

INCH-POUND

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SUPERSEDING
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PERFORMANCE SPECIFICATION SHEET

ELECTRON TUBE, PHOTOMULTIPLIER
TYPE 931VA

This specification is approved for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the electron tube described herein shall consist of this specification sheet and MIL-PRF-1.

DESCRIPTION: 9-stage, side-on, S4 spectral response.

DIMENSIONS AND PIN CONNECTIONS: See figure 1.

ABSOLUTE RATINGS:

Parameter:	Ebb	Eb-Edy9	Light source	Light	Ib	TA	Rp	Cathode area	Shock	Alt
Unit:	V dc	V dc	---	lm	mA dc	°C	Ohms	Lighted sq cm	G	ft
Maximum:	1,250 (notes 1 and 19)	250 (notes 2 and 19)	---	---	1.0 (note 10b)	75	note 3	---	200	40,000
Test conditions:	1,000	100	LS1	10 ⁻⁵	---	---	10,000	0.8	---	--

GENERAL:

Qualification - Not Required.

TABLE I. Testing and inspection.

Inspection	Method MIL-STD- 1311	Notes	Conditions	Acceptance Level <u>20/</u>	Symbol	Limits Min	Limits Max	Units
<u>First Article Inspection</u>								
Low-frequency (25 Hz) vibration	1031	4	No voltages; t=60 minutes	---	---	---	---	---
Direct-interelectrode capacitance (1)	1331	8		---	C	2.0	6.0	pF
Direct-interelectrode capacitance (2)	1331	9		---	C	3.5	9.5	pF
Low-pressure breakdown	---	12,13, 14	Ebb =1,250 V dc Eb to Edy9 =125 V dc; voltages for all other stages=125 V dc per stage; Rp = 1 Meg Ω ; t = 12 S4	---	---	---	---	---
Spectral response identification	5303	---		---	---	---	---	---
Base material insulating quality	1216	---		---	---	---	---	---
<u>Conformance inspection, part 1</u>								
Cathode current	---	5, 6	Light = 0.01 lm	---	lk	0.06	---	μ A dc
Dark current (1)	5301	---	Light = 0	---	Llk	---	5.0	μ A dc
Dark current (2)	5301	5, 15		---	Llb	---	0.05	μ A dc
Anode current	5301	5		---	lb	45	---	μ A dc
Amplification	---	---	Amplification= lb(A/lm) lk(A/lm)	---	Mu	75,000	---	---
Dark current (3)	5301	7	Light=0	---	Llb	---	5.0	μ A dc
<u>Conformance inspection, part 2</u>								
Secureness of base, cap or insert	1101	11		---	---	---	---	---
Shock	1041	16, 17	200 G \pm 10%; no voltages applied	---	---	---	---	---
Base pin solder depth	1111	---		---	---	---	---	---
Permanence of marking	1105	---		---	---	---	---	---

See footnotes at end of table.

TABLE 1. Testing and inspection - Continued.

Inspection	Method MIL-STD- 1311	Notes	Conditions	Acceptance Level <u>20/</u>	Symbol	Limits Min	Limits Max	Units
<u>Conformance inspection, part 3</u>								
Life test	---	10	Group C	---	---	---	---	---
Life-test end point:	---							
Amplification	---	---		---	Mu	25,000	---	---

NOTES:

- Overall anode to cathode dc supply voltage.
- Anode to 9th dynode dc supply voltage.
- An anode load resistance of at least 10,000 ohms is recommended for a protective resistance.
- Vibration test is to be performed prior to other qualification inspection tests.
- Adjust tube position to give maximum sensitivity. The light during test, except during life test, shall be incident upon the aperture approximately 0.8 inch x 0.2 inch (20.32 mm x 5.08 mm) located to center of the cathode.
- Apply 100 volts between the cathode and all other pins tied together.
- Apply Ebb according to the range of Ib in the following table:

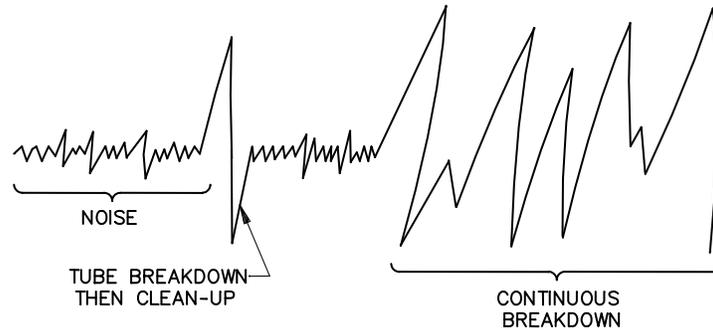
Range	Ib	45 to 63	63 to 88	88 to 120	120 to 162	162 to 214	214 to 284	284 to 374	374 and greater
	Ebb	1,600	1,550	1,500	1,450	1,400	1,350	1,300	1,250

- Capacitance between anode and dy9, all other elements grounded.
- Capacitance between anode and all other elements.
- Life test.
 - Life test shall be made during a cycle of 6 hours on and 18 hours off. The life test duration of 500 hours shall consist of 21 cycles. The luminous flux at the cathode shall be adjusted initially and at the end of 15 minutes operation daily to give an anode current of 2.5 mA dc. Color temperature shall be greater than 2,000°K.
 - Longer tube life may be expected when operating conditions require lower anode current.
- Omit immersion in water and test dry. Apply torque test with 20.0 pound-inches minimum.
- Test circuit and test equipment requirements.

A bleeder network to provide equal voltage per stage; 8-Meg Ω series resistance for cathode, and all dynodes excluding the last dynode (9th); 1-Meg Ω series resistance for last dynode (9th) and anode; a regulated (0.1 percent) power supply with low-ripple (0.05 volts peak-to-peak maximum) as a voltage source; a sensitive dc microammeter to determine anode current; an oscilloscope, with a low-capacity divider, is connected across the anode load resistance (1-Meg Ω) to monitor noise and breakdown; base pins of photomultiplier under test connected so that the degradation of breakdown characteristic is minimized; a vacuum pump, low-pressure chamber and manometer; a light source with an adjustable iris and sand-blasted glass.

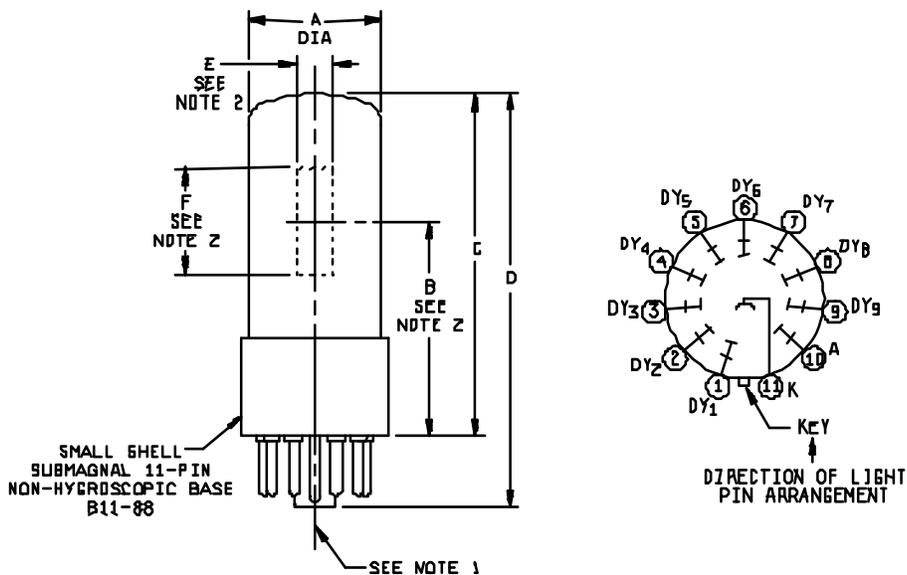
Test method.

Mask tube with light-proof material. The light-source should be located so that light from it is striking the cathode of the photomultiplier. (Light from the light source should be the only light striking the cathode.) The opening of the iris is varied to obtain approximately 10 microamperes of anode current. Observe the tube noise signal as displayed by the oscilloscope. Reduce pressure of vacuum chamber to 130 millimeters of mercury. The tube should be subjected to this pressure for a period of 2 minutes. During pressure reduction, the tube noise signal, as displayed by the oscilloscope, should be observed to determine tube breakdown. When breakdown occurs, the signal being monitored by the oscilloscope will resemble the following:



When continuous breakdown occurs, a change in anode current will result.

13. Vary light to obtain approximately 10 microamperes of anode current.
14. The tube shall operate without indication of breakdown in an evacuated chamber in which the pressure does not exceed 130 mmHg absolute.
15. With 10^{-5} lumen incident on the cathode, vary the overall voltage (Ebb) to obtain an anode current of 200 μ A dc. Exclude light and read the dark current.
16. The clamp shall be as specified in Drawing 216-JAN.
17. After the socket test is performed, the tube shall meet the requirements of all the tests specified in conformance inspection, part 1.
18. All conformance inspection, part 1, tests to be performed at the conclusion of the holding period.
19. An ac supply voltage may be used having a peak value equal to this maximum value.
20. This specification sheet uses accept on zero defect sampling in accordance with MIL-PRF-1, table III.



Dimensions				
Ltr	Inches		Millimeters	
	Min	Max	Min	Max
Qualification inspection				
C		3.125		79.38
E	0.312		7.92	
F	0.937		23.80	
Conformance inspection, part 2				
A		1.187		30.15
B	1.843	2.031	46.81	51.59
D		3.687		93.65

NOTES:

1. Centerline of bulb shall not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.
2. Dimensions B, E and F refer to the usable cathode area.

FIGURE 1. Outline drawing for electron tube type 931VA.

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Referenced documents. In addition to MIL-PRF-1, this document references the following:

MIL-STD-1311
JETEC DWG 216-JAN

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Air Force - 99

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