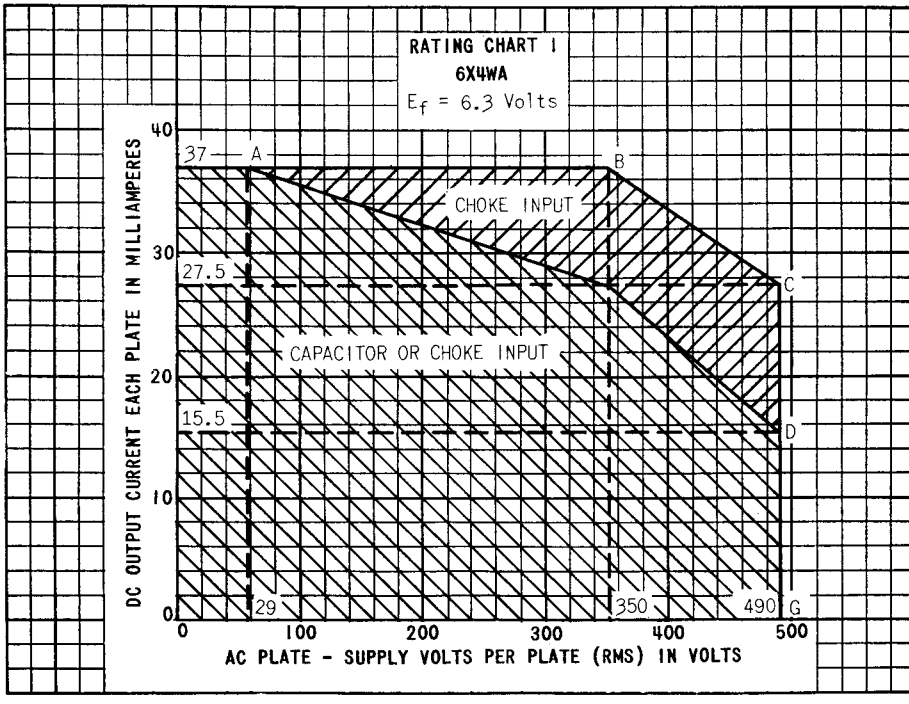
8. FOR SURVIVAL RATE LIFE TEST THE SAMPLING AND TESTING SHALL BE AS SPECIFIED IN 20.2.5.2 TO 20.2.5.4 INCLUSIVE OF APP. C. WITH THE FOLLOWING EXCEPTIONS: 20.2.5.3 – REPLACE THE LAST SENTENCE WITH "IF SUCH SELECTION RESULTS IN A SAMPLE CONTAINING ONE OR MORE TUBES WHICH ARE DEFECTIVE WHEN TESTED UNDER CONDITIONS OF INITIAL SHORT AND CONTINUITY TEST (REF. NOTE 7) SUCH TUBES SHALL BE REPLACED BY RANDOMLY SELECTED GOOD TUBES." 20.2.5.4(6): REPLACE WITH "UPON COMPLETION OF 100 HOURS, THE TUBES SHALL AGAIN BE SUBJECTED TO THE SHORT AND CONTINUITY TEST (REF. NOTE 7).

TENTATIVE DATA









TENTATIVE DATA