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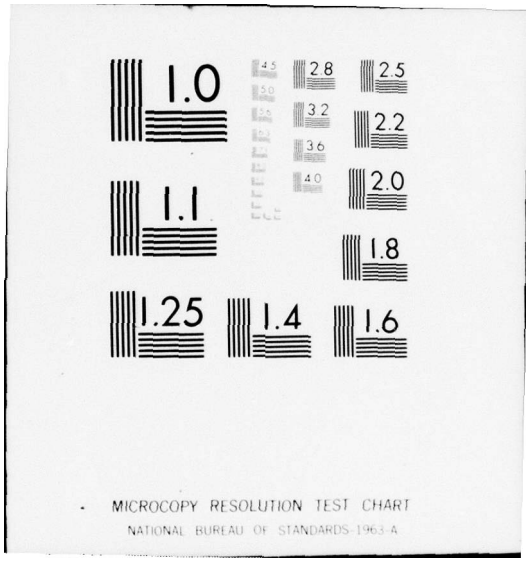
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EVALUATION OF TECHNICAL SPECIFICATIONS IN PURCHASE DESCRIPTION: RADIATION SOURCE, INFRARED FOR SEARCHLIGHT, INFRARED, AN/VSS-3A

Final Technical Report

by

Robert A. Eckel

August 1974

USAMERDC

Attention: AMSEL-NV-SD
Night Vision Laboratory
Fort Belvoir, Virginia 22060

Contract Number DAAK02-74-C-0020

ILC TECHNOLOGY, INC.
164 Commercial Street
Sunnyvale, California 94086

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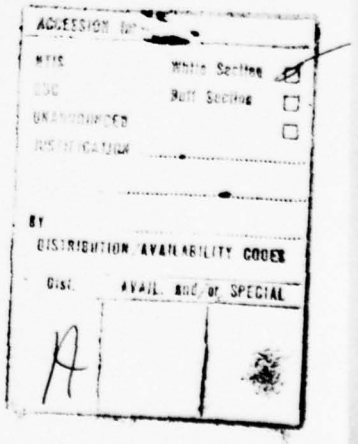

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FOREWORD

The work reported herein was accomplished under Contract Number DAAK02-74-C-0020 for the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Virginia, under the guidance of Mr. William A. Bryant, Contracting Officer's designated representative.

The work was performed in the Engineering Division of ILC Technology, which is under the direction of Dr. I. Reed. Subcontract services were performed by Viking Laboratories, Sunnyvale, California.

Mr. R. Eckel was the principal investigator. Mr. C. Skatell was responsible for assembly of power supply and test fixtures and for testing and measuring lamp performance. Mr. D. Johnson was responsible for fabrication of all lamps.

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1.0 SUMMARY AND CONCLUSIONS

A total of 19 lamps were fabricated during the course of this program. Three of these lamps were considered prototype units and were fabricated for design analysis and for fabrication and test training of personnel.

Sixteen final design Radiation Sources, Infrared (RSI's) were fabricated; of this group six were delivered to the Night Vision Laboratory for their evaluation. Three lamps were tested according to the Quality Assurance Plan of Section 4.0 of the Purchase Description. Four lamps were accidentally broken. The remaining three units either failed physical inpsection tests or were consumed in some other way.

One RSI failed during the shock phase (70.0 g's) of the environmental testing; there is reason to believe this failure was due to human error in not properly securing the RSI in the shock mounting fixture.

All optical requirements of the Purchase Description were met or exceeded initially and throughout the life test of the RSI's.

Electrical performance characteristics were met initially. Only slight variations from the specification arose during the life test schedule.

The mechanical manufacturing requirements of the source control drawing SC-D-646931 were achieved within the standard production yield factors.

Although the requirements of the Purchase Description were met with good yields during the course of this contract, future large volume procurements may not achieve a similar high yield factor. This results from the criticality of cathode processing, and the individual skills required for this operation. Consequently, ILC recommends that a detailed cathode study program be performed by an experienced lamp manufacturer in order to establish a reproducible and deskilled procedure for the processing of cathodes, as will be required for high volume production.

ILC further recommends the investigation of the molybdenum cup hermetic seal for the manufacture of RSI design. Substantial potential cost savings can be expected in high volume production using the cup seal.

Although the requirements of the purchase description have been met under ideal laboratory conditions, actual performance under the continued and severe environments encountered in field operation may greatly affect lamp life.

ILC therefore recommends that the specifications be adopted after actual field testing has been carried out.

2.0 INTRODUCTION

The purpose of this program was the evaluation of the technical specifications in the purchase description· Radiation Source, Infrared for Searchlight, Infrared, AN/VSS-3A, dated 1 March 1973, and the adjunct drawing SC-D-646931, "RSI, Xenon Short Arc, 1 kW." The technical specifications of the purchase description were developed at a Joint Government-Manufacturers Conference held at Fort Belvoir, Virginia in December 1972.

2.1 Objectives

The principal objective of the evaluation program was determination of suitability of the Purchase Description, as written, to provide an accurate specification for procurement of RSI, Xenon Short Arc devices. Although all mechanical requirements of the drawing SC-D-646931 were maintained during fabrication of the lamps, emphasis during the lamp performance evaluation was mainly concerned with electrical and optical performance.

2.2 Approach

The approach delineated in the contract provided for IIC to design and fabricate 10 RSI's and test certain electrical and optical parameters. After inspection of these units at IIC by the Contracting Officer's Designated Representative, seven units were to be shipped to Fort Belvoir for Government testing, and the remaining three units were to be submitted to the full extent of testing as provided for in the Purchase Description, Section 4.0 - Quality Assurance Provisions. Upon completion of all tests on all three lamps per Section 4.0, one lamp was to be operated for an additional 200 hours life test. Final lumen output measurements were taken at the conclusion of all testing.

After award of the contract the Government requested a change in scope of the required test plan, the deletion in its entirety of Paragraph 3.6.10,

the Electromagnetic Compatibility requirement, and the Quality Assurance plan of Paragraph 4.6.11. In consideration, ILC agreed to provide additional monitoring, at 50 hour intervals, of the arc brightness of the three RSI's tested at ILC.

All test and evaluation lamps fabricated on this program were manufactured according to standard ILC procedures so as to be representative of products manufactured in volume production.

3.0 BACKGROUND

The 1 kW Army searchlight design can be traced back to about 1967. Since then only interim Purchase Description or Product Specification documentation has existed. Potential manufacturers of the searchlight were required to purchase xenon arc lamps according to the existing specification for the 2.2 kW xenon short arc lamp but with reduced power requirements. Under these circumstances, the searchlight manufacturers matched lamps to the requirements of their own specific design. As a result of many long years of close working relationships between various lamp and equipment manufacturers, lamps evolved to meet the requirements of each searchlight design, but these lamps would not meet the slightly different circuits of other present and potential manufacturers of searchlights. It became apparent that a severe logistics problem could result in the future. To eliminate a possible future problem, a separate lamp specification is needed. To achieve this end, a purchase description of a one kilowatt lamp was prepared as noted in Section 2.0. It is this Purhcase Description dated 1 March 1973, to which this program and final technical report are directed.

4.0 LAMP DESIGN AND CONSTRUCTION

Because of the severe environmental shock and vibration requirements of the RSI Purchase Description, a molybdenum foil seal construction was chosen for the basic design of the lamp. This particular hermetic seal design permits "hard" mounting of the electrode structures in the quartz body of the lamp, improving the integrity of the lamp under severe shock and vibration. The basic feature of the molybdenum foil seal is illustrated in Figure 1.

Although other seal designs, cf., the molybdenum cup seal,* might also meet the shock and vibration requirements, funding limitations precluded the development of them. It is expected that the successful development of a molybdenum cup seal would significantly reduce the cost of lamp manufacture in volume procurement.

The envelope configuration of the ILC design is presented in Figure 2, and is fully responsive to the requirements of the design control drawing SC-D-646931. The lamp envelope was fabricated from Amersil clear fused quartz. The lamp bases were machined from free machining brass and were nickel plated. The bases were attached with #1 Sauereisen Cement. Glastic insertion pins were cemented in the cathode base with adhesive 2214. The final lamp assembly was filled to approximately seven atmospheres (absolute) with xenon gas, after being thoroughly pumped and processed at elevated temperatures. The electrode design will be discussed later in this report.

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* The molybdenum cup seal is a recent innovation in high power lamp design. The seal is made from a molybdenum cup, which is vacuum shrunk to provide a hermetic seal at the open end of the cup. In this configuration the hermetic seal is not part of the electrical current path; and, therefore, ohmic heating losses are not encountered as in the molybdenum foil seal since a heavy conductor, via the closed end of the cup, is used to carry the high currents to the lamp electrodes. ILC has been active in the development and application of this seal design and presently employes it in many standard products.

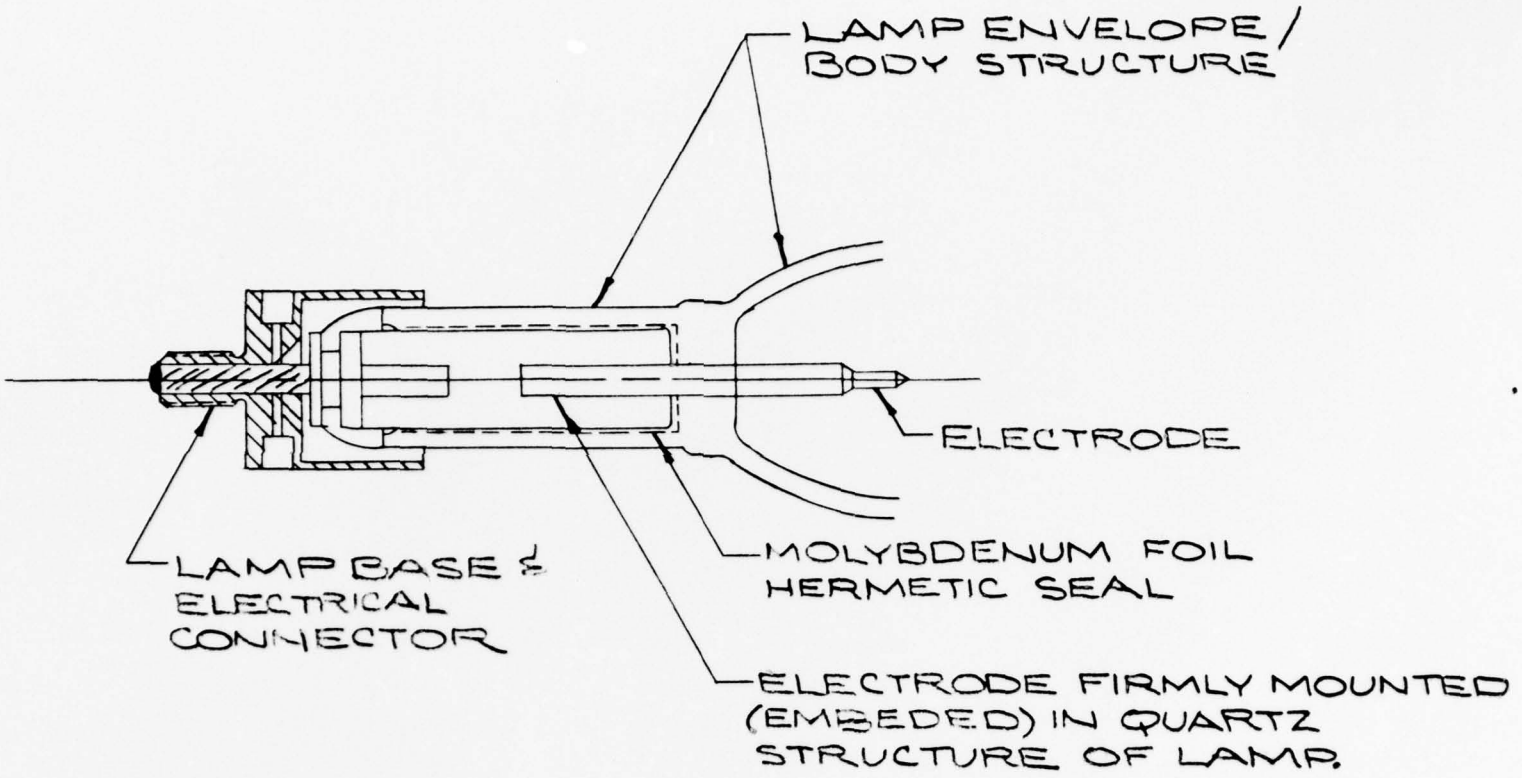

FIGURE 1 MOLYBDENUM FOIL SEAL STRUCTURE

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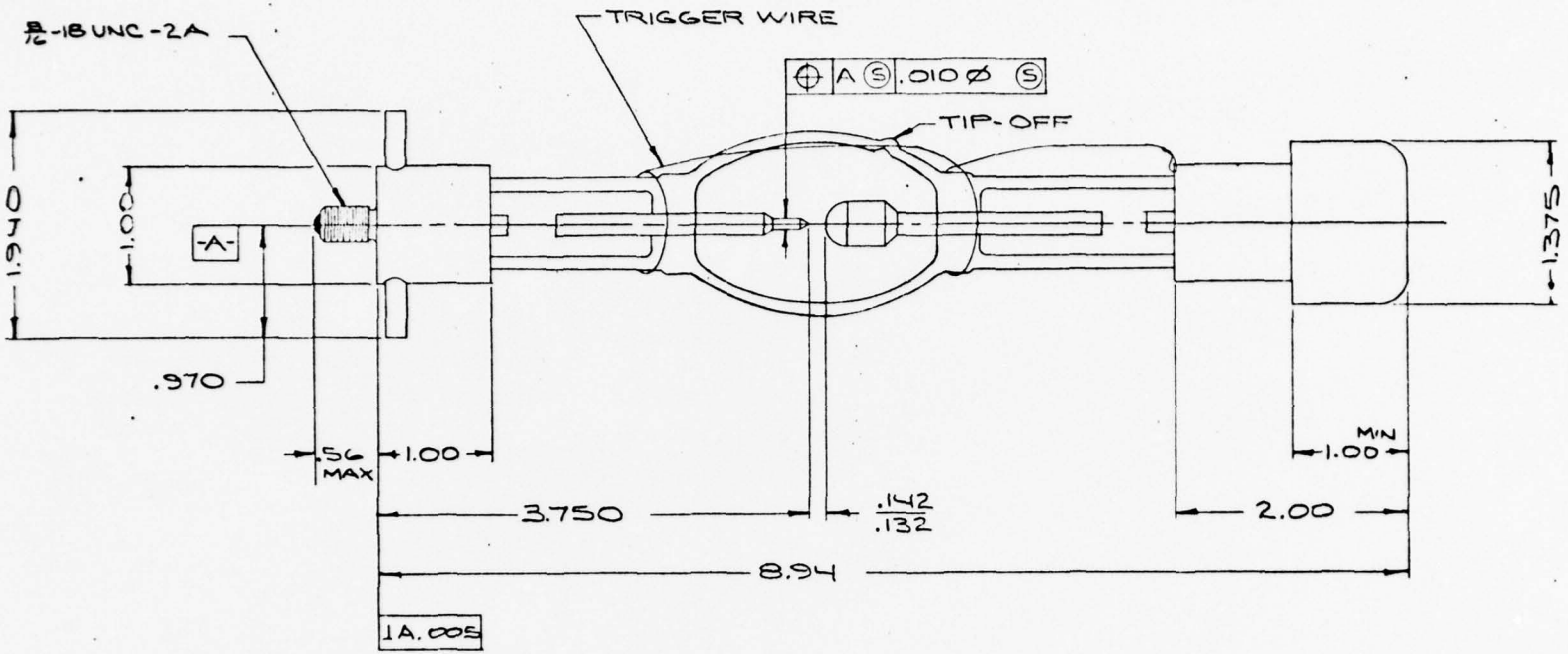

FIGURE 2 ILC RSI DESIGN

5.0 ELECTRICAL DESIGN REQUIREMENTS

5.1 Lamp Requirements

The electrical requirements of Paragraph 3.6.1 of the Purhase Description impose critical demands on the voltage-current characteristics of the RSI. Figure 3, presents a plot of the required V-I curve and the limits of lamp operating voltage. As is illustrated, the voltage-current relationship requires a slope of 0.14 from an operating current of 24 amperes to 47.5 amperes with a voltage spread of 2 volts at the low end and a spread of only 1.3 volts at the upper end. This electrical requirement and the necessary allowable tolerance for electrode arc space setting (0.010 inch) represented a major challenge to the electrode design and fill pressure manipulation. The author's experience is that a cold fill pressure of xenon above 8 atmospheres absolute represents a severe safety hazard and should be avoided if possible although certain optical efficiency improvements could be obtained with higher pressures. A suitable electrode configuration design was developed to provide the necessary fill pressure/operating pressure gradient over the operating power range of the required RSI evaluation without exceeding this 8 atmosphere fill limit.

The particular electrode-envelope design was verified with the fabrication of several early prototype lamps at the beginning of the program.

5.2 Power Supply Design

In order to provide the starting and operating electrical parameters required for complete evaluation of RSI performance, a power regulator circuit was constructed. The circuit design, employed for all electrical evaluation measurements, is illustrated in Figure 4.

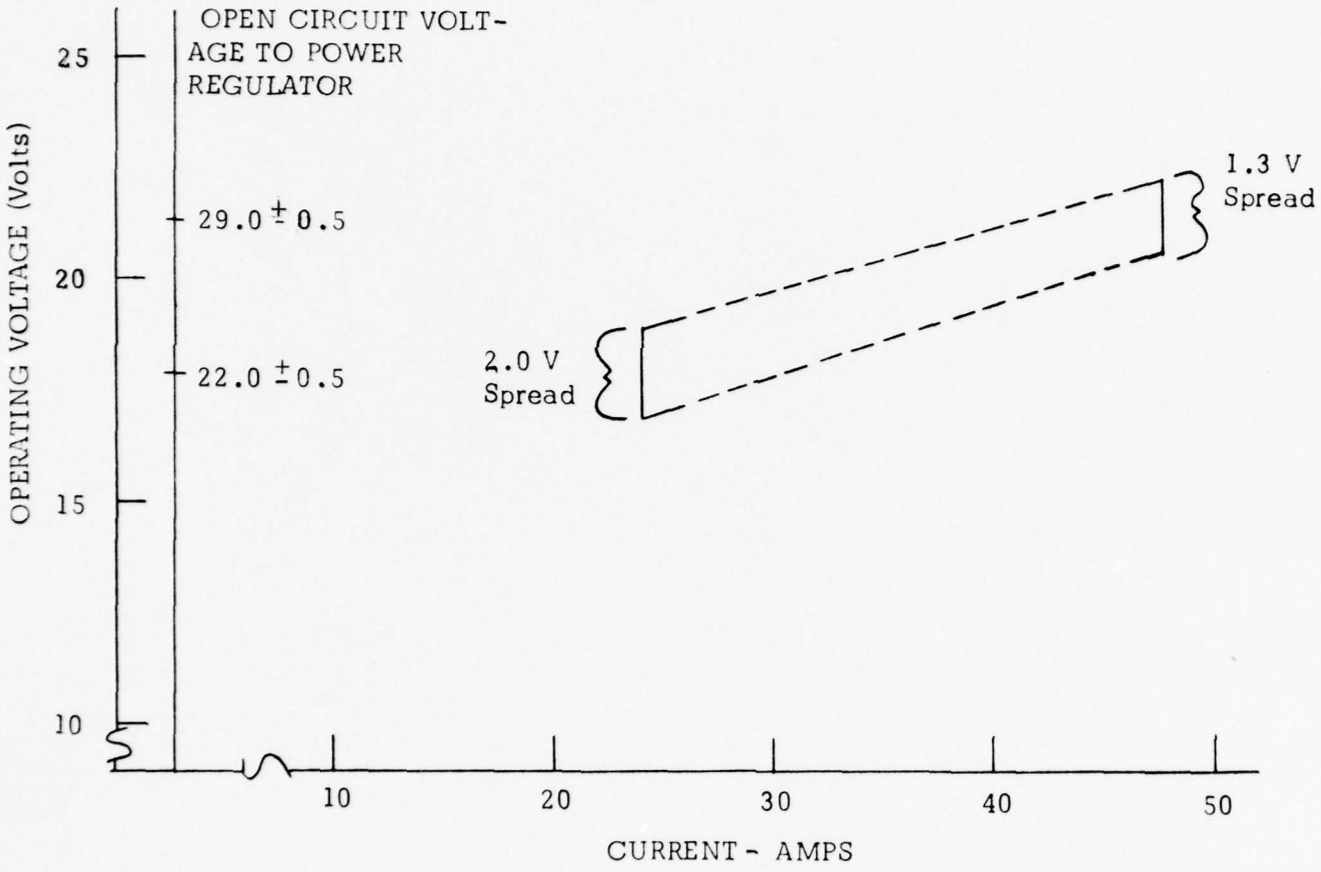

FIGURE 3 - RSI V-I REQUIREMENTS

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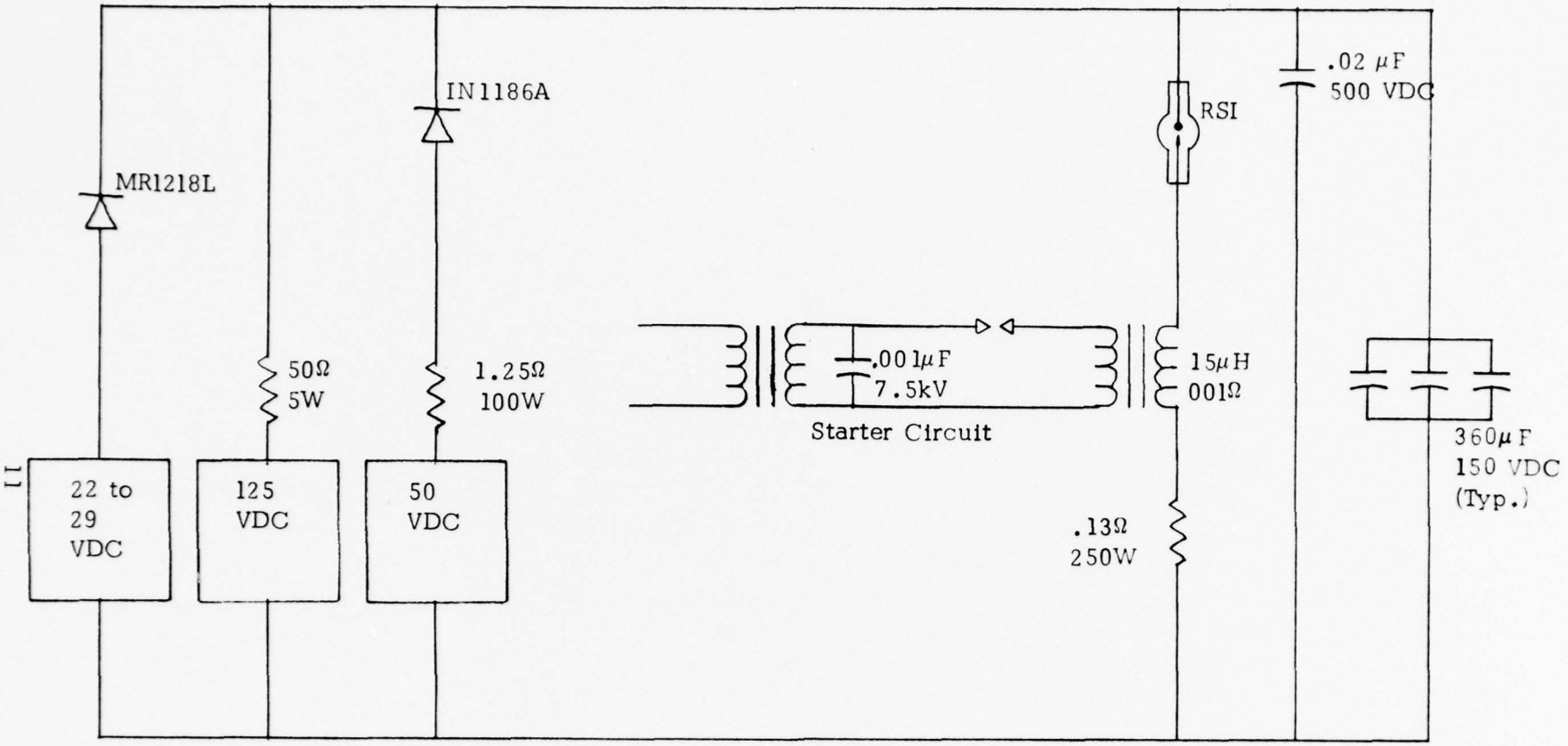

FIGURE 4 RSI POWER REGULATOR DESIGN

6.0 TEST FIXTURES

ILC constructed two test fixtures (see Figure 5), similar in design to Figure 1 of the Purchase Description, for operational testing of all lamps. Each fixture was attached to a blower fan; air speed was measured with a series anemometer, and a variable exit port valve was adjusted to the exact air cooling volume as provided in Paragraph 4.6 of the Purchase Description, i.e., 37 ± 0.5 cm was measured with a water manometer. One fixture was provided to our environmental testing subcontractor. Upon completion of the environmental tests this fixture was returned to ILC for life testing of RSI's.

Quartz bulb quality (Para. 4.6.1) was measured by means of a modified rotary indexing table and rear projection light. This unit was adapted with both a RSI mounting fixture so that the 360° rotation about the longitudinal centerline could be achieved. Azimuthal rotation was accomplished by turning the rotational control of the indexing table. In addition to the RSI mounting fixture, a special lamp envelope examination fixture was fabricated to allow evaluation of the envelopes prior to fabrication of the RSI. In this fixture (see Figure 6) a simulated cathode tip was precisely positioned within the open lamp body. The test procedure of Paragraph 4.6.1 were performed on lamp envelopes in this fixture to eliminate lamp rejections by this test after completion of the entire RSI.

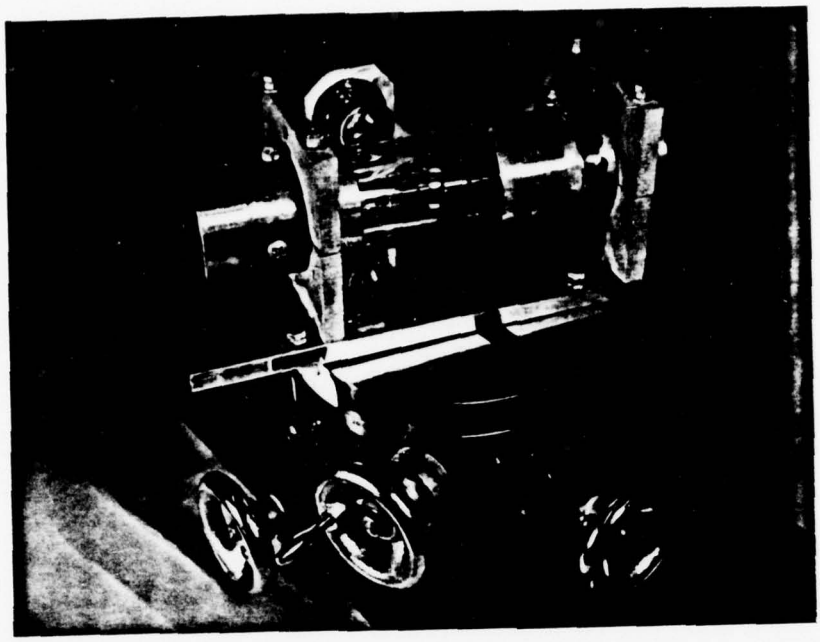

FIGURE 5 LAMP TEST FIXTURE

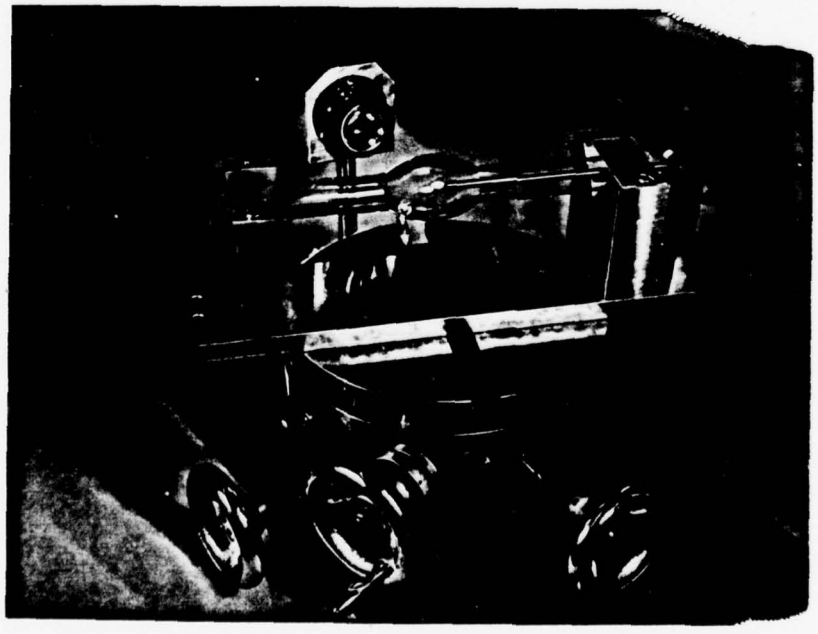

FIGURE 6 LAMP ENVELOPE QUALITY EVALUATION FIXTURE

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7.0 TEST PROGRAM

The program employed at ILC for the contract as awarded was divided into two phases: (1) Design and Development, and (2) RSI Evaluation.

7.1 Design and Development Phase

Phase One of the program was concerned with the establishment of the design for meeting the various RSI electrical and optical requirements. The electrical V-I characteristics required of the RSI were verified during this phase of the program, prior to fabrication of the final and deliverable units. In addition, both brightness and initial lumen output verifications were conducted at this time. A second and equally important objective of this initial phase was the training of assembly and test technicians. During this period the exact fabrication procedures for meeting the mechanical tolerances were established.

7.2 RSI Evaluation Phase

In Phase Two of the program ILC performed and/or had performed all tests of Section 4.0 of the Purchase Description (except as deleted by the Government, see Section 2.2). All tests were conducted per the requirements and procedures of the Purchase Description. At the request of Mr. William Bryant, the Contracting Officer's Designated Representative, the sequence of the scheduled tests was not conducted in the order prescribed; this was done so that Mr. Bryant could witness what he felt were the most critical tests. The data to be presented in the next section will follow the testing order of the Purchase Description.

8.0 RSI TESTS, PERFORMANCE, AND EVALUATION

8.1 Phase One - Design and Development

Three RSI's were fabricated during the Design and Development Phase of the program. No formal documentation is presented on these lamps. As discussed above, these lamps were used for evaluating and verifying certain design parameters.

8.2 Phase Two - RSI Purchase Description Evaluation

Sixteen RSI's were fabricated during the second phase of the program. The RSI's were serialized one to seventeen, (#13 serializing tag was damaged and discarded). Thirteen lamps were initially constructed (#'s 1 through 14) for the evaluation of the Purchase Description. All these lamps were submitted to Mr. William Bryant for his inspection at ILC. These lamps were inspected for workmanship, mechanical compliance with drawing SC-D-646931, and Quartz Bulb quality. The data taken from these examinations is given in Table I.

Four of this group were shipped to the Night Vision Laboratory; three were submitted to testing at ILC according to the Purchase Description; one RSI was ignited with the wrong polarity and destroyed due to cathode tip burn back; one RSI exploded, and four RSI's were accidentally broken.

Three additional RSI's were fabricated to complete delivery of seven units to the Night Vision Laboratory; one of these three final units had a defective anode base alignment and was not shipped.

8.2.1 Mechanical Dimensions

An examination of mechanical dimension of the RSI's show only three deviations from the required tolerances. Two of these occur in the cathode tip to cathode base measurement and one, #15, occurred in the cathode tip TIR measurement (0.005 inches over maximum allowable tolerance).

TABLE I

MECHANICAL AND OPTICAL PARAMETER

RSI S/N	Arc Gap (0.142/0.132) inches	Cath. Tip-Base (3.760/3.740) inches	End/End (8.97/8.91) inches	TIR (0.010) inches	Bulb Quality	Defects	Disposition
			First Group				
001	0.138	3.747	8.934	0.005	OK	None	Anode base broke during shock testing
002	0.137	3.735	8.924	0.007	OK	None	Shipped to NVI
003	0.138	3.730	8.938	0.004	OK	None	Tested at ILC to 300 hours Exploded 308 hrs.
004	0.135	3.749	8.946	0.008	OK	None	Shipped to NVI
005	0.138	3.742	8.933	0.006	OK	None	Shipped to NVI
006	0.139	3.750	8.945	0.010	OK	None	Tested at ILC to 532 hours
007	0.141	3.750	8.958	0.008	OK	None	Broken in transit
008	0.138	3.745	8.938	0.008	OK	None	Broken in transit
009	0.140	3.741	8.934	0.005	OK	None	Broken in transit
010	0.139	3.750	8.937	0.006	OK	None	Exploded during test
011	0.137	3.755	8.933	0.008	OK	None	Shipped to NVI
012	0.138	3.746	8.932	0.007	OK	None	Operated wrong polarity
014	0.138	3.740	8.956	0.004	OK	None	Broken in transit
			SECOND GROUP				
015	0.138	3.725	8.950	0.015	OK	Anode Base Askew	Scrapped
016	0.133	3.750	8.944	0.008	OK	None	Shipped to NVI
017	0.136	3.750	8.926	0.008	OK	None	Shipped to NVI

All RSI's passed the quartz bulb inspection requirement of Paragraph 4.6.1.
Conclusion: Only minor mechanical discrepancies existed; during volume production these discrepancies would fall within a reasonable production yield factor.

8.2.2 Quartz Envelope Quality

No completed RSI failed to meet the quartz bulb shadowgraph optical quality requirement.
Conclusion: Envelope optical quality presents no problems.

8.2.3 Electrical Ignition and Operating Characteristics

Table II presents the electrical ignition and operating characteristics of RSI's per the requirements of paragraph 4.6.2 of the Purchase Description. The ten lamps evaluated, only one RSI voltage measurement was not within the voltage limits at the upper end of the required voltage-current characteristics curve. This particular RSI showed somewhat unstable operation, and later exploded with less than five hours operating time.
Conclusion: Electrical ignition and operating characteristics appear to present no major problem. The discrepancy is within a reasonable production yield factor.

8.2.4 Brightness

RSI brightness values were determined from foot-candle measurements with a calibrated detector exhibiting a photopic response. Nine measurements were taken within the projected arc image and these values were averaged to provide an average foot candle value. This value was converted to arc brightness through the equation (1)*

$$B = \frac{4ES^2}{T\pi D^2} \approx \frac{4(17.58)^2}{0.93(3.14)(20)^2} E = 1.06E \text{ cd/mm}^2$$

* See references

TABLE II ELECTRICAL IGNITION AND OPERATING CHARACTERISTICS OF RSI's PER PARA. 4.6.2

RSI S/N	Input Volts	Start	I_o Amps	V_o Volts	Input Volts	I_o' Amps	V_o' Volts	Start	Input Volts	Start
001	22	yes	24.0	17.6	28.5	47.5	20.8	yes	22.0	yes
002	"	"	"	17.9	"	"	20.9	"	"	"
003	"	"	"	17.7	"	"	20.8	"	"	"
004	"	"	"	17.6	"	"	21.1	"	"	"
005	"	"	"	18.0	"	"	21.1	"	"	"
006	"	"	"	18.6	"	"	21.1	"	"	"
010	"	"	"	17.8	"	"	20.3	"	"	"
011	"	"	"	18.1	"	"	21.0	"	"	"
016	"	"	"	17.6	"	"	20.9	"	"	"
017	"	"	"	18.5	"	"	21.1	"	"	"

where S is the distance in feet from the arc to the arc image
E is the image illumination in foot candles
T is the imaging lens transmission
D is the lens stop diameter in millimeters, and
B is brightness in candelas per square millimeter

Table III is a tabulation of both the peak brightness and the average brightness for nine RSI's tested. The E distributions for seven of these RSI's are given in Figures 7 through 13 (two E distributions not presented here are given later in the life test evaluation). As can be noted from the data, the average value for the average brightness of nine RSI's measured is 494 candelas per square millimeter, as compared to the PD requirement of 400 candelas per square millimeter.
Conclusion: All RSI's met or exceeded the required arc brightness.

8.2.5 Lumen Output

Lumen output determination of 10 RSI's is presented in Table IV. These measurements were made using ILC's five foot integrating sphere calibrated with a standard tungsten lamp (traceable to NBS). The sphere calibration was 1689 lumens per 1 mV detector reading. The average initial lumen output value for the RSI's test was 33,830 lumens, as compared to a required value of 30,000 lumens per the Purchase Description.
Conclusion: All RSI's met or exceeded the required lumen output.

8.2.6 Mechanical Shock

Mechanical shock and all other environmental testing was performed by and at Viking Laboratories, Sunnyvale, California. A copy of the Test Letter Report, 30353, is included in Appendix I at the end of this report.

TABLE III RSI BRIGHTNESS DETERMINATION

RSI S/N	E (Peak) Ft-cd	B (Peak) cd/mm^2	E (Avg.) Ft-cd	B (Avg.) cd/mm^2
002	1130	1198	467	495
003	1175	1245	462	490
004	1080	1145	468	496
005	1080	1250	416	441
006	1180	1250	433	459
010	980	1039	452	479
011	1380	1463	493	523
016	1080	1145	494	524
017	1180	1250	513	543

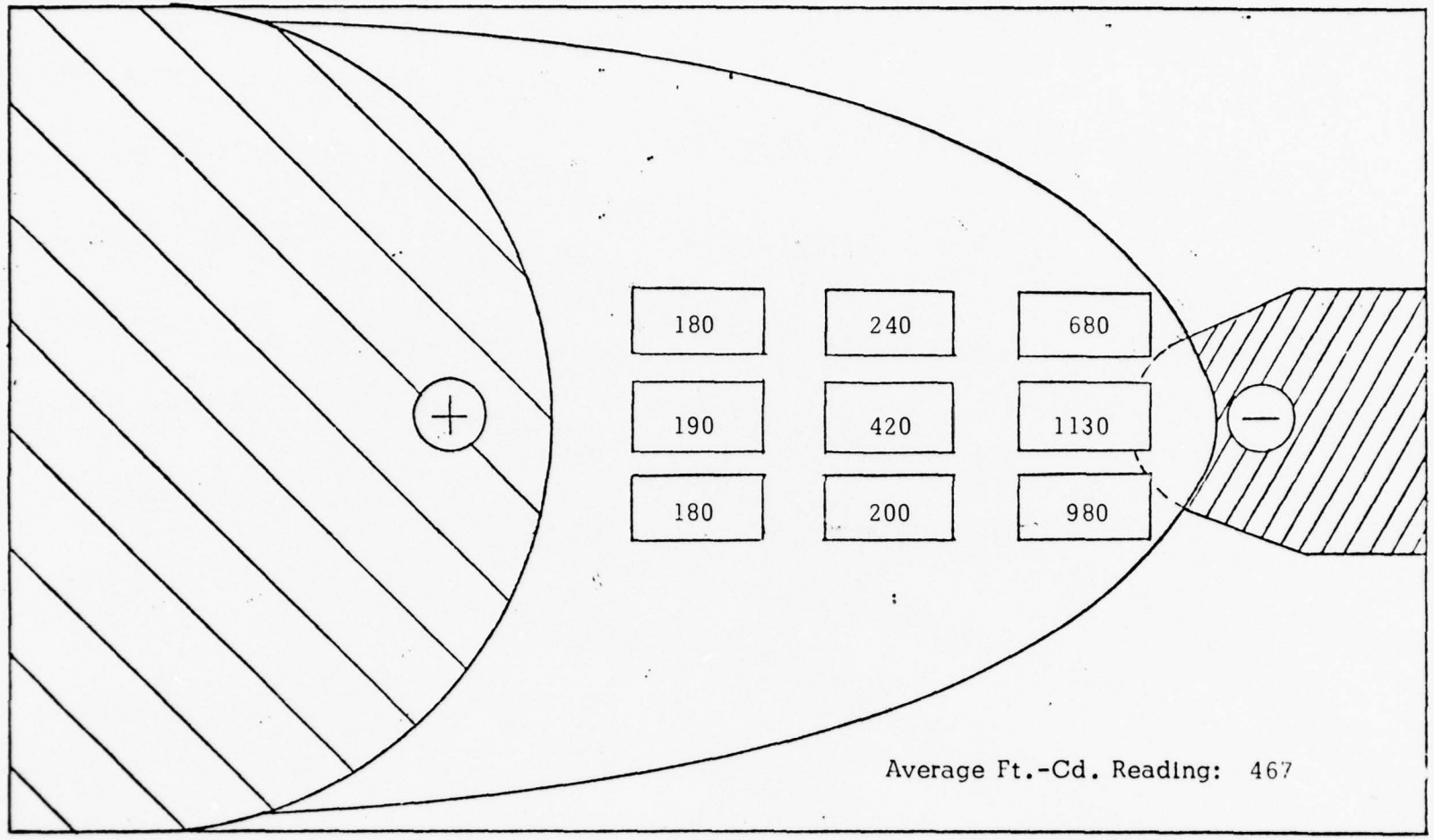

FIGURE 7, E-DISTRIBUTION FOR RSI S/N 2

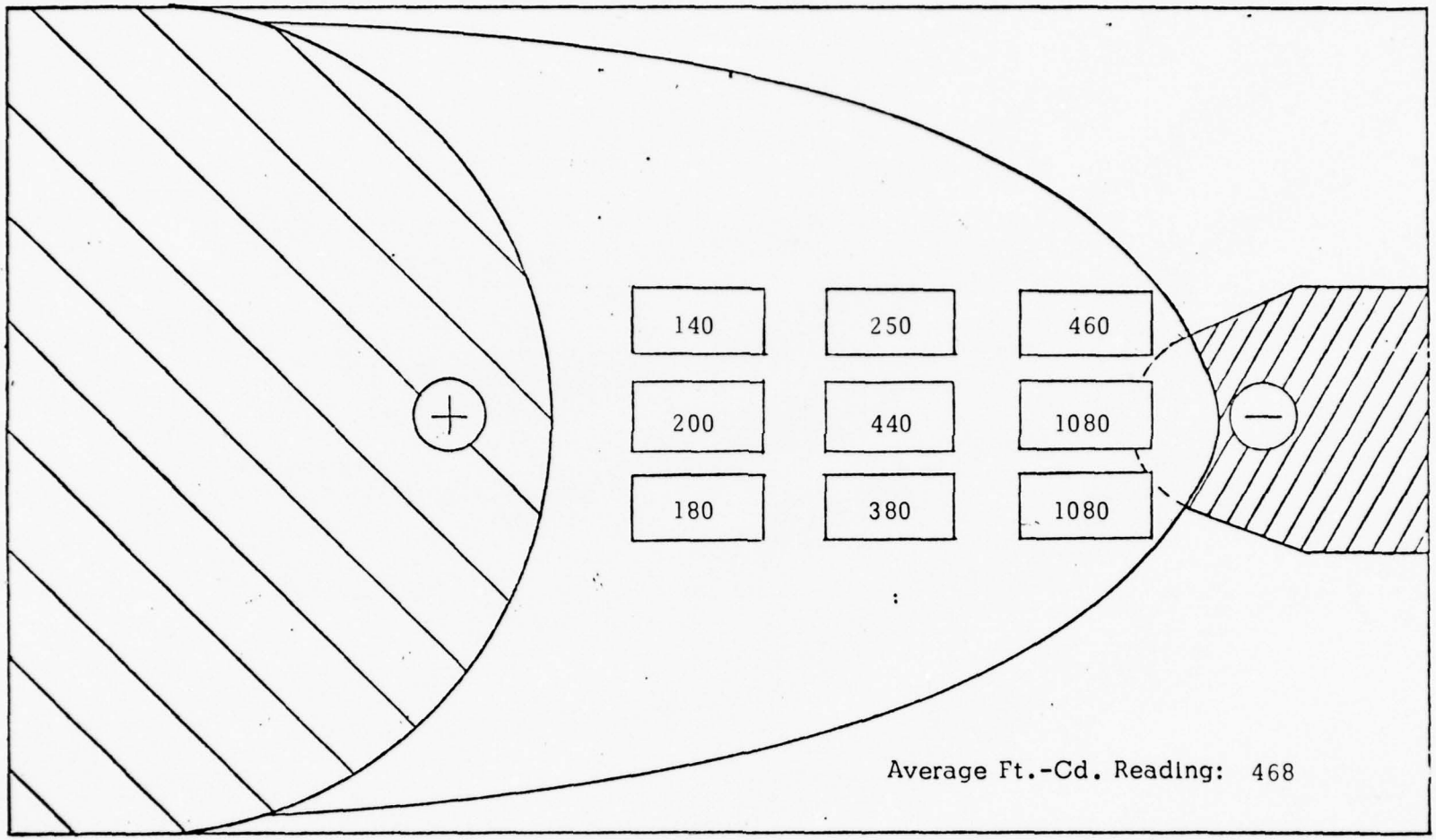

FIGURE 8, E-DISTRIBUTION FOR RSI S/N 4

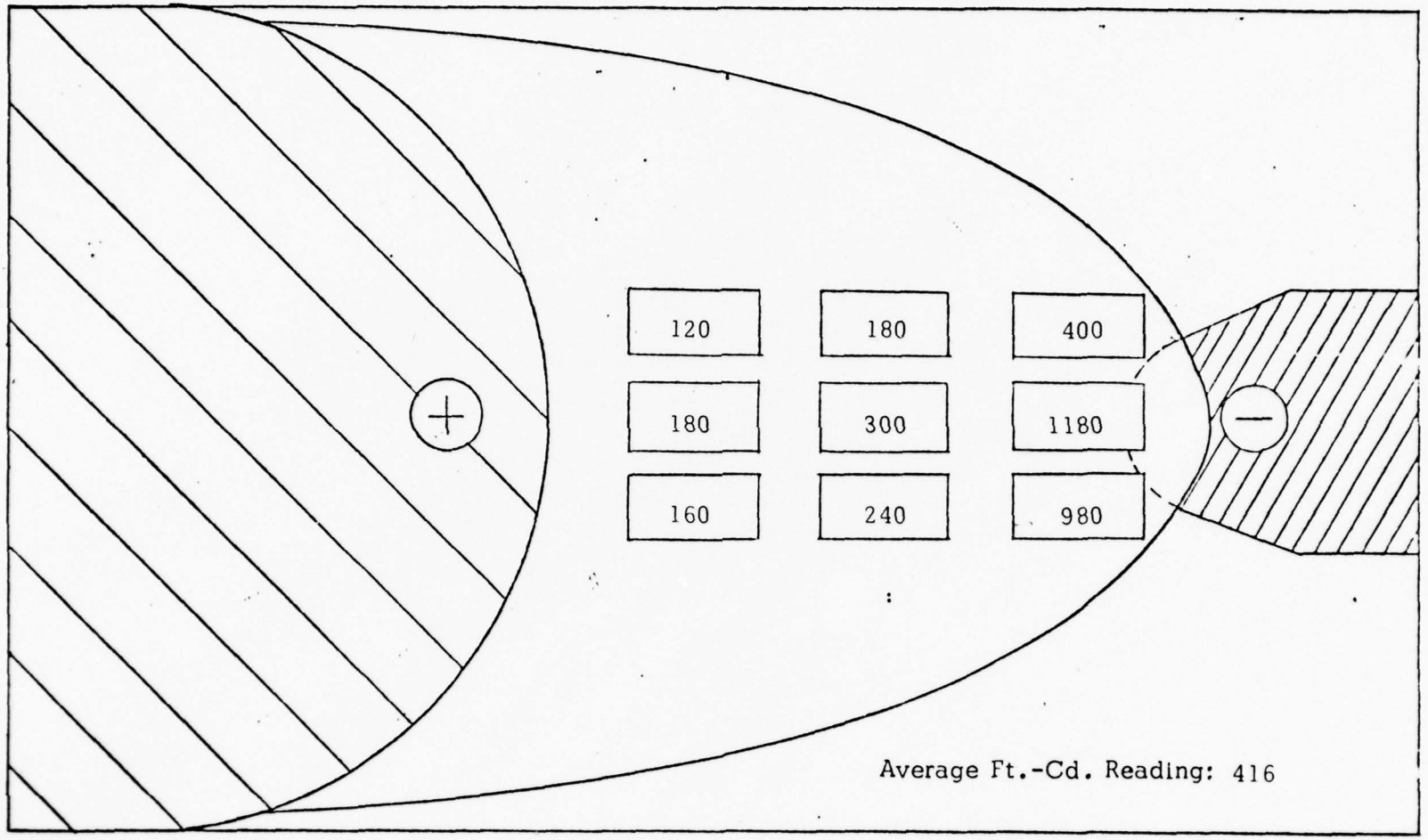

FIGURE 9, E-DISTRIBUTION FOR RSI S/N 5

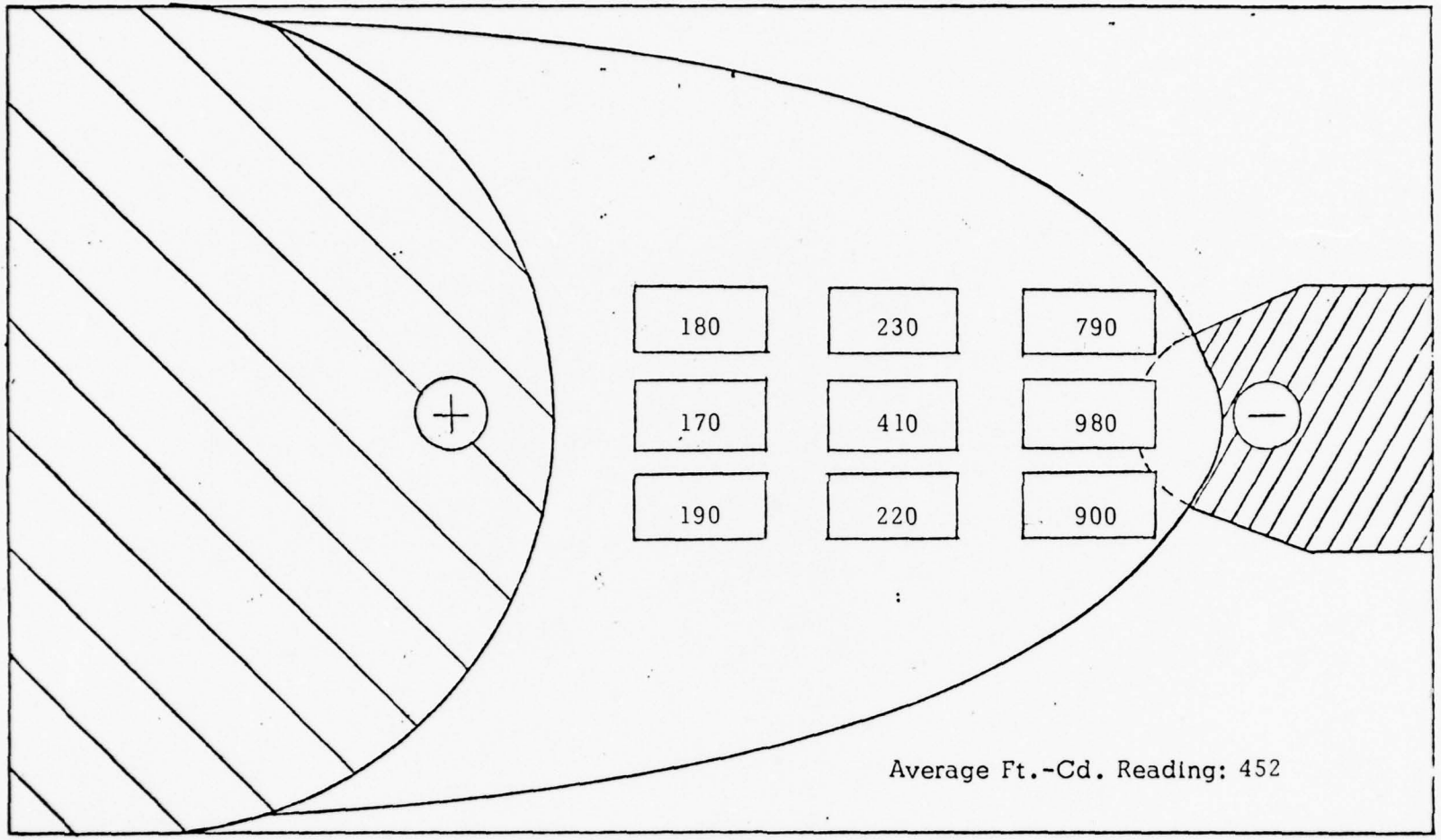

FIGURE 10, E-DISTRIBUTION FOR RSI S/N 10

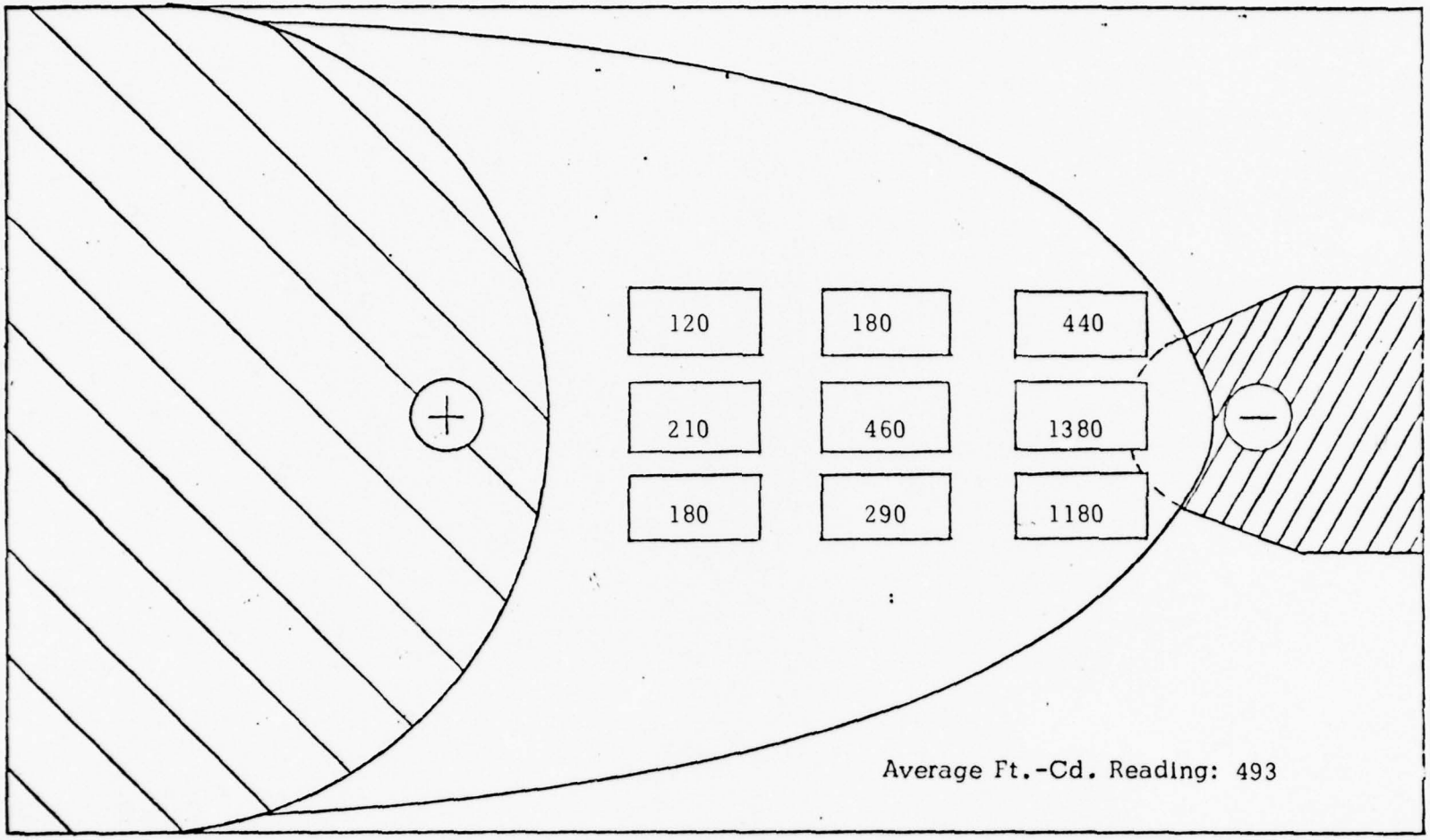

FIGURE 11, E-DISTRIBUTION FOR RSI S/N 11

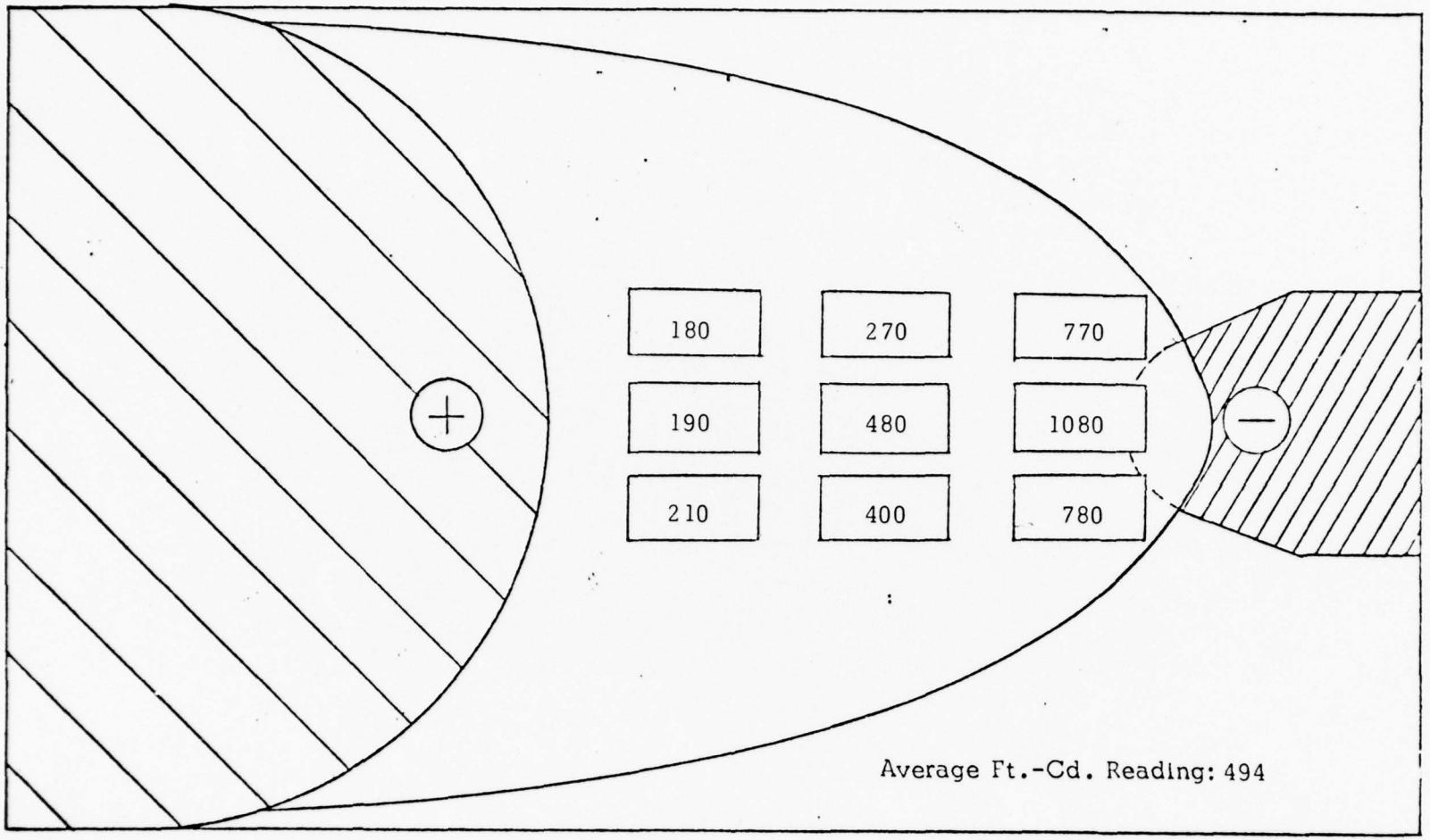

FIGURE 12, E-DISTRIBUTION FOR RSI S/N 16

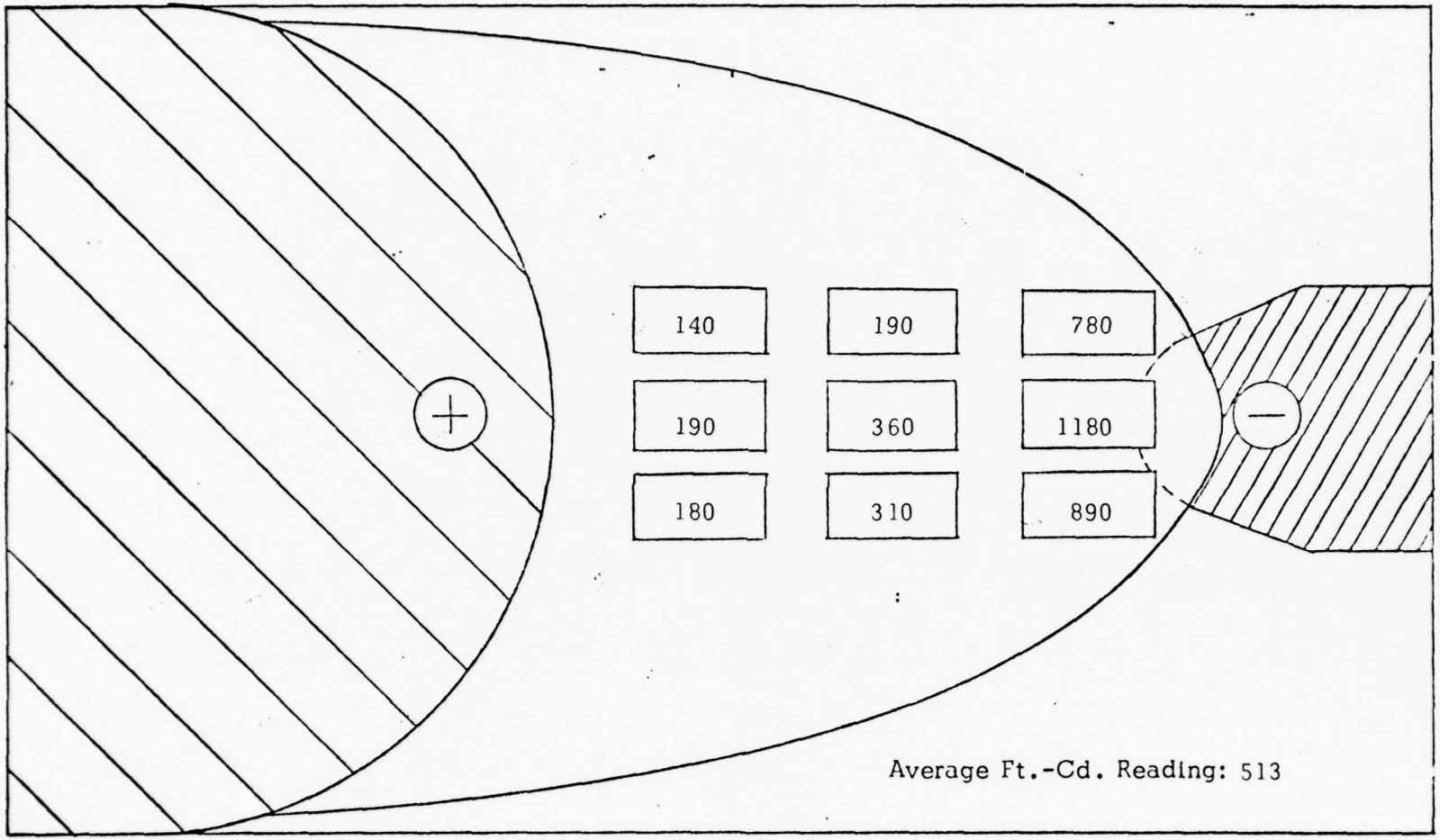

FIGURE 13, E-DISTRIBUTION FOR RSI S/N 17

TABLE IV

LUMEN OUTPUT MEASUREMENTS

		0 Hours	100 Hr		300		500	
RSI S/N	MV Read	Lumen Output	MV	Lumen Output	MV	Lumen Output	MV	Lumen Output
001	20.0	33780						
002	19.5	32935						
003	19.5	32935	17.1	28880	17.0	28710		
004	20.0	33780						
005	20.0	33780						
006	20.0	33780	17.0	28710	16.5	27870	15.4	26010
010	19.5	32935						
011	21.0	35470						
016	20.5	34625						
017	20.3	34285						

SPHERE CALIBRATED, 1 MV = 1689 LUMENS

Test details can be found in this report of Viking Laboratories. The environmental testing performed at Viking was witnessed by Mr. William Bryant.

Conclusion: Two of the three units performed satisfactorily during shock testing. The third, RSI S/N 001, failed the shock test after the first cycle of shocks parallel to the axis of the electrodes. Although not brought out in the Viking Report, the mounting fixture was subjected to frequent arc breakdown during ignition. Consequently the mounting fixture was removed and replaced to reinforce insulation during each cycle. There is reason to believe that during the last remounting the lamp was not properly secured in the test fixture, and failure was caused by loose mounting.

8.2.7 Vibration

Conclusion: All RSI's subjected to the vibration requirements of the Purchase Description performed satisfactorily.

8.2.8 Storage and Operation

Conclusion: All RSI's subjected to storage and operation at both low and high temperatures performed satisfactorily.

8.2.9 RSI Life

Due to the failure of one unit during the environmental shock testing only two RSI's were available for life testing. This test provided for an ignition and operation cycle of 50 minutes followed by an off time of 10 minutes. Per a contract change after award of the contract, RSI life was measured by means of brightness determinations at 50 hour intervals. Upon completion of the 300 hour life test requirement of the Purchase Description, one RSI was operated for an additional 200 hours with the brightness being monitored during this time. To shorten the time

required to accumulate the additional 200 hours Mr. Bryant agreed that twenty-four hour continuous operation would be allowed as long as the required number of starts for each fifty minute operation was made up during regular working hours.

Table V presents a tabulation of the RSI brightness measurements as a function of time for the two units. Figure 14 is a plot of the data given in Table V. Figures 15 through 33 present the E distributions for the life test RSI at the 50 hour intervals. It should be noted that the accuracy of interval is within plus or minus 5 hours of the stated interval time.

The output of the two RSI's life tested, Table IV, after 300 hours exceeds the 24,000 lumen required value.

Table VI presents the required input voltage to the power regulator necessary to ignite the RSI during the life test sequence, and the operating voltage measurements at various times during the life test. Conclusion: Both lamps life tested meet the minimum lumen output requirement of the Purchase Description.

8.2.10 Altitude Test

All RSI's subjected to this test met the required Purchase Description specification. This test was performed and witnessed at Viking Laboratories by Mr. Bryant.

8.2.11 Altitude Transportation

All RSI subjected to this test met the Purchase Description requirement.

8.2.12 Electromagnetic Compatibility

This test was deleted from the test sequence requirements by a contract change order.

TABLE V

LAMP BRIGHTNESS DURING LIFE TEST

Hours Brightness (cd/mm^2)		HOURS OPERATED											
		0	50	100	150	200	250	300	350	400	450	500	532
RSI S/N 003	Avg.	490	422	416	420	415	395	414					
	Peak	1245	825	848	827	805	769	816					
RSI S/N 006	Avg.	459	443	439	430	429	420	419	421	371	360	349	349
	Peak	1180	1060	864	890	795	822	822	795	715	742	742	768

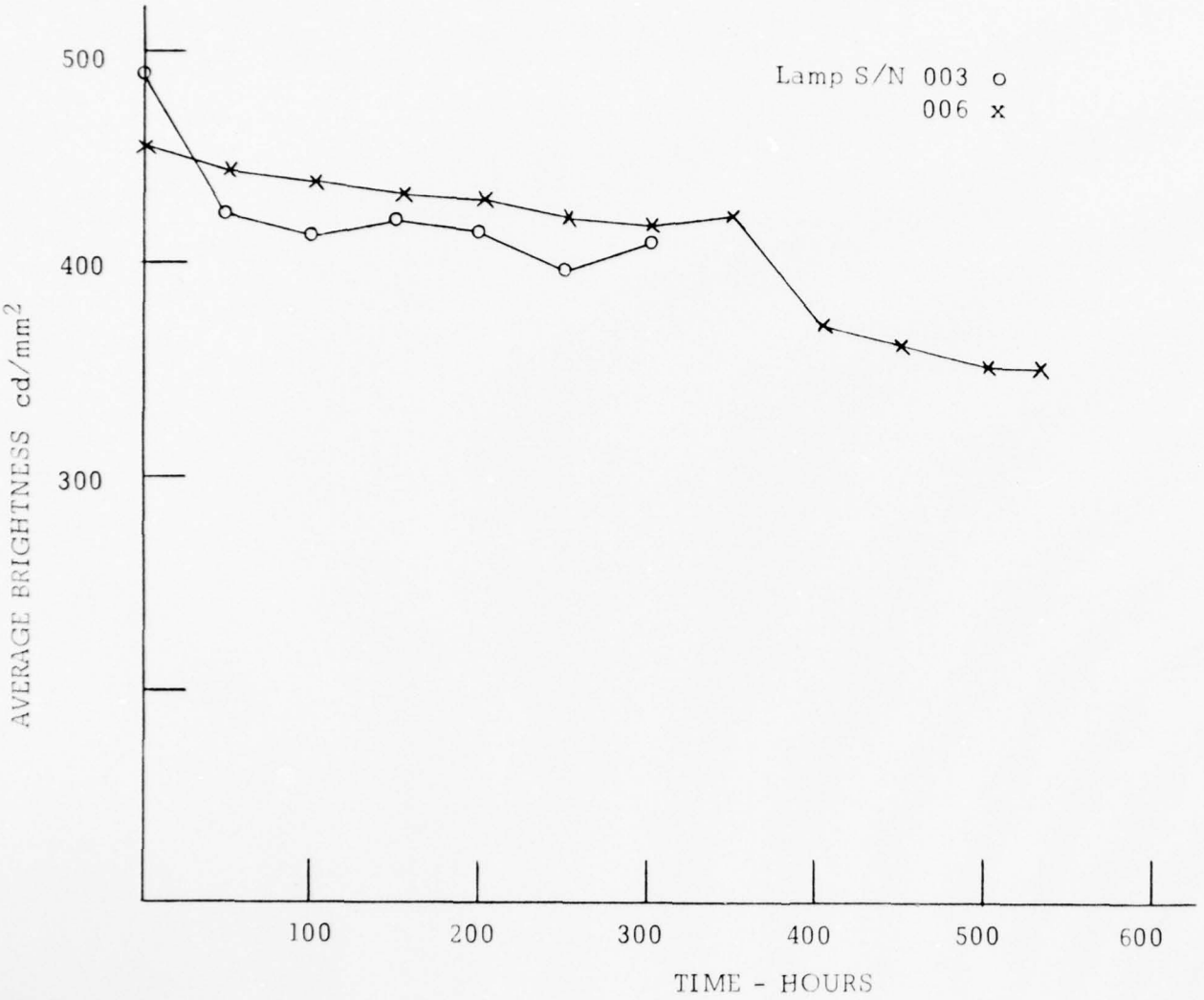

FIGURE 14, AVERAGE BRIGHTNESS AS FUNCTION OF TIME

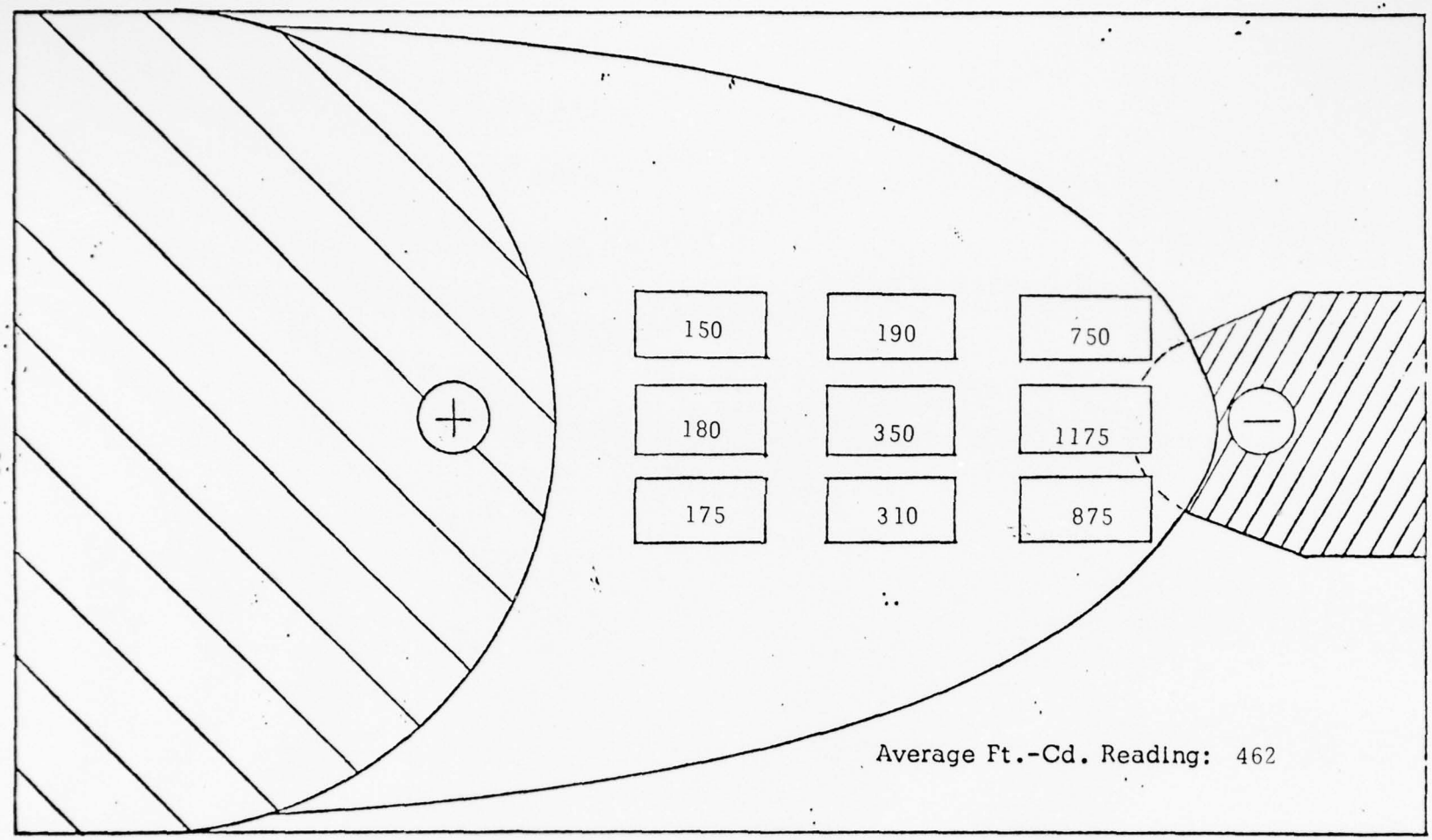

FIGURE 15, E-DISTRIBUTION FOR RSI S/N 003 AT 0 HOURS

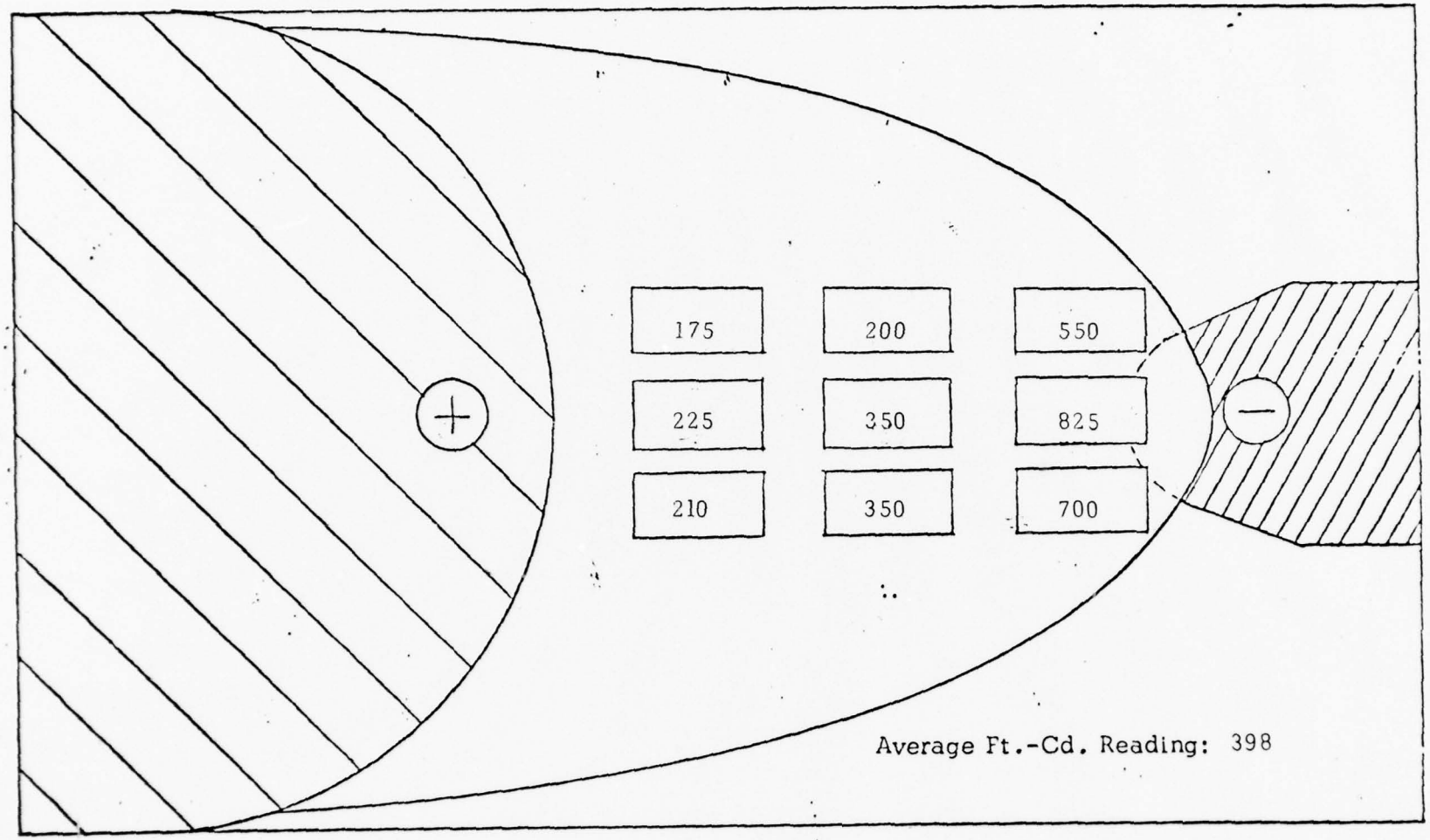

FIGURE 16, E-DISTRIBUTION FOR RSI S/N 003 AT 50 HOURS

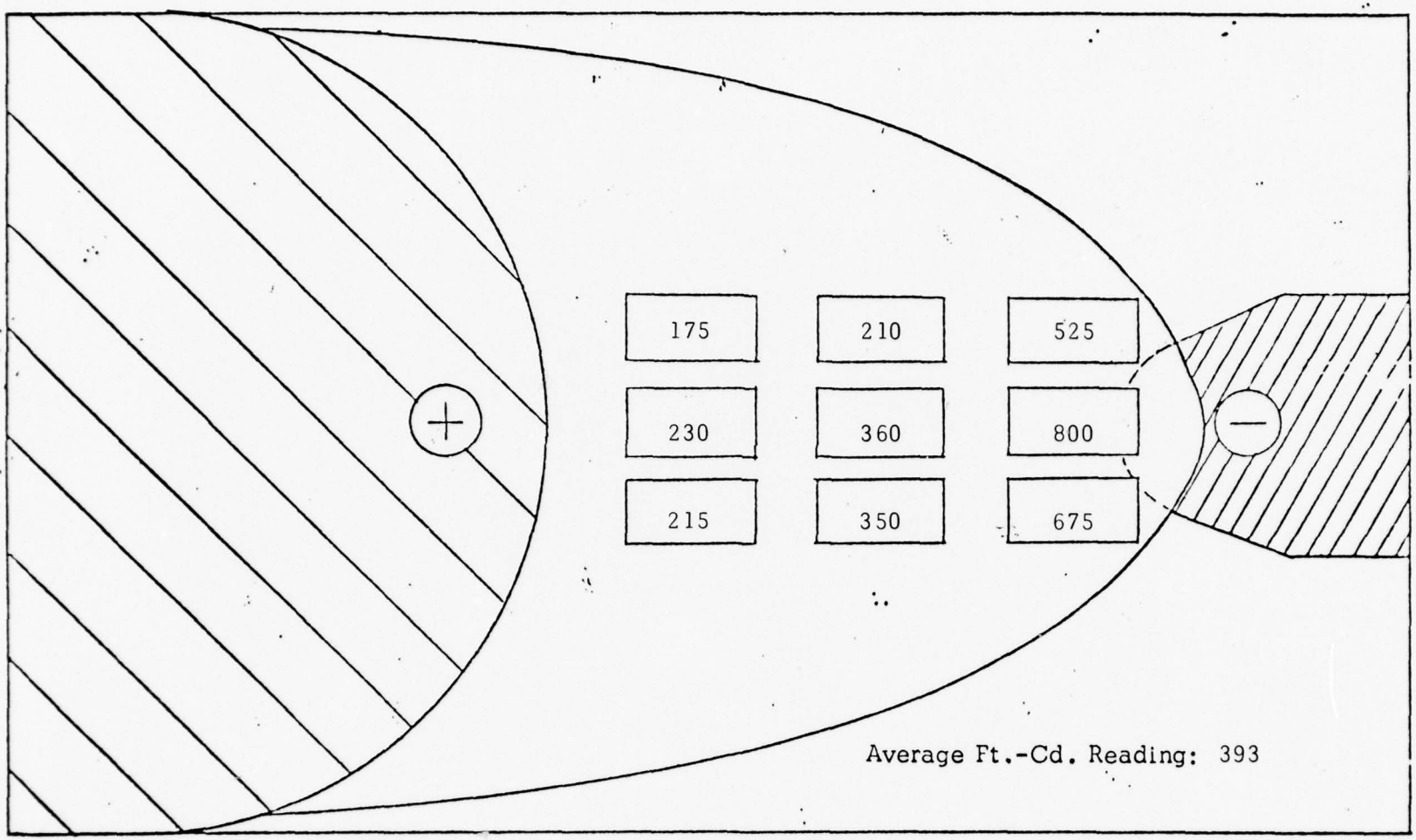

FIGURE 17, E-DISTRIBUTION FOR RSI S/N 003 AT 100 HOURS

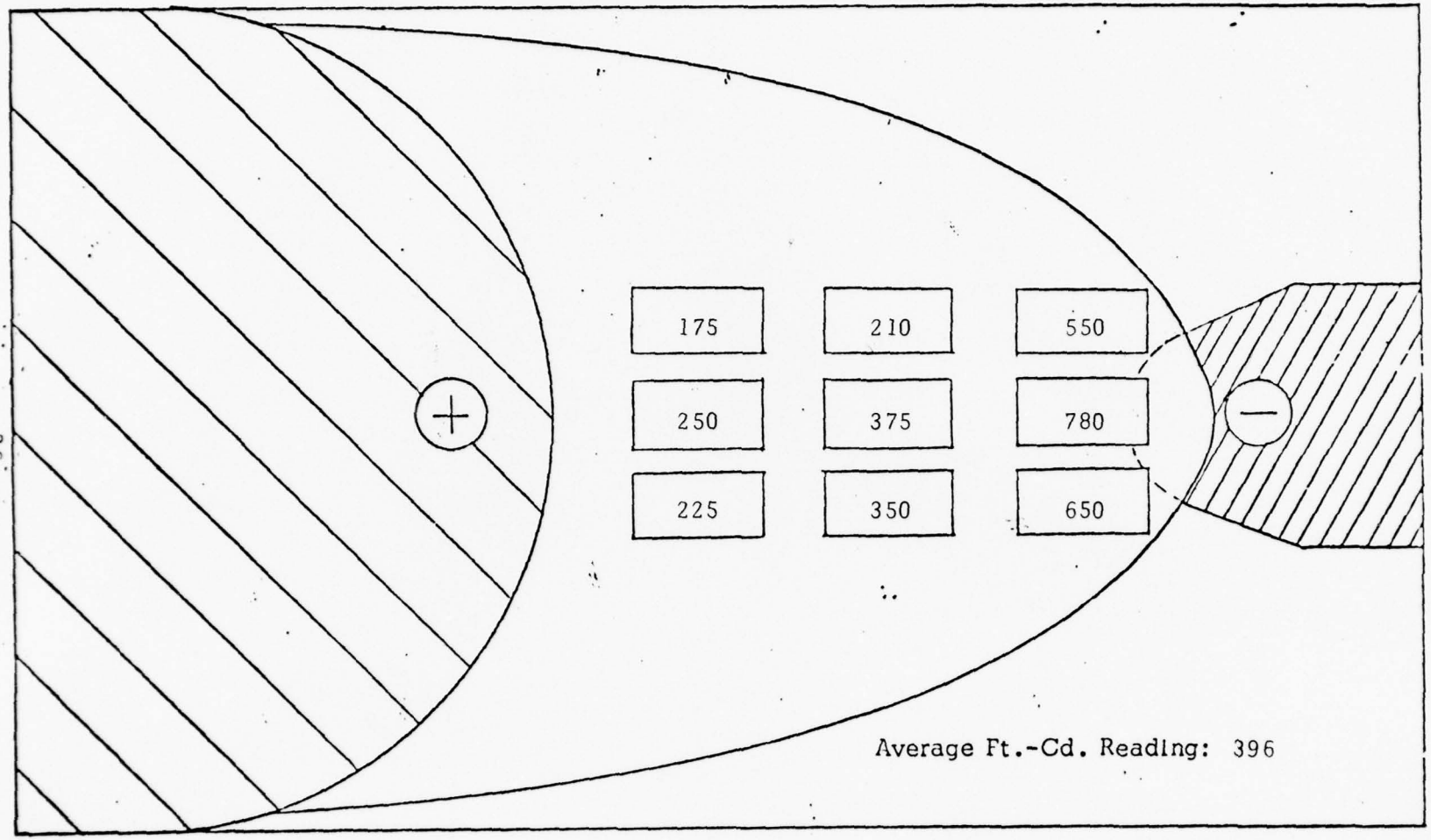

FIGURE 18, E-DISTRIBUTION FOR RSI S/N 003 AT 150 HOURS

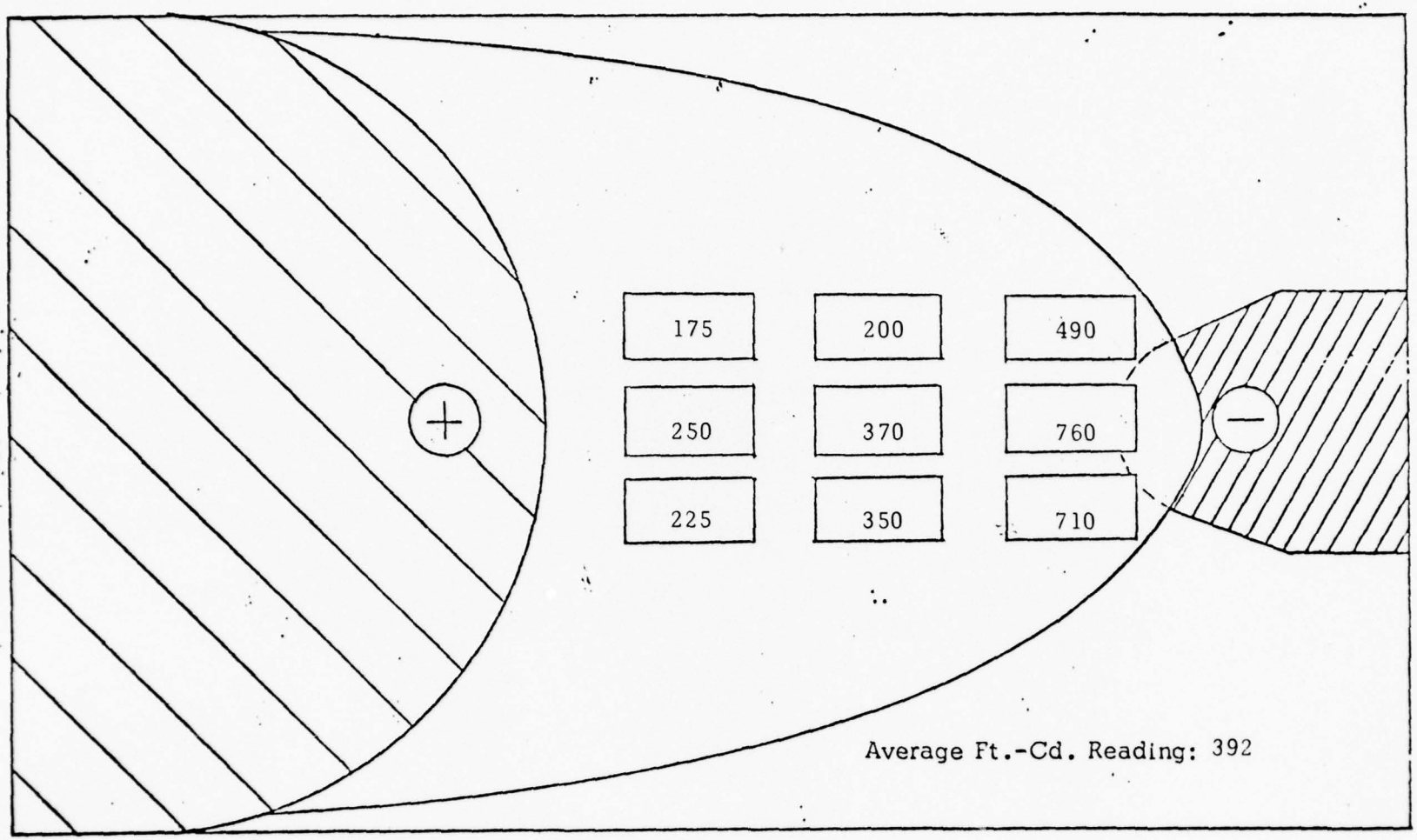

FIGURE 19, E-DISTRIBUTION FOR RSI S/N 003 AT 200 HOURS

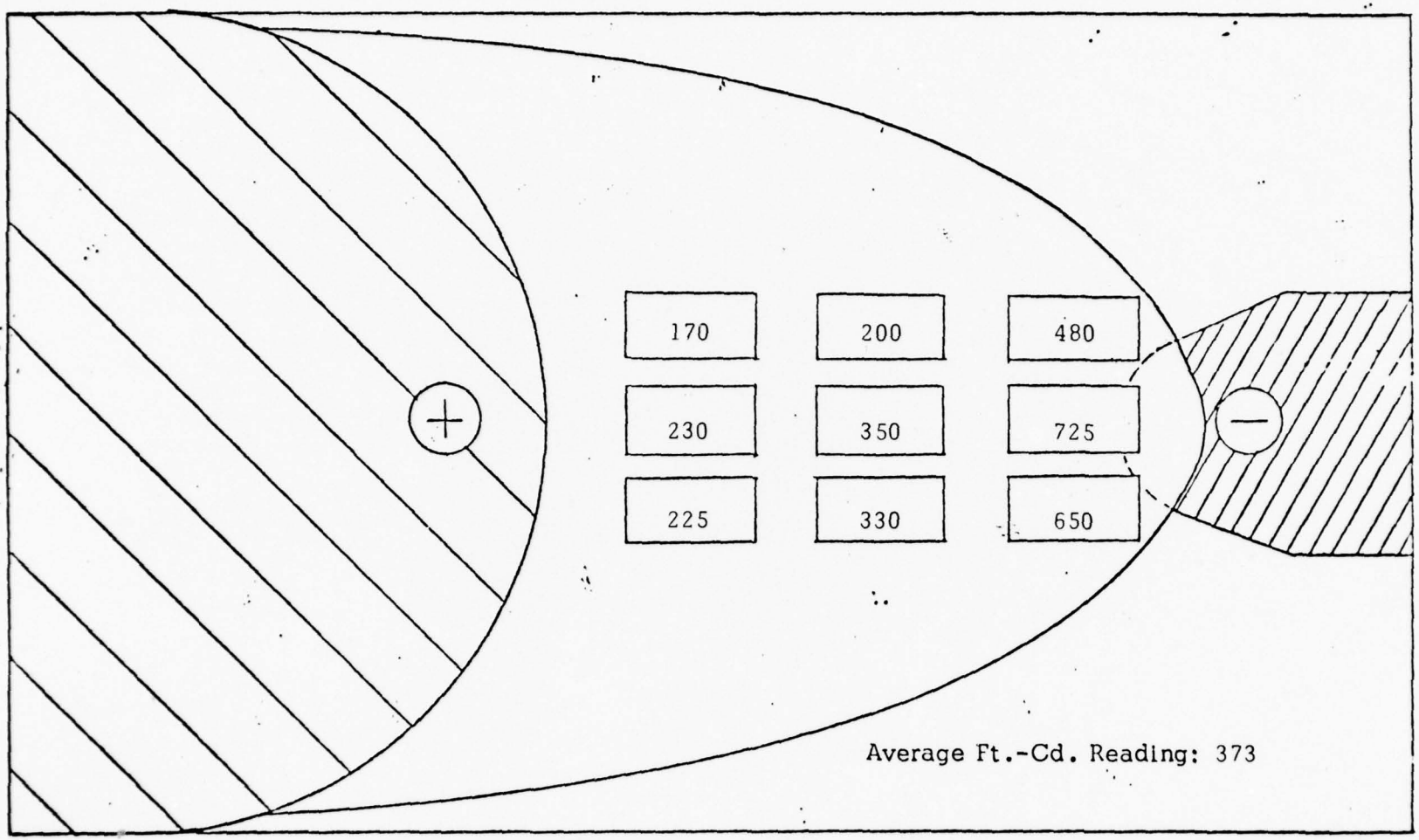

FIGURE 20, E-DISTRIBUTION FOR RSI S/N 003 AT 250 HOURS

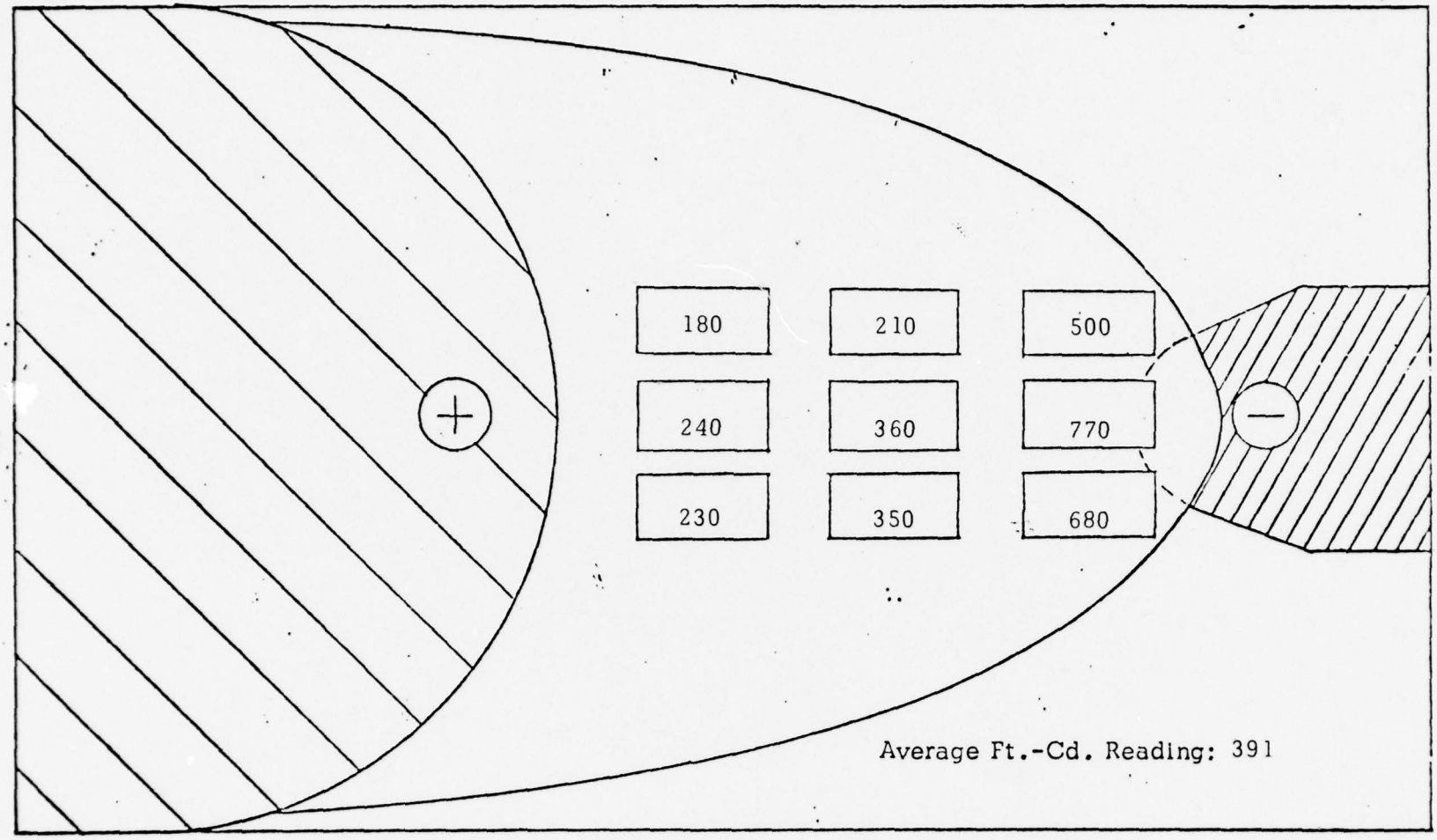

FIGURE 21, E-DISTRIBUTION FOR RSI S/N 003 AT 300 HOURS

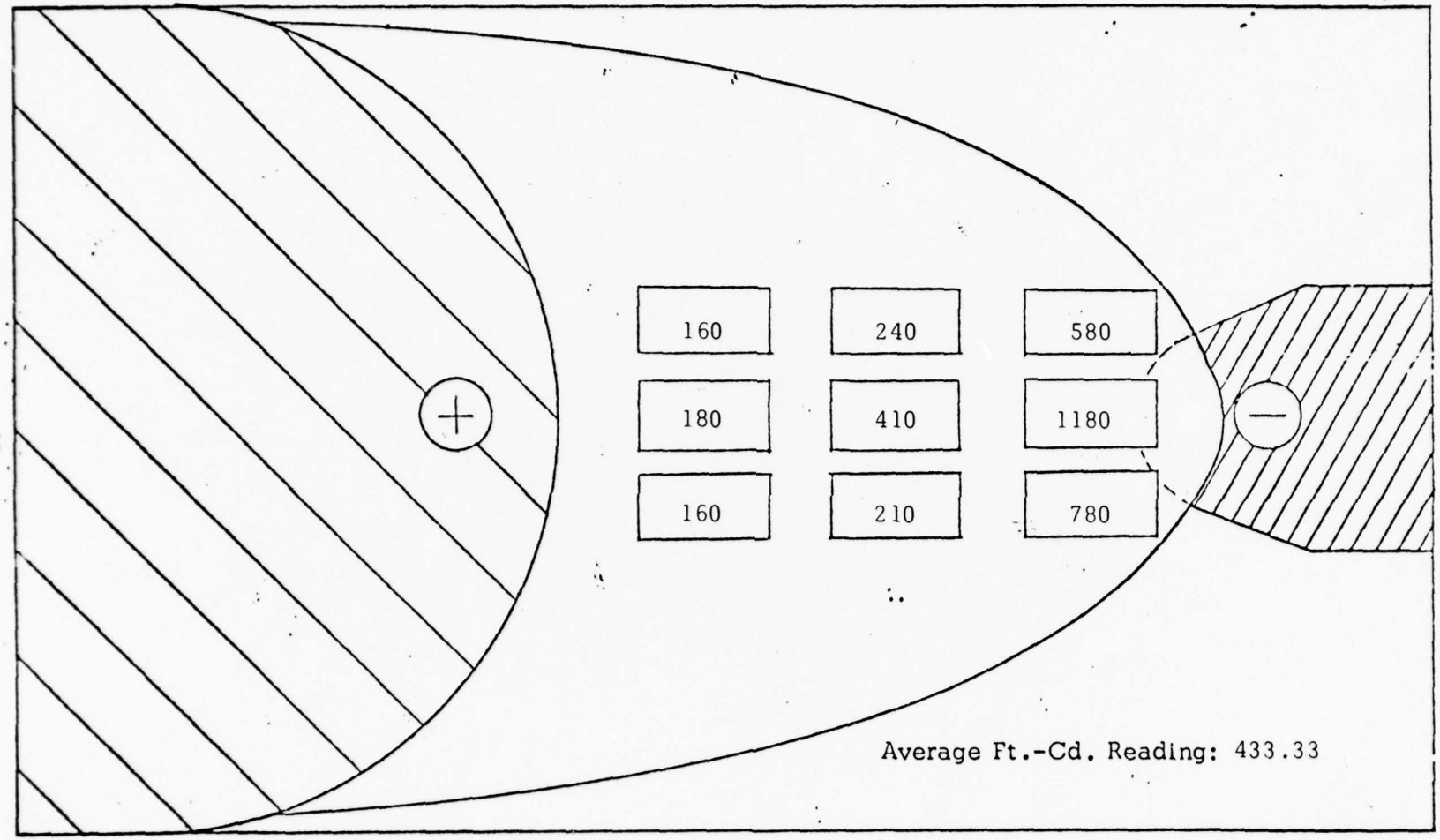

FIGURE 22, E-DISTRIBUTION FOR RSI S/N 006 AT 0 HOURS

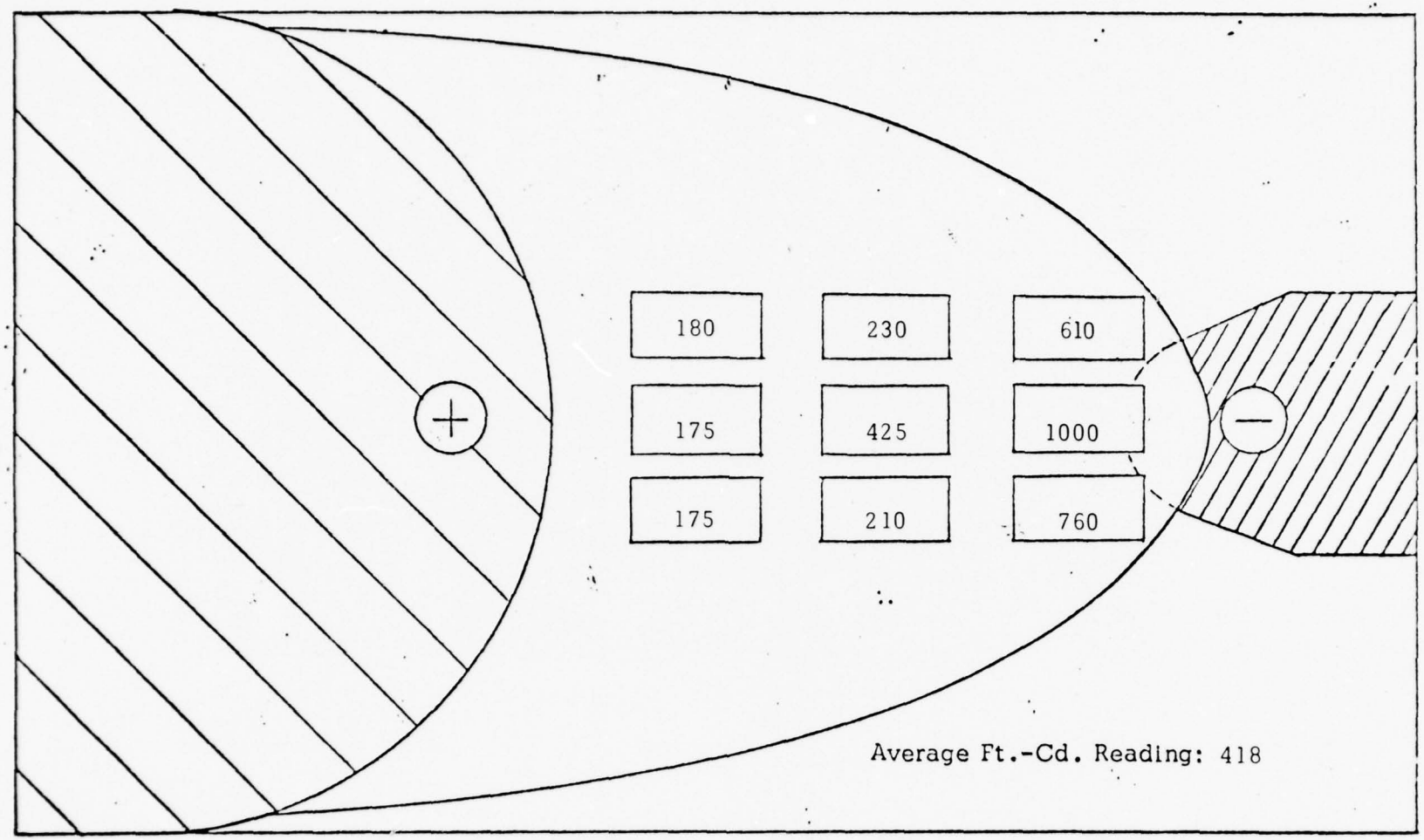

FIGURE 23 E-DISTRIBUTION FOR RSI S/N 006 AT 50 HOURS

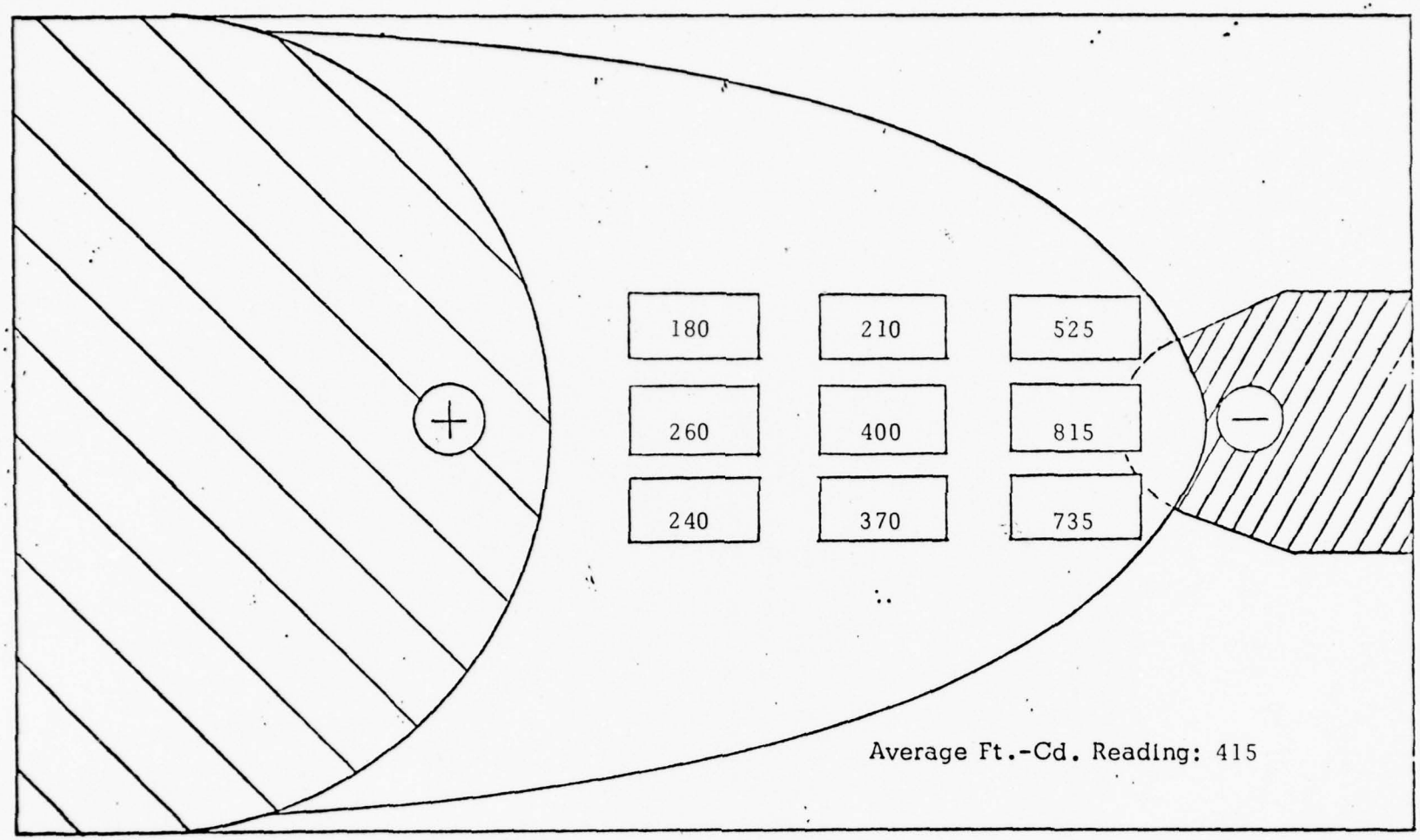

FIGURE 24, E-DISTRIBUTION FOR RSI S/N 006 AT 100 HOURS

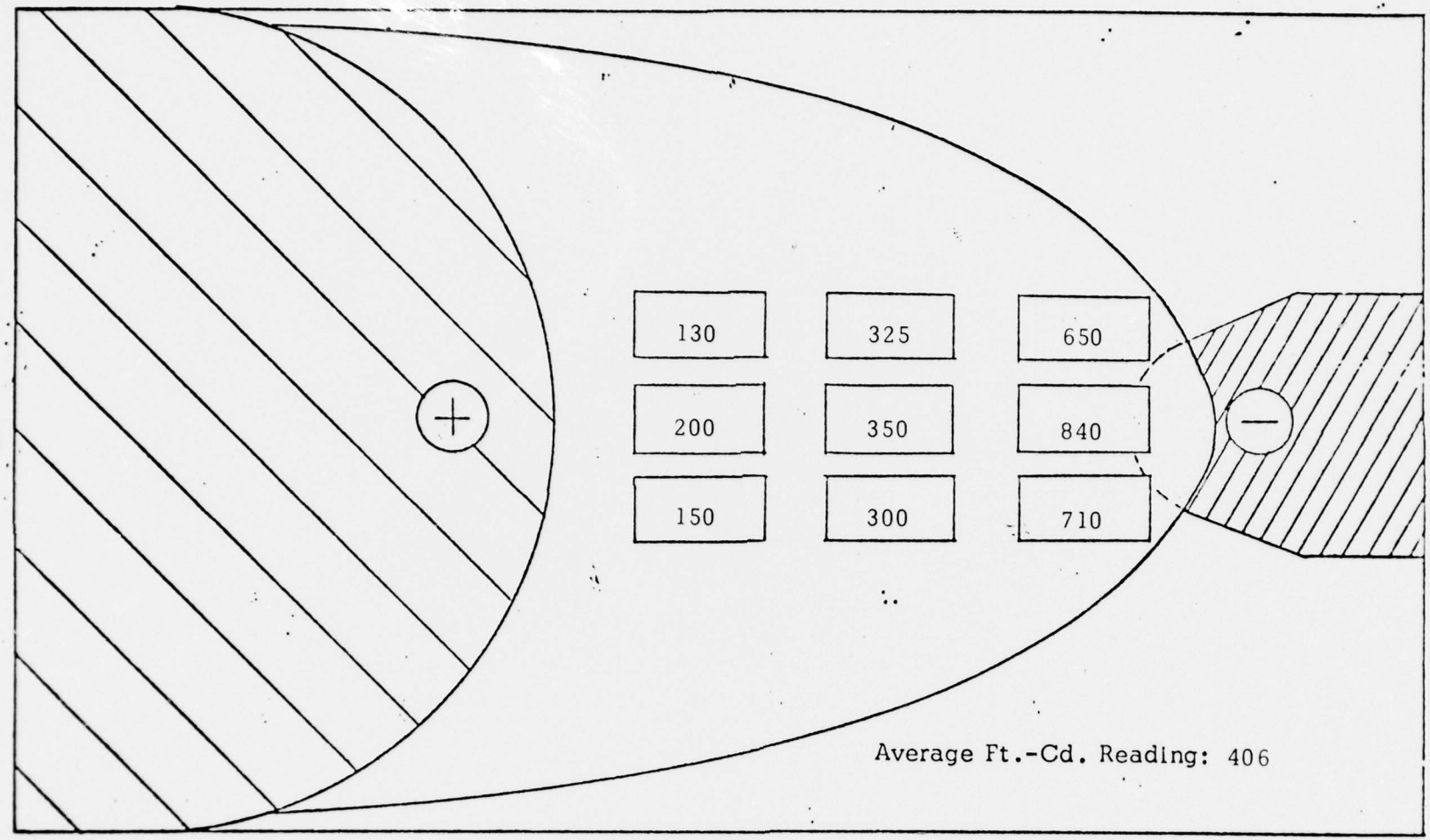

FIGURE 25, E-DISTRIBUTION FOR RSI S/N 006 AT 150 HOURS

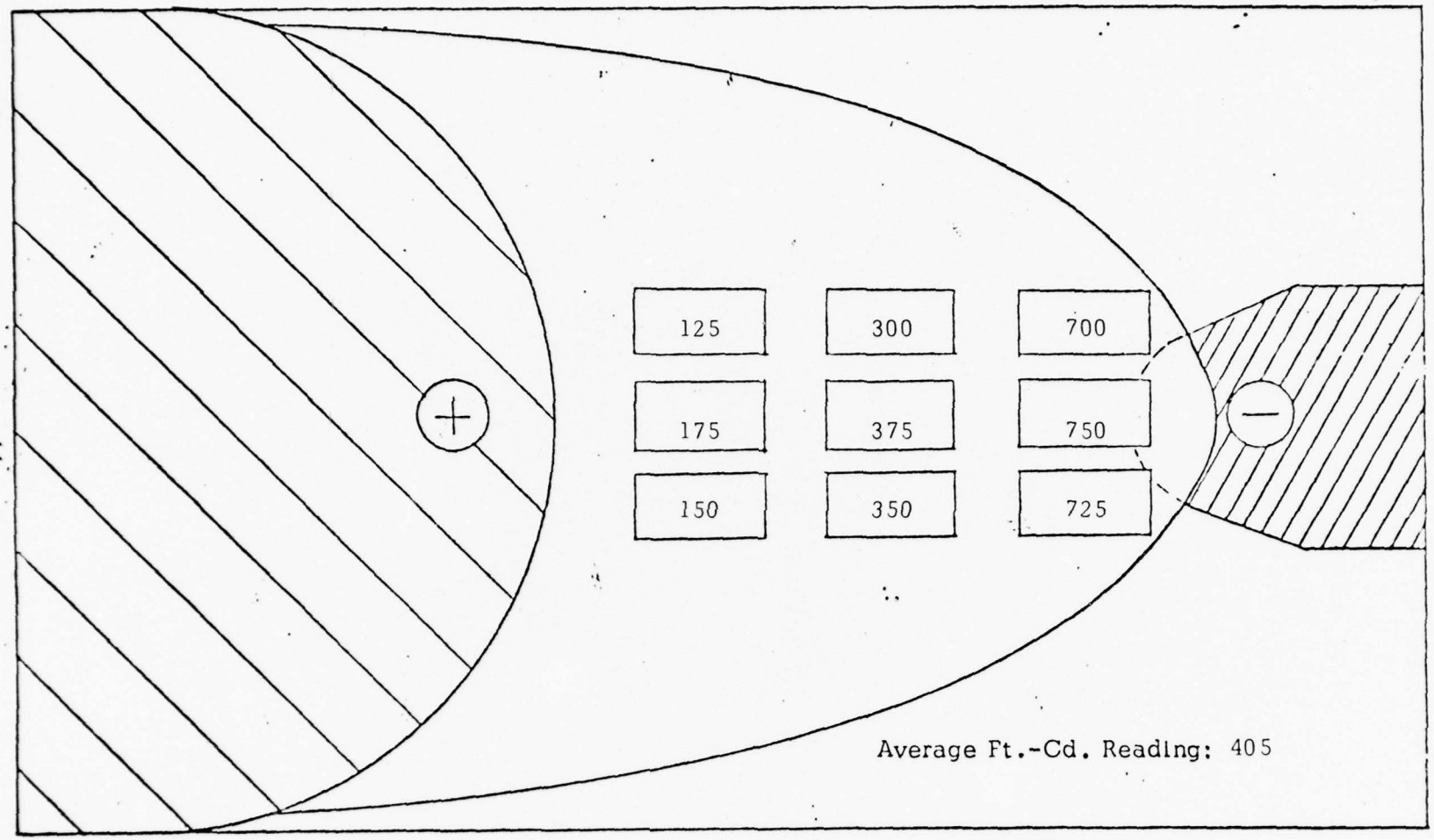

FIGURE 26, E-DISTRIBUTION FOR RSI S/N 006 AT 200 HOURS

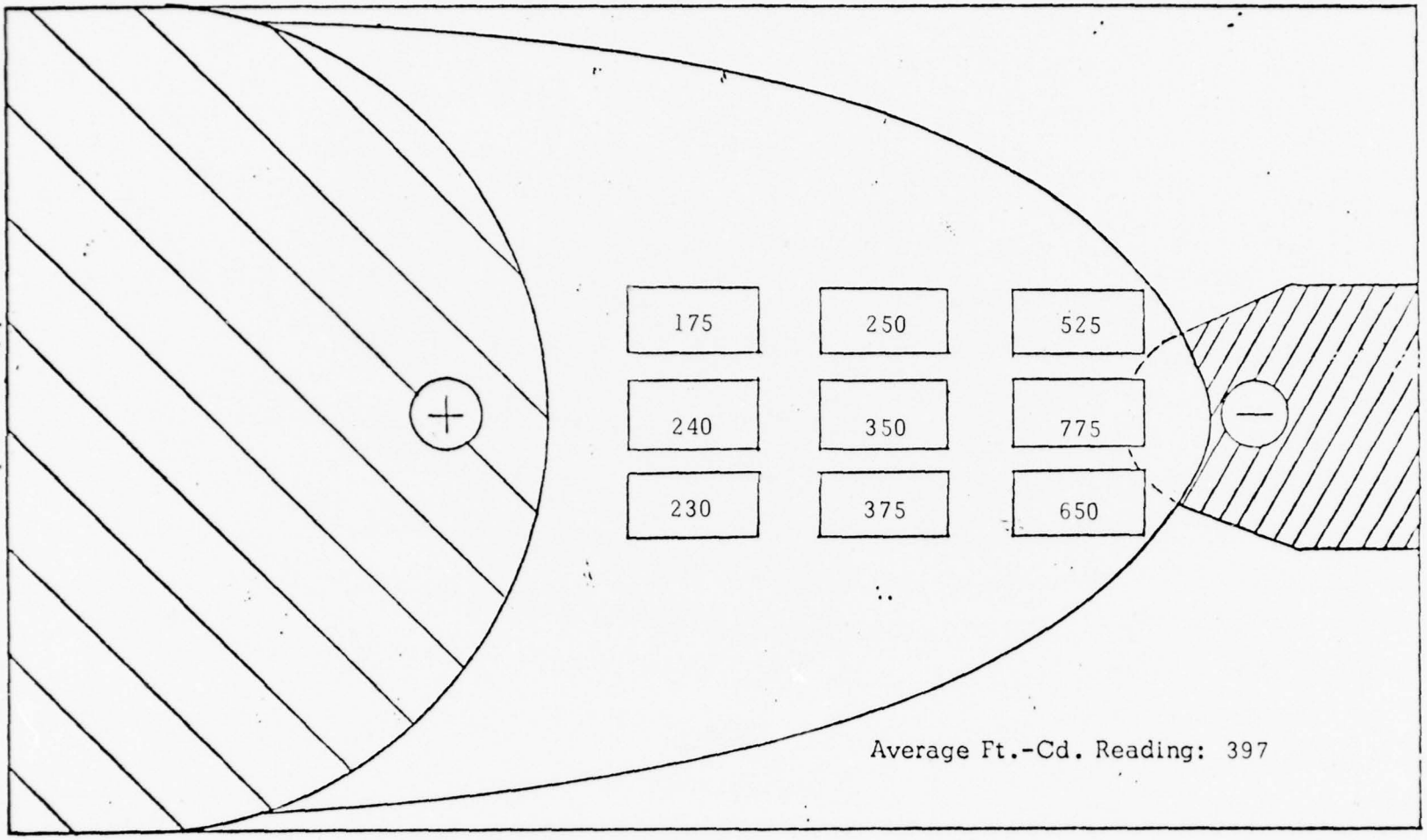

FIGURE 27, E-DISTRIBUTION FOR RSI S/N 006 AT 250 HOURS

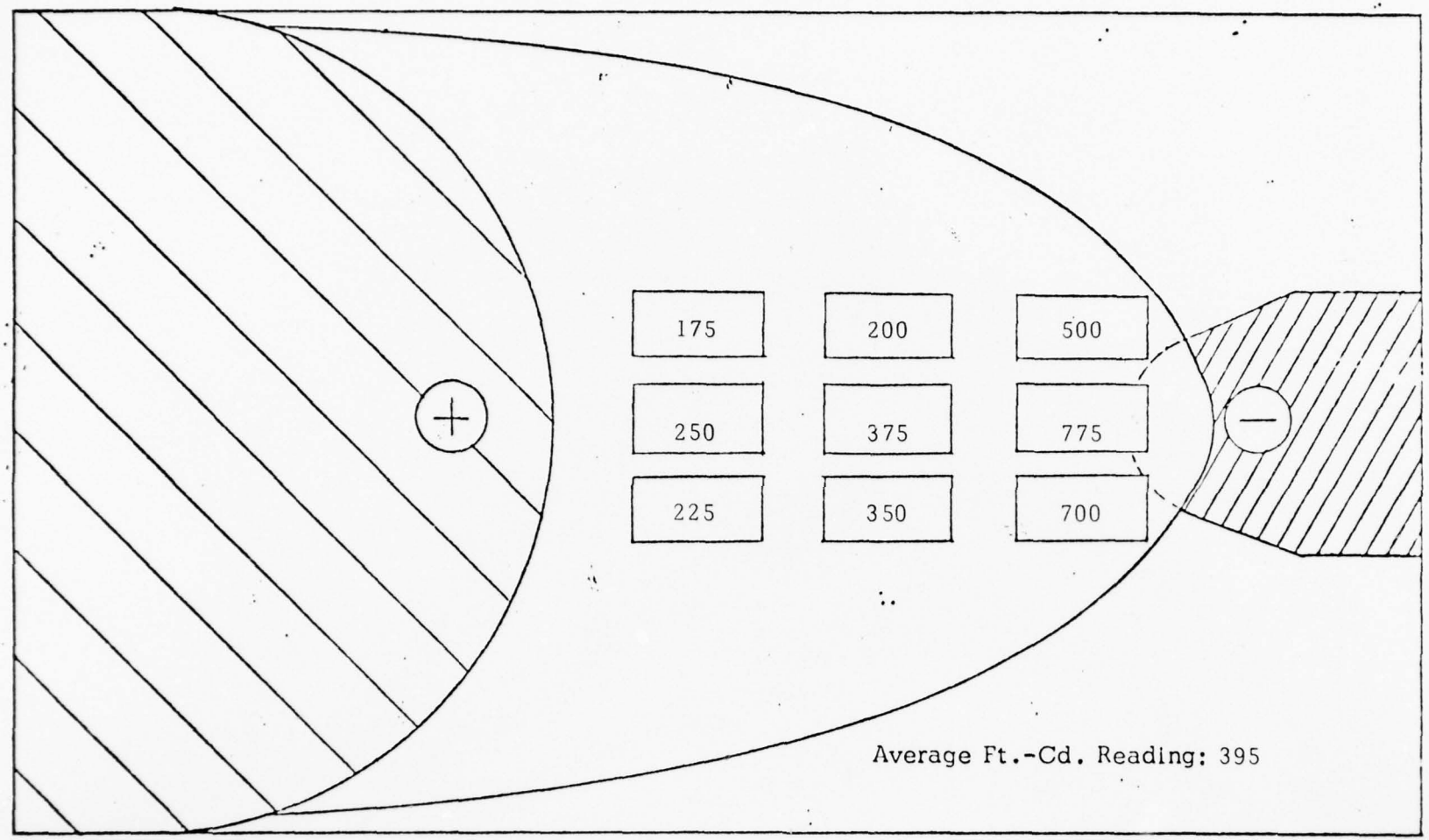

FIGURE 28, E-DISTRIBUTION FOR RSI S/N 006 AT 300 HOURS

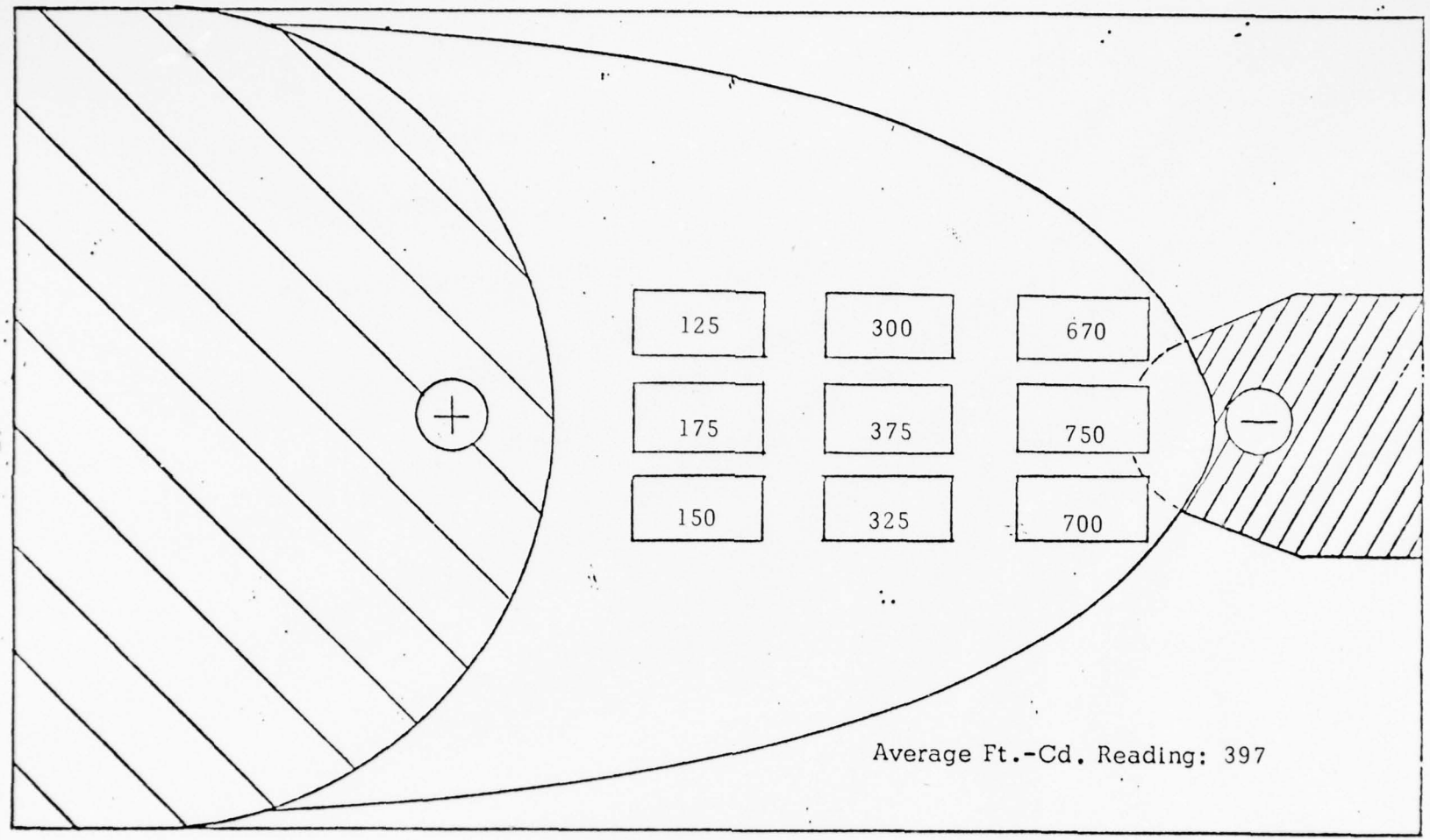

FIGURE 29, E-DISTRIBUTION FOR RSI S/N 006 AT 350 HOURS

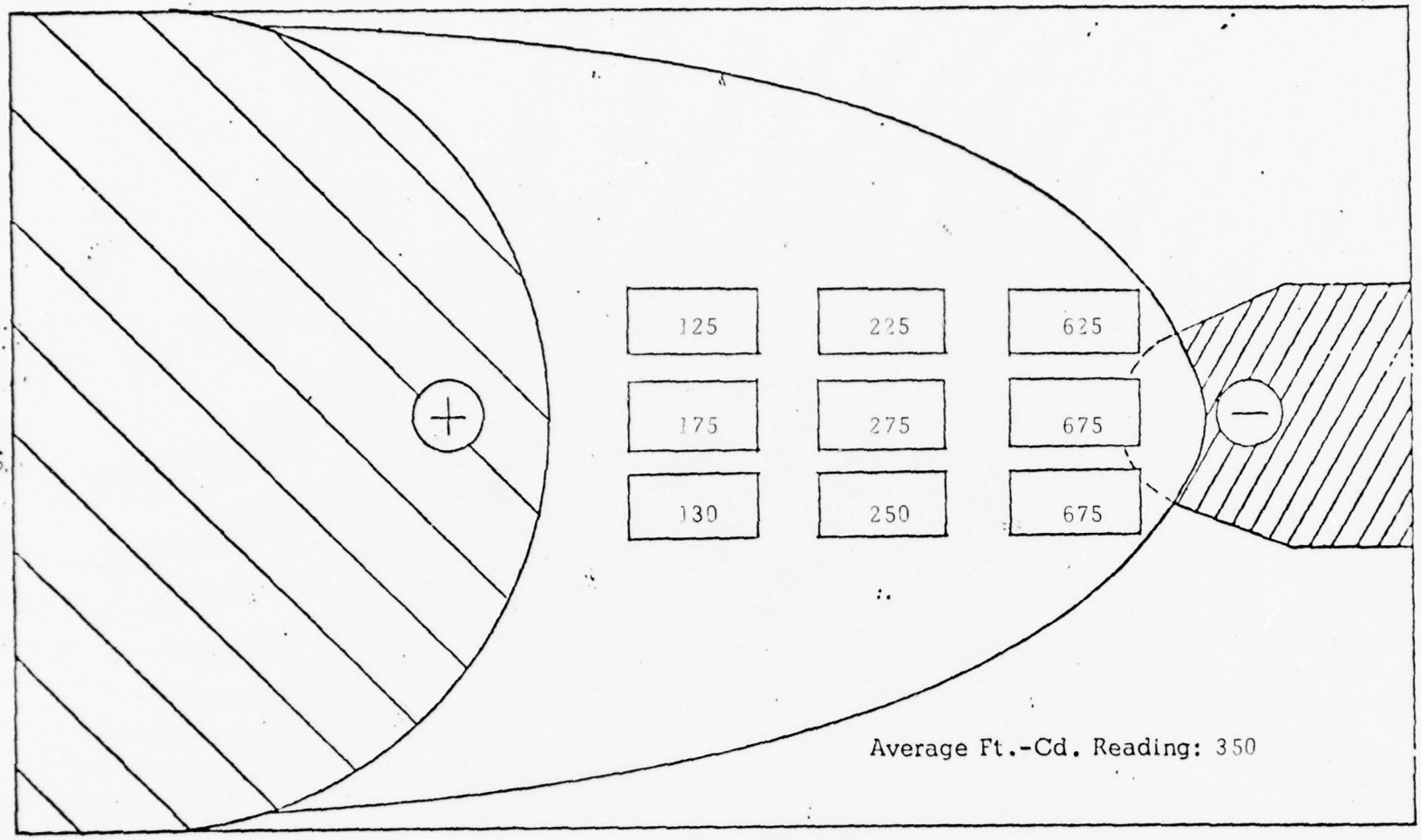

FIGURE 30, E-DISTRIBUTION FOR RSI S/N 006 AT 400 HOURS

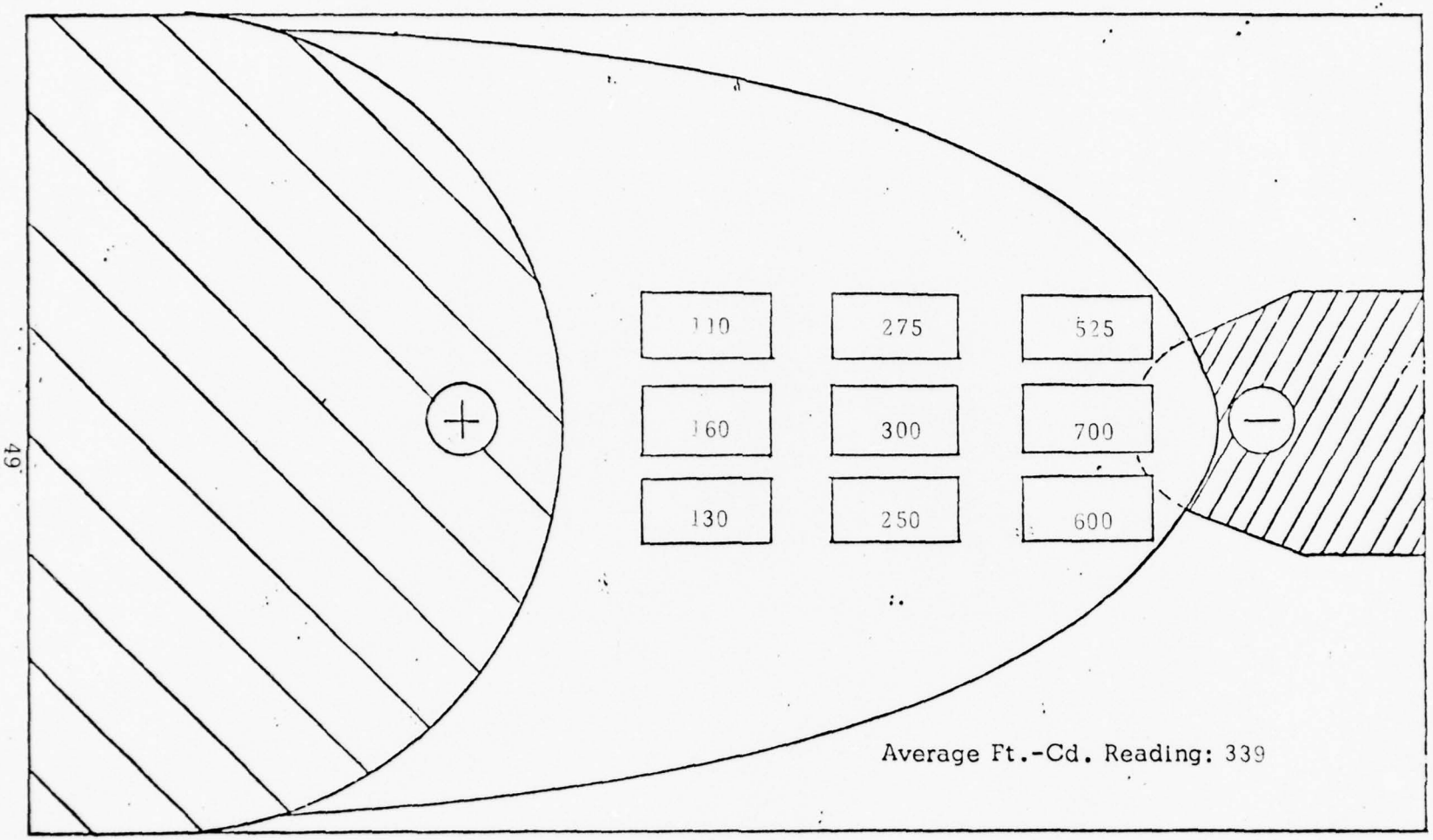

FIGURE 31, E-DISTRIBUTION FOR RSI S/N 006 AT 450 HOURS

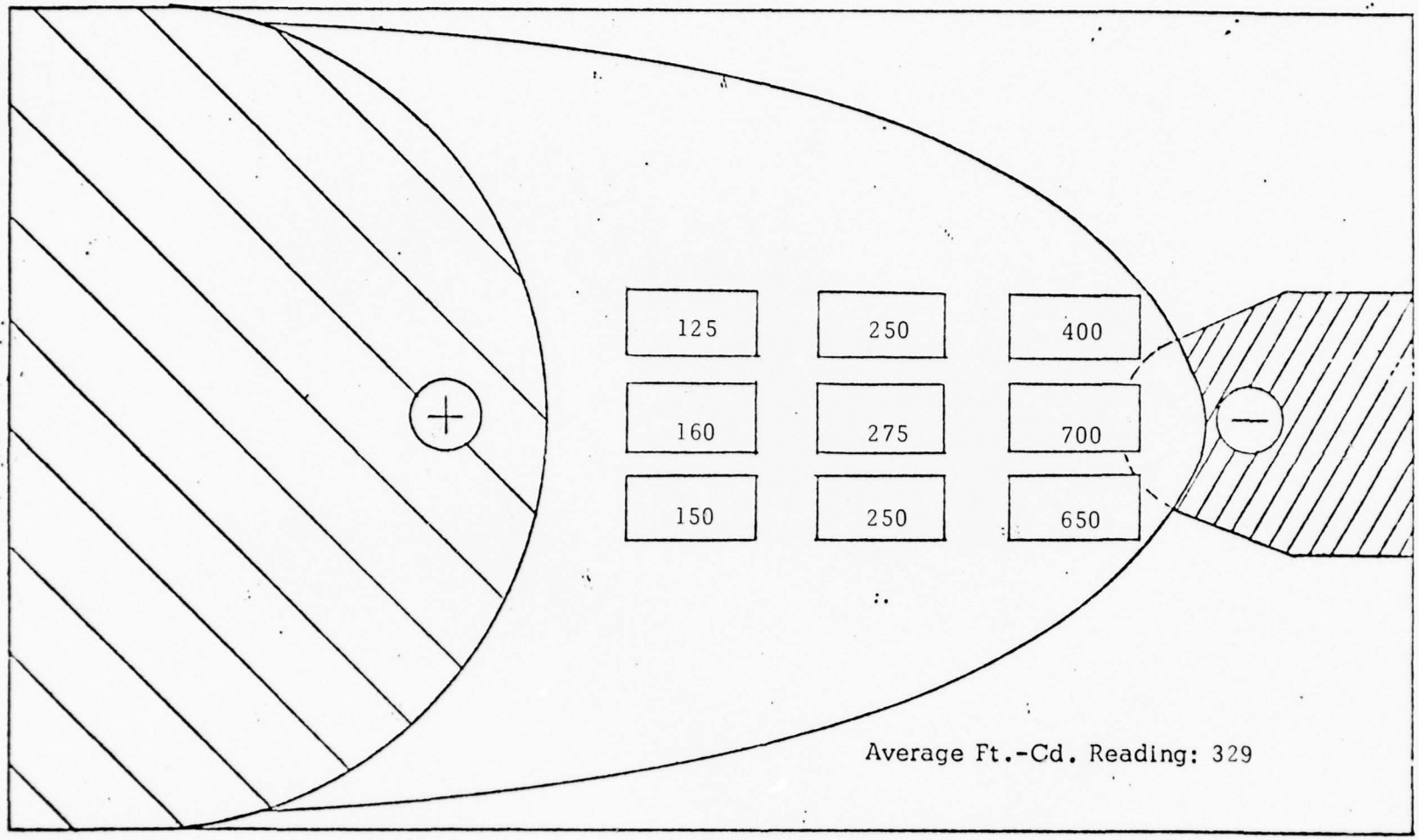

FIGURE 32, E-DISTRIBUTION FOR RSI S/N 006 AT 500 HOURS

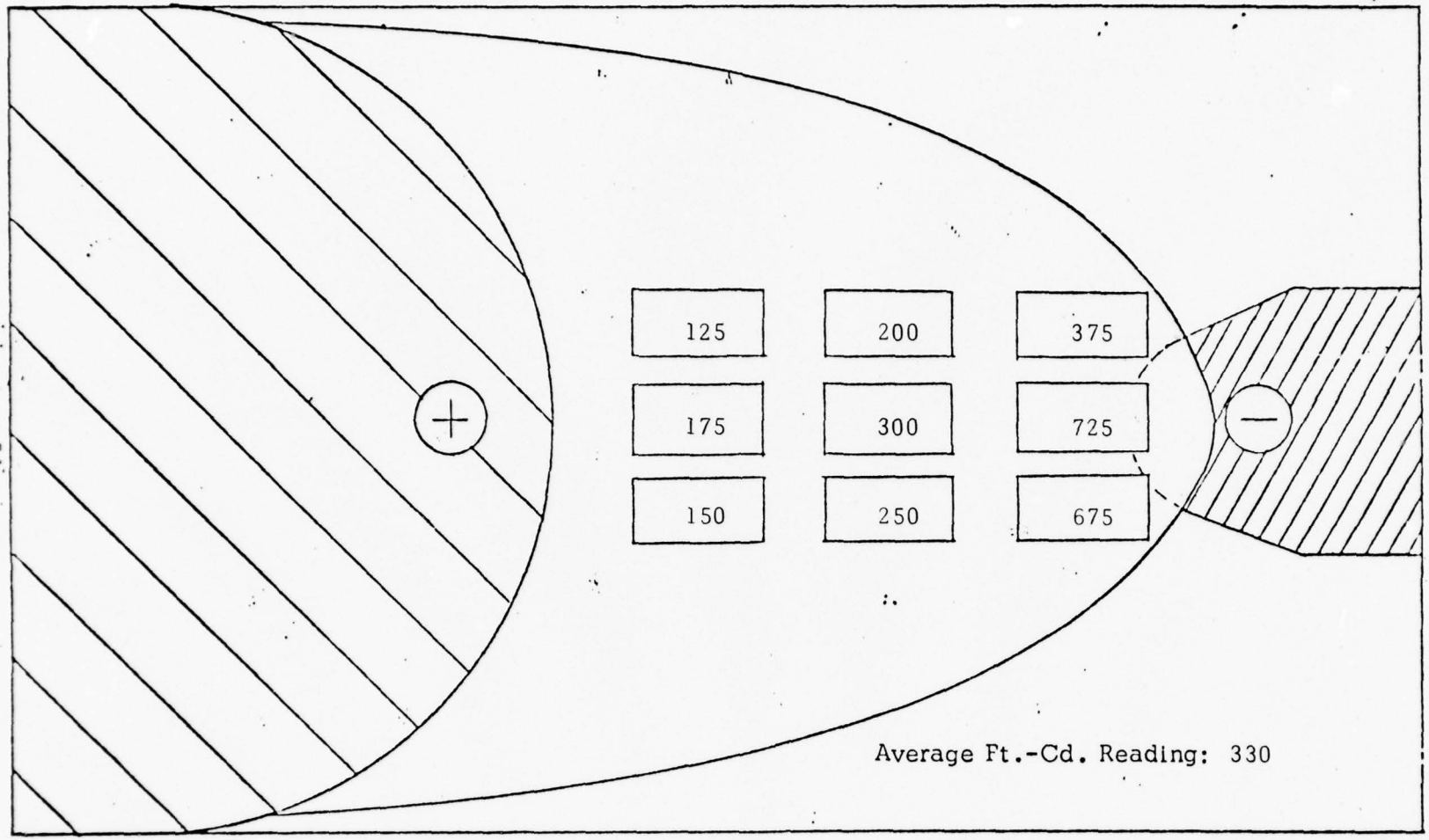

FIGURE 33, E-DISTRIBUTION FOR RSI S/N 006 AT 532 HOURS

TABLE VI

Life Test Starting Open Circuit Voltage Required, and Operating Voltage

RSI S/N	Parameter	HOURS OPERATED 0	50	100	150	200	250	300	350	400	450	500
003	Start V	22	--	--	24	28	--	26				
	Operate V	20.8	--	--	21.4	--	--	21.5				
006	Start V	22	--	--	24	24	--	24	--	--	--	25.0
	Operate V	21.1	--	--	21.6	--	--	22.0	--	--	--	22.4

9.0 ANALYSIS OF PURCHASE DESCRIPTION EVALUATION CONDUCTED BY ILC

The requirements of Section 3.0 of the Purchasing Description, Radiation Source, Infrared Searchlight, Infrared, AN/VSS-3A, dated 1 March 1973 were evaluated according to the Quality Assurance Plan of Section 4.0. Although the test results reported above indicate little discrepancy with the requirements, it is the experience of the author that future production units may not meet all of the source requirements unless the cathode behavior is better understood and manufacturing procedures be developed in accordance with this understanding.

Summarizing the present study, the optical requirements appear to be achievable, while electrical parameters of the devices tend to change from the in-specification initial conditions. Since it is common for all gas discharge devices to increase in ignition and operating voltage as a function of operating time, it appears that some allowance for this phenomena should be made.

Although ILC Technology has demonstrated that the requirements of the present purchase description can be met under laboratory conditions, the severe and continued environmental conditions encountered in actual field performance could adversely affect lamp performance. ILC therefore recommends that the specifications be adopted after actual field testing has been carried out.

REFERENCES

(1) Segal, Stanley M, "A Study of High Intensity Light Sources" Illumination Engineering, Vol. L, No. 5, May 1955.

APPENDIX I

VIKING LABORATORIES TEST LETTER REPORT 30353

VIKING LABORATORIES

TEST LETTER REPORT 30353

30 April 1974

I.L.C. Technology, Inc.
164 Commercial St.
Sunnyvale, California 94086

Attention: Mr. R. Eckel

Subject: Environmental Testing of three(3) each Infrared Radiation Sources P/N L-2104 S/N 001, 002, & 003

Reference:
1. I.L.C. Technology, Inc. P.O. Number 010098
2. Purchase Description Radiation Source, Infrared for Searchlight, Infrared, AN/VSS-3A (1 March 1973)
3. V.L.I. Quotation No. QT-023-005-2

SUMMARY

Three (3) Infrared Radiation Sources (specimens) were received for testing. Upon receipt the specimens were visually examined. The visual examination revealed no notable discrepancies.

The three specimens were individually subjected to the Altitude Test outlined in Paragraph 4.6.9 of the referenced purchase description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

The three specimens were next subjected to the Altitude Transportation Test outlined in Paragraph 4.6.10 of the referenced purchase description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

Viking Laboratories, Inc.
150 Wolfe Road, Sunnyvale
California 94086
(408)739-5900, TWX 910-339-9259

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The three specimens were next individually subjected to the Low Temperature Operation Test outlined in Paragraph 4.6.7.2 of the referenced purchase description. Some difficulty was experienced in functioning specimen S/N 001. The problem was determined to be caused by faulty wiring and not the specimen. The visual examination conducted upon completion of the test revealed no notable discrepancies.

The three specimens were next subjected to the Low Temperature Storage Test outlined in Paragraph 4.6.7.1 of the referenced purchase description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

Specimen S/N 002 was next subjected to the Vibration Test outlined in Paragraph 4.6.6 of the referenced purchase description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

The three specimens were next individually subjected to the Shock Test outlined in Paragraphs 4.6.5.1 and 4.6.5.2 of the referenced purchase description. After completion of shock in the perpendicular axis and while being shocked in the parallel, the anode base of specimen S/N 001 separated from the glass envelope. All testing was terminated on this specimen. The visual examination conducted upon completion of the test revealed no notable discrepancies to the remaining two specimens.

Specimen S/N 003 was next subjected to the Vibration Test outlined in Paragraph 4.6.6 of the referenced Purchase Description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

The remaining two specimens were next subjected to the High Temperature Storage Test outlined in Paragraph 4.6.7.3 of the referenced Purchase Description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

The remaining two specimens were next subjected to the High Temperature Operation Test outlined in Paragraph 4.6.7.4 of the outlined Purchase Description. The visual examination conducted upon completion of the test revealed no notable discrepancies.

All operational testing was performed by I.L.C. Technology personnel.

This report contains a brief description of how the tests were performed, the test data, and lists of the equipment used.

PROCEDURE

1.0 Altitude: Specimen S/N 001 was placed in an altitude chamber. The wiring necessary to function was fed through ports in the wall of the chamber and sealed with rubber stoppers. The internal pressure of the chamber was then reduced to correspond to 10,000 feet above sea level. Upon obtaining this reduced pressure, the specimen was ignited and allowed to function for a period of one hour. After the one hour functional power was removed from the specimen and the chamber was allowed to return to sea level.

The above procedure was repeated with specimen S/N 002 and 003.

2.0 Altitude Transportation: All three specimens were placed in an altitude chamber. The internal pressure of the chamber was reduced to correspond to 40,000 feet above

sea level. The chamber, with the specimens non-operating, remained at this condition for a period of four hours. Upon completion of the four hour conditioning, the chamber was allowed to return to sea level. Upon removal from the chamber each specimen was individually ignited.

3.0 Low Temperature Operation: Specimen S/N 003 was placed on a rack and placed in a temperature chamber. The wiring necessary to operate the specimen was fed through a chamber port. The internal temperature was reduced to -54°C. (-65°F.). The specimen was allowed to condition at this temperature for two hours. Upon completion of the two hour conditioning, and while at this temperature, the specimen was ignited four separate times.

The above procedure was repeated with specimens S/N 001 and 002.

4.0 Low Temperature Storage: All three specimens were placed on a rack and placed in a temperature chamber. The internal temperature of the chamber was reduced to -62°C. (-80°F.) and maintained for a period of six hours. Upon completion of the six hour conditioning chamber was allowed to return to ambient. The specimens were then removed from the chamber and individually operated.

5.0 Vibration: Specimen S/N 002 was mounted in a test fixture which was in turn attached to the vibration exciter in such a manner that the direction of vibration was parallel to the axis of the electrodes. The specimen operating was then subjected to a vibration cycle at 2.5 g's with

the frequency varying logarithmically from 15 Hz. to 120 Hz. and back to 15 Hz. in a period of 3.5 minutes. The cycling was continued until the specimen had been vibrated for 90 minutes. The specimen was then subjected to a 15 minute dwell at a frequency of 30 Hz. and 2.5 g's. The above procedure was repeated with the specimen mounted in such a manner that the direction of vibration was perpendicular to the axis of the electrodes.

Specimen S/N 003 was subjected to the Vibration Test described above after the Shock Test.

6.0 Shock: The test fixture was installed on the carriage of the shock machine. An accelerometer was cemented, with Eastman 910, to the fixture. The output of the accelerometer was fed, through an accelerometer amplifier and bandpass filter, to an oscilloscope. The oscilloscope was adjusted for a horizontal sweep rate of 2 ms/cm and a vertical sensitivity of 0.2 v/cm (20g/cm). Several calibration drops were then performed by elevating the shock tower carriage and allowing it to impact on a rubber medium. When the carriage was dropped, the oscilloscope was triggered immediately prior to impact; resulting in the shock pulse being presented on the oscilloscope. After the desired impact medium was obtained, the required drop height was noted and a calibration verification photograph taken of the shock pulse.

Specimen S/N 002 was then mounted in the test fixture with the direction of shock parallel to the axis of the electrodes. The carriage of the shock machine was then elevated to the pre-determined height and the specimen was ignited. After one minute of operation, the specimen was

subjected to one 70 g ± 7g, 6.0 m. sec., half-sine shock pulse. After the shock the specimen was allowed to operate for one additional minute before power was removed. Once power had been removed, the specimen was subjected to three additional shocks of the same level and duration. The three shocks were applied within 5 minutes after turning off the power. The above constitutes one shock cycle. The specimen was subjected to three such cycles in this axis for a total of twelve shocks. The specimen was then mounted with the direction of shock perpendicular to the axis of the electrodes and subjected to three additional shock cycles as described above for a total of twenty-four shocks for the specimen.

Specimen S/N 001 was subjected to three shock cycles as described above with the direction of shock perpendicular to the axis of the electrodes. Upon completion of the first shock cycle with the direction of shock parallel to the axis of the electrodes, the specimen would not operate. It was noted that the anode base had separated from the glass envelope. All testing was terminated on this specimen.

Specimen S/N 003 was subjected to all six shock cycles in much the same manner as specimen S/N 002 with no discrepancies noted.

7.0 High Temperature Storage: Specimens S/N 002 and 003 were placed in a temperature and humidity chamber. The internal temperature and humidity of the chamber were increased to 68°C. (154°F.) and 90% to 98% relative humidity. The

specimens were maintained at this condition for a period of six hours. Upon completion of the six hour period, the chamber was returned to laboratory ambient condition and the specimens were removed and individually ignited.

8.0 High Temperature Operation: Specimen S/N 003 was placed in a temperature and humidity chamber and the wiring necessary to operate the specimen was fed through a chamber port. The internal temperature and humidity of the chamber was increased to 52°C. (125°F.) and 90% to 98% relative humidity. The chamber was maintained at this condition for two hours.

The chamber was then decreased over a period of one hour to 23°C. (74°F.) and 90% to 98% relative humidity. This condition was maintained for one hour. The chamber was then increased over a period of one hour to 52°C. (125°F.) and 90% to 98% relative humidity. This condition was maintained for two hours.

The chamber was decreased over a period of one hour to 23°C. (74°F.) and 90% to 98% relative humidity. This condition was maintained for one hour.

The chamber was then increased over a period of one hour to 52°C. (125°F.) and 90% to 98% relative humidity. This condition was maintained for two hours.

The above constitutes one twelve hour cycle. The specimen was subjected to two such cycles. Upon completion of the second cycle, and while at 52°C. (125°F.) and 90% to 98% relative humidity, the specimen was ignited. Once ignition

was verified visually, the specimen power was turned off and the specimen was removed from the chamber.

Specimen S/N 002 was subjected to High Temperature Operation Test in the manner described above.

DISPOSITION

Testing was completed on 5 April 1974 and the specimens were returned to I.L.C. Technology on 8 April 1974.

VIKING LABORATORIES

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SIGNATURE PAGE

STATE OF CALIFORNIA)
COUNTY OF SANTA CLARA) ss

E. W. Magoon, being duly sworn, deposes and says: That the information contained in this report is the result of complete and carefully conducted tests and is to the best of his knowledge true and correct in all respects.

E. W. Magoon

E. W. Magoon, Vice President Operations
VIKING LABORATORIES, INC.

SUBSCRIBED and sworn to before me this
30 day of April 1974.

Esther T. Vance

Esther T. Vance

OFFICIAL SEAL
ESTHER T. VANCE
NOTARY PUBLIC — CALIFORNIA
PRINCIPAL OFFICE IN THE
COUNTY OF SANTA CLARA
My Commission Expires August 4, 1974

Test Engineer: W. Lien
W. Lien

Quality Control Supervisor: Gary G. Lagier
Gary G. Lagier

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
3-26-74	ILC	D. D. Dingman (VLT T1)
DATE COMPLETED	**SPECIMEN DESCRIPTION** AN/VSS-3A	**ENGINEER (SIGNATURE)**
3-26-74	Radiation Source, Infrared Searchlight, Infrared	W. Lien (VLT E3)
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
72°F	VISUAL EXAMINATION - Initial	W. Lien
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
57% Rh	ILC	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para 4.3.1	

SPECIMEN NUMBER	SERIAL NUMBER	PART OR MODEL NUMBER	LOT NO.	REMARKS
1	001	L-2104		No physical discrepancies Noted
2	002	L-2104		No physical discrepancies Noted
3	003	L-2104		No physical discrepancies Noted

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
3-26-74	ILC	D. D. Ingman
DATE COMPLETED	SPECIMEN DESCRIPTION AN/VSS-3A	ENGINEER (SIGNATURE)
3-26-74	Radiation Source, Infrared Searchlight, Infrared	W. Lien
TEMPERATURE	TYPE OF TEST	ENGINEER
72°F	Altitude	W. Lien
HUMIDITY	MANUFACTURER	JOB NUMBER
57% Rh	ILC	30353
SPECIMEN NUMBER	TEST SPECIFICATION	
	Purchase Description (1 March 1973) Para. 4.6.9	

Specimen Number	Altitude (x 1000 ft)	Time	Remarks
1	SL	1257	START PRESSURE DECREASE
	10	1258	Light Lamp - START 1 hour Conditioning
	10	1313	
	10	1328	
	10	1343	
	10	1358	POWER OFF To Specimen
	~~SL~~ 10	1400	START PRESSURE INCREASE
1	SL	1401	No discrepancies noted
2	SL	1451	START PRESSURE DECREASE
	10	1452	Lamp will not Light - START PRESSURE INCREASE
	SL	1454	appears that an ~~arc~~ insulator broke
	SL	1503	START PRESSURE DECREASE
	10	1504	Light Lamp - START 1 hour Conditioning
	10	1519	
	10	1534	
	10	1549	
	10	1604	POWER OFF To Specimen - START PRESSURE INCREASE
2	SL	1605	No discrepancies noted
3	SL	~~1615~~ 1618	START PRESSURE DECREASE
	10	1619	Light Lamp - START 1 hour Conditioning
	10	1719	Power Off TO Specimen - Start Pressure Increase
3	SL	1721	No discrepancies noted

VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Altitude	Stratosphere Chamber	Tenney Eng.	27 STR-100	6001	-100°F To 300°F SL To 60,000 FT.	± 3°F ± 3%	1-25-74	3 MO.

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
3-26-74	ILC	D.D. Dingman
DATE COMPLETED	**SPECIMEN DESCRIPTION** AN/VSS-3A	**ENGINEER (SIGNATURE)**
3-26-74	Radiation Source, Infrared Searchlight, Infrared	W. Lien
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
72°F	Altitude Transportation	W. Lien
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
57% Rh	ILC	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para. 4.6.10	

Specimen Number	Time	Altitude (x1000 ft)	Remarks
1-3	1805	SL	Start pressure decrease
	1810	40	Start 4 hour cond.
	1840	40	
	1910	40	
	1940	40	
	2010	40	
	2040	40	
	2110	40	
	2140	40	
	2210	40	Start pressure increase
1-3	2213	SL	No discrepancies noted

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EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Altitude Transportation	Stratosphere Chamber	Tenney Eng	27 STR-100	6001	-100°F To 300°F SL To 60,000 FT.	± 3°F ± 3%	1-25-74	3 Mo.

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
3-27-74	ILC	D. D. Dingman
DATE COMPLETED	**SPECIMEN DESCRIPTION**	**ENGINEER (SIGNATURE)**
3-27-74	Radiation Source, Infrared Searchlight, Infrared AN/VSS-3A	W. Lien
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
72°F	Low Temperature operation	W. Lien
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
55% Rh	ILC	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para. 4.6.7.2	

Specimen Number	Date	Time	Chamb. Temp (°F)	Remarks
3	3-27-74	0830	72	Spec. in the chamber and appears to be working properly - START Temp. decrease
|	|	0925	-65	START 2 hr. Cond.
|	|	0955	-65	
|	|	1035	-67	
|	|	1110	-67	
|	|	1135	-67	
|	|	1210	-66	
|	|	1225	-66	Spec Lit four times - No discrepancies noted
3	|	1230	-66	Spec Removed from the Chamb.
1	|	1240	41	Spec. in the chamb and appears to be working properly - START Temp decrease - Spec. 2 in chamber also
|	|	1255	-66	START 2 hr Cond.
|	|	1310	-66	
|	|	1340	-66	
|	|	1410	-67	
|	|	1440	-65	
|	|	1455	-65	Lamp will not lite - appears to be bad wiring
1	|	1500	-35	Lamp Lit four times - No discrepancies noted
2	|	1510	44	Spec. in the chamb and appears to be working properly - START Temp. decrease
|	|	1525	-65	
2	3-27-74	1600	-67	Spec. Lit four times - No discrepancies noted

VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Low Temp. operation	high-low Temp. Chamber	Missimers Inc.	FT8 100 x 350	6015	-100°F To 350°F 24"x 24"x 24"	± 3°F	Time of Test	
	Temperature Potentiometer	Leeds & Northrup	8693	7005	-100°F To 500°F	± 1.2°F	2-22-74	6 Mo.

in an altitude chamber. The internal pressure of the chamber was reduced to correspond to 40,000 feet above

VIKING LABORATORIES

TEST DATA

DATE STARTED: 3-27-74	CUSTOMER: I L C	TECHNICIAN (SIGNATURE): Dave Morris (VLE I-21)
DATE COMPLETED: 3-27-74	SPECIMEN DESCRIPTION: Radiation Source, Infrared Searchlight, Infrared AN/VSS-3A	ENGINEER (SIGNATURE): W. Lien (VL E3)
TEMPERATURE: 72°F	TYPE OF TEST: Low Temperature Storage	ENGINEER: W. Lien
HUMIDITY: 55% Rh	MANUFACTURER: I L C	JOB NUMBER: 30353
SPECIMEN NUMBER:	TEST SPECIFICATION: Purchase Description (1 March 1973) Para. 4.6.7.1	

Specimen Number	Date	Time	Temp (°F)	Remarks
1-3	3-27-74	1605	-25	Spec. in The Chamber - START Temp decrease
"	"	1625	-80	START 6 hour CONDITIONING
"	"	1735	-80	
"	"	2115	-80	
1-3	3-27-74	2225	-80	END of 6 hour Conditioning - return to ambient -

was then subjected to a vibration cycle at 2.5 g's with

VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Low Temp. storage	High - Low Temp. chamber	Missimers Inc.	FT8-100 X350	6015	-100°F TO 350°F 24"X24"X24"	± 3°F	Time of	Test
	Temperature Potentiometer	Leeds & Northrup	8693	7005	-100°F TO 500°F	± 1.2 °F	2-22-74	6 mo.

VIKING LABORATORIES

TEST DATA

DATE STARTED: 3-28-74	CUSTOMER: ILC.	TECHNICIAN (SIGNATURE): Dave Morris
DATE COMPLETED: 3-28-74	SPECIMEN DESCRIPTION: AN/VSS-3A RADIATION SOURCE, INFRARED SEARCHLIGHT, INFRARED	ENGINEER (SIGNATURE): W. Lien
TEMPERATURE: 74°F	TYPE OF TEST: VIBRATION – SINE	ENGINEER: W. LIEN
HUMIDITY: 50% R.H.	MANUFACTURER: ILC	JOB NUMBER: 30353
SPECIMEN NUMBER: S/N 002, 003	TEST SPECIFICATION: PURCHASE DESCRIPTION (1 MARCH 1973) PARA. 4.6.6	

SPECIMEN NUMBER	DATE	AXIS	TIME START	TIME STOP	VIBRATION FREQUENCIES AND LEVELS	REMARKS
002	3-28	Y	1008	1138		SPECIMEN OPERATING CONTINUOUSLY DURING VIBRATION
002	3-28	X	1323	1453		SPECIMEN OPERATING CONTINUOUSLY DURING VIBRATION
003	3-29	Y	1335	1505	15-120-15 Hz @ 2.5 g's, 3.5 minutes/cycle, 90 minutes/axis (2 AXES ONLY)	SPECIMEN OPERATING CONTINUOUSLY DURING OPERATION
003	3-29	X	1545	1715		SPECIMEN OPERATING CONTINUOUSLY DURING OPERATION

VIKING LABORATORIES

TEST DATA

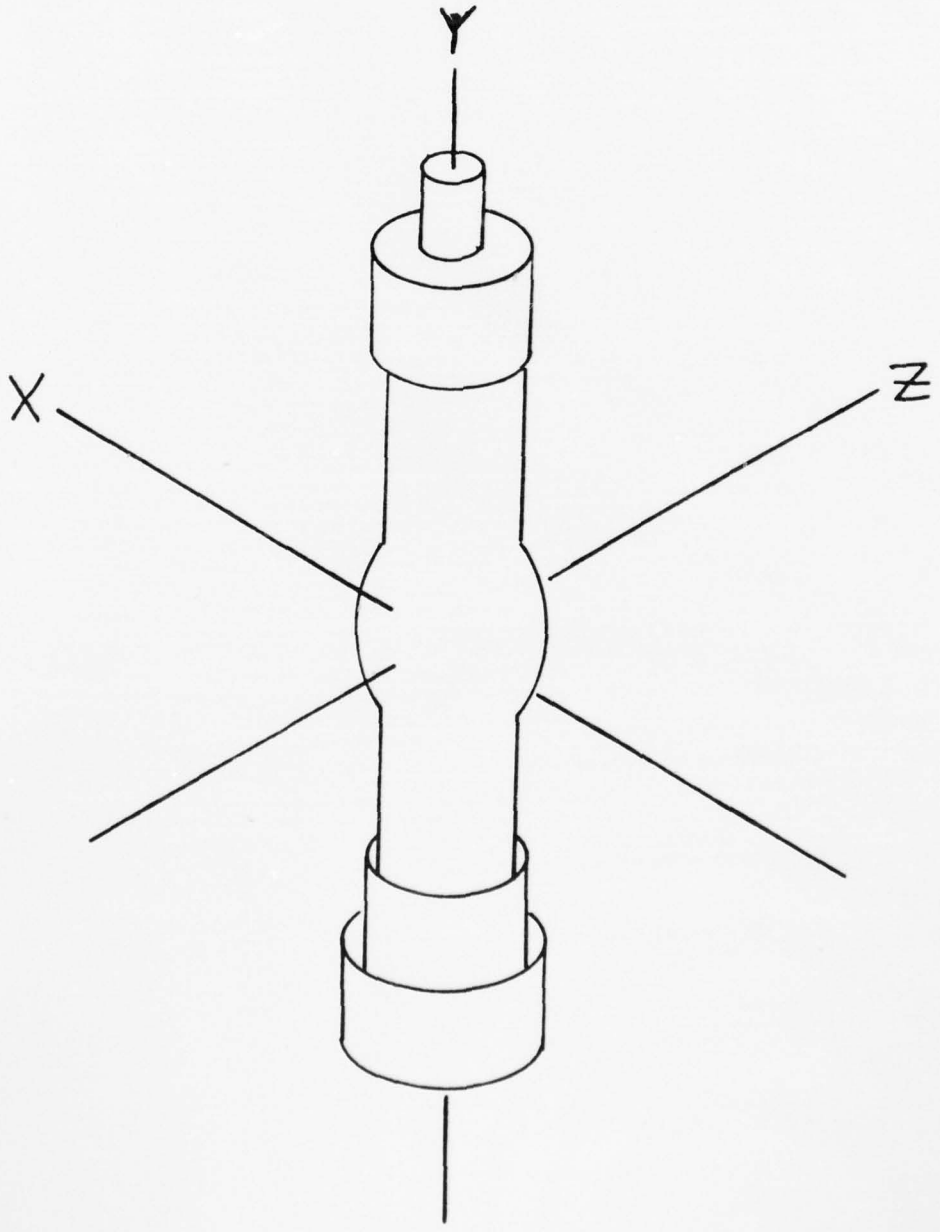
DATE STARTED: 3-28-74	CUSTOMER: ILC	TECHNICIAN (SIGNATURE): Dave Norris (VLE T-21)
DATE COMPLETED: 3-29-74	SPECIMEN DESCRIPTION: AN/VSS-3A RADIATION SOURCE, INFRARED FOR SEARCHLIGHT, INFRARED	ENGINEER (SIGNATURE): W. Lien
TEMPERATURE: 74°F	TYPE OF TEST: VIBRATION-DWELL	ENGINEER: W. LIEN
HUMIDITY: 50%	MANUFACTURER: ILC	JOB NUMBER: 30353
SPECIMEN NUMBER: S/N 002,003	TEST SPECIFICATION: PURCHASE DESCRIPTION (1 MARCH 1973) PARA. 4.6.6	

SPECIMEN NUMBER	DATE	AXIS	TIME START	TIME STOP	VIBRATION FREQUENCIES AND LEVELS	REMARKS
002	3-28	Y	1138	1153	30 Hz @ 2.5 g's 15 minutes/axis (2 AXES ONLY)	SPECIMEN OPERATING CONTINUOUSLY DURING VIBRATION
002	3-28	X	1453	1508		SPECIMEN OPERATED CONTINUOUSLY DURING VIBRATION
003	3-29	Y	1505	1520		SPECIMEN OPERATING CONTINUOUSLY DURING VIBRATION
003	3-29	X	1715	1730		SPECIMEN OPERATING CONTINUOUSLY DURING VIBRATION

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
NA	ILC	Dave Morris
DATE COMPLETED	SPECIMEN DESCRIPTION	ENGINEER (SIGNATURE)
NA	INFRARED RADIATION SOURCE for INFRARED SEARCHLIGHT, AN/VSS-3A	W. Lien
TEMPERATURE	TYPE OF TEST	ENGINEER
NA	VIBRATION - Shock	W. LIEN
HUMIDITY	MANUFACTURER	JOB NUMBER
NA	ILC	30353
SPECIMEN NUMBER	TEST SPECIFICATION	
NA	PURCHASE DESCRIPTION (1 MARCH 1973) PARA 4.6.6	



VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	ASSET NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Sine Vibration	Vibration System	MB Electronics	C-60	6201	5K force Lbs. 5-3K Hz	±10%	TOT	
	Sweep Oscillator	Bruel & Kjaer	1019	6205	5-5K Hz	±1% or 0.25 Hz	2-7-74	3 mo.
	Accelerometer	Endevco	2211	6401	1Kg, 2-8K Hz	±5%	10-22-73	6 mo.
	Accelerometer Amplifier	Unholtz-Dickie	8PMCV	6417E	5-10K Hz	±2%	3-13-74	6 mo.

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
3-28-74	ILC	J.D. Dugma
DATE COMPLETED	**SPECIMEN DESCRIPTION**	**ENGINEER (SIGNATURE)**
3-29-74	Radiation Source, Infrared searchlight, Infrared AN/VSS-3A	W. Lien
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
74°F	SHOCK	W. LieN
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
55% Rh	ILC	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para. 4.6.5.2 + 4.6.5.1	

SPECIMEN NUMBER	DATE	AXIS	LEVEL (g)	PULSE DURATION (MS)	NO. OF SHOCKS	REMARKS
2	3-28-74	parallel	72	6.0	1	Power on - Lamp lit
			72	6.0	3	Power off
			72	6.0	1	Lamp lit
			72	6.0	3	power off
			72	6.0	1	Lamp lit
	3-28-74	parallel	72	6.0	3	Power off
	3-29-74	perpen.	70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
2		perpen.	70	6.0	3	power off
1		perpen	70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
1			70	6.0	3	power off
3			70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
3			70	6.0	3	power off
1			70	6.0	1	Lamp lit
1		perpen	70	6.0	3	power off
		parallel	70	6.0	1	Lamp lit
			70	6.0	3	power off
1						Specimen will not light - Metal
3 4						end appears to have broken off
						anode base
3			70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
			70	6.0	3	power off
			70	6.0	1	Lamp lit
2	3-29-74	parallel	70	6.0	3	power off

VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	ASSET NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Shock	Shock Machine	Barry controls	15575	6214	Impact Vel. 36'/sec. 500g's Max Acc. min Pulse duration 1.0 msec.	±10%	Time of	Test.
	Accelerometer	Endevco corp.	2215C	6404	1,000 g's 2-6 KHz	±5%	10-22-73	6 mo.
	Accelerometer Amplifier	Endevco corp.	2614	6422	5-15 KHz 5V. RMS	±3%	10-16-73	6 mo.
	Power Supply	Endevco corp.	2623	6425	6.3 VAC Plate voltage 100-200 VDC fil. 4-8 VAC.	5mv Rip. ±1% Reg.	4-12-73	12 mo.
	Band Pass filter	Krohn Hite Inst. Co.	330M	6430	~~0.0~~ 0.2 TO 20,000 Hz	±5%	11-13-73	6 mo.
	oscilloscope	Tektronix Inc.	535A	2006	DC-10 MHz 22 NS R.T. .1M TO 5 sec. /cm	±3%	1-2-74	4 mo.
	Plug-in	Tektronix Inc.	CA	2212	DC-15 MHz 10 NS R.T. 0.05 V TO 20 V/cm	±3%	2-1-74	4 mo.
	Camera	Tektronix Inc.	C-12	2404	focal length 75MM F1.9 1.0:0.9 object To figure		No cal	Req.

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
4-2-74	ILC	D.D Ongman
DATE COMPLETED	**SPECIMEN DESCRIPTION**	**ENGINEER (SIGNATURE)**
4-2-74	Radiation Source, Infrared Searchlight, Infrared AN/VSS-3A	W. Lieu
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
67 °F	High Temperature Storage	W. Lieu
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
53% RH	ILC	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para. 4.6.7.3	

Specimen Numbers	Time	Temp. (°F)	Humidity (% RH)	Remarks
243	0835	67	53	Specimens in the Chamber - START Temp and humidity increase
	0915	154	90	START 6 hour conditioning
	0945	154	93	
	1015	154	93	
	1045	154	93	
	1115	154	93	
	1145	154	93	
	1215	154	93	
	1245	154	93	
	1315	154	93	
	1345	154	93	
	1415	154	93	
	1445	154	93	
	1515	154	93	START Temp. and humidity decrease
243	1545	77	93	Specimens Removed from the Chamber

VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
High Temp. Storage	Temp & Humidity Chamber	Missimers INC.	FTh27-100 X350	6004	-100°F TO 500°F 25% TO 98% RH 36" X 36" X 36"	± 3°F	3-29-74	3 mo.

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
4-3-74	I.L.C.	T. T. Hertz
DATE COMPLETED	**SPECIMEN DESCRIPTION**	**ENGINEER (SIGNATURE)**
4-5-74	Radiation Source, Infrared Searchlight, Infrared AN/VSS-3A	W. Lien
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
78°F	TEMPERATURE-HUMIDITY	W. Lien
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
43%	I L C	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para 4.6.7.4	

SPECIMEN NUMBER	DATE	TIME	TEMP. (°F)	HUMIDITY (% RH)	CYCLE NO.	REMARKS
3	4-3-74	1600	72	48	1	Specimen in The Chamber - START Test
		1630	125	94		
		1830	123	98		
		1930	75	98		
		2030	75	98		
		2130	124	98		
	4-3-74	2330	123	98		
	4-4-74	0036	73	98		
		0130	73	98		
		0235	123	98	1	
		0435	123	98	2	
		0635	123	98		
		0735	73	98		
		0835	73	98		
		0935	123	98		
		1135	123	98		
		1235	73	98		
		1335	73	98		
		1446	123	98		
3	4-4-74	1630	123	98	2	Specimen operated - Remove Specimen from The Chamber
2	4-4-74	1635	76	43	1	Spec. in The chamber - START Test
		1645	125	98		
		1845	123	98		
		1945	75	98		
		2045	75	98		
		2145	124	98		
	4-4-74	2345	123	98		
	4-5-74	0045	73	98		
		0145	72	98		
		0245	123	98	1	
		0445	123	98	2	
		0645	123	98		
		0745	70	98		
		0846	70	98		
		0945	124	98		
		1145	124	98		
		1245	75	98		
		1345	73	98		
2	4-5-74	1460	123	98	2	

VIKING LABORATORIES

TEST DATA

DATE STARTED	CUSTOMER	TECHNICIAN (SIGNATURE)
4-5-74	I L C	J. L. Ostenberg, I-3
DATE COMPLETED	**SPECIMEN DESCRIPTION**	**ENGINEER (SIGNATURE)**
4-5-74	Radiation Source, Infrared searchlight, Infrared AN/VSS-3A	W. Lien
TEMPERATURE	**TYPE OF TEST**	**ENGINEER**
76°F	TEMPERATURE-HUMIDITY	W. Lien
HUMIDITY	**MANUFACTURER**	**JOB NUMBER**
39%	I L C	30353
SPECIMEN NUMBER	**TEST SPECIFICATION**	
	Purchase Description (1 March 1973) Para 4.6.7.4	

SPECIMEN NUMBER	DATE	TIME	TEMP. (°F)	HUMIDITY (% RH)	CYCLE NO.	REMARKS
2	4-5-74	1645	125	98	2	Specimen operated - Removed specimen from chamber
						NOTE: No Physical damage Noted due To This Test.

VIKING LABORATORIES

EQUIPMENT LIST

JOB NUMBER 30353

TEST DESCRIPTION	EQUIPMENT DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	RANGE	ACCURACY	CALIB. DATE	CALIB. PERIOD
Temperature & Humidity	Temp. & Humidity chamber	Missimevs	FTh27-100 X350	6002	-100°F TO 350°F 25% TO 98% RH 36"x36"x36"	± 3°F	3-19-74	3mo.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER (14) R-ILC-74-7	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER (9)	
4. TITLE (and Subtitle) (6) Evaluation of Technical Specifications in Purchase Description: Radiation Source, Infrared for Searchlight, Infrared, AN/VSS-3A	5. TYPE OF REPORT & PERIOD COVERED Final Technical Report. Oct. 73 - June 74
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Robert A. Eckel	8. CONTRACT OR GRANT NUMBER(s) C DAAK02-74-0020
9. PERFORMING ORGANIZATION NAME AND ADDRESS ILC Technology, Inc. 164 Commercial St. Sunnyvale, California	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS (11)	12. REPORT DATE August 1974
	13. NUMBER OF PAGES 55 plus Appendix
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (12) 94p.	15. SECURITY CLASS. (of this report) Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

(5) DAAK02-74-C-0029

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Xenon Short Arc; Radiation Source, Infrared; Searchlight, Infrared

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An evaluation of the technical specifications in the purchase description: Radiation Source, Infrared for Searchlight, Infrared, AN/VSS-3A, dated 1 March 1973, was made. Although several minor fabrication and test problems occurred, the performance of lamps manufactured meet the purchase description requirements under ideal laboratory conditions. Rugged environmental operation under field conditions may adversely affect lamp life, additional

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Abstract (Continued)

cathode improvement studies are recommended to produce greater reliability for production volume.

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