VALVE ELECTRONIC

ADMIRALTY SURFACE WEAPONS ESTABLISHMENT

CV6137

Specification AD/CV 6137 incorporating MIL-E-1/889B Issue 1A Dated 30.4.65 To be read in conjunction with K1006.	SECURITY Specification: Unclassified Valve: Unclassified

TYPE OF VALVE: Tetrode with external anode.	MARKING: See K1001/4
CATHODE: Indirectly heated.	
ENVELOPE: Ceramic and metal.	BASE: 9-pin Special
PROTOTYPE: 7203/4CX250B.	

RATING
(All limiting values are absolute)

			Note
Heater Voltage	(V)	6.0	
Heater Current	(A)	2.6	
Max. Grid Voltage	(V)	-250	
Max. Control Grid Dissipation	(W)	2	
Max. Screen Dissipation	(W)	12	
Max. Anode Temperature	(°C)	250	
Max. Base Seal Temperature	(°C)	250	
Max. Frequency	(Mc/s)	500	
Min. Cathode Heating Period	(Secs.)	30	
Class AB Audio			
Max. Anode Voltage	(V)	2000	
Max. Anode Dissipation	(W)	250	
Max. Anode Input	(W)	500	
Max. Anode Current	(mA)	250	
Max. Screen Grid Voltage	(V)	400	
Class C Telephony			
Max. Anode Voltage	(V)	1500	
Max. Anode Dissipation	(W)	165	
Max. Anode Input	(W)	300	
Max. Anode Current	(mA)	200	
Max. Screen Grid Voltage	(V)	300	
Class C Telegraphy			
Max. Anode Voltage	(V)	2000	
Max. Anode Dissipation	(W)	250	
Max. Anode Input	(W)	500	
Max. Anode Current	(mA)	250	
Max. Screen Grid Voltage	(V)	300	

CONNECTIONS

Pin	Electrode
1	g2
2	k
3	h
4	k
5	int. con.
6	k
7	h
8	k
Centre Pin	g1

DIMENSIONS
See drawing on Page 5

CAPACITANCES (pF)

C in	(nom)	15.7
C out	(nom)	4.5
Ca-g1	(Max.)	0.06

The Joint Services Catalogue Number is 5960-99-037-3829

TESTS

The tests for Valve Type 7203/4CX250B in Specification MIL-E-1/889B shall apply with the addition of the following test which is to be regarded as part of Acceptance Inspection Part 2 (design) on Page 2:-

SWEPT FREQUENCY SHORT CIRCUIT TEST

The valve shall be vibrated over the range 20 c/s to 1000 c/s, using the equipment described in S.V.T.L. Technical Report No. 124/61 to detect short circuits. With screen grid connected to cathode, there shall be no shorts between these electrodes and the grid of duration greater than the limits stated in Paragraph 5 of the Report.

The rate of change of frequency shall be not more than 25 c/s per minute from 20 c/s to 75 c/s, and not more than 50 c/s per minute from 75 c/s to 1000 c/s.

The acceleration shall be not less than 2g from 20 c/s to 75 c/s, and not less than 1g from 75 c/s to 1000 c/s, and shall be applied in any two mutually perpendicular directions normal to the major axis of the valve.

CV6137

MIL-E-1/889B
5 July 1962
SUPERSEDING
MIL-E-1/889A
14 October 1960

MILITARY SPECIFICATION SHEET

ELECTRON TUBE, TETRODE, EXTERNAL ANODE, INTEGRAL-FINNED

[1/] JAN-7203/4CX250B, 7204/4CX250F
a b

This specification sheet forms a part of the latest issue of Military Specification MIL-E-1.

DESCRIPTION: RF power amplifier, oscillator or frequency multiplier, with an F1 = 500 Mc

PIN CONNECTIONS AND DIMENSIONS: See figure 1

ABSOLUTE-MAXIMUM RATINGS:

Parameter: / Unit:	TEST CODE a, b / a, b	Ef Vac	Eb Vdc	Ec1 Vdc	Ec2 Vdc	Ehk Vdc	Ib mAdc	Pg1 W	Pg2 W	Pp W	T (seals and anode core) °C	tk sec min	Cooling (See note 2)	Alt ft
C Tel:	a, b	(See note 1)	1,500	-250	300	⨍150	200	2	12	165	250	30	---	10,000
C Tlg:	a, b	(See note 1)	2,000	-250	300	⨍150	250	2	12	250	250	30	---	10,000
AB:	a, b	(See note 1)	2,000	-250	400	⨍150	250	2	12	250	250	30	---	10,000
TEST CONDITIONS:														
	a	6.0	1,000	adj	300	0	150	---	---	---	---	120	(See note 3)	---
	b	26.5	1,000	adj	300	0	150	---	---	---	---	120	(See note 3)	---

PAR. NO.	TEST	TEST CODE	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS Min	LIMITS Max	UNIT
	General								
3.1	Qualification	a, b	Required for JAN marking	---	---	---	---	---	---
3.6	Performance	a, b	(See note 4)	---	---	---	---	---	---
4.5	Holding period	a, b	t = 72 hours min	---	---	---	---	---	---
---	Cathode	a, b	Coated unipotential	---	---	---	---	---	---
	Qualification inspection (see note 5)								
3.4.3	Base connections	a, b	9-pin special (see fig. 1)	---	---	---	---	---	---
---	Cooling	a, b	Ec1/Ib = 250 mAdc (see note 6)	---	---	T (anode core)	---	225	°C
---	Pressure drop	a, b	No voltages applied (see note 7)	---	---	---	---	0.35	In. H_2O
---	Life test (3)	a, b	Power output, except air flow = 1.5 cfm	---	---	t	100	---	hr
---	Life test (3) end point	a, b	Power output	---	---	Po	200	---	W (useful)

[1/] To identify immediately those tests that are applicable to a given type or to several types, tube types are designated by letters.

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PAR. NO.	TEST	TEST CODE	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS Min	LIMITS Max	UNIT
	Acceptance inspection, part 1 (production) (see note 8)								
4.10.4.3	Screen-grid current	a, b		0.65	II	Ic2	-7.0	±3.0	mAdc
4.10.5.2	Grid voltage	a, b		0.65	II	Ec1	-32.0	-45.0	Vdc
4.10.6.1	†Total grid current	a, b	Eb = 2,000 Vdc; Ec1/Ib = 125 mAdc	0.65	II	Ic1	---	-15	uAdc
4.10.6.6	Primary grid emission (control)	a, b	Ic1 = 70 mAdc; t = 120; plate and screen grid floating	0.65	II	Isg1	---	-250	uAdc
4.10.6.6	Primary grid emission (screen)	a, b	Ec1 = 0 Vdc; t = 120; Ic2 = 100 mAdc; plate floating	0.65	II	Isg2	---	-250	uAdc
4.10.8	Heater current	a		0.65	II	If	2.30	2.90	Aac
		b		0.65	II	If	0.50	0.62	Aac
---	Pulse emission (1)	a, b	Eb = Ec2 = 250 Vdc; Ec1 = -100 Vdc; ec1/ik = 1.5 a; prr = 11.0±1.0; tp = 4,500 us min (see note 9)	0.65	II	Δik	---	200	ma
		a	Ef = 5.4 Vac						
		b	Ef = 23.8 Vac						
---	Positive grid-current division	a, b	Eb = Ec2 = 250 Vdc; Ec1 = -100 Vdc; ec1/ib = 1.0 a; prr = 11.0±1.0; tp = 4,500 us min (see note 10)	0.65	II	ec1	8	18	v
						ic1	---	200	ma
						ic2	---	260	ma
	Acceptance inspection, part 2 (design)								
4.9.19.1	Low-frequency vibration	a, b	No voltages applied	6.5	L6	---	---	---	---
4.9.19.3	Bump	a, b	Angle = 20°	6.5	L6	---	---	---	---
---	Control-grid lug bending test	a, b	(See note 11)	6.5	L6	---	---	---	---
4.10.1.5	Pulse emission (2)	a, b	eb = ec1 = ec2 = 850 v (see note 12)	6.5	L6	is	40	---	a
4.10.14	Direct-interelectrode capacitance	a, b	EIA standard shields No. 320 and 321, or equivalent	6.5	L6	Cgp	---	0.06	uuf
						Cin	14.2	17.2	uuf
						Cout	4.0	5.0	uuf
4.10.15	Heater-cathode leakage	a, b	Ehk = ±150 Vdc	6.5	L6	Ihk	---	150	uAdc
			Ehk = -150 Vdc			Ihk	---	150	uAdc
---	Power output	a, b	Class C amplifier; F = 470 to 500 Mc; Eb = 2,000 Vdc; Ec1 = -90 Vdc; Ec2 = 250 to 300 Vdc; Ic1 = 25 mAdc max; Eg1/Ib = 250 mAdc (see note 13)	6.5	L6	Po	225	---	W (useful)
		a	Ef = 5.5 Vac						
		b	Ef = 24.3 Vac						

PAR. NO.	TEST	TEST CODE	CONDITIONS	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL OR CODE	SYMBOL	LIMITS Min	LIMITS Max	UNIT
	Acceptance inspection, part 3 (life)								
4.11	Life test (1)	a, b	Group C; power output	---	---	t	500	---	hr
4.11.4	Life test (1) end points	a, b	Pulse emission (2)	---	---	is	30	---	a
			Primary grid emission (control)	---	---	Isg1	---	-250	uAdc
			Primary grid emission (screen)	---	---	Isg2	---	-250	uAdc
			Heater-cathode leakage						
			Ehk = ⁄150 Vdc	---	---	Ihk	---	150	uAdc
			Ehk = -150 Vdc	---	---	Ihk	---	150	uAdc
4.11	Life test (2)	a, b	Group C; Eb = Ec1 = Ec2 = 0 Vdc	---	---	t	500	---	hr
		a	Ef = 6.60 Vac						
		b	Ef = 29.1 Vac						
---	Life test (2) end points	a, b	(See notes 14 and 15)	---	---	Rg1g2	10	---	Meg
						Rg2k	10	---	Meg
						Rg1k	10	---	Meg
---	Humidity test	a, b	(See notes 16 and 17)	---	---	---	---	---	---
---	Post humidity test end point	a, b		---	---	Ic1	---	-15	uAdc
4.9.18 and 4.9.18.1.7	Container drop	a, b	Required						
5.	Preparation for delivery	a, b	(See notes 18 and 19)						

NOTES:

1. To obtain maximum life, it is necessary to adjust heater voltage to the values indicated below at the indicated frequencies of operation. These figures are for straight-through amplifier operation.

Frequency (Mc)	Ef (Vac) 7203	Ef (Vac) 7204
300 or lower	6.00	26.5
301 to 400	5.75	25.3
401 to 500	5.50	24.3

It is recommended that the heater voltage be maintained within ⁄5 percent when consistent operation and extended tube life are factors (applies to both nominal and derated voltages), but in no case shall the heater of the 7203/4CX250B be operated at less than 5.4 volts, nor should the heater of the 7204/4CX250F be operated at less than 23.9 volts.

2. At a plate dissipation of 250 watts and an incoming air temperature of 25° C maximum, a minimum air flow of 3.8 cubic feet per minute (cfm) at sea level must pass through the anode cooler. At this flow of 3.8 cfm, the static pressure drop across the tube and socket shown on Drawing 246-JAN is approximately 0.30 inch of water. The pressure drop varies with the amount of escaping air and with the shape and construction of the air director. This rating applies at bias voltages less than 100 volts and frequencies less than 500 Mc. Air cooling on the tube base must be increased with increasing negative grid bias or with increasing frequency, or a combination of both. In all cases of operation, a socket which provides forced-air cooling of the base must be used and maximum seal temperature ratings must not be exceeded. The air flow shall be applied before or simultaneously with electrode voltages, and may be removed simultaneously with them.

3. In all electrical tests involving heater voltage, the socket shown on Drawing 246-JAN, or equivalent, shall be used. Forced-air cooling is permitted at the rate of 4.0 cfm maximum for the base and anode, unless otherwise specified in the specific test conditions. A separate source may be used for the base and anode, but neither shall exceed 4.0 cfm.

NOTES:

4. In addition to the paragraphs specified hereon, the following tests and requirements listed in 3.6 shall apply: 3.3, 3.3.1, 3.4.1, 3.4.2, 3.7, 3.7.7, 3.8, 4.1, 4.3, 4.4, 4.6, 4.7, 4.9.1, 4.9.2, 4.9.4, 4.9.5, and 4.9.21.

5. All tests listed hereon shall be performed during qualification; however, these tests are normally performed during qualification inspection only.

6. The cooling test shall be made as follows: At an ambient temperature of 25° C, both base and anode shall be cooled by applying an air flow of 3.8 cfm maximum at sea level from a single source using the infinite baffle system as shown on figure 2, or equivalent. At the specified test conditions, the anode core temperature shall not exceed the specified limits. Temperature shall be measured by means of a thermocouple located as follows: The thermocouple shall be embedded in the top of the core, adjacent to the cooler, by means of drilling a small hole, shallow enough so that the tube vacuum shall not be lost, placing the welded thermocouple junction therein, and then peening the edges of the hole to hold the thermocouple firmly in place. In all cases, good electrical continuity between the thermocouple and the metal area in close proximity must be demonstrated before the cooling test can be performed. The size and material of the thermocouple, its installation, and the measuring instrument used to determine temperature shall be in accordance with good engineering practice.

7. An infinite baffle system, as shown on figure 2, or equivalent, with an air flow of 3.8 cfm at sea level shall be used. The static pressure drop is measured across the tube and socket.

8. The AQL for the combined defectives for attributes in acceptance inspection, part 1 (production), excluding inoperatives and mechanical, shall be 1 percent.

9. Pulse emission (1) is taken at the voltage conditions specified. The grid voltage pulse is essentially a square wave, and the magnitude is adjusted to produce a total cathode current of 1.5 amperes at the leading edge of the pulse. (See fig. 3.) The Δik from the leading edge to the falling edge of the pulse (see fig. 3) shall not exceed the specified limit. The input wave shape shall have a tr and a tf of 25 us maximum each, and the slope of the top of the pulse shall be not greater than 0.5 percent with a ripple not to exceed 0.1 percent. For the basic test circuit, see figure 4.

10. Positive current division is taken with the voltage conditions as specified. The grid voltage is essentially a square wave and its magnitude is adjusted to produce a plate current of 1.0 ampere at the leading edge of the pulse. (See fig. 5.) The magnitude of ec1, ic1, and ic2 is recorded and shall be within the specified limits. The input wave shape shall have a tr and a tf of 25 us maximum each, and the slope of the top of the pulse shall be not greater than 0.5 percent with a ripple not to exceed 0.1 percent. For the basic test circuit see figure 4.

11. The control-grid lug bending test shall be made as follows:

    a. Tube shall be mounted in a horizontal position.
    b. A bending moment of 5.25 in.-lb shall be applied to the control-grid lug by means of the fixture shown on figure 6.
    c. After this test the tube shall pass all the electrical measurements of acceptance inspection, part 2 (design).

12. The maximum value of the voltage applied to the plate and grids shall not exceed 900 volts. The pulse duration measured at 5 percent of the maximum value shall be not less than 3 us. At 50-percent amplitude, the duration shall be less than 2 us. The applied voltage shall have a maximum repetition rate such that the duty cycle, based on the pulse length measured at 50-percent amplitude, shall not exceed 0.0002 (0.02 percent). An alternate pulse-emission test may be used with the following conditions and limits:

Conditions		Minimum	Maximum	
is = 40 a; eb = ec1 = ec2	etd:	---	850	v

    For life-test end points, is = 30 a.

13. Circuit and cavity in accordance with Drawing 223-JAN, or equivalent.

14. This is a destructive test.

15. This test shall be made 30 minutes after Ef is turned off. Rated air flow shall still be maintained during the 30-minute interval. Use circuit shown on figure 7, or equivalent.

16. The tube shall be subjected to an atmosphere of 95 to 100 percent relative humidity at a temperature of 95° to 100° C for a period of 96 hours. These conditions may be met by exposing the tube in close proximity to a water bath heated to 95° to 100° C.

17. Sample size shall be 10 tubes, selected at random from the first production lot each year, and every 3 months thereafter. One failure is allowed. In case of sample failure, the test shall revert to a design test, AQL 6.5, inspection level L6. After 3 consecutive successful submissions, the test shall revert to a 10-tube quarterly test.

18. Tubes shall be packaged and packed, as specified in the contract or order, in accordance with Specification MIL-E-75 and appendix thereto. When specified in the contract or order, rough handling (container drop) test (1) shall be performed on the individual package or pack utilized.

19. Pack in sealed, moisture-vaporproof bag. If opaque bag is used, the tube-type number shall be stamped thereon.

20. Production lots shall be suitably identified.

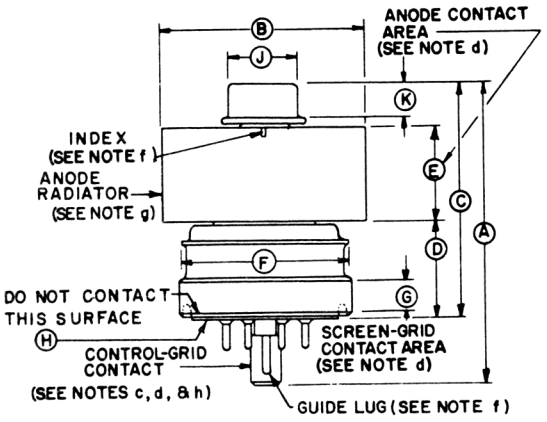
21. Referenced documents shall be of the issue in effect on the date of invitation for bids.

Custodians:
Army - SigC
Navy - Ships
Air Force - AFSC

Preparing activity:
Navy - Ships
(Project 5960-1466)

PIN CONNECTIONS

Pin No.	Element
1	g2
2	k
3	h
4	k
5	int con
6	k
7	h
8	k
center post	g1
radiator	p
base ring	g2



DIM.	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	LIMITS	
			Min	Max
QUALIFICATION INSPECTION				
B	---	---	1.610 dia	1.640 dia
D	---	---	0.750	0.810
E	---	---	0.710	0.790
F	---	---	---	1.406 dia
G	---	---	0.187	---
H	Base: B8-236 (see notes b, c, and j)			
J	---	---	0.559 dia	0.573 dia
K	---	---	0.240	0.280
ACCEPTANCE INSPECTION, PART 2 (DESIGN)				
A	6.5	L6	2.324	2.464
C	6.5	L6	1.810	1.910

NOTES:

a. All dimensions in inches.
b. JEDEC designation.
c. Pin alinement shall be checked by means of JEDEC gage GB8-3. Dimensions of control-grid contact shall be inspected by means of gages specified on Drawing 246-JAN and shall be acceptance inspection, part 2 (design).
d. Alinement of anode, screen-grid, and control-grid contact surfaces shall be determined by means of gage specified on Drawing 168-JAN. Acceptance inspection, part 2 (design), shall apply.
e. Air-system socket shall be as specified on Drawing 246-JAN.
f. Location of guide lug of control-grid contact shall be referenced by a notch or arrow on the anode radiator in position shown.
g. Anode clamping shall be confined to anode radiator.
h. Allowable control-grid contact torque shall be 5 in.-lb maximum. Acceptance inspection, part 2 (design), shall apply.
j. Allowable pin bending moment shall be 0.25 in.-lb maximum. Acceptance inspection, part 2 (design), shall apply.

Figure 1. Outline drawing.

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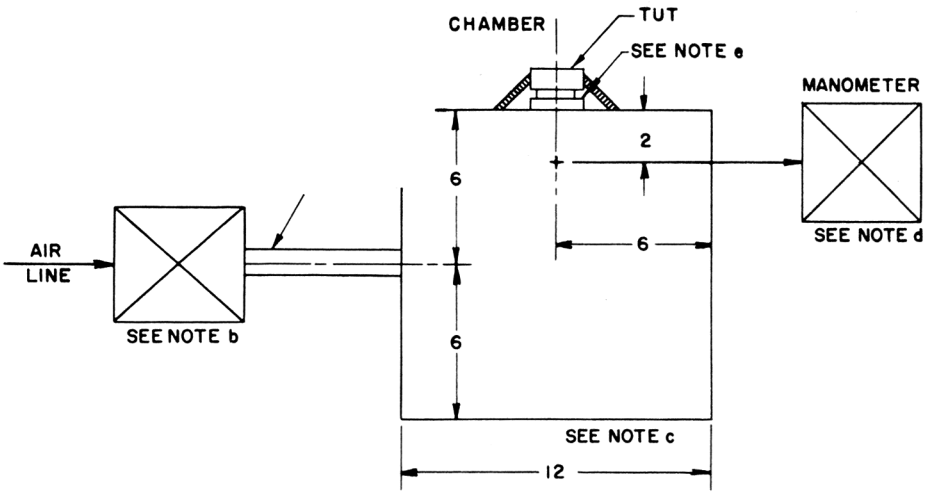

Figure 2. Block diagram.

NOTES:
a. All dimensions in inches.
b. Fischer Porter Flowrater Model B4-27-10/77, or equivalent.
c. 12-inch cube inside dimensions, compound sealed.
d. F. W. Dwyer Manometer, 0 to 1 inch of water (Fischer Scientific Company 11-295-5 draft gage), or equivalent.
e. Socket specified on Drawing 246-JAN, or equivalent.

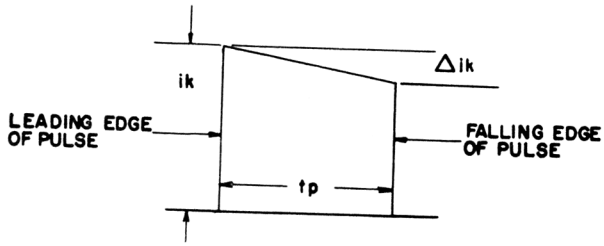

Figure 3. Pulse emission.

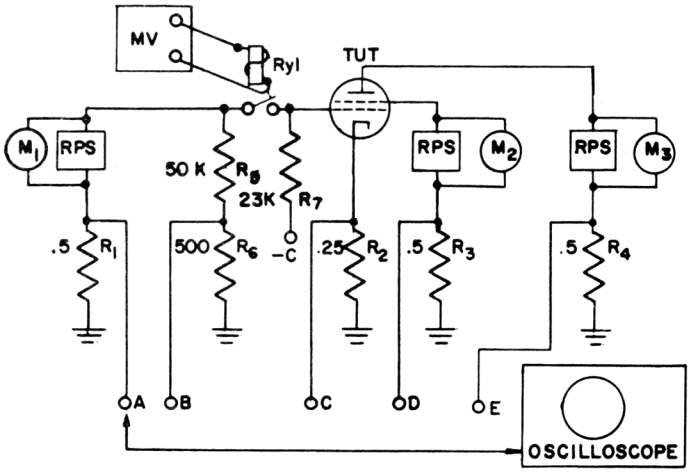

Figure 4. Basic test circuit.

NOTES:

a. Regulated power supplies are capable of maintaining the voltage steady over the duration of the pulse.
b. Meters are accurate to within 1 percent.
c. Ryl mercury wetted contact type, or equivalent.
d. Unused metering resistors may be shorted out.
e. Peak reading devices which measure pulse amplitude may be used in place of oscilloscope. Amplitude of leading edge shall be measured within 30 us.

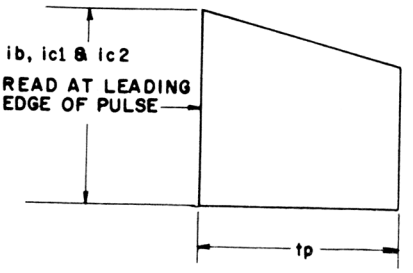

Figure 5. Grid-voltage pulse.

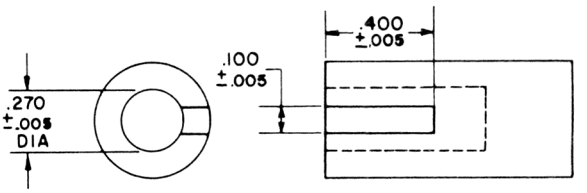

Figure 6. Control-grid lug fixture.

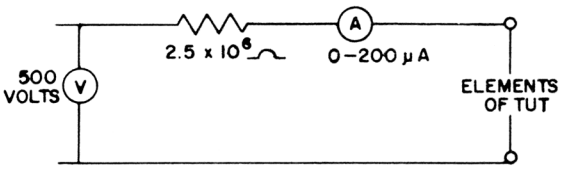

Figure 7. Interelectrode leakage test circuit.