ENVIRONMENTAL TEST REPORT

FOR THE

WX-32335 SEC CAMERA TUBE

Prepared for:

PRINCETON UNIVERSITY

PRINCETON, NEW JERSEY

NSR-31-001-286

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1.0 INTRODUCTION

This report describes the environmental tests performed with the WX-32335 SEC camera tube and the results obtained from these tests. All of these tests were carried out by the Electro-Optical Department of the Westinghouse Electronic Tube Division located in Elmira, New York, on behalf of Princeton University for NASA Goddard Space Flight Center. The activity on this test program was completed at Westinghouse during the period of August 1973 through September 1973.

A total of five (5) SEC camera tubes of the WX-32335 type were subjected to non-operational thermal cycling and sinusoidal vibration tests as required by Amendment #1 to Subcontract #1 under NASA Grant NSF 31-001-286. Random vibration tests initially scheduled were not performed with these tubes at the request of Princeton University.

A detailed discussion of the thermal cycling tests and the sinusoidal vibration tests performed as well as the results obtained from these tests are included in Sections 3.0 and 4.0 of this report, respectively. The electrical testing conditions and photographs of the picture quality of each tube before and after the environmental tests were performed are included in Appendix I of this report. Also included in Appendix I is a description of the design configuration for each tube.

2.0 SUMMARY

The environmental testing activity on the WX-32335 was carried out to determine if this tube type could withstand the environmental requirements established for the International Ultraviolet Explorer (IUE) camera tube (WX-32224). The results of the tests carried out during this test period led to the following conclusions:

1. The WX-32335 as processed with a CsTe photocathode surface can withstand the temperature extremes established for the IUE camera tube without damage to the photocathode surface or without introducing background signal in the tube after one hour of dark integration.

2. The WX-32335 built with a WX-32224 type target support structure can withstand the sinusoidal vibration requirements established for the IUE camera tube.

3. Although the vibration test of the WX-32335 type tubes built with the flat target ring structure could not be completed, there was no indication that these tubes could not withstand the sinusoidal vibration requirements established for the IUE camera tube.

3.0 THERMAL TESTS

Four (4) SEC camera tubes of the WX-32335 type were subjected to non-operational thermal cycling tests as described in Figure 1. Electrical performance tests were performed on each tube before and after exposure to the thermal tests. The performance tests documented the sensitivity, picture quality, and the background (after dark integration for one hour) for each tube. No degradation in tube performance was observed in any of the four (4) tubes tested after exposure to the thermal cycling testing schedule.

The testing sequence and the pertinent data recorded at each electrical test for thermal as well as vibration testing are shown in Table 1.

The thermal tests were performed in a Westinghouse Model E150H Temperature Chamber (Associated Testing Laboratory #K3105).

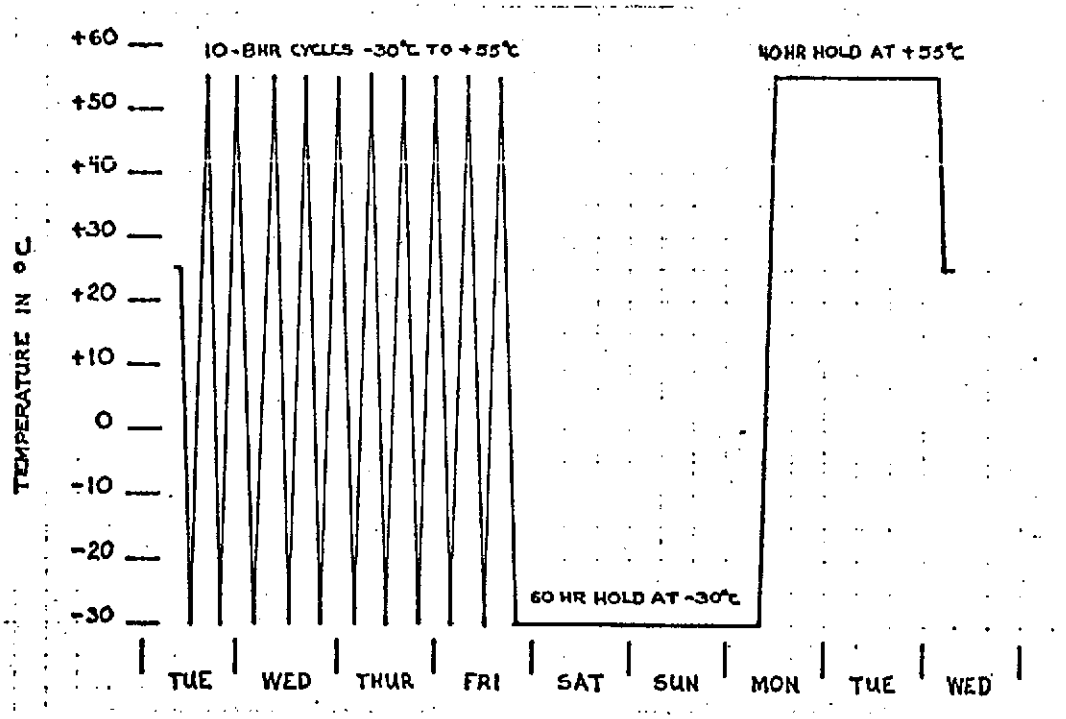


Figure 1 - Thermal Test Schedule

Tube Ser. #		Test	Thermal Testing	Test	Level I X	Test	Level I Z	Test	Level II X	Test	Level II Y	Test	Level II Z	Test
73 09 426	Sensitivity	9.1[1]	14 Aug	9.0		-		-		-		-		9.0
	Picture Quality	Pic.	-	No Change	7 Sep	No Change	7 Sep	No Change	8 Sep	No Change	8 Sep	No Change	8 Sep	No Change
	Background	None	22 Aug	None		-		-		-		-		None
73 09 429	Sensitivity	11.5	N/A	N/A		-		-	-	-	-	-	-	-
	Picture Quality	Pic.			8 Sep[2]	-	8 Sep	No Change	-	-	-	-	-	-
	Background	No Test				-		Gassy	-	-	-	-	-	-
73 09 430	Sensitivity	2.9	14 Aug	28	-	-	-	-		-		-		28
	Picture Quality	Pic.	-	No Change	-	-	-	-	12 Sep	No Change	12 Sep	No Change	12 Sep	No Change
	Background	None		None	-	-	-	-		-		-		None
73 17 353	Sensitivity	30	14 Aug	30		-[3]	-	-	-	-	-	-	-	-
	Picture Quality	Pic	-	No Change	7 Sep	No Change	-	-	-	-	-	-	-	-
	Background	None		None		-	-	-	-	-	-	-	-	-
73 17 363	Sensitivity	2.0	14 Aug	2.1		-		-		-		-		2.0
	Picture Quality	Pic.	-	No Change	7 Sep	No Change	7 Sep	No Change	8 Sep	No Change	8 Sep	No Change	8 Sep	No Change
	Background	None		None		-		-		-		-		None

(1) Sensitivity - Photocurrent in amperes X 10^{-8} when illuminated with a Pen-Ray lamp.

(2) Tube glass faceplate seal cracked when securing tube in fixture. Tube slowly lost vacuum because of crack and could not be used for further testing.

(3) Tube was dropped after electrical testing and could no longer be used.

TABLE I - ENVIRONMENTAL TEST SEQUENCE AND TABULATED DATA

4.0 SINUSOIDAL VIBRATION TESTS

Five (5) SEC camera tubes of the WX-32335 type were subjected to the sinusoidal vibration test levels described in Figure 2. As indicated, the sinusoidal vibration tests were divided into two (2) levels. Level II represents the full specification levels of sinusoidal vibration as described by the IUE team. Level I represents approximately one-half the IUE specification levels. At each level the exposure consisted of one (1) sweep from the lowest to the highest frequency at a rate of approximately two (2)

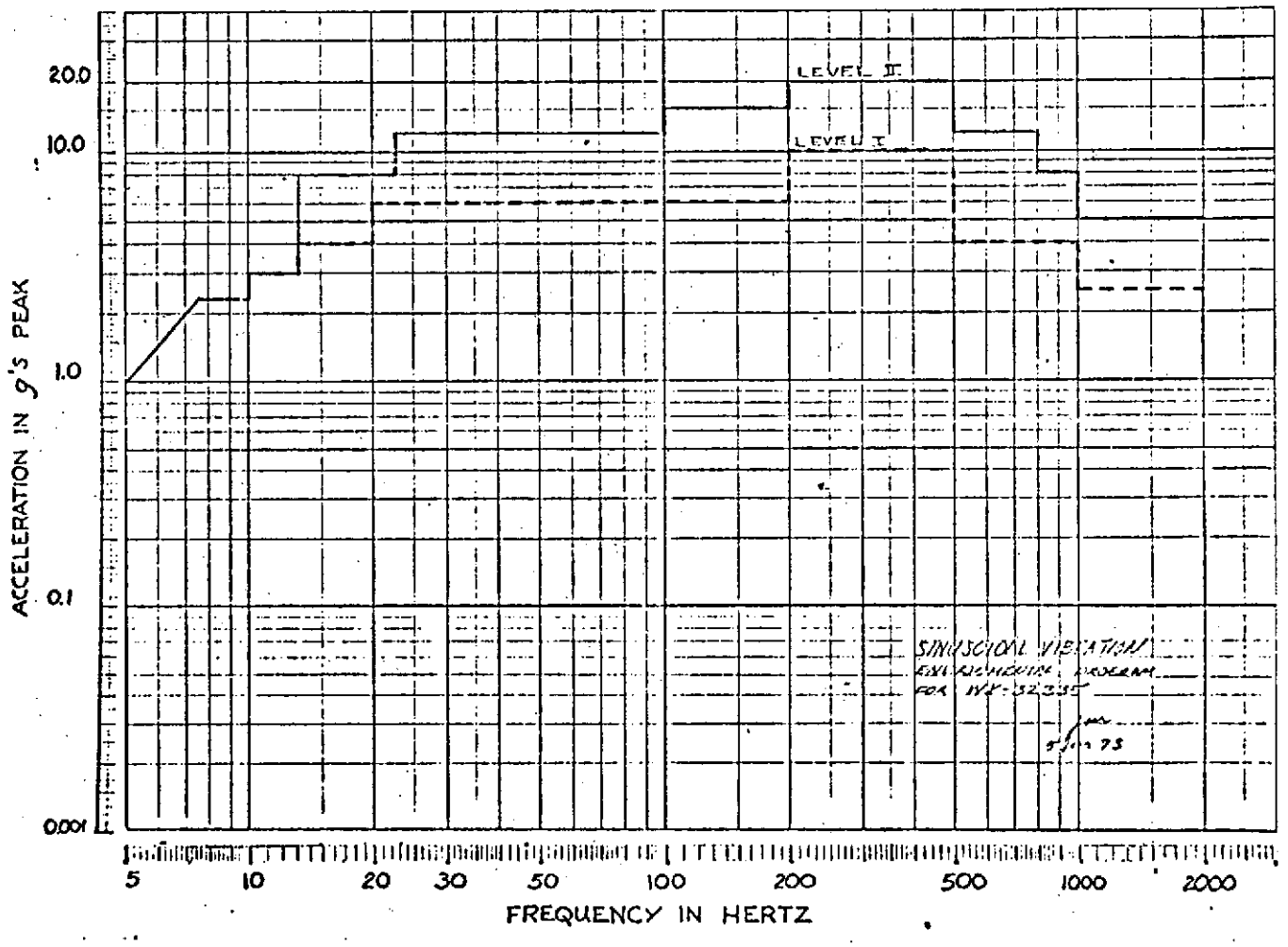


Figure 2 - Sinusoidal Vibration Test Levels

The tubes were vibrated along each of the three (3) mutually perpendicular axes shown in Figure 3.

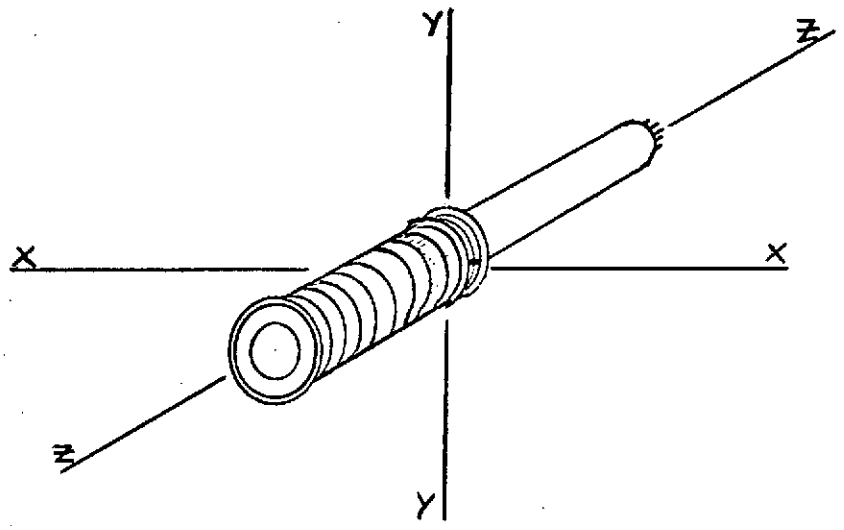


Figure 3 - Axes of Vibration

Before and after the vibration testing, each tube was given an electrical performance test to determine sensitivity, picture quality, and background. In addition, each tube was checked for envelope damage and blemishes after vibration at each level in each axis. Three (3) of the five (5) tubes subjected to vibration tests incurred no physical damage or degradation in electrical performance during or after the vibration testing. One (1) tube was dropped by the test operator and was, therefore, only exposed to the Level I vibration levels. The remaining tube was damaged while securing it in the vibration fixture. This tube was built with a glass faceplate and the damage incurred was a fracture in the glass-to-metal seal between the faceplate and the faceplate support flange. This tube was tested following vibration in two (2) axes at Level I but could not be used for further testing because it was losing vacuum due to the seal fracture. The vibration testing

sequence as well as the pertinent data recorded for each test can be found in Table 1 along with the thermal testing data.

Included in Apprndix II of this report is a sketch showing the tubes as mounted in the vibration fixture.

All of the sinusoidal vibration tests were performed at Westinghouse using a Westinghouse Model C-50 Vibration System.

APPENDIX I - TUBE DATA

Tube Start No.	Tube Serial No.	Date of Start	Face-Plate Type	Photo-Cathode Type	Photo-Cathode Substrate	Photo-Cathode Response	Target Ring Type	Target Buffer Layer	Area of Target Material	Light Gold Coating	Target Shield	Comments
1	72 48 031	29 Jan	Glass	S-20	None	N/A	32224	Al Black	Standard	None	None	Inoperable (air tube). Could not locate leak.
2	72 35 137	27 Feb	Glass	S-20	None	155 μA/lm	Flat	None	Standard	None	None	Operable tube.
3	72 35 139	28 Feb	Glass	S-20	None	115 μA/lm	Flat	None	Standard	None	None	Operable tube; to Princeton
4	73 09 429	7 Mar	Glass	S-9	None	18 μA/lm	Flat	Al Black	Standard	None	None	Operable tube; to Princeton
5	73 09 431	9 Mar	MgF_2	CsTe	Pd	6% Q.E.	Flat	Al Black	Standard	Yes	None	Operable tube; to Princeton
6	73 09 426	14 Mar	MgF_2	CsTe	Pd	7%Q.E.	32224	Al Black	Limited	Yes	None	Operable tube; to Princeton
7	73 09 430	20 Mar	MgF_2	CsTe	Pd	16%Q.E.	32224	Al Black	Limited	Yes	None	Operable tube; to Princeton
8	73 17 386	12 Apr	MgF_2	KCsSb	Pd	N/A	Flat	Al Black	Limited	Yes	Yes	Inoperable tube (air tube); Leak in Cu to ceramic seal
9	73 17 353	18 Apr	MgF_2	CsTe	Pd	12%Q.E.	Flat	Al Black	Limited	Yes	Yes	Operable tube.
10	73 17 355	26 Apr	MgF_2	KCsSb	Pd	N/A	Flat	Al Black	Limited	Yes	Yes	Inoperable (air tube); Leak in target pin seal
11	73 17 454	1 May	MgF_2	CsTe	Pd	N/A	Flat	Al Black	Limited	Yes	Yes	Inoperable (air tube); Leak in Cu to ceramic seal
12	73 17 445	7 May	MgF_2	KCsSb	Pd	N/A	Flat	Al Black	Limited	Yes	Yes	Inoperable (air tube); Leak in Cu to ceramic seal
13	73 17 356	25 May	MgF_2	KCsSb	Pd	16 μA/lm	32224	Al Black	Limited	Yes	Yes	Operable tube; solid Cu flange
14	73 17 434	31 May	MgF_2	CsTe	Pd	N/A	Flat	Al Black	Limited	Yes	Yes	Inoperable (air tube); Leak in pinch-off tube.
15	73 17 363	6 Jun	MgF_2	CsTe	Pd	9%Q.E.	32224	Al Black	Limited	Yes	Yes	Operable tube, machined kover flange.

FIGURE 1

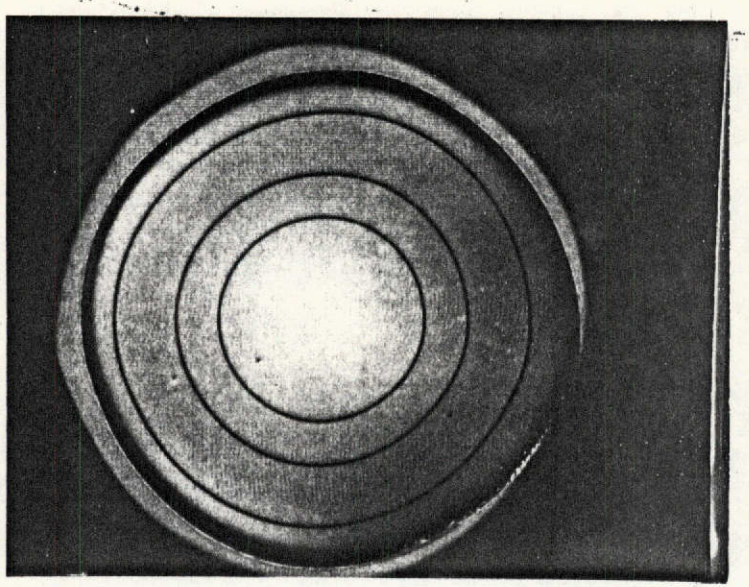
TUBE TYPE WX-32335 TUBE S/N 73-09-426

OPERATING CONDITIONS

E_{G1} -62 V E_{G2} 300 V E_{G3} 70 V E_{G4} 90 V E_{TGT} 12 V E_{pc} -7 kV

E_f 6.3 V

I_{FOCUS} (IMAGE SECTION) 350 mA I_{FOCUS} (SCANNING SECTION) 50 mA



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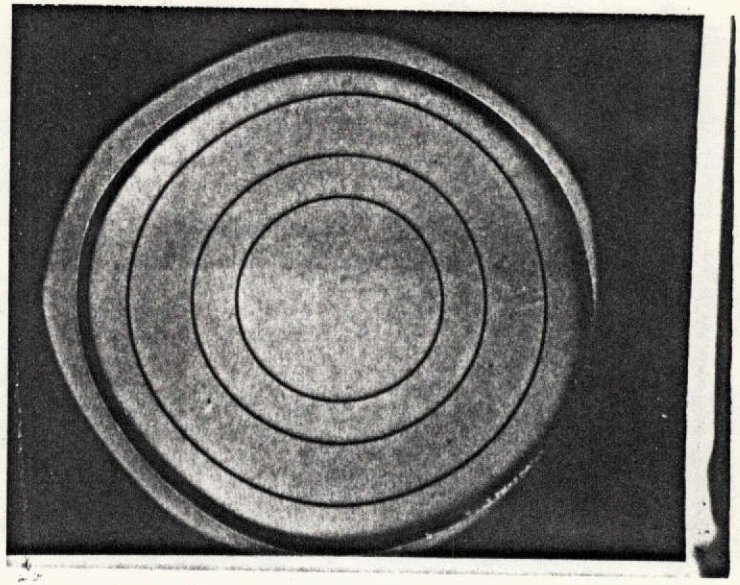


AFTER
ENVIRONMENTAL TESTING

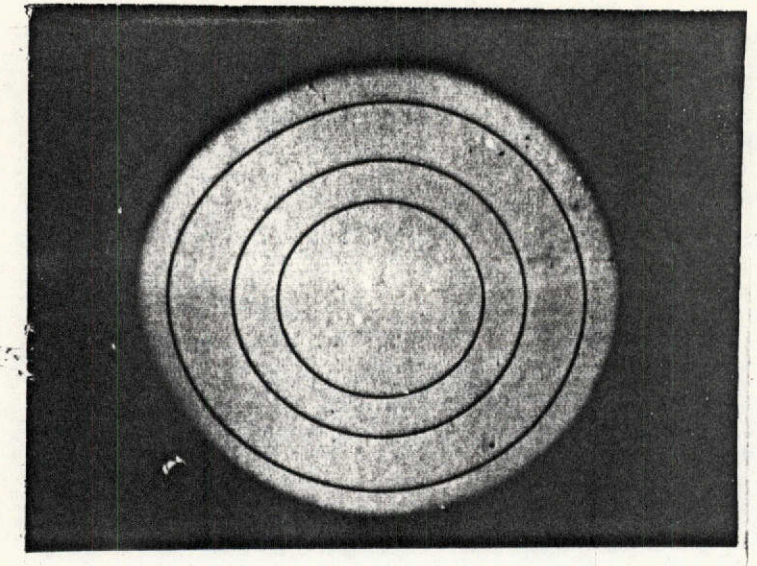
TUBE TYPE WX-32335 TUBE S/N 73 09 429

OPERATING CONDITIONS

E_{G1} -54 V E_{G2} 300 V E_{G3} 75 V E_{G4} 90 V E_{TGT} 12 V E_{FC} -7 kV

E_f 6.3 V

I_{FOCUS} (IMAGE SECTION) 350 mA I_{FOCUS} (SCANNING SECTION) 50 mA



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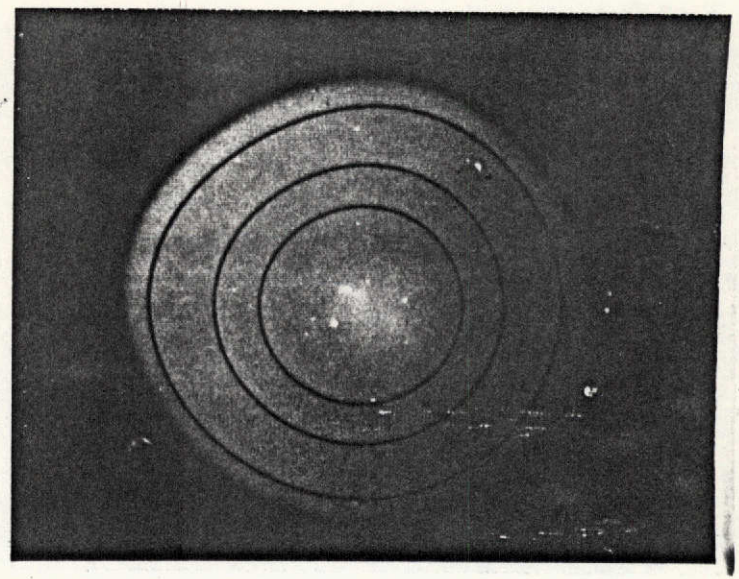


AFTER
ENVIRONMENTAL TESTING

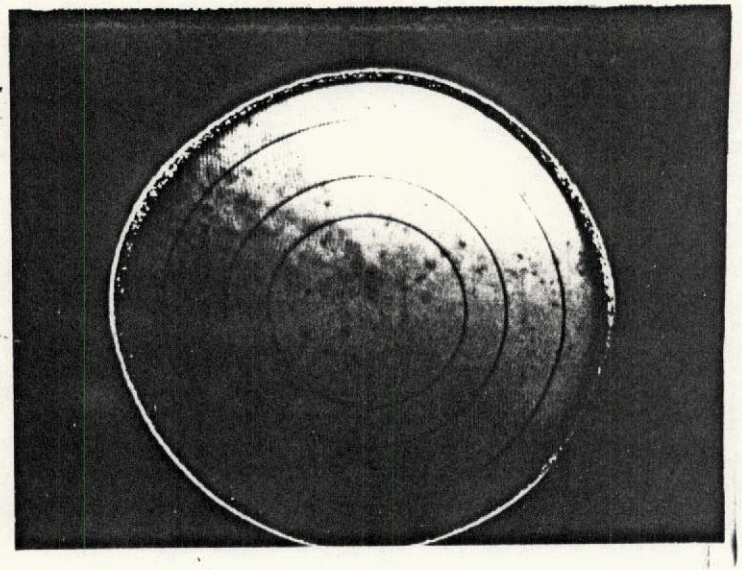
TUBE TYPE WX-32335 TUBE S/N 73 09 430

OPERATING CONDITIONS

E_{G1} -70 V E_{G2} 300 V E_{G3} 66 V E_{G4} 90 V E_{TGT} 20 V E_{PC} -7.3 kV

E_{S} 6.3 V

I_{FOCUS} (IMAGE SECTION) 350 mA I_{FOCUS} (SCANNING SECTION) 50 mA



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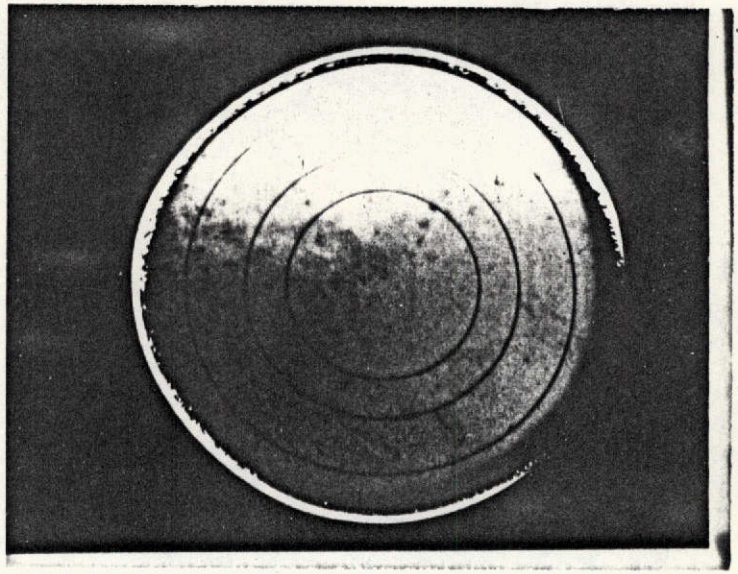


AFTER
ENVIRONMENTAL TESTING

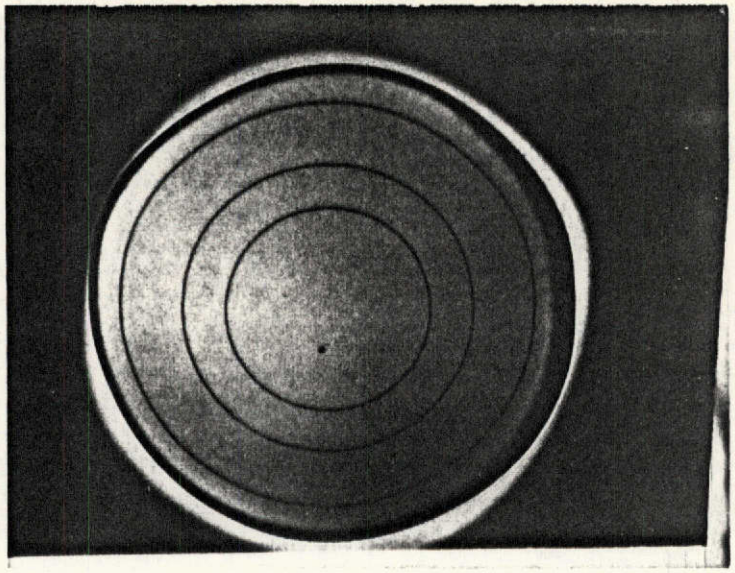
TUBE TYPE WX 32335 TUBE S/N 23 17 353

OPERATING CONDITIONS

E_{G1} -42 V E_{G2} 300 V E_{G3} 70 V E_{G4} 90 V E_{TGT} 12 V E_{FC} -7 kV

E_f 6.3 V

I_{FOCUS} (IMAGE SECTION) 350 mA I_{FOCUS} (SCANNING SECTION) 50 mA



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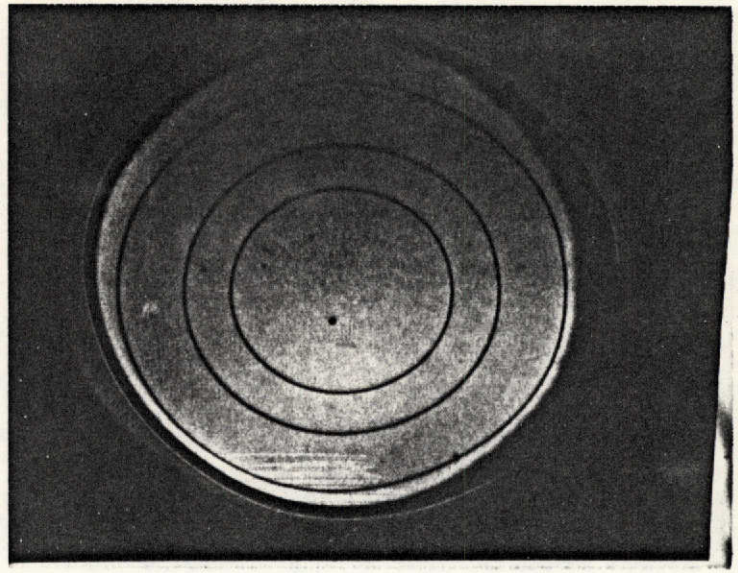


AFTER
ENVIRONMENTAL TESTING

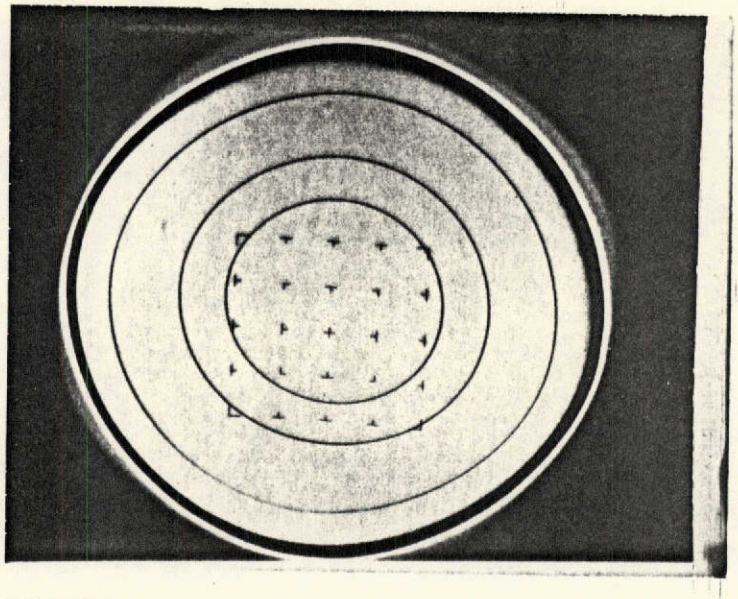
TUBE TYPE WX-32335 TUBE S/N 73 17363

OPERATING CONDITIONS

E_{G1} -20 V E_{G2} 300 V E_{G3} 25 V E_{G4} 90 V E_{TGT} 12 V E_{FC} -7 kV

E_{S} ____ V

I_{FOCUS} (IMAGE SECTION) 350 mA I_{FOCUS} (SCANNING SECTION) 50 mA



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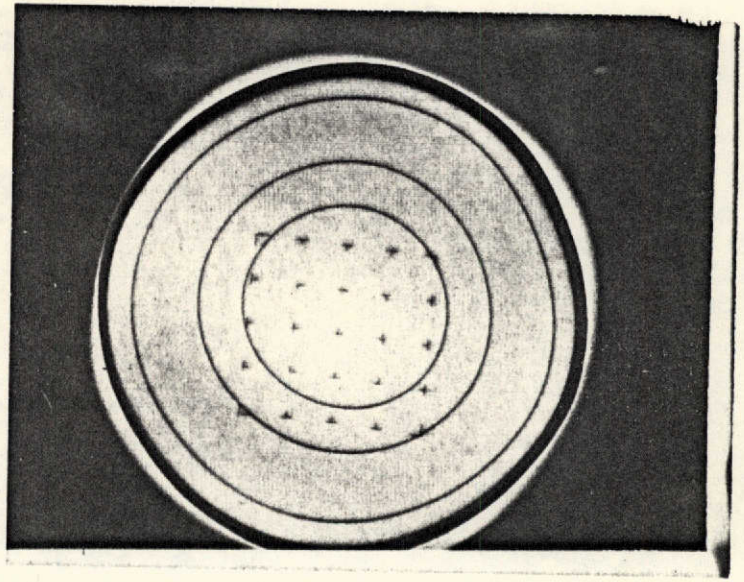

AFTER
ENVIRONMENTAL TESTING

APPENDIX II - VIBRATION FIXTURE

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