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7486 CERAMIC TRIODE

PRODUCTION ENGINEERING MEASURE

FINAL REPORT

19 JUNE 1962 THROUGH 19 MAY 1964

CONTRACT NO. DA-36-039-SC-86738

ORDER NO. 19060-PP-62-81-81

U. S. ARMY ELECTRONICS MATERIEL AGENCY
PHILADELPHIA, PENNSYLVANIA

CLASSIFICATION - NONE

TUBE DEPARTMENT
GENERAL ELECTRIC
OWENSBORO, KENTUCKY

7486 CERAMIC TRIODE, PRODUCTION ENGINEERING MEASURE

FINAL REPORT

19 JUNE 1962 THROUGH 19 MAY 1964

Objective:

(1) To provide improved vacuum exhaust equipment for processing 7486 tubes.

(2) To improve tube ratings by evaluation on new test equipment.

(3) To increase tube life expectancy by improved tube design features.

(4) To demonstrate 100 tube per day production capability.

(5) To prepare and distribute progress reports.

(6) To prepare the Step II report covering a rate of 10,000 tubes per month.

CONTRACT NO. DA-36-039-SC-86738

ORDER NO. 19060-PP-62-81-81

SIGNAL CORPS INDUSTRIAL PREPAREDNESS
PROCUREMENT REQUIREMENTS NO. 15

CLASSIFICATION - NONE

REPORT BY - J. D. MARSHALL

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1.0 ABSTRACT

The period covered by this report is from 19 June 1962 through 19 May 1964.

A summary of progress during the program is given with graphs and illustrations. The capability for producing 100 good tubes type 7486 per 8 hour day was demonstrated. Preproduction and production test reports are included. A copy of the improved test specification is presented.

2.0 PURPOSE

One of the objectives of this contract was to provide improved tube processing equipment capable of producing 100 tubes type 7486 per day. The principal improvement in processing was to fire component parts and seal tubes on ion pump exhaust equipment. Other improvements in cathode spray equipment were expected to improve the uniformity of the product. By evaluation under various conditions on new test equipment it was intended to reflect the benefits of this work in improved ratings of this tube, particularly in the areas of high frequency performance, and to give assurance that these ratings will be compatible with stable performance during life.

This evaluation included life testing at increased values of plate dissipation and cathode current, under 450 megacycle conditions. Performance tests were also conducted at 2200 and 5900 megacycles.

Design modifications were to be made to the heater to assure longer life. The possible advantages of tungsten-rhenium wire and darkened insulation coating were to be evaluated.

The test requirements for the improved tube are defined by the SCL-7001/74B specification dated 28 October 1963.

3.0 NARRATIVE AND DATA

The 7486 is a triode electron tube of ceramic-and-metal planar construction. The primary applications of the 7486 are in military end use equipment. Some of the advantages of this tube over other devices are:

1. High gain and power output at UHF frequencies.
2. Small size and light weight.
3. Rugged-resistant to shock and vibration.
4. Capable of operation at high temperatures.
5. Tolerant of nuclear radiation.

The tube was developed by the General Electric Company on its own funds. It is shown in cross-section in Figure 1.

The program described herein has been a Production Engineering Measure to improve the processing equipment, manufacturing methods, and design features for type 7486 and to establish a test specification and appropriate test equipment to give increased assurance of its performance at frequencies up to 5900 Mc. The following tasks were performed during the course of the project and describe the progress attained.

3.1 TASK I - VACUUM EXHAUST AND SEALING EQUIPMENT

Experience on various tube types has indicated that oil diffusion pumps are a source of contamination in the tube. The contamination can be reduced with the use of several types of baffles and filters. A positive method of eliminating this hazard is the use of another pumping system.

The equipment developed in this phase incorporates an ion

TYPE 7486

VHF - UHF CERAMIC TRIODE

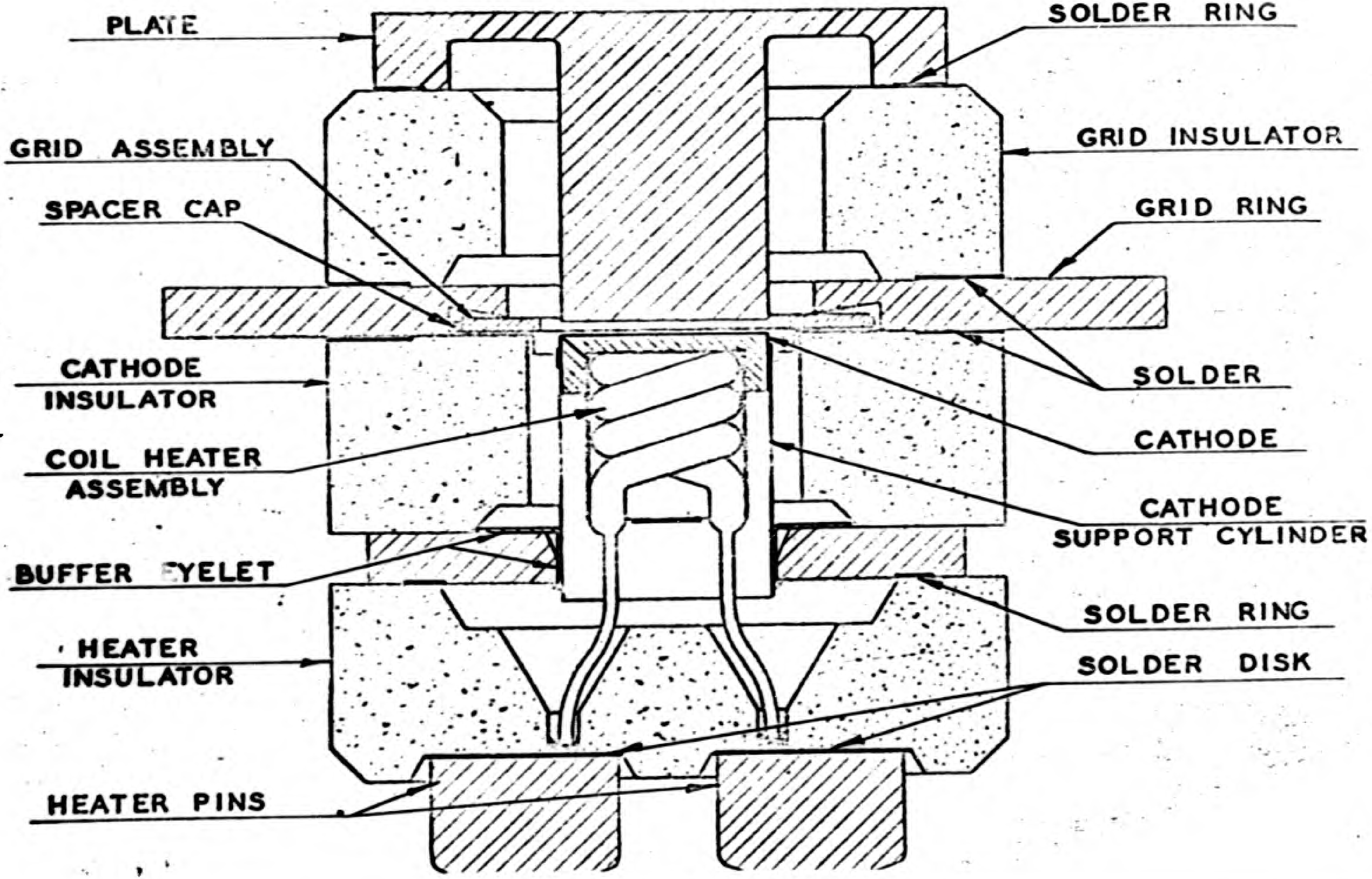


Figure 1 - Page 4

pump which can operate completely isolated from any type of backing pump after a pressure of 1 micron has been acquired. The design consists of two 12" X 18" stainless steel bell jar type chambers located side by side. A photograph of the system as initially installed is included as Figure 2.

The primary roughing system consists of a 15 cubic feet per minute mechanical roughing pump which reduces the pressure in the vacuum chamber from atmospheric pressure to less than 10^{-2} torr (10 microns). The secondary roughing system, consisting of an Ultek 20/140 Boostivac pump, reduces the pressure to 10^{-6} torr (10^{-3} microns). High vacuum pumping is accomplished with an Ultek 400 liter per second ion pump with Boostivac elements which produce a 4000 liter per second pumping capability. The ultimate vacuum acquired is then 2 X 10^{-6} torr.

This vacuum system was received from the Ultek Corporation on June 28, 1963. This was to have been delivered to the Equipment Development Operation in Owensboro, Kentucky by March 29, 1963 for initial evaluation. The delay forced a modification in the schedule. Delivery was made directly to the Special Products Section. Installation and system prove-out was accomplished at this location which was to be the site of final operation.

Typical pumpdown characteristics as reported by the supplier are represented in Figure 3. Pumpdown characteristics

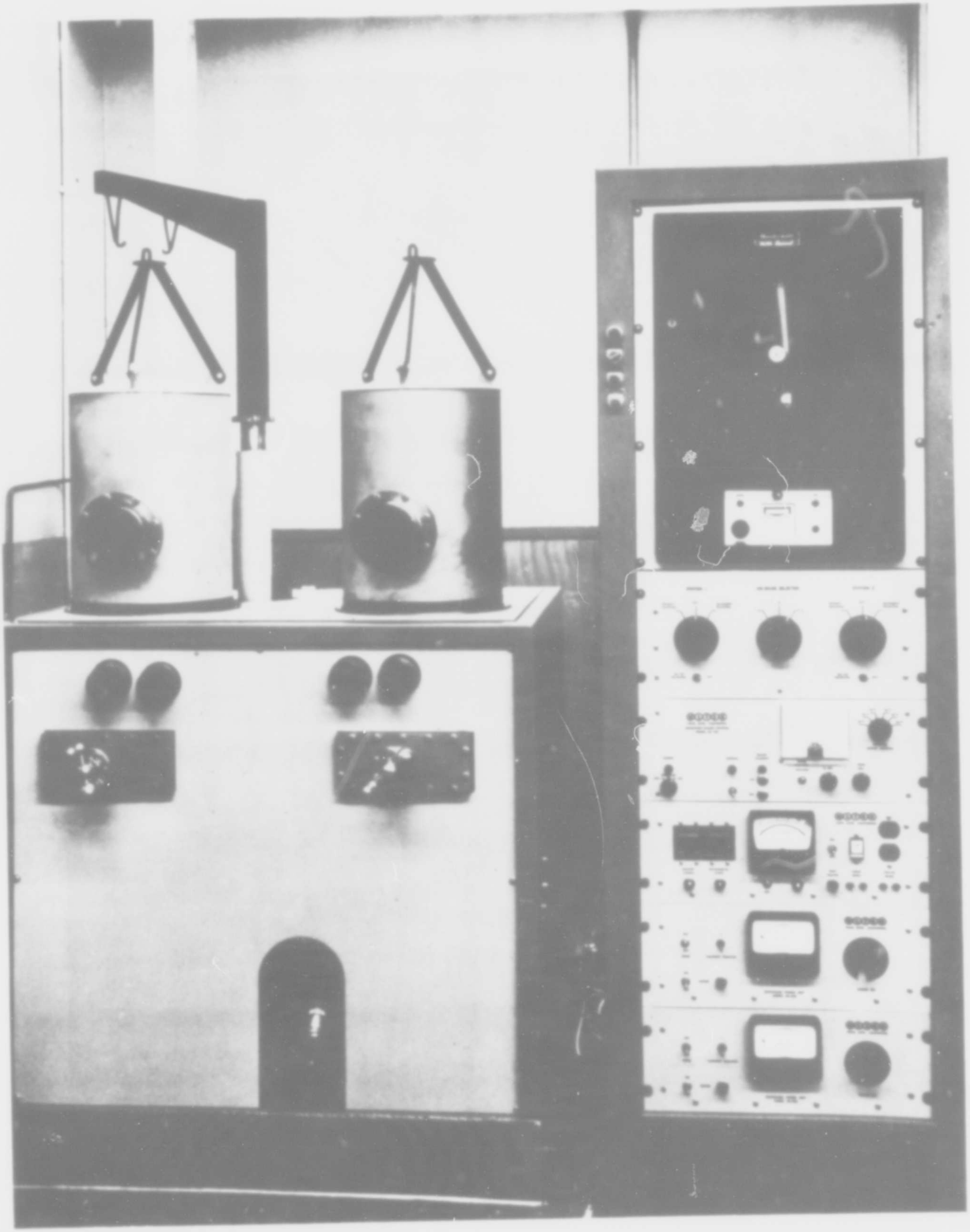
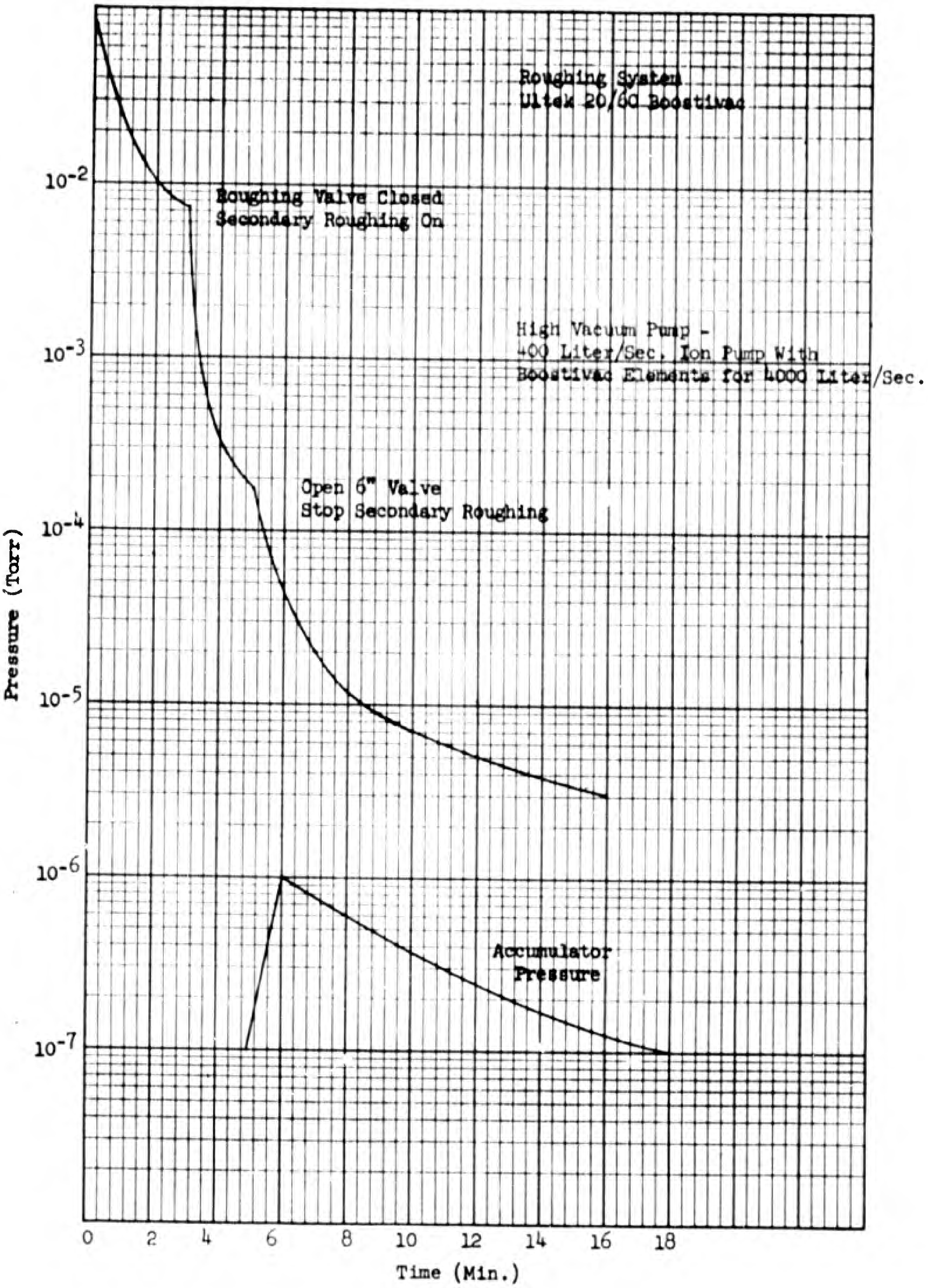


Figure 2 ION-PUMP VACUUM PROCESSING SYSTEM

Figure 3 - Typical Pumpdown Characteristics Reported By Supplier



as determined during prove-out are shown in Figure 4.

When the system was placed in service it was found that a loss of vacuum occurred during parts firing for extended periods. At temperatures of approximately 600°C and over 1000°C the vacuum would drop to the point ($2 X 10^{-4}$ torr) at which there was a danger of extinguishing the ion pump requiring removal of power from the oven.

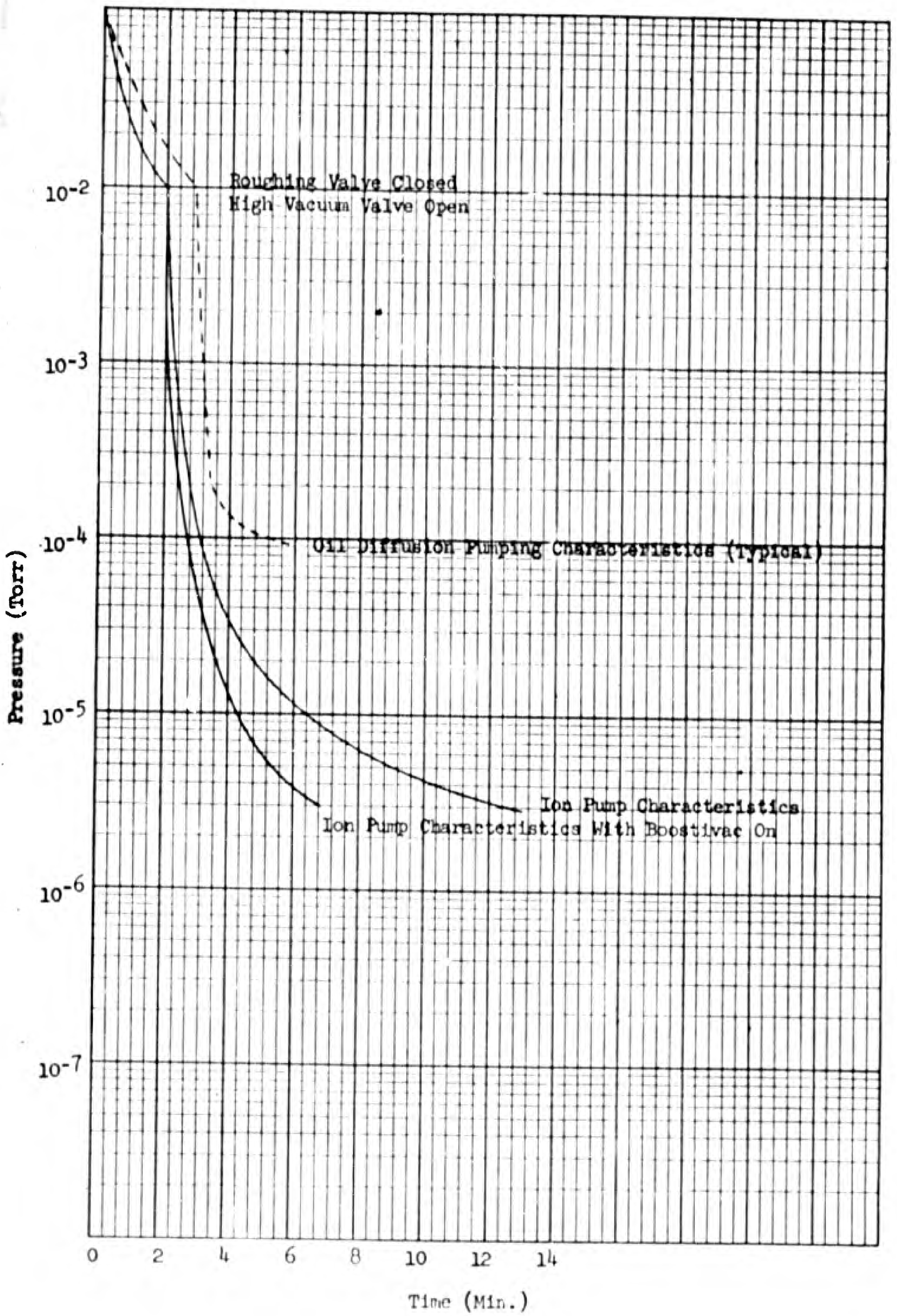
It was found that the oven heat was causing an increase in temperature of the stainless steel bell jar. This chamber which is mounted on a flat baseplate is sealed by an ell-shaped gasket seal of Viton "A". The heat being conducted from the metal bell jar toward the baseplate was causing a failure of this seal. A glass bell jar was substituted for the metal enclosure. Adequate vacuum was maintained for a longer period of time, but serious loss of vacuum occurred during parts firing.

Water cooling of the metal bell jar was applied. Figure 5 shows the modified bell jar. Tubing was brazed to the outer surfaces of the stainless steel bell jar. Flexible tubing permits continuous circulation of cooling water for all operating positions of the bell jar. The relationship of pressure to temperature during typical operation is represented graphically in Figure 6.

3.2 TASK II - TEST EQUIPMENT

Specialized test equipment was designed and constructed and additional testing was performed. Modifications to the test

Figure 4 - Average Actual Pumpdown Characteristics After Installation
(No Secondary Roughing)



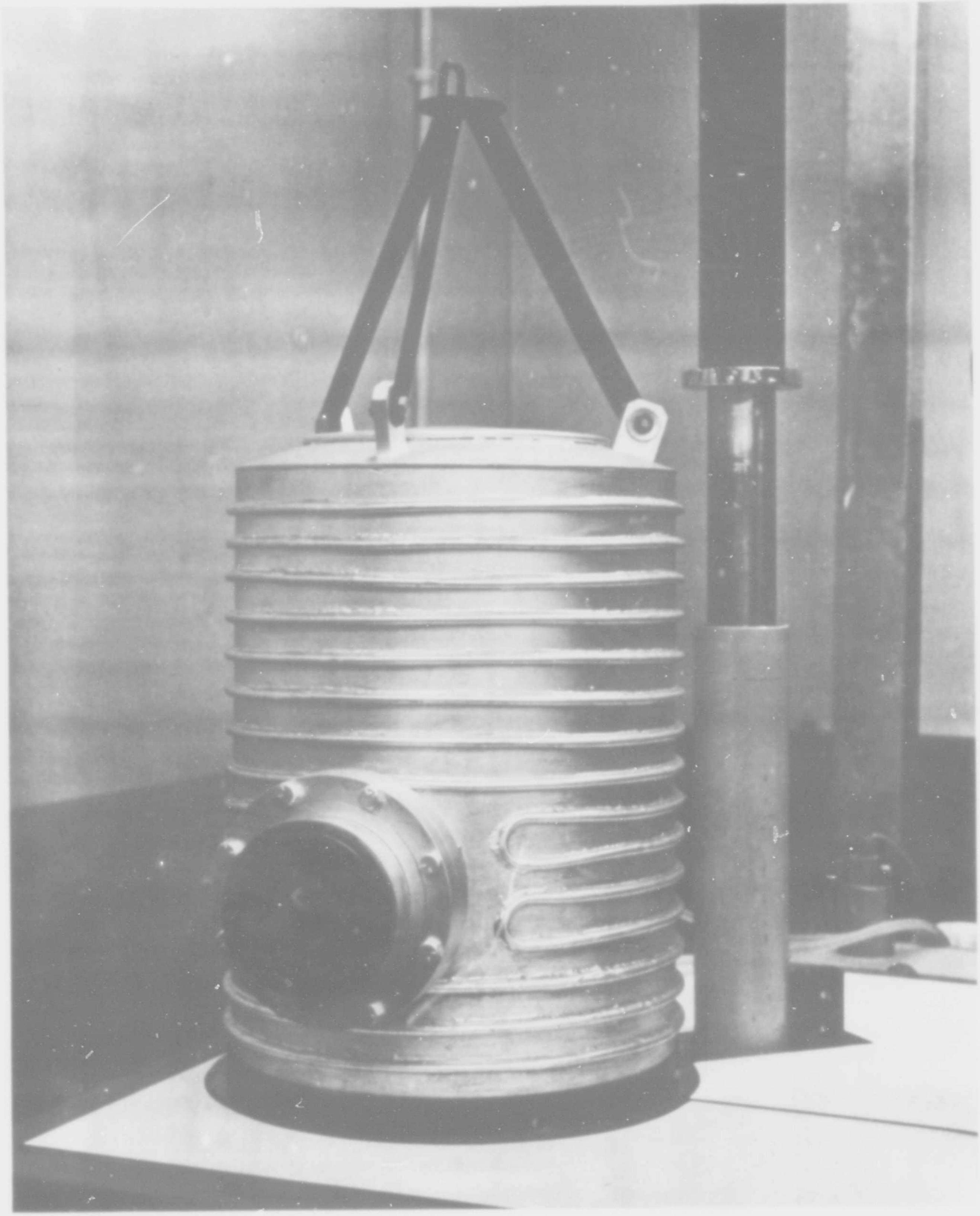
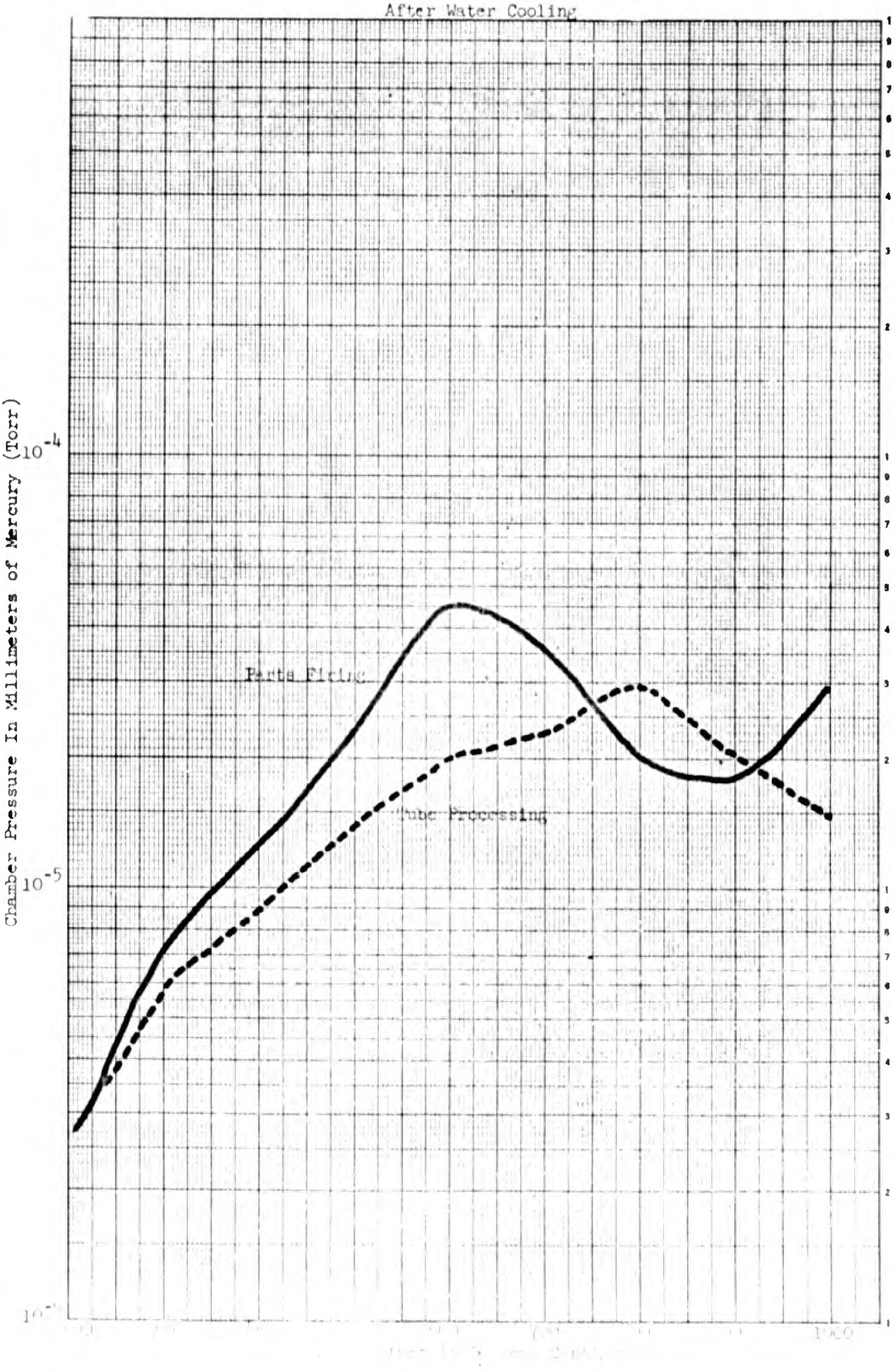


Figure 5 WATER COOLED VACUUM CHAMBER

Figure 6 - Temperature Vs. Pressure Characteristics After Water Cooling



specification were made to reflect increased ratings. Additions were made to the specification to assure its performance in applications where an increase in operational frequencies to as high as 5900 megacycles is anticipated. R.F. life test at 450 Mc was added and performance testing at 2200 Mc and 5900 Mc was included.

3.2.1 - 450 MC LIFE TESTING EQUIPMENT

A 450 Mc oscillator life test was designed. Figure 7 shows the layout of the components on the individual chassis. Fifty units were constructed and used during the program.

The oscillator is a grounded grid circuit with quarter-wave shorted tuned lines in both anode and cathode circuits. Ground planes are used on both sides of the tuned lines to minimize radiation losses. The feedback is variable capacitance from the anode to the cathode. The output coupling is a moveable loop near the shorted end of the plate line. A variable grid resistor is used to adjust the tube operating point for maximum plate efficiency with different plate voltages and currents.

Results of operation of typical tubes with various plate voltages and currents are represented in Table I. Five conditions, shown in Table II, were chosen to begin the evaluation of tubes under R.F. life testing.

3.2.2 - 60 CYCLE LIFE TEST

Conditions were established for life testing at 60 cycles with cathode currents and plate dissipation comparable to those used for 450 Mc life testing. These conditions are included as Table III.

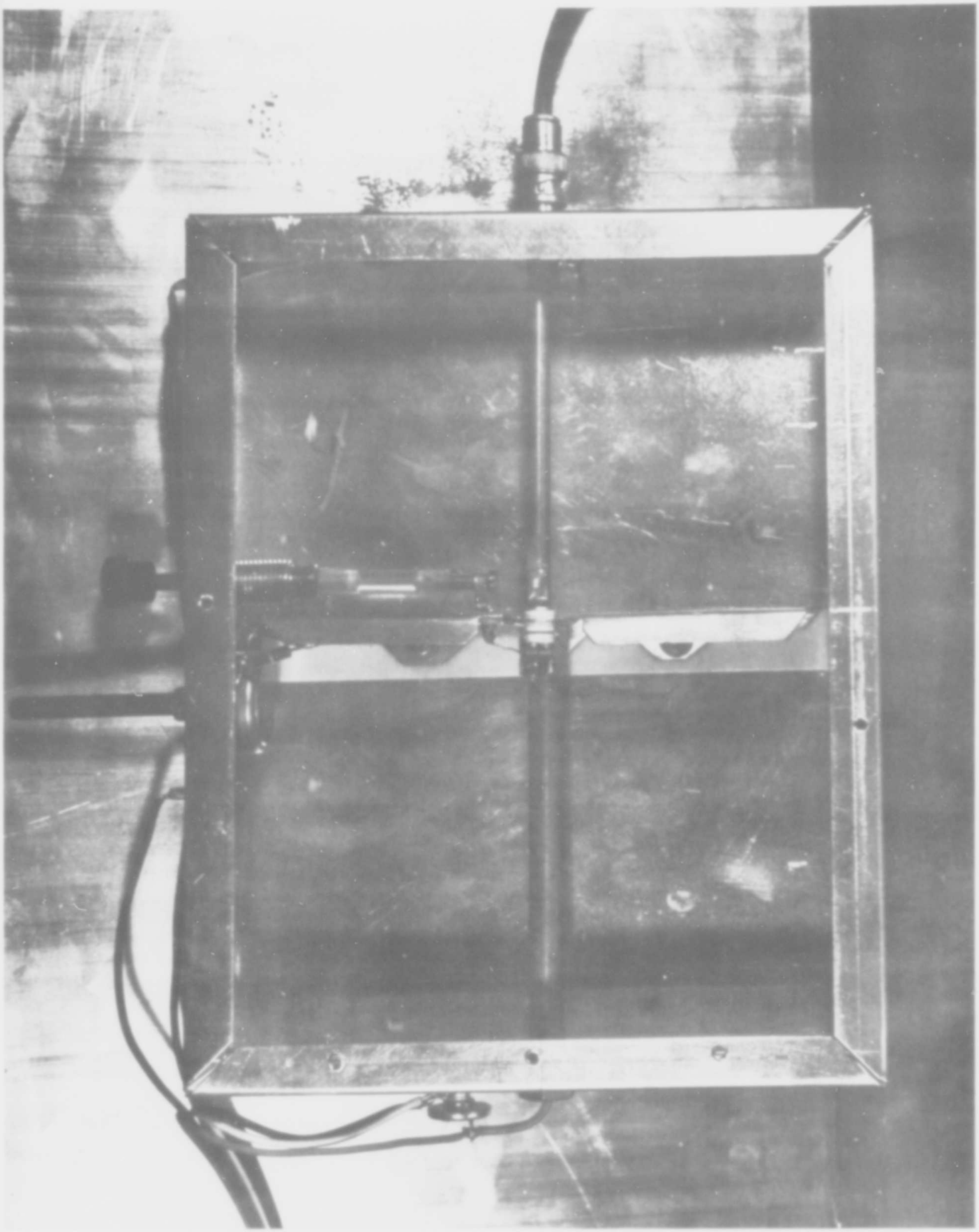


Figure 7   450 MC. OSCILLATOR LIFE TEST UNIT

Ebb Volts	Ib ma	Ig ma (Approx.)	Ik ma (Approx.)	Po W (Into Load)	Overall Plate Efficiency %
100	7	3	10	.4	57
150	7	3	10	.58	55
150	10	4.5	14.5	.88	58.6
200	10	5	15	1.1	55
200	15	7	22	1.85	61.7
250	10	4	14	1.3	52
250	15	6	21	2.3	61.3
300	10	4	14	1.45	48.5
300	15	6	21	2.65	59
350	20	8	28	4.2	60

Table I. Characteristics of Bogey Tubes For Various Plate Voltages and Currents

Condition	Ebb (Volts)	Ib (ma)	Ig (ma)	Pi (Watts)	Po (Watts)
1	150	7	3	1.25	0.6
2	150	10	5	1.5	0.85
3	200	15	7	3.0	1.8
4	250	15	6	3.75	2.3
5	350	20	8	7.	4.2

Table II. 450 Mc Life Test Conditions Selected For Initial Evaluations

	Ep (Vrms)	Ik (ma)	Ig (ma)	Rg (Ohms)	Pp (Watts)
Cond. 1	130	11	1.0	6800	1.5
Cond. 2	103	15	2.5	2200	1.5
Cond. 3	130	16	2.3	2700	2.0
Cond. 4	150	17	2.5	2700	2.5
Cond. 5	130	21	3.5	1600	2.5

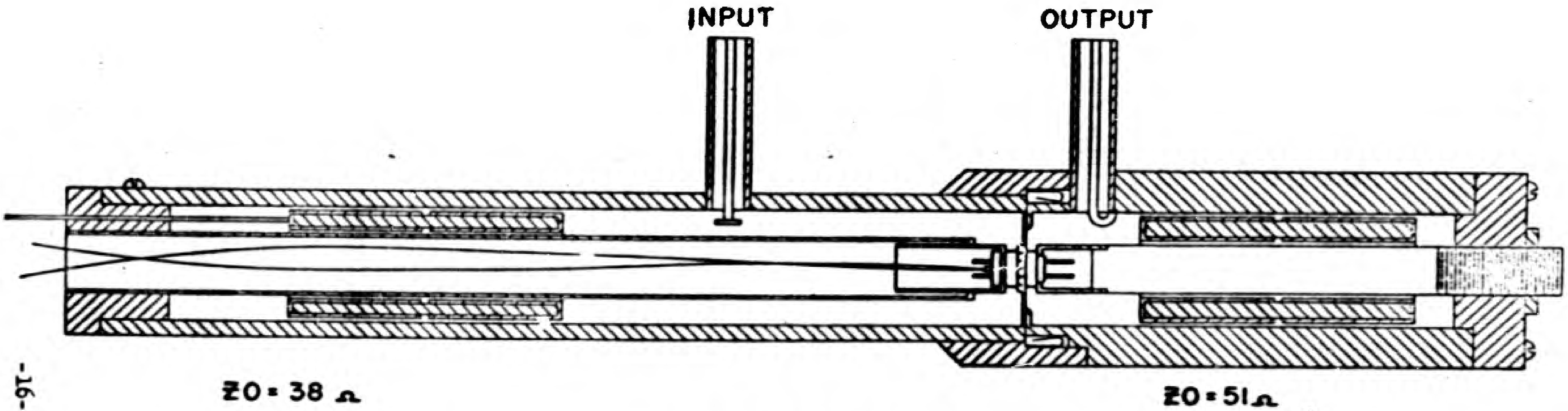
Table III. 60 Cycle Life Test Conditions Selected For Initial Evaluations

The tests chosen were intended to represent present tube ratings, improved ratings as listed in the specification SCL-7001/74, and higher ratings from which some failures could be expected. One hundred positions of 60 cycle testing were constructed and used during the program.

3.2.3 - 2200 MC AMPLIFIER CAVITY

A cavity amplifier for 2200 Mc operation was designed and constructed. Figure 8 shows a cross-section view of the amplifier cavity. Detailed construction drawings are referenced in the test specification.

The input circuit is a coaxial cavity having a characteristic impedance of 38 ohms and operating in the three-quarter wave length mode. The cavity shorting device consists of non-contacting choke and bucket plunger. The R.F. driving power is coupled into the cavity by means of a capacitive probe. This input cavity is tuneable so that it can be resonated with the output cavity.



-ASSEMBLY-
7486 AMPLIFIER CAVITY FOR 2,200 MC.

Figure 8

The grid of the 7486 is grounded for both R.F. and D.C. in order to eliminate the problem of adequate by-passing of the grid at this frequency. Biasing of the circuit is accomplished by floating the power supply above ground and using a combination of cathode and grid leak bias.

The output cavity is of coaxial configuration operating in the one-quarter wave mode foreshortened by the tube grid-anode capacitance. The shorting plunger is the same choke and bucket type used in the input cavity, and is non-contacting to permit the anode voltage to be fed to the tube. The output cavity is adjusted to the specified frequency of 2200 Mc with a bogie tube and the shorting plunger then locked in place. Power is coupled from the cavity by means of an inductive loop which is adjustable to permit the coupling to be optimized.

The characteristic impedance of the output cavity has been set at approximately 51 ohms. Calculations were made using characteristic impedances of 77 ohms and 100 ohms, but these higher impedances resulted in configurations which were too short to permit satisfactory coupling methods.

The 7486 tube was evaluated in this cavity. Using 8 mw of driving power at 250 Vdc and 13 ma Ib an average power output of 175 mw was acquired for a 10 tube sample. Drive power versus power output and gain were next investigated to explore the tube's potential in this circuit. Tentative test conditions which were established are:

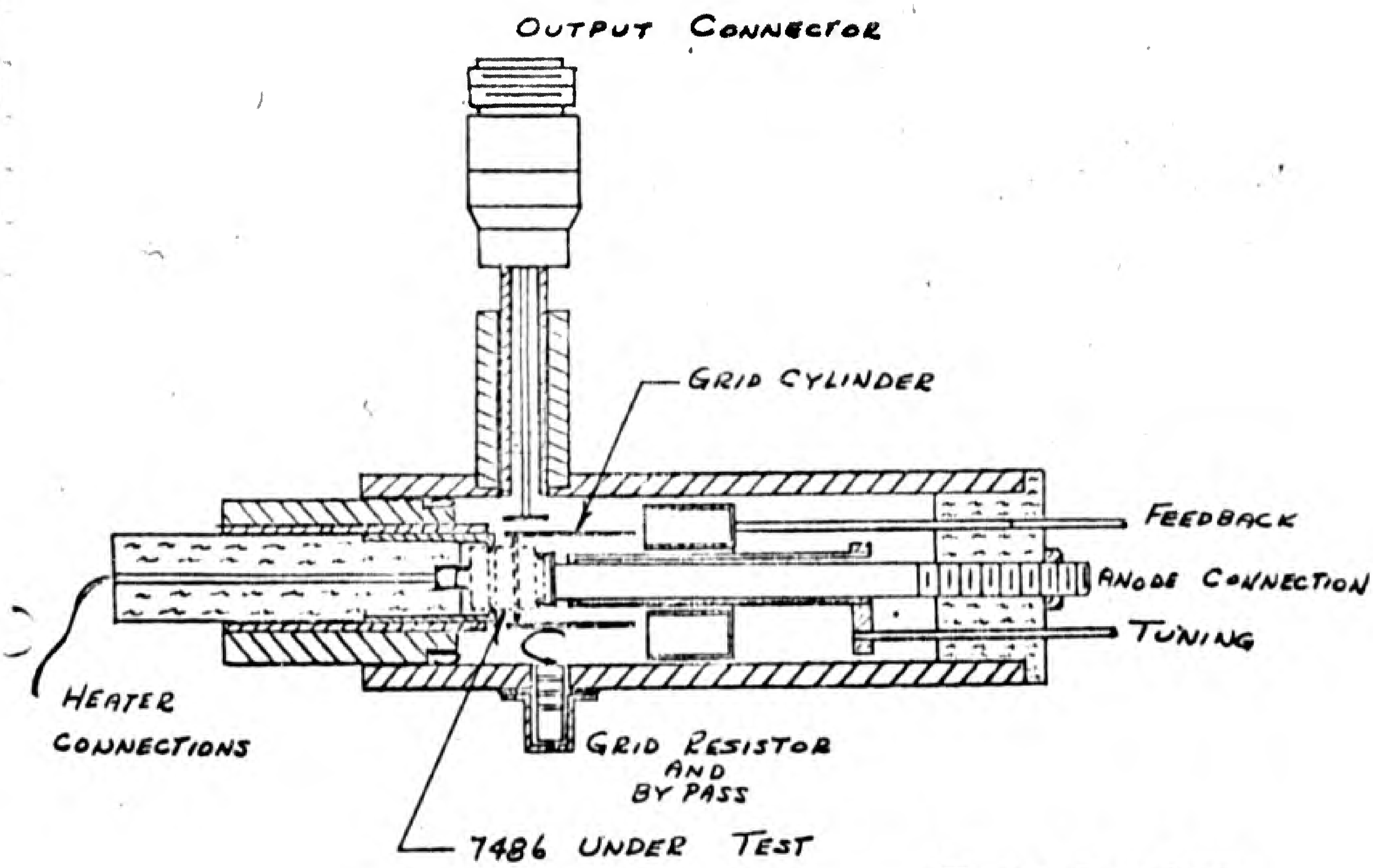
Ef = 6.3 Vac
Ebb = 200 Vdc
Ib = 13 mAdc
F = 2200 Mc approx.
Rg = 1000 Ohms
Pd = 50 mW
Vary Rk for Ib = 13 mAdc
Tune input and output cavities and loading for max. Po
Record Po, gain, and 3 db bandwidth
Po = 350 mW min.
Gain = 8.4 db min.

Minor modifications to the initial cavity design were made during the course of the evaluations. These included changes in heater pin contacts and changes in the finger contacts of the grid cylinder. These were required to make for easier insertion and to make positioning in the cavity less critical.

3.2.4 - 5900 MC OSCILLATOR CAVITY

A 5900 Mc oscillator test cavity was designed and constructed. This is shown in cross-section in Figure 9. Detailed construction drawings are referenced in the test specification. The design is a re-entrant circuit with adjustable tuning and feedback arrangements. Tubes were evaluated in the test cavity. An average power output of 35 mw was observed for 50 tubes when tested under the following conditions:

F = 5900 Mc approx.
Ef = 6.3 Vac
Ebb = 200 Vdc



SCALE = FULL SIZE

FIGURE 9 : 5,900 MEGACYCLE OSCILLATOR FOR 7486 OSCILLATION (Z) TEST.

Rk/Ib = 13 mAdc

Ic = 2 mAdc max.

Rg = 2200 Ohms

Adjust cavity for maximum Po at 5900

It was found that, after setting the cavity as outlined, only minor peaking of the output coupling was required when changing tubes.

3.2.5 - AUXILIARY EQUIPMENT

An R.F. driving source was designed and constructed for the 2200 Mc amplifier test. It utilizes a GL 2C43 planar triode in a re-entrant oscillator. A commercial piece of equipment (GR 1360-AR) was made available from another project and has been utilized for most testing during the last part of the program because of its greater versatility.

3.2.6 - ENGINEERING SAMPLES

Tubes were withdrawn from production lot 62-17 of type 7486. These were to represent the present product. Life tests at 60 cycles and at 450 Mc were performed using the five conditions for each test as outlined in Tables II and III.

A fifty tube sample was life tested at 450 Mc with 10 tubes tested at each of the 5 conditions. A summary of the failures encountered during this test is included as Table IV.

One hundred tubes were life tested at 60 cycles with 20 tubes subjected to each of the 5 test conditions. A summary of the failures encountered is presented as Table V.

	Inop.	If	450 Mc Δ Po t	5900 Mc Po	Δ F t	Ihk	IR
LTEP		222-264	30%	3 mW	50 Mc	20 μa	50 Meg.
Cond. 1	0	0	0	0	0	0	0
Cond. 2	1	0	0	1	0	0	0
Cond. 3	0	0	0	0	0	0	0
Cond. 4	1	0	0	0	0	0	0
Cond. 5	2	0	0	2	1	0	0
Total	4*	0	0	3	1	0	0

Table IV. Number of Defectives on Life Testing at 450 Mc for 1000 Hours (10 Tubes/Condition)

* Includes 2 which were physically damaged during final testing period.

	Inop.	If	OSm	Sm Δ Ef	Ihk	IR
LTEP		222-264	6500	25%	20 μa	50 Meg.
Cond. 1	2	0	0	2	0	4
Cond. 2	0	2	0	1	0	0
Cond. 3	1	0	1	0	0	1
Cond. 4	2	2	0	0	0	1
Cond. 5	2	1	0	2	0	0
Total	7	5	1	5	0	6

Table V. Number of Defectives on Life Testing at 60 Cycles Per Second For 1000 Hours (20 Tubes Per Condition)

3.2.7 - SELECTION OF LIFE TEST CONDITIONS

The life test data on production lot 62-17 was reviewed. From Table V it is evident that a number of tubes developed low insulation resistance even at the lower ratings of Condition 1. This was apparently caused by a high grid drive source voltage which appeared between grid and cathode during warmup as the heater was cycled on life. The basic life test circuit was modified to reduce Rg and use a lower grid source voltage, with D.C. plate voltage to obtain the equivalent current and dissipation conditions. Two conditions each of 450 Mc life and 60 cycle life were then selected for comparable tube operation. The desired end result was a single test condition which would give assurance of a quality product at the improved ratings. The proposed specification includes an increased cathode current rating and higher plate dissipation. One condition was selected to reflect these ratings and the second condition was at a higher point at which the tube would be expected to pass, thus demonstrating a margin of safety. The selected conditions for both 60 cycle and 450 Mc life are presented in Table VI.

3.3 TASK III - TUBE DESIGN IMPROVEMENTS

The major effort was directed toward reduction of the number of inoperatives at initial test due to loose cathode coating particles, and toward improving heater reliability.

3.3.1 - CATHODE COATING TECHNIQUES

An attempt was made to reduce the number of loose particles

60 Cycle Life

	Condition 1	Condition 2
Ebb	180 Vdc	180 Vdc
Eg	6 V RMS	6 V RMS
Rp	3300 Ohms	2200 Ohms
Rg	1200 Ohms	700 Ohms
Ig	1.9 ma	2.9 ma
Ib	13.2 ma	17.1 ma
Pp	1.53 watts	2.08 watts

450 Mc Life

Ebb	150 Vdc	250 Vdc
Ig	5 ma	6 ma
Ik	15 ma	21 ma
Pi	1.5 watts	3.75 watts
Po	0.85 watts	2.3 watts

Table VI. Life Test Conditions Selected For Evaluation Under Task III of cathode coating which utlimately remain in the sealed tube. The technique involved the use of new spray mask designs during the cathode coating operation which would prevent or significantly reduce the deposition of coating particles near or beyond the edge of the cathode surface. The two designs tested are illustrated in Figure 10.

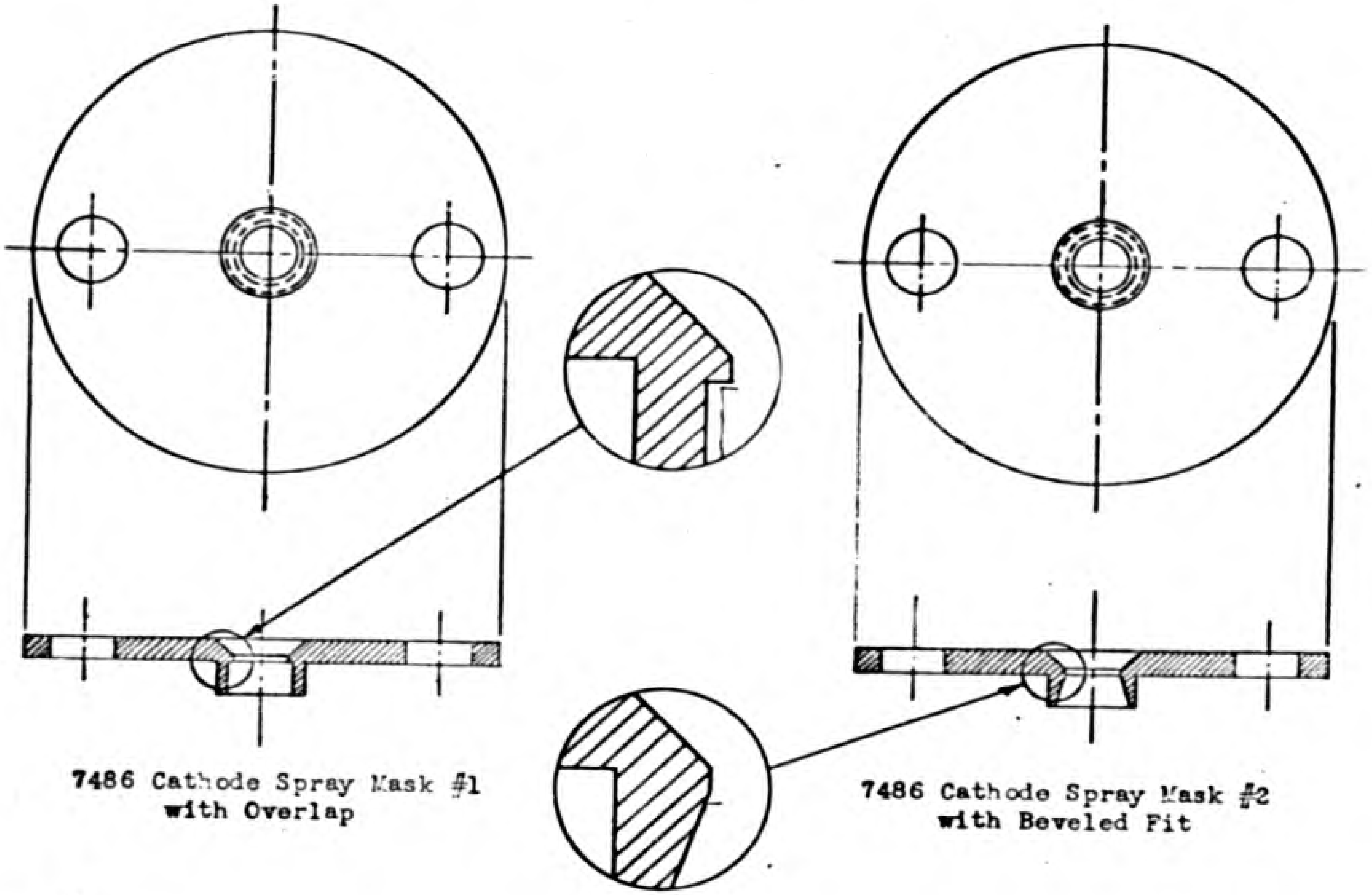
Life tests on tubes fabricated for this evaluation included 60 cycles at room temperature, D.C. life test at high ambient temperature (250°C), and pulse life test. The results of zero bias transconductance and plate current characteristics during these tests are shown in Table VII. An adverse effect on readings of transconductance at reduced heater voltage was observed for tubes processed using the mask which shielded the outer edge completely (#1 in Figure 10). The mask which was chosen (#2 in Figure 10) used a small angle (6°) for a beveled fit to the cathode lid. Edges of the lid were still coated, but at a reduced thickness. There was a distinct reduction in the accumulation of cathode coating at the junction of the cathode support wall and the contact ring which was the purpose of the design. No grid to cathode shorts occurred with tubes processed using the new mask designs. Forty tubes were life tested for each mask design.

3.3.2 - HEATER DESIGN

The use of tungsten-rhenium heater wire has been proved to be effective in reducing the amount of recrystallization of the wire during extended life tests. Darkening of the surface of the

PROPOSED CATHODE SPRAY MASK MODIFICATIONS

7486 PEM



7486 Cathode Spray Mask #1
with Overlap

7486 Cathode Spray Mask #2
with Beveled Fit

	0 Hours		500 Hours		1000 Hours	
	0 Sm	Ip	0 Sm	Ip	0 Sm	Ip
60 Cycle Room Temp.						
Beveled Mask	12,228	7.28	11,336	6.93	11,700	7.48
Lipped Mask	10,128	6.84	9,914	6.7	9,812	7.20
Regular Mask (50#)	12,860	6.88	12,060	6.36	13,000	7.18
Regular Mask (40#)	14,420	7.54	12,860	6.54	13,040	7.02
Pulse Life						
Beveled Mask	11,052	6.88	9,028	6.00	10,292	6.48
Lipped Mask	12,868	7.96	11,202	6.88	11,480	7.76
Regular Mask (50#)	13,060	7.34	11,054	5.84	11,100	6.08
Regular Mask (40#)	13,544	7.40	11,704	6.24	11,360	7.24
High Ambient Life						
Beveled Mask	9,906	6.15	9,229	6.23	8,250	6.06
Lipped Mask	9,487	6.27	8,382	6.0	8,458	6.2
Regular Mask (50#)	11,020	6.66	9,832	6.26	9,751	6.21
Regular Mask (40#)	11,243	6.76	9,516	6.17	9,871	6.37

Table VII. Zero Bias Transconductance and Plate Current From Life Tests On Cathode Spray Mask Effects heater insulation has also been shown to add to reliability by permitting more efficient heat transfer so that the wire operates at a cooler temperature. Both of these modifications required a change in heater design to obtain the value of heater current already specified for the product.

Sample tubes were made during this evaluation to determine the effects of the darkening operation. An average change of 27 ma was observed from three heater configurations. The wire size used to compensate for this effect and to produce the required heater current of 240 milliamperes was ordered. It was wound into the two configurations to be tested. KR45348 describes a white heater and KR45339 a darkened heater.

Evaluation of tubes incorporating the tungsten-rhenium designs were compared with tubes containing the regular tungsten designs using four types of presently available life test equipment.

1. A progressive stress heater cathode life test. This test consists of applying a progressively increasing value of heater-to-cathode voltage which is intended to cause all tubes to ultimately fail. The comparison of the rates of failure can be used as a criterion of effective design.

2. A heater cycling test - This test consists of a repeated cycling, on and off, of an elevated heater voltage.

3. A 1000 hour life test under 60 cycle conditions with a positive heater-cathode potential.

4. A 1000 hour life test under 60 cycle conditions with a

negative heater-cathode potential.

A summary of heater current changes on these and other tests is included as Table VIII. It has been observed that life testing with a negative Ehk accelerates the increase in heater current. Life tests for tungsten-rhenium wire both white and darkened were extended beyond the 1000 hour end point. At the end of 9000 hours the amount of If change was +17 ma for white coating and -2 ma for darkened coating.

3.3.3 - SECOND ENGINEERING SAMPLE

The tubes from which the second engineering sample was supplied were subjected to two conditions of 450 Mc life test. There was one inoperative from the 12 tubes tested which was due to a broken heater pin during installation in the oscillator. From 30 tubes tested under two conditions of 60 cycle life there were no failures.

The performance of tubes subjected to each of the two conditions of 450 Mc life and of 60 cycle life was reviewed and the life test conditions were selected for inclusion in the test specification. These conditions are as follows:

	Ebb	Eg	F	Rg	Rp	TA
Cond. 1	180 Vdc	6.0 Vac	60 cps	1200	3300	Room
Cond. 2	250 Vdc		475 Mc ±25 Mc	Vary for Ib = 15 mAdc Ig = 5-7 mAdc		Room

On the basis of experience gained during the program, modifications to the specification were proposed. The revised SCL-7001/74B dated 28 October 1963 was accepted as the basis for

Test	Average Change In Heater Current	Number Tubes Above 264 mA (0-1000 Hrs.)	Total Tubes
Regular 60 Cycle Life (Lot 62-17)	+ 16.07 mA	2	15
Pulse Life (Lot 62-17)	+ 12.67 mA	0	15
Special 60 Cycle Life (From Lot 62-17) (-Ehk)			
Condition 1	+ 13.22 mA	0	20
Condition 2	+ 15.25 mA	2	20
Condition 3	+ 13.89 mA	0	20
Condition 4	+ 14.67 mA	2	20
Condition 5	+ 16.58 mA	1	20
450 Mc Life (From Lot 62-17) (No Ehk)			
Condition 1	+ 10.8 mA	0	10
Condition 2	+ 9.0 mA	0	10
Condition 3	+ 8.7 mA	0	10
Condition 4	+ 9.4 mA	0	10
Condition 5	+ 11.3 mA	0	10
Heater Tests (+Ehk)			
Tungsten-Rhenium - Dark	- 1.5 mA	0	10
Tungsten-Rhenium - White	+ 7.4 mA	0	10
Tungsten - Dark	+ 6.3 mA	0	10
Tungsten - White	+ 10.1 mA	0	10
Heater Tests (-Ehk)			
Tungsten-Rhenium - Dark	+ 1.3 mA	0	10
Tungsten-Rhenium - White	+ 9.0 mA	0	10
Tungsten - Dark	+ 4.5 mA	0	10
Tungsten - White	+ 31.7 mA	6	10

Table VIII. Heater Current Climb During Life future testing of the preproduction and pilot production samples. It is included as Appendix I.

3.4 TASK IV - EVALUATION OF EXHAUST EQUIPMENT

Tubes were processed to compare ion pump and oil diffusion vacuum systems. Results indicated that the value from ion pump processing could be observed by readings for grid recovery or for a reduction in oscillator power output during the first 100 hours of life. Figure 11 represents these data. If adequate baffling or trapping of contaminants from oil diffusion systems is used, little difference in tube performance is found when comparing ion pump processing.

3.5 TASK V - PREPRODUCTION RUN

In preparation for the preproduction run an Inspection and Quality Control Manual was prepared and found to be acceptable. It is included as Appendix II.

The preproduction samples were tested according to SCL-7001/74B during the period 10, 11, and 12 December 1963. A Preproduction Test Report dated 13 December 1963 was issued. This report is included as Appendix III.

3.6 TASK VI - PRODUCTION RUN

The pilot production facilities were inspected during the initial phases of pilot production. A flow chart representing these facilities is shown in Figure 12. The fabrication of tubes was completed and testing to SCL-7001/74B was performed. All tests were successfully passed with the exception of the

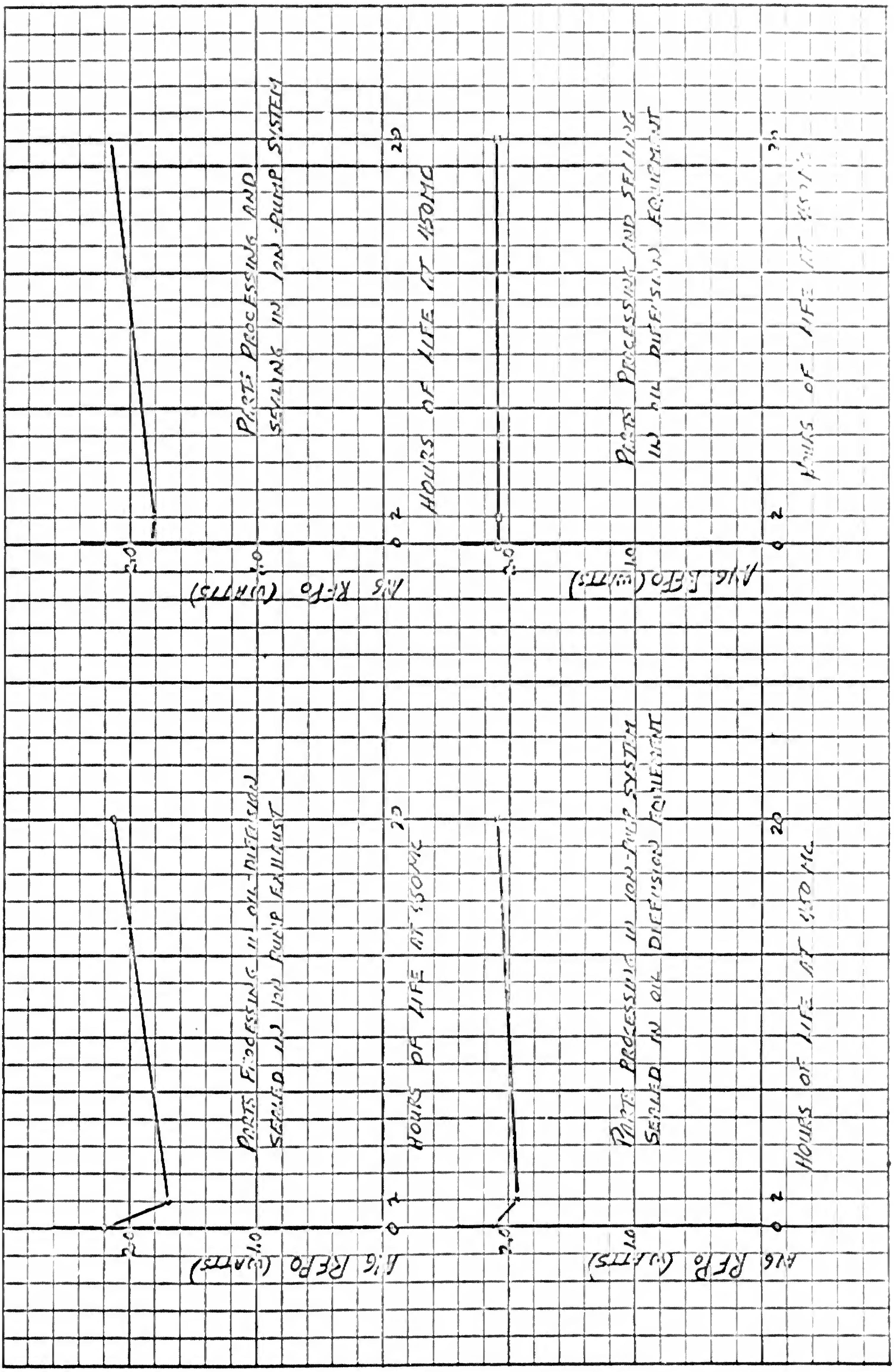
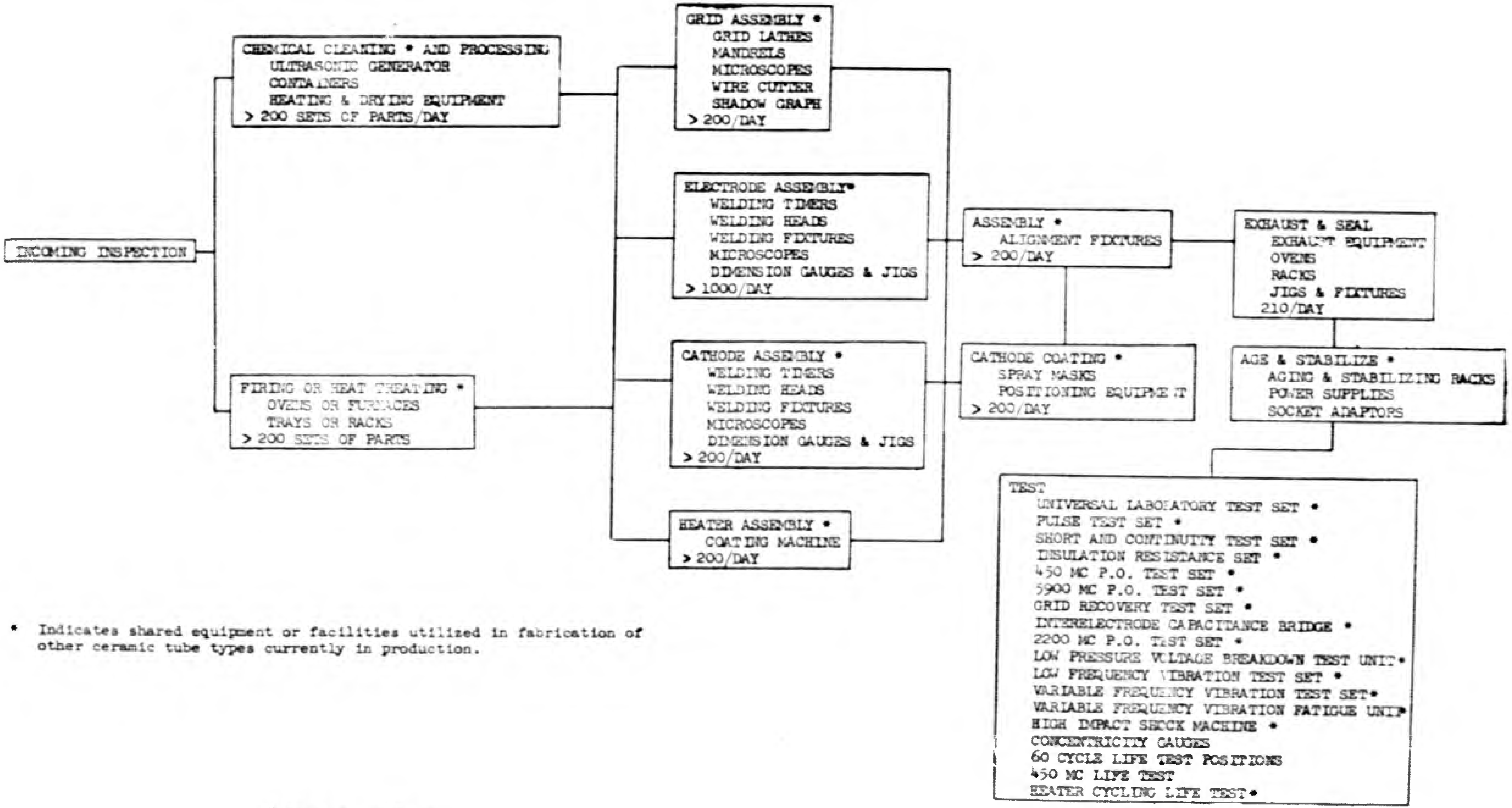


Figure 11 - Page 31

FLOW CHART OF PILOT PRODUCTION LINE - 7486 PEM



* Indicates shared equipment or facilities utilized in fabrication of other ceramic tube types currently in production.

Figure 12 - Page 32

60 cycle life tests. The Pilot Production Test Report is provided as Appendix IV. Losses incurred during this run were as follows:

Total Sealed	2,495
Concentricity	12
Air Tube	203
Short - Grid-Cathode	60
Short - Grid-Plate	19
Short - Heater-Cathode	18
Miscellaneous (Open heater, chipped ceramics, mechanical)	34
Net Operable	2,149
% Operable	86.2%
Low Emission	84
Grid Emission	32
Low Plate Current	4
Hi Plate Current	13
Low Zero Bias Transconductance	379
Low Transconductance at Reduced Ef	9
Amplification Factor	30
Miscellaneous (Pulse emission, IR, Capacitance)	38
Heater Current - High	367
Total Good After Test	1,193
% Yield	46.9%

4.0 CONCLUSIONS

A production capability for producing 100 tubes per day using oil free vacuum equipment has been established. The advantage of using such vacuum is in the elimination of the possibility of hydrocarbon residues from oil diffusion equipment commonly used in this application. Testing for effects on tube performance indicated advantages for oil free processing in some lots of tubes while oil diffusion processing performed as well or better than other lots processed with the new equipment.

An improved test specification was established which reflected the increases in tube ratings. The allowable plate dissipation was increased from 1.0 watts to 1.5 watts. The maximum ratings for cathode current was raised from 10 ma to 20 ma. The grid current limit increased from 2.0 ma to 5.0 ma. An R.F. oscillator life test was established operating at 450 Mc. Tests were established to measure amplifier performance at 2200 Mc, and oscillator performance limits were set for 5900 Mc operation.

The use of tungsten-rhenium heater wire has been shown to be effective in providing improved heater current stability. This wire has been successfully included in other tubes in the product line.

Darkening the surface of the heater insulation was intended to serve the same purpose. An increase in losses has been observed due to non-uniformity of darkening which has prevented its widespread acceptance in other tubes in this product line.

5.0 PUBLICATIONS, REPORTS AND CONFERENCES

5.1 PUBLICATIONS - None

5.2 REPORTS - Monthly Report No. 1
PEM For Tube Type 7486
by J. D. Marshall for the period of
19 June 1962 to 1 August 1962

Monthly Report No. 2
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 August 1962 to 1 September 1962

Monthly Report No. 3
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 September 1962 to 1 October 1962

Quarterly Report No. 1
PEM For Tube Type 7486
by J. D. Marshall for the period of
19 June 1962 through 30 September 1962

Monthly Report No. 4
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 October 1962 to 1 November 1962

Monthly Report No. 5
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 November 1962 to 1 December 1962

Monthly Report No. 6
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 December 1962 to 1 January 1, 1963

Quarterly Report No. 2
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 October 1962 through 31 December 1962

Monthly Report No. 7
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 January 1963 to 1 February 1963

Monthly Report No. 8
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 February 1963 to 1 March 1963

Monthly Report No. 9
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 March 1963 to 31 March 1963

Quarterly Report No. 3
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 January 1963 through 31 March 1963

Monthly Report No. 10
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 April 1963 to 1 May 1963

Monthly Report No. 11
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 May 1963 to 1 June 1963

Monthly Report No. 12
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 June 1963 to 1 July 1963

Quarterly Report No. 4
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 April 1963 through 30 June 1963

Monthly Report No. 13
PEM For Tube Type [illegible]
by J. D. Marshall for the period of
28 June 1963 to 31 July 1963

Monthly Report No. 14
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 August 1963 to 31 August 1963

Monthly Report No. 15
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 September 1963 to 30 September 1963

Quarterly Report No. 5
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 July 1963 through 30 September 1963

Monthly Report No. 16
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 October 1963 to 31 October 1963

Monthly Report No. 17
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 November 1963 to 30 November 1963

Monthly Report No. 18
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 December 1963 to 31 December 1963

Quarterly Report No. 6
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 October 1963 through 31 December 1963

Monthly Report No. 19
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 January 1964 through 31 January 1964

Monthly Report No. 20
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 February 1964 through 29 February 1964

Monthly Report No. 21
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 March 1964 through 31 March 1964

Quarterly Report No. 7
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 January 1964 through 31 March 1964

Monthly Report No. 22
PEM For Tube Type 7486
by J. D. Marshall for the period of
1 April 1964 to 30 April 1964

5.3 CONFERENCES

1. Organizations and personnel present:

   USASSA
   L. Coblentz
   S. Cohen

   USASIMSA
   S. Zucker

   USA Electronic Materiel Agency
   M. Vitkanskas

   General Electric Company
   C. E. Albrecht
   E. L. Davis
   J. T. Duncan
   H. L. Thorson

   Place and date:
   USASSA
   Philadelphia, Pa.

   29 August 1962

   Subject:
   Discuss the contract interpretation, planning and clarification of any questions.

2. Organizations and personnel present:

   USASSA
   L. Coblentz

   General Electric Company
   J. D. Campbell
   E. L. Davis
   J. D. Marshall
   H. L. Thorson

   Place and date:
   General Electric Company
   Owensboro, Kentucky

   9 September 1962

   Subject:
   To review progress to date and discuss future schedule.

3. Organizations and personnel present:

USASSA
L. Coblentz

General Electric Company
J. D. Campbell
E. L. Davis
J. D. Marshall
H. L. Thorson

Place and date:
General Electric Company
Owensboro, Kentucky

16 January 1963

Subject:
To review progress to date and discuss future schedule.

4. Organizations and personnel present:

USAEMA
L. Coblentz

General Electric Company
J. D. Campbell
E. L. Davis
J. D. Marshall
H. L. Thorson

Place and date:
General Electric Company
Owensboro, Kentucky

24 April 1963

Subject:
To review progress to date and discuss future schedule. August was set as tentative date for review of test specification prior to preproduction run. A letter to S. Zucker was suggested requesting inspection of preproduction test facilities in May.

5. Organizations and personnel present:

USAEMA
S. Zucker

General Electric Company
J. D. Campbell
H. L. Thorson

Place and date:
General Electric Company
Owensboro, Kentucky

2 May 1963

Subject:
Discussion of test facilities in regard to preproduction approval.

6. Organization and personnel present:

USAERDL
- H. M. Kaunzinger

General Electric Company
- J. D. Campbell
- L. F. Jeffrey
- S. A. Jolly
- W. H. Lemaster
- J. D. Marshall
- C. L. Reynolds
- H. L. Thorson

Place and date:
General Electric Company
Owensboro, Kentucky

27 June 1963

Subject:
The test specification was reviewed and refinements were tentatively agreed upon which reflect test results obtained with the new equipment.

7. Organizations and personnel present:

USASSA
- S. Sokolove

General Electric Company
- J. D. Campbell
- J. D. Marshall
- H. L. Thorson

Place and date:
General Electric Company
Owensboro, Kentucky

22 January 1964

Subject:

To review progress to date and to inspect pilot production facilities.

APPENDIX I

SIGNAL CORPS
TECHNICAL
REQUIREMENTS

SCL-7001/74B
28 October 1963
Superseding
SCL-7001/74A
8 June 1962

ELECTRON TUBE, IMPROVED TYPE 7486

---

1. SCOPE

1.1 This specification covers requirements for an improved UHF triode, oscillator and radio-frequency power amplifier, type 7486 modified.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein.

SPECIFICATIONS

SIGNAL CORPS

SCL-7001	Electron Tubes

(Copies of the documents required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Both the title and identifying number or symbol should be stipulated when requesting copies.)

3. REQUIREMENTS

3.1 The physical characteristics and ratings of the tube shall be in accordance with Table I and SCL-7001.

TABLE - 1

DESCRIPTION: UHF Triode, Oscillator and Radio-frequency Power Amplifier, Ceramic.

ABSOLUTE RATINGS:

Parameter:	Ef	Eb	Ec	Ehk	Rk	Rg	Ik	Ic	Pp	T Envelope	Alt.
Units:	V	Vdc	Vdc	v	ohms	Meg	mAdc	mAdc	W	°C	ft.
Maximum:	6.6	250	0 -50	+50 -50	---	.01	20	5.0	1.5	250 (see note 1)	100,000
Minimum:	6.0	---	---	---	---	---	---	---	---	---	---
TEST COND.:	6.3	150	0	---	82	---	---	---	---	---	---

CATHODE: Coated Unipotential

ENVELOPE: Ceramic, per figure 1

For the purpose of inspection, use the applicable reliable paragraphs of Specification MIL-E-1.
For miscellaneous requirements, see paragraph 3.6 of MIL-E-1.

Par. No.	Test (See Note 2)	Conditions	AOL (%)	Insp. Level or Code	Sym	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	General											
3.1	Qualification	Required	---	---	---	---	---	---	---	---	---	---
3.7	Marking	(see note 35)	---	---	---	---	---	---	---	---	---	---
3.6	Performance	(see note 36)	---	---	---	---	---	---	---	---	---	---
4.5	Holding Period	168 hours (min)	---	---	---	---	---	---	---	---	---	---
	Periodic-check test (see note 4)											
---	Power Output	F=2200 Mc approx; Ebb=200 Vdc; Pd=50mW; Vary Rk for Ib=15 mAdc; (see note 33)	---	---	Po	350	---	---	---	---	---	mW
---	Resonant Frequency	(Power Output test conditions; see note 33)	---	---	F	2050	---	---	---	2350	---	Mc

Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	<u>Acceptance Inspection Part 1 (Production) (see note 5)</u>											
4.10.8	Heater current		0.65	II	If	222	---	240	---	258	---	mA
4.10.15	Heater-cathode leakage	Ehk=+100 Vdc Ehk=-100 Vdc	0.65	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	20 20	--- ---	µAdc µAdc
4.10.4.1	Plate current		---	---	Ib	---	5.7	7.5	9.3	---	4.0	mAdc
4.10.4.1	Plate current		0.65	II	Ib	4.5	---	---	---	11.0	---	mAdc
4.10.9	Transconductance(1)	Eb=100Vdc; Rk=0	0.65	II	Sm	8000	---	11500	---	---	---	µmho
4.10.7.3	Pulse Cathode Current	Ec=-10Vdc; egk=+7v; Rk=1.0 ohm (see note 6)	0.65	II	Ik	90	---	---	---	---	---	ma
4.7.3	Continuity and shorts for reliable tubes	(see note 7)	0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical-production tests	(per figure 1)	---	---	---	---	---	---	---	---	---	---
	<u>Acceptance Inspection Part 2 (Design)</u>											
4.8	Insulation of electrodes	E(g-all)=-100 Vdc E(p-all)=-300 Vdc	2.5	I	R R	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance(2)	Ef=6.0; Eb=100 Vdc; Rk=0	2.5	I	ΔSm Ef	---	---	---	---	20	---	%
4.10.5.2	Grid Voltage	Rk=0; Ec/Ib=0.1 mAdc	2.5	I	Ec	---	---	-2.4	---	-4.5	---	Vdc
4.10.11.1	Amplification factor	Ck=1000 µf	2.5	I	Mu	65	---	90	---	115	---	---
4.10.2.2	Power Oscillation(1)	F=450 mc, Ebb=250 Vdc; Rg=1000 ohms; Ib=15mAdc; (See note 8)	2.5	Code G	Po	1.8	---	---	---	---	---	W
4.10.2.2	Power Oscillation(2)	F=5900 mc; Ebb=200 Vdc; Rg=470ohms; Vary Rk for Ib=15 mAdc; (See note 9)	2.5	Code G	Po	10	---	---	---	---	---	mW

Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	Acceptance Inspection Part 2 (Design) (Cont'd)											
4.10.6.2	Grid emission	Ef=7.0V; Ecc=-20 Vdc; Rg=0.1 Meg (see note 10)	2.5	I	Ic	0	---	---	---	-2.0	---	μAdc
---	Grid Recovery	Ebb=250 Vdc; Ec/Ib=3.0 mAdc; Rp=.01 Meg (see note 11)	6.5	I				(see note 11)				
4.10.14	Direct interelectrode capacitance	(see note 12)	6.5	Code E	Cgp Cin Cout Chk	0.84 1.25 .004 1.00	--- --- --- ---	1.00 1.70 .010 1.30	--- --- --- ---	1.16 2.15 .016 1.60	--- --- --- ---	pf pf pf pf
4.9.12.1	Low pressure voltage breakdown	Pressure=8±1 mm Hg; potential=300 Vac; (see notes 13 & 14)	6.5	Code F	---	---	---	---	---	---	---	---
---	Variable frequency vibration (1)	Ebb=150 Vdc; Rk=82 ohms; Ck=1000 μf; Rp=10,000 ohms (see noteq 14 & 15)	---	(see note 16)	Ep	---	---	---	---	15	---	mVac
4.9.19.1	Low-frequency vibration (2)	Ebb=150 Vdc; Rk=82; Ck=1000 μf; Rp=10,000; G=15; F=40 cps; (see note 17)	6.5	Code I	Ep	---	---	---	---	10	---	mVac
	Acceptance Inspection Part 3 (Degradation Rate) (see note 18)											
4.9.20.5	Shock	Acceleration=450g; Eb=150 Vdc; Ec=0 Vdc; Rk=82 ohms; Ehk=+100 Vdc; (see notes 14 & 19)	---	(see note 20)	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue	G=10; Ef=6.3V; No other voltages applied; Variable frequency (see notes 14 & 21)	---	(see note 22)	---	---	---	---	---	---	---	---

Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	Acceptance Inspection Part 3 (Degradation Rate (see note 18) (Cont'd)											
...	Post shock and fatigue test end points	Vibration (2)	...	...	Ep	...	...	...	...	15	...	mVac
		Heater-cathode leakage										
		Ehk = +100 Vdc	...	...	Ihk	...	...	...	...	20	...	μAdc
		Ehk = -100 Vdc	...	...	Ihk	...	...	...	...	20	...	μAdc
		Heater current	...	...	If	222	...	...	...	258	...	mA
4.9.6.3	Envelope strain		2.5	I	..	...	...	...	...	...	...	...

Par. No.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defects per Characteristic	Sym	LIMITS		Units
							Min	Max	
	Acceptance Inspection Part 4 (Life) (see note 18)								
4.11.7	Heater-cycling life test	Ef=7.0; Ehk=+70; Rk=0; Ec=Eb=0; (see note 24)	...	...	...	...	...	...	...
4.11.4	Life test end points (heater-cycling)	Heater-cathode leakage							
		Ehk=+100 Vdc	....	...	...	Ihk	...	40	μAdc
		Ehk=-100 Vdc	...	...	...	Ihk	...	40	μAdc
4.11.5	Intermittent life test	(see note 25)							
	Operation-1	Ebb=180Vdc, Rk=0; Eg=6.0Vac;F=60cps; Ehk=-70Vdc;Rg=1200 ohms;Rb=3300ohms; TA=Room;(see note 26)	...	...	...	...	...	...	...
	Operation-2	F=475±25mc;Ebb=250 Vdc; Vary Rg for Ib= 15 mAdc; Ig=5-7 mAdc TA=Room;(see note 27)	...	...	...	...	...	...	...
4.11.4	Life test end point (stability) (2 & 20 hours)	Change in Transconductance (1) of individual tubes	...	...	1	ΔSm t	...	15	%
4.11.3.1 (b)	Life test end point (survival-rate) (100 hours)	Inoperatives (see note 28)	...	...	0	...	...	...	...
		Transconductance (1)	...	...	1	Sm	7000	...	μmho

Par. No.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defects per Characteristic	Sym	LIMITS		Units
							Min	Max	
	Acceptance Inspection Part 4 (Life) (see note 18) (Cont'd)								
4.11.4	Intermittent life test end points (500 hours)	(see note 29)							
	Operation -1	Inoperatives (see note 30)	---	---	1	---	---	---	---
		Heater current	---	---	1	If	222	262	mA
		Transconductance(1)	---	---	1	Sm	7000	---	µmho
		Transconductance(2)	---	---	1	Sm	---	25	%
		Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	1	Ihk	---	20	µAdc
		Ehk=-100 Vdc	---	---		Ihk	---	20	µAdc
		Insulation of Electrodes							
		g-all	---	---	1	R	60	---	Meg
		p-all	---	---		R	60	---	Meg
		Total Defectives			3				
	Operation -2	Power Oscillation (see note 31)	---	---	1	ΔPo t	---	25	%
4.11.4	Intermittent life test end points (1000 hours)	(see note 29)							
	Operation-1	Inoperatives (see note 30)	---	---	1	---	---	---	---
		Heater current	---	---	1	If	222	264	mA
		Transconductance(1)	---	---	1	Sm	6500	---	µmho
		Transconductance(2)	---	---	1	ΔSm Ef	---	25	%
		Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	1	Ihk	---	20	µAdc
		Ehk=-100 Vdc	---	---		Ihk	---	20	µAdc
		Insulation of Electrodes							
		g-all	---	---	1	R	50	---	Meg
		p-all	---	---		R	50	---	Meg
		Total Defectives			4				

Par. No.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defects per Characteristic	Sym.	LIMITS		Units
							Min.	Max.	
	Acceptance Inspection Part 4 (Life) (see note 18) (Cont'd) Intermittent life test end points (1000 hours) (Cont'd)								
	Operation-2	Inoperatives (see note 30)	---	---	---	---	---	---	---
		Heater Current	---	---	---	If	222	264	mA
		Power Oscillation (see note 31)	---	---		ΔPo t	---	30	%
		Power Oscillation (2)	---	---	---	Po	5	---	mW
		Change in Resonant Frequency (see note 32)	---	---	---	ΔF t	---	20	mc
		Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	---	Ihk	---	20	µAdc
		Ehk=-100 Vdc	---	---	---	Ihk	---	20	µAdc
		Insulation of Electrodes							
		g-all	---	---	---	R	50	---	Meg
		p-all	---	---	---	R	50	---	Meg
		Total Defectives			1				
4.9.18	Container drop	(see note 34)							
5.1	Preparation for Delivery	(see note 36)							

Note 1: Operation below the rated maximum temperature is recommended for application requiring the longest possible tube life.

Note 2: The sequence of tests listed hereon is the suggested order in which tests should be conducted.

Note 3: Variables Sampling Procedure (see 4.1.1.7).

Note 4: Periodic-check test listed hereon shall be performed during qualification and at 6-month intervals during production.

Note 5: The AQL for the combined defectives for attributes in Acceptance Inspection Tests, Part 1, excluding Inoperatives and Mechanical shall be 1.0 percent.

Note 6: Positive portion of the grid pulse shall be a rectangular wave meeting pulse shape requirement of MIL-E-1, paragraph 4.10.7.5 and, in addition, the maximum amplitude shall occur within the first 20% of tp; tp = 10µs and prr = 1000 pps. The pulse shall be applied to the grid by means of a driving circuit which produces the specified peak pulse voltage directly at the grid terminal with respect to cathode. Grid resistance, not exceeding 50 ohms may be inserted to prevent oscillation, provided readjustment of grid drive is made to maintain the specified pulse amplitude directly at the grid terminal. Peak currents shall be measured by means of high impedance oscilloscope or equivalent device connected across a cathode resistor of 1.0 ± .01 ohms. The specified limit refers to the maximum of the pulse amplitude.

Note 7: The testing and acceptance procedure for this test shall be as specified in 4.7.7 and 4.7.5 with the following exceptions:

4.7.7 (a) through 4.7.7(c): Replace with the following: "The tube shall be inserted into adaptor socket in the shorts test equipment and the tube and socket assembly shall be tapped three times in each of two planes 90° ± 10° apart. The tapping device shall be so designed and adjusted that it will deliver an impulse of approximately one-half sine wave of 300 ± 50 µs duration, as measured at 10 percent of the amplitude of the halfwave, and have a minimum average amplitude equivalent to 80g peak acceleration."

4.7.5(d): Replace with the following: "Air Leaks shall be rejected as evidenced by high Heater Current of 300 mA or more."

Note 8: The Power Oscillation (1) test shall be performed on the tube in a cw oscillator circuit as shown on GE Drawing 13700K-T6-11-6. The output coupling and feedback shall be adjusted for maximum power output with Ib= 15 mA.

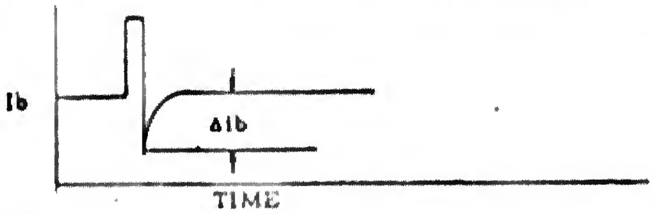
Note 9: The Power Oscillation (2) test shall be performed on the tube in a cw oscillator circuit as shown on GE Drawing 13700K-T6-11-7. The output coupling and feedback shall be adjusted for maximum power output with Ib= 15 mA.

Note 10: Prior to this test, tubes shall be preheated a minimum of five minutes at the conditions indicated below. Three minute test is not permitted. Test within 3 seconds after preheating. Grid Emission shall be the last test performed on the sample selected for the grid emission test.

Ef V	Ecc Vdc	Eb Vdc	Rk ohms	Rg Meg
7.0	0	150	82	0.1

Note 11: The Grid Recovery test shall be performed as follows:

(a) With TUT operating under specified conditions, adjust Ec for Ib = 3.0 mAdc.
(b) Apply 5 volt pulse, 20 µsec duration, 60 pps to the grid.
(c) With application of pulse, measure undershoot (ΔIb) and change in average current (ΔIb).



(d) Test limits are as follows:
Change in average plate current (ΔIu) = 0.6 mA.
Undershoot below quiescent plate current (ΔIb) = 1.0 ma.

Note 12: Test in fixture as shown on GE Drawing C1GA-653.

Note 13: The tube shall be tested as specified in 4.9.12.1 with the exception that the specified voltage shall be applied between the anode and grid.

Note 14: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes.

Note 15: The Vibration (1) test shall be performed as follows:

(a) The frequency shall be increased from 100 to 3000 cps with approximately logarithmic progression in 3 ± 1 minutes. The return sweep (3000 to 100 cps) is not required.

(b) The tube shall be vibrated with simple harmonic motion in each of two planes: Y and X1 as defined in Figure 2. At all frequencies from 100 to 3000 cps, the total harmonic distortion of the acceleration wave form shall be less than 5%.

(c) The peak acceleration shall be maintained at 15 ± 1.5 g throughout the test.

(d) The value of the alternating voltage, Ep, produced across the resistor, Rp, as a result of the vibration shall be measured with a suitable device having a response to the RMS value of a sine wave voltage to within ±0.5 db of the response at 100 cps over the frequency range of 50 to 5000 cps, and having a frequency cut-off such that the response is down a minimum of 12 db at 10,000 cps. The meter shall have a dynamic response characteristic equivalent to or faster than a VU meter (operated in accordance with Standard ASA No. C16.5-1954).

Note 16: Variable vibration test sampling procedure and acceptance criteria shall be as follows: First sample (n1) shall consist of 4 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 8 tubes with an acceptance number (cc) equal to one (1) for the cumulative sample.

Note 17: The tube shall be vibrated with simple harmonic motion in each of two planes Y and X2 as defined in Figure 2.

Note 18: Destructive tests.

Tubes subjected to the following destructive tests are not to be accepted under this specification:

4.9.20.5	Shock
...	Fatigue
4.11.7	Heater-cycling life test
4.11.5	Intermittent life test

Note 19: Tube shall be subjected to 5 blows in each of 4 positions as follows: Y1, Y2, X1, and X2 as defined in Figure 2. Use fixture as shown on GE Drawing 13700K-T6-11-106.

Note 20: Shock test sampling procedure and acceptance criteria shall be as follows: first sample (n1) shall consist of 4 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 8 tubes with an acceptance number (cc) equal to four (4) for the cumulative sample.

Note 21: The tubes shall be rigidly mounted to a table vibrating at a constant peak acceleration level of 10g. The frequency of vibration shall be varied from 30 to 2000 cps and back to 30 cps with the period of the sweep cycle being 10 minutes. The tubes shall be vibrated for a total of 6 hours, that is, 3 hours in each of two planes Y and X1 as defined in Figure 2.

Note 22: Fatigue test sampling procedure and acceptance criteria shall be as follows:

First sample (n1) shall consist of 4 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 8 tubes with an acceptance number (cc) equal to one (1) for the cumulative sample.

Note 23: Envelope Strain Procedure.

Tubes shall be tested as specified in 4.9.6.3. Tubes having high Heater Current of 300 mA or more shall be rejected as evidence of air leaks.

Note 24: Heater-cycling life test sampling procedure and acceptance criteria shall be as follows: First sample (n1) shall consist of 15 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 15 tubes with an acceptance number (c_c) equal to one (1) for the cumulative sample. Electrical rejects, other than inoperatives and heater-cathode leakage failures, may be used in performance of this test.

Note 25: Intermittent Life Test

Sampling procedure and acceptance criteria for this test shall be as specified in 20.2.5.3 of Appendix C with the following exceptions:

(a) The Intermittent Life Test sample shall consist of a combination of 25 tubes under Operation-1 conditions and 5 tubes under Operation-2 conditions.

(b) The life test sample shall be read for the specified characteristics at the following times:

0 hours (Operation-1 and Operation-2 samples)
$2 \pm 1/2$ hours (Operation-1 sample only)
20 ± 4 hours (Operation-1 sample only)
100^{+26}_{-16} hours (Operation-1 sample only)
500^{+48}_{-24} hours (Operation-1 and Operation-2 samples)
1000^{+48}_{-24} hours (Operation-1 and Operation-2 samples)

Additional reading periods may be used at the discretion of the tube manufacturer.

(c) The early-life stability acceptance criteria shall be applied to the 25-tube Operation-1 life test sample at the 2 and 20 hour reading periods.

(d) The survival-rate acceptance criteria shall be applied to the 25-tube Operation-1 life test sample at the 100 hour reading period.

(e) Eligibility for reduced testing of Operation-2 life test shall be as follows: No lot failure due to the regular 1000 hour Operation-2 life test has occurred in the preceding 3 consecutive lots. Reduced testing shall then consist of one lot tested for Operation-2 life test each 30 days approximate.

Note 26: The specified Rg is unbypassed and is in series with the signal source and the grid.

Note 27: Operation-2 life test shall be performed on tubes operated in self-excited oscillator units as shown on GE Drawing 13700K-T6-11-10. Grid resistor, feed back, and output coupling shall be optimized for maximum power output.

Note 28: Tubes shall be tested at 100 hours for Continuity and Shorts (Inoperatives) under the same conditions as for the initial test. When any tap short indication is obtained, the test shall be repeated. When any short indication is again obtained, the tube shall be rejected as inoperable.

Note 29: Order for Evaluation of Life Test Defects: (See 4.11.3.1.2)

Note 30: An inoperative as referenced in life test is defined as a tube having one (1) or more of the following defects: discontinuity (continuity and short test conditions except tube and socket assembly shall not be tapped), permanent short (continuity and short test conditions except tube and socket assembly shall not be tapped), air leak as evidenced by high Heater Current of 300 mA or more.

Note 31: Oscillator power output measured under the Operation-2 life conditions shall not exceed the maximum limit for $\frac{\Delta Po}{t}$.

Note 32: The 2200 Mc Resonant Frequency test shall be applied to the Intermittent Life Test (Operation-2) samples on a periodic-check basis, that is, during qualification and at 6-month intervals during production. The change in Resonant Frequency (0-1000 hours) shall not exceed the specified life test end point limit.

Note 33: The Power Output and Resonant Frequency tests shall be performed on the tube inserted in a grid separation amplifier test cavity as shown on GE Drawing 13700K-T6-11-10. The amplifier test cavity contains a low loss fixed frequency plate resonator in the one-quarter wave mode at 2200 Mc and is adjusted for 2200 Mc ± 10 Mc using a reference tube selected for Cgp and Cgk within 2% of bogie. The output loop must be adjusted for maximum gain and shall remain fixed. The 3 db band width, resonant frequency, power output and gain of the amplifier shall be recorded simultaneously for each tube tested. Acceptance shall be based on specified test limits for Power Output and Resonant Frequency.

Note 34: Not required for qualification approval of the end product.

Note 35: Tubes shall be marked "USA-7486".

Note 36: 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, 4.7, 3.8, 4.1, 4.3, 4.5, 4.6, 4.7, 4.9, 4.9.2, and 4.9.21.

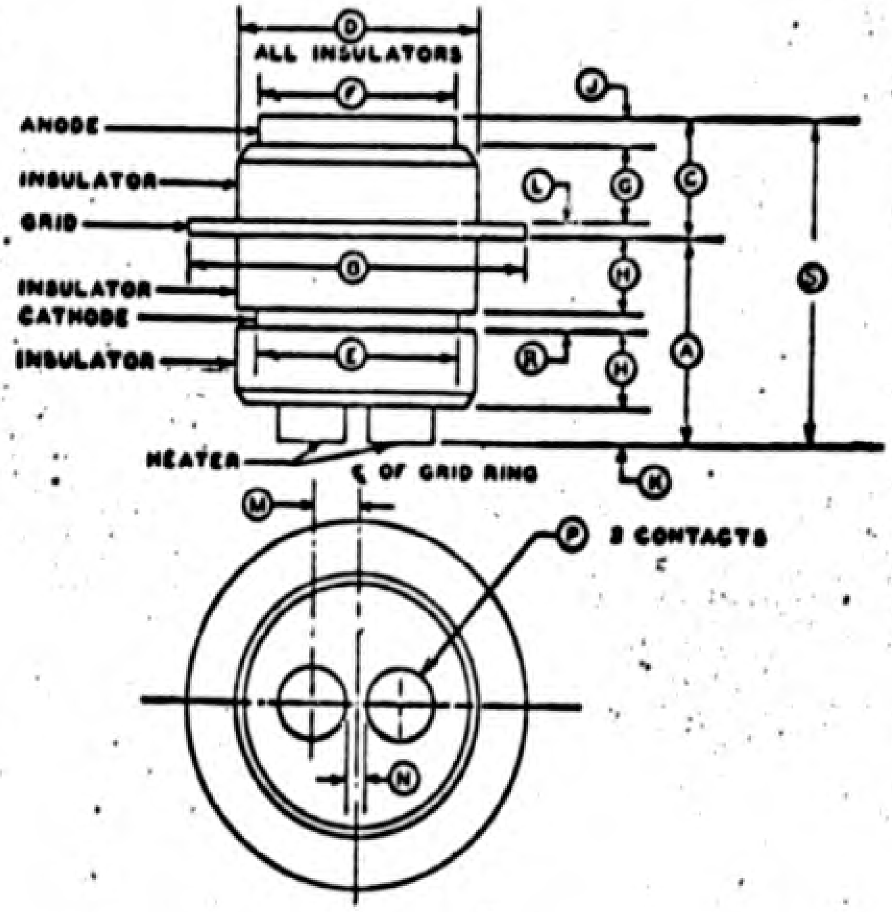
Note 37: Preservation, Packaging and Packing.

Unless otherwise specified in the contract or order, preservation, packaging, and packing shall be as follows:

(a) Preservation and packaging shall be sufficient to afford adequate protection against corrosion and deteriorating during shipment from the supply source to the using activity and until installation.

(b) Packing shall be accomplished in a manner which will insure acceptance and protection against physical or mechanical damage during direct shipment from the supply source to the using activity.

NOTICE: When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.



DIM.	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	LIMITS	
			Min	Max
ACCEPTANCE INSPECTION, PART 1 (PRODUCTION)				
A	(See note b)	I	0.268	0.292
B			0.476 dia	0.484 dia
C			0.156	0.174
D			---	0.335 dia
E			0.281 dia	0.289 dia
F			0.271 dia	0.279 dia
G			0.094	0.104
H			0.095	0.105
J			0.034	0.046
K			0.047	0.063
L			0.024	0.030
M			0.055	0.081
N			0.030	---
P			0.086 dia	0.094 dia
R			0.022	0.028
S			0.430	0.460

a. All dimensions in inches.

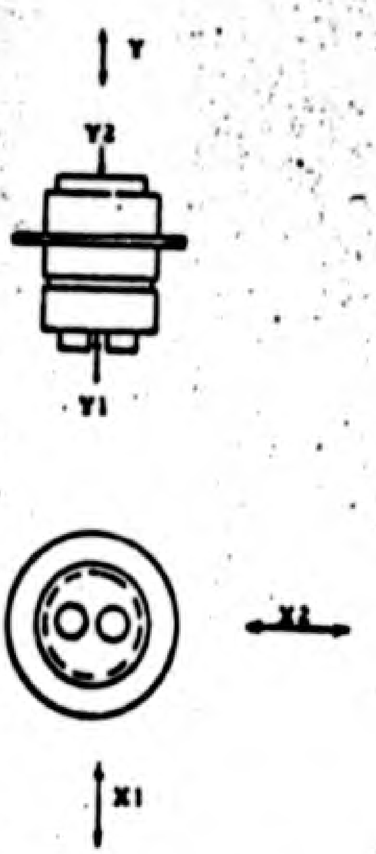
b. The AQL for the combined mechanical defectives in acceptance inspection, part 1 (production), shall be 1 percent.

c. Eccentricity of anode, grid, and cathode with respect to centerline shall be 0.005 maximum.

d. Eccentricity of insulators with respect to centerline shall be 0.010 maximum.

e. Centerline of grid ring shall be reference life for horizontal tolerances.

f. Bottom surface of grid ring shall be reference plane for vertical tolerances.



The directions of the accelerating force for the specified vibration, fatigue, and shock tests shall be in accordance with the definitions above.

FIGURE 2

APPENDIX II

DRAWING LIST

AND

PROCESS SPECIFICATION

DATE

COMPILED BY

INSPECTED BY

DRAWING LIST N13508CC

TUBE TYPE 7486

TW Owensboro ENGG.

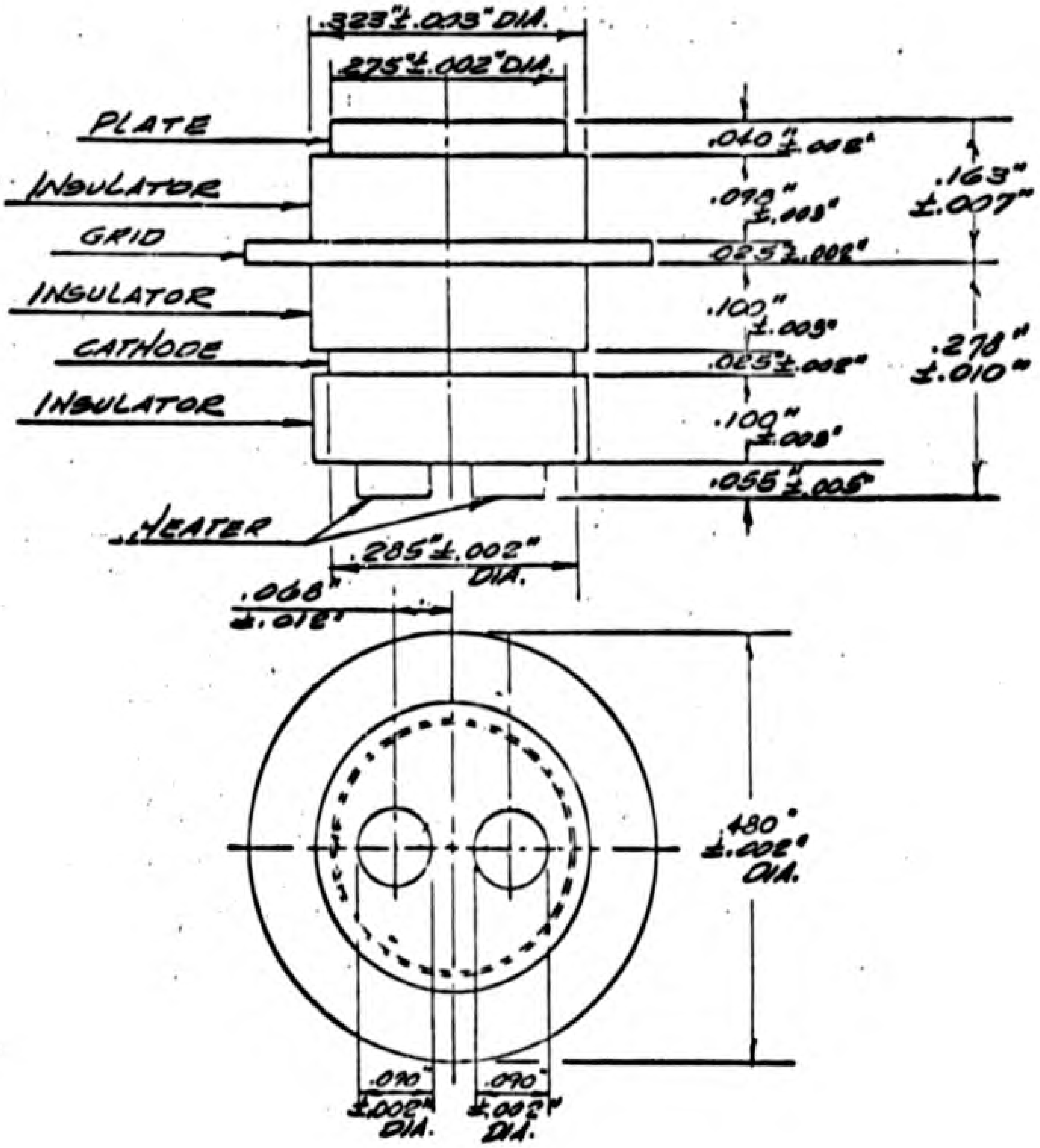
SHEET NO. 1 CONT. ON SHEET

ITEM	FUNCTIONAL NAME	DR. OR MATL. NO.	G OR F NO.	Q	OPERATIONS *PREFIX 13700-
	FINAL ASSEMBLY	N13502AA			
	MOUNT ASSEMBLY	N13502AB			
	HEATER PIN	KR70157			Degrease, Clean, Rinse, Vacuum Fire
	SOLDER DISC	KR70198			Degrease, Clean, Rinse, Vacuum Fire
	INSULATOR	KR382			Clean, Rinse, Air Fire
	COIL HEATER ASSEMBLY	N13506FA			
	COIL	KR45339			Degrease, Clean, Hydrogen Fire
	CATHODE RING	KR70185			Degrease, Clean, Rinse, Vacuum Fire
	SOLDER RING #1	KR70293			Degrease, Clean, Rinse, Hydrogen Fire
	CATHODE WALL BUFFER	KR70134			Degrease, Clean, Rinse, Vacuum Fire
	HEAT SHIELD	KR75024			Degrease, Clean, Rinse, Hydrogen Fire
	CATHODE SUPPORT	.0004 X .115" Therlo			Cut to length, Degrease, Clean, Rinse, Hydrogen Fire
	CATHODE	KR70174			Degrease, Clean, Rinse, Hydrogen Fire
	INSULATOR	KR383			Clean, Rinse, Air Fire
	SPACER	KR70113			Degrease, Clean, Rinse, Vacuum Fire
	GRID ASSEMBLY	N13502GA			
	GRID WIRE	.0004" Dia. Tungsten			
	GRID SUPPORT	KR88091			Degrease, Clean, Rinse, Hydrogen Fire
	GRID RING	KR70159			Degrease, Clean, Rinse, Vacuum Fire
	SOLDER RING	KR70294			Degrease, Clean, Rinse, Hydrogen Fire
	INSULATOR	KR384			Clean, Rinse, Air Fire
	ANODE	KR60877			Degrease, Clean, Rinse, Vacuum Fire

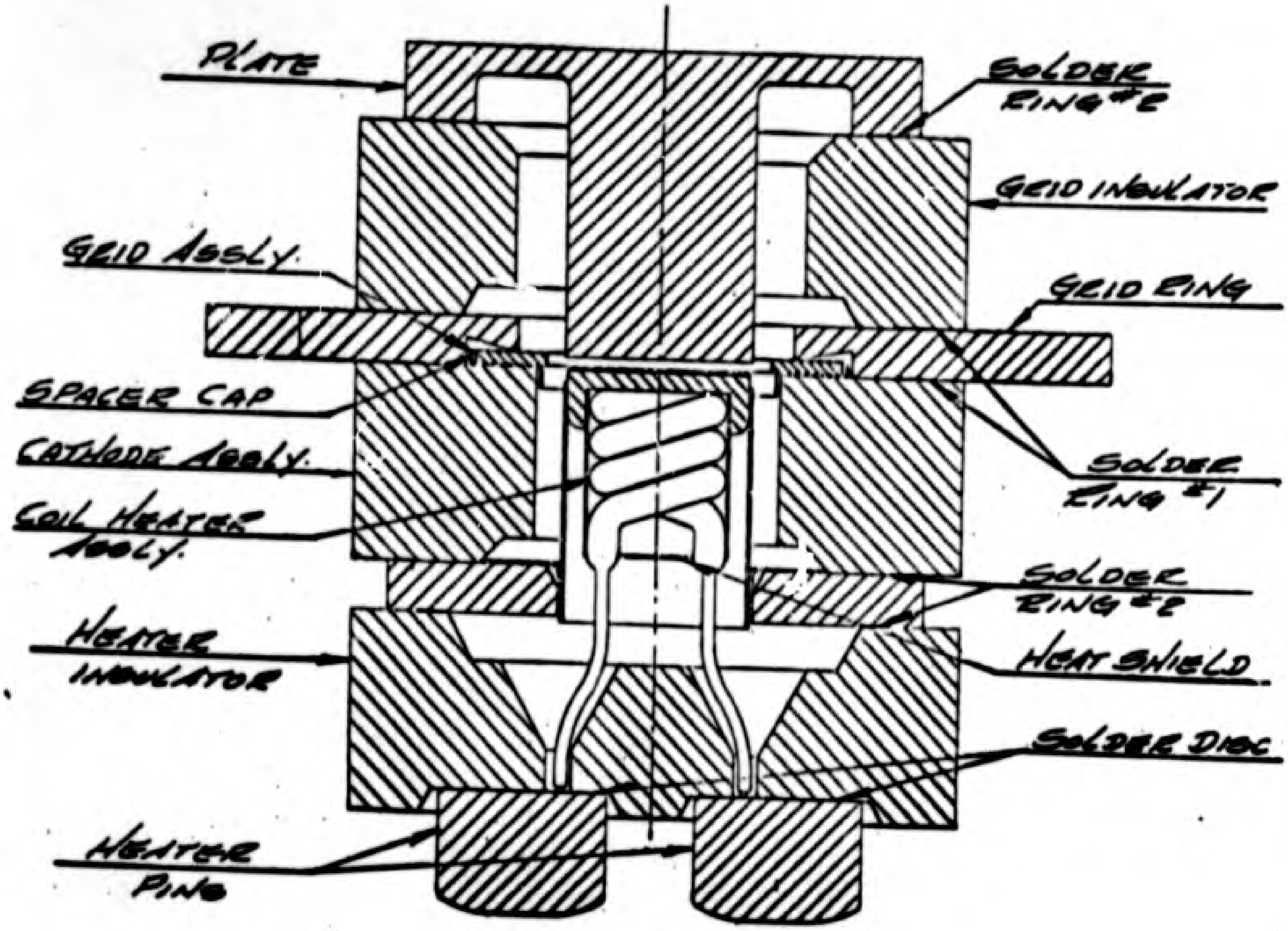
REVISIONS

ELECTRONICS DEPT. GENERAL ELECTRIC TUBE DIVISION

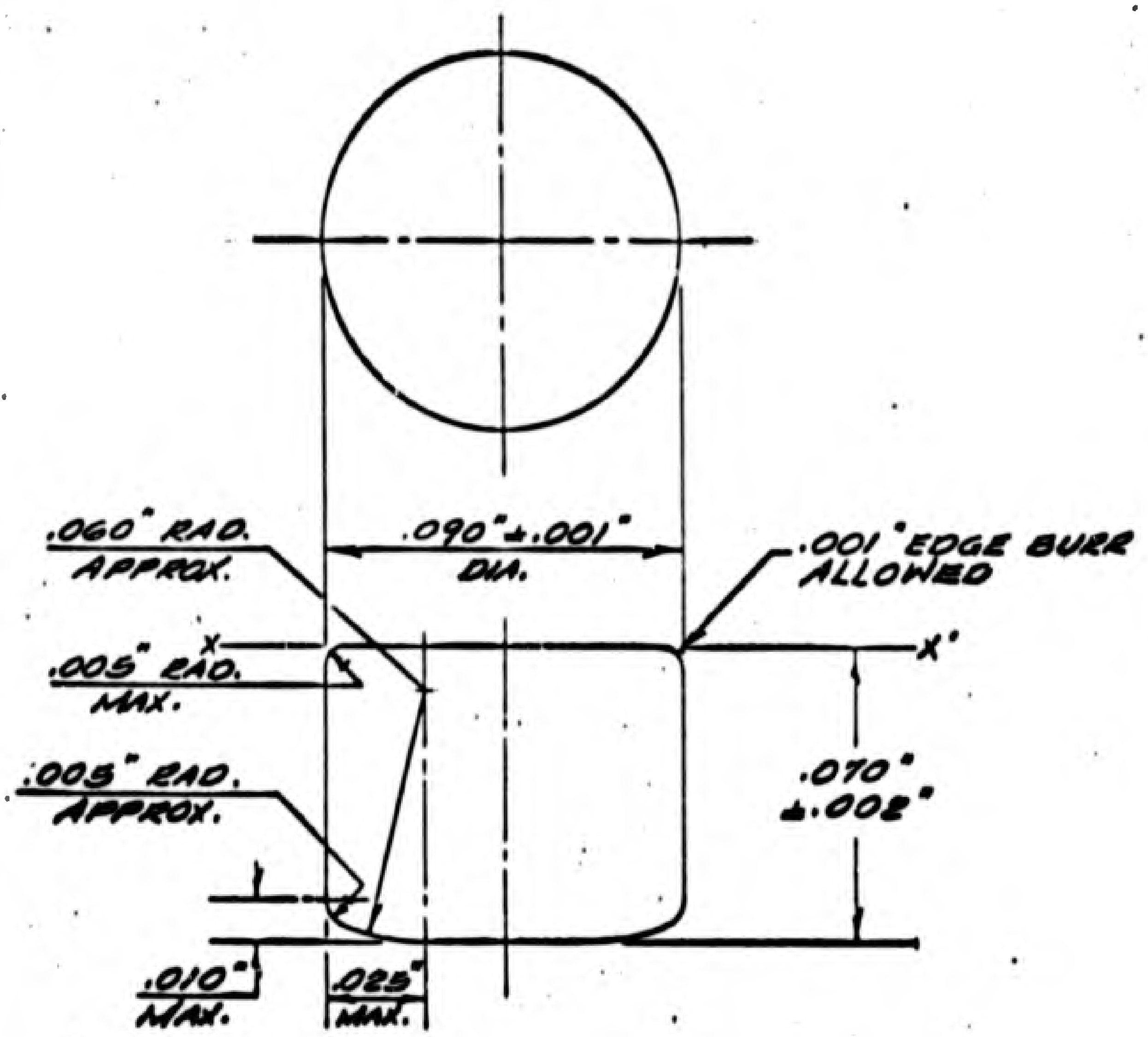
FINAL ASSEMBLY - N13502AA



MOUNT ASSEMBLY - ML3502AB

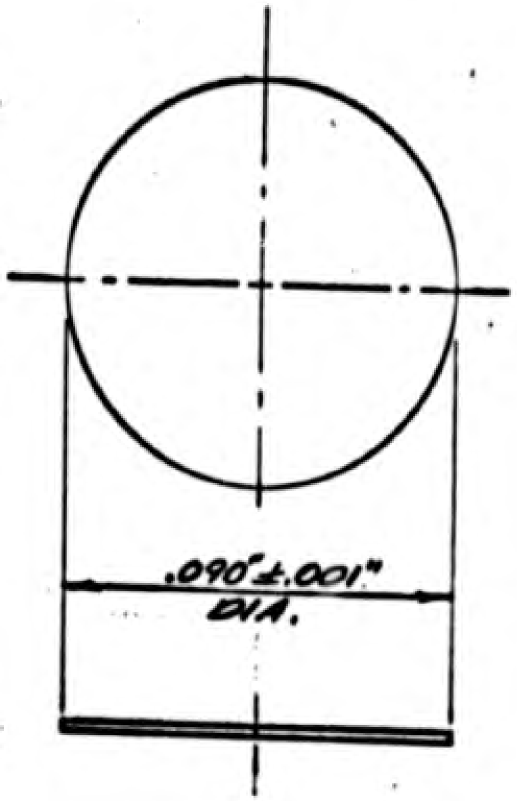


HEATER PIN - KR70157



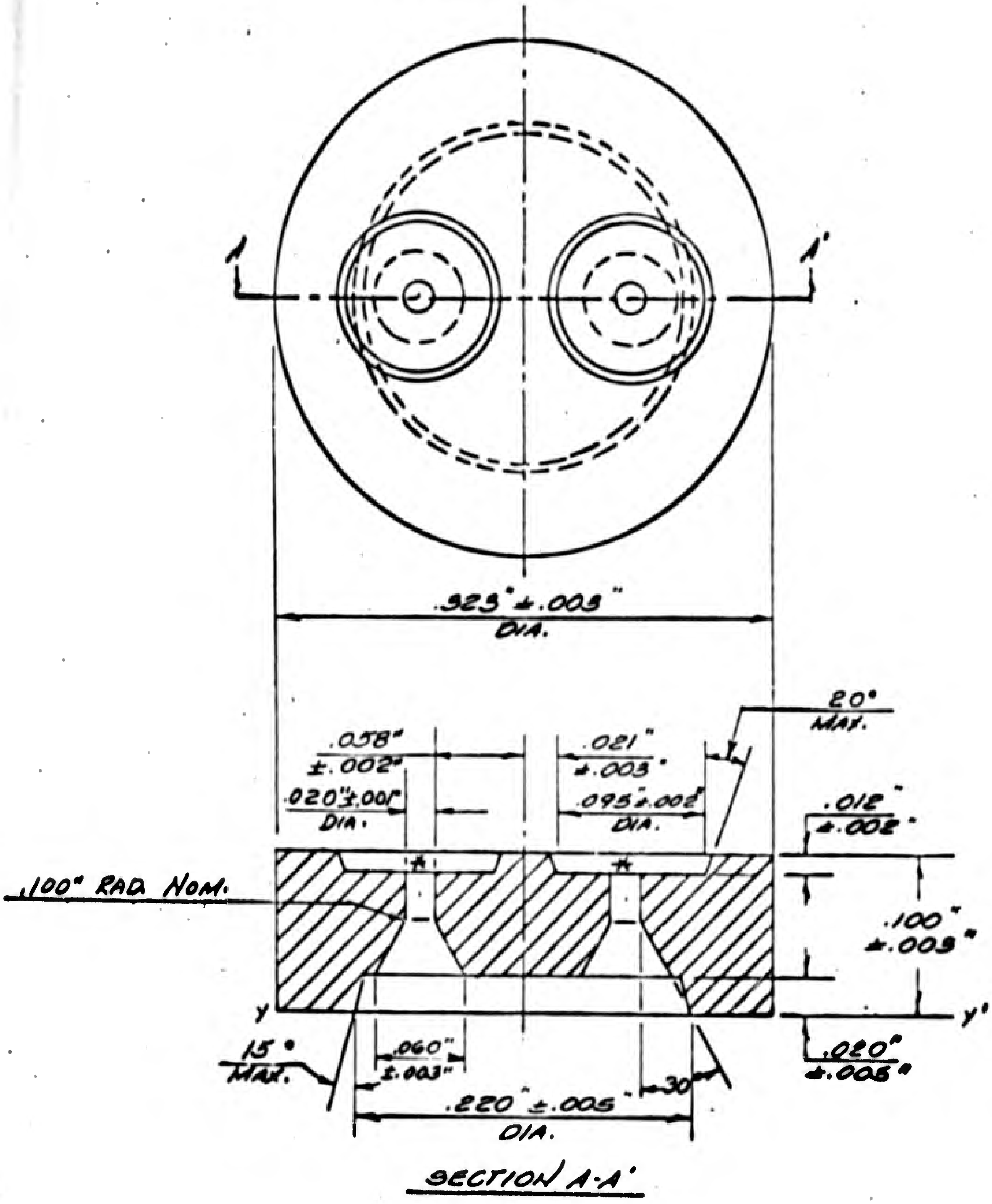
MATERIAL: TITANIUM

SOLDER DISC - KR70198



MATERIAL: .0005" THICK NICKEL

INSULATOR - KR382



MATERIAL: FORSTERITE CERAMIC

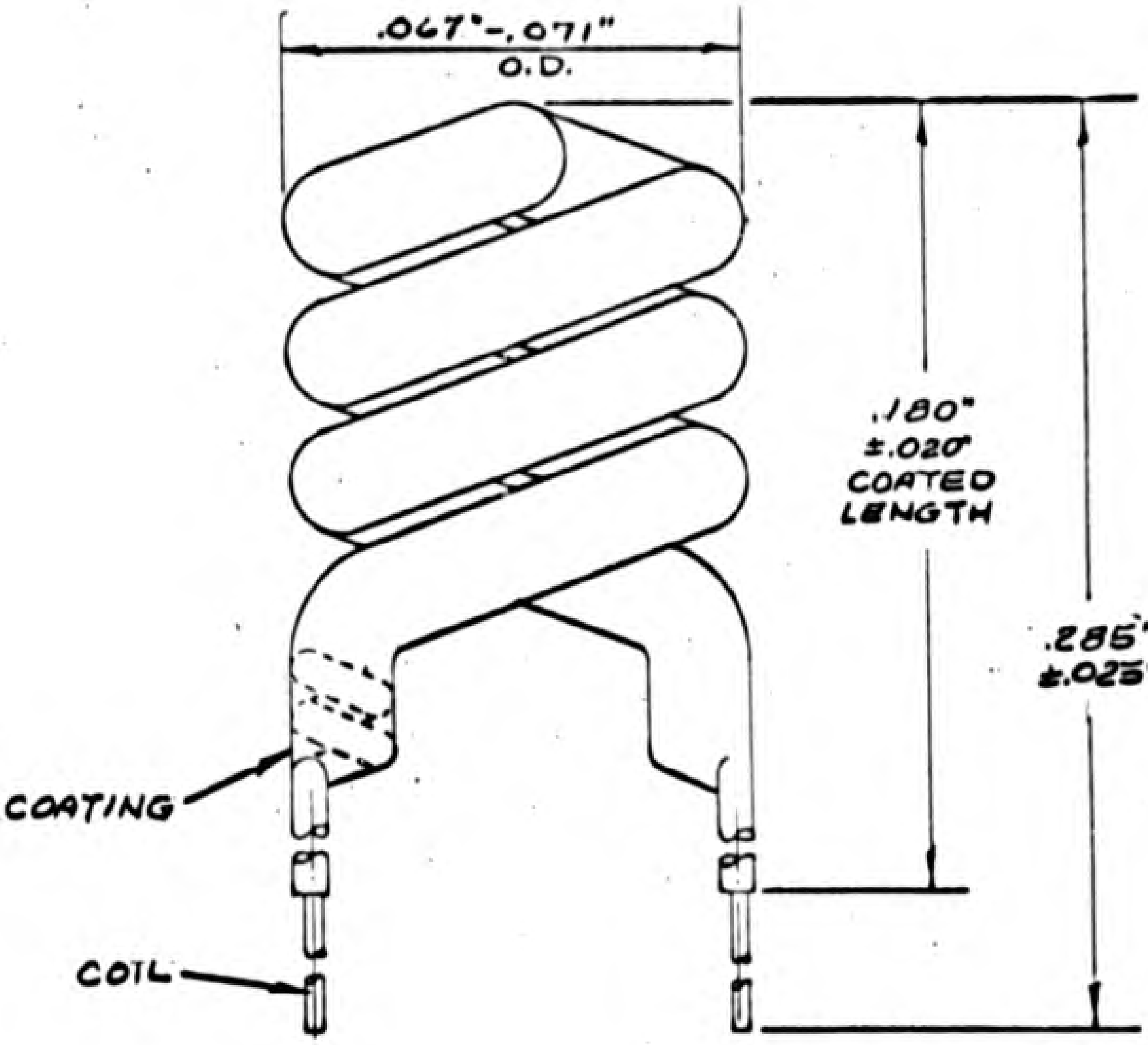
1. Heater coil is degreased, cleaned, and hydrogen fired.

2. Coat with AL_2O_3, air dry.

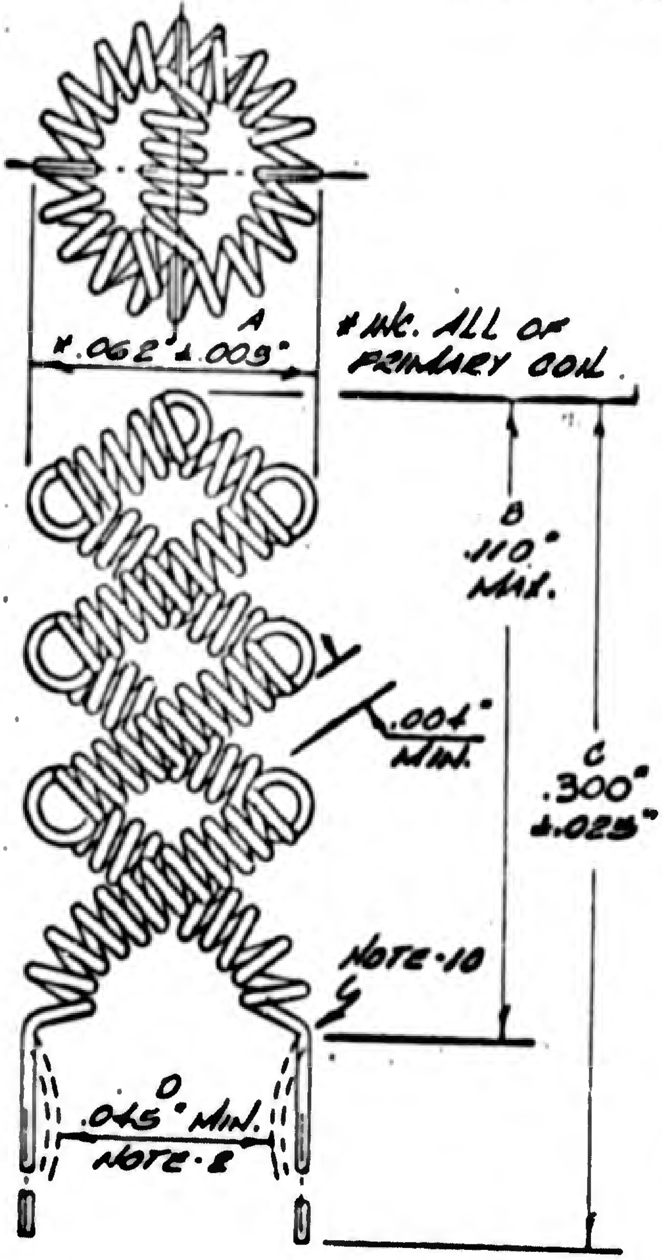
3. Immerse in a watery suspension of Tungsten to darken surface.

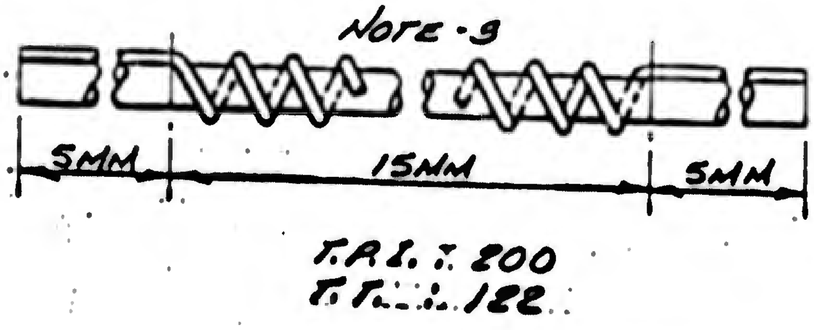
4. Hydrogen fire to sinter insulation and set dark overcoat.

COIL HEATER ASSEMBLY - N13506FA



COIL - KR45339





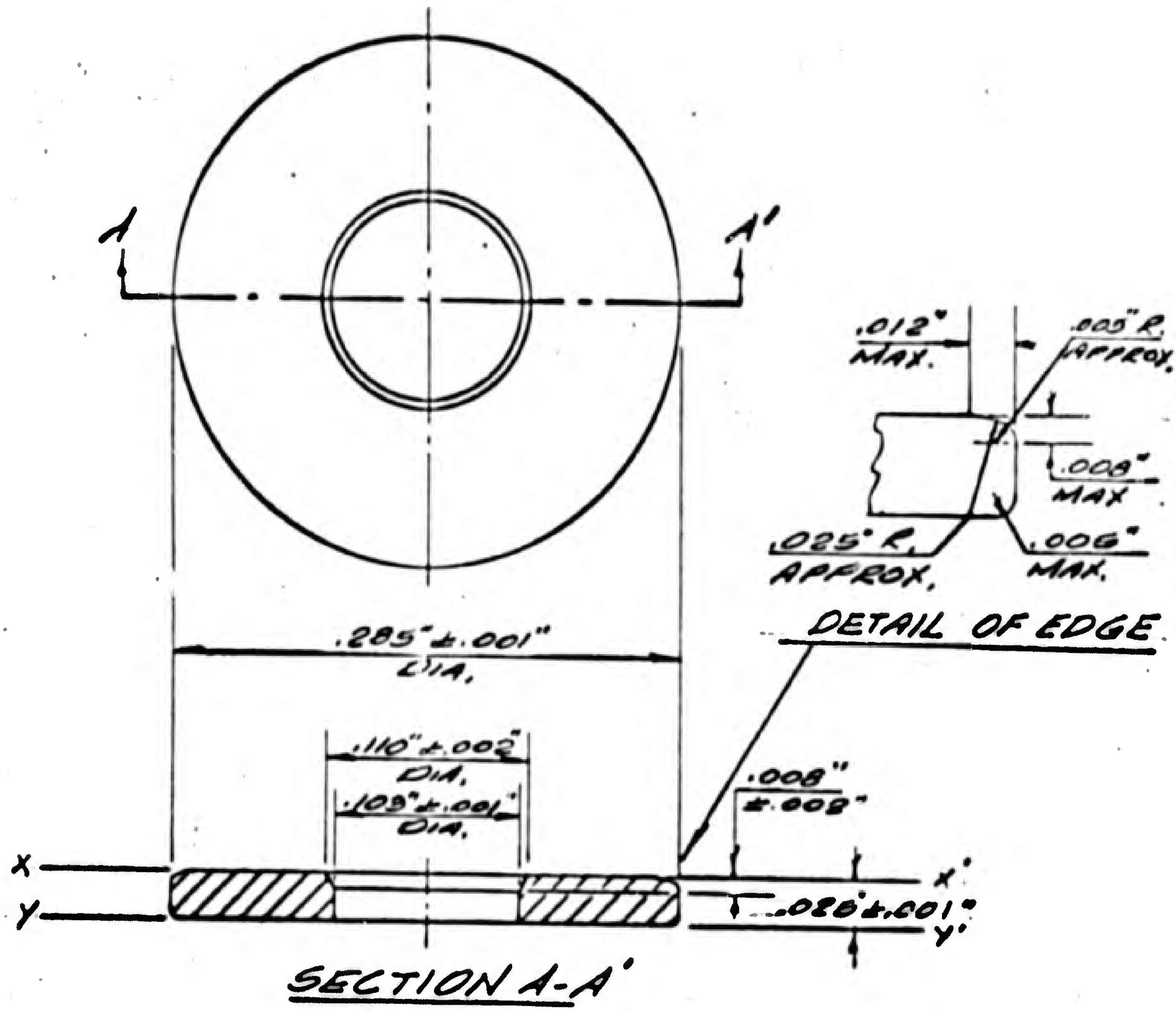
NOTES:
1 - Bare coil weight 4.47-4.62 mgm.
2 - .045" min. due to non-straightness of legs.
3 - Design dimensions (not for incoming inspection).
4 - Flattened, split, or nicked wire is a basis for rejection.
5 - Dissolve mandrel.
6 - Pack coils on corrugated paper strips.
7 - Fibrous condition of primary wire must be consistent with G.E. non-sag standards.
8 - Copy of statistical check of dimensions and bell jar measurements to be supplied with each lot.
9 - Bell Jar Measurements:
$E_f = 6.3$ Vdc (Across coil)
Avg. of 10 I_f readings must be 230 ± 3 ma.
Allowable I_f range: 225-235 ma
10 - Coiled shoulder mismatch not to exceed 2 full turns.

QUALITY LEVEL:
Dimensions A, B, C, D, and Notes 1, 4, 10:
a) Separately..............4.0% AQL
b) Combined................6.5% AQL

INSPECTION AND TESTING:
1 - Check dimensions A, B, C, D, and Note 10 with Fixture FX-1 and Screen SD-1.
2 - Damaged wire (Note 4) with 10X microscope.

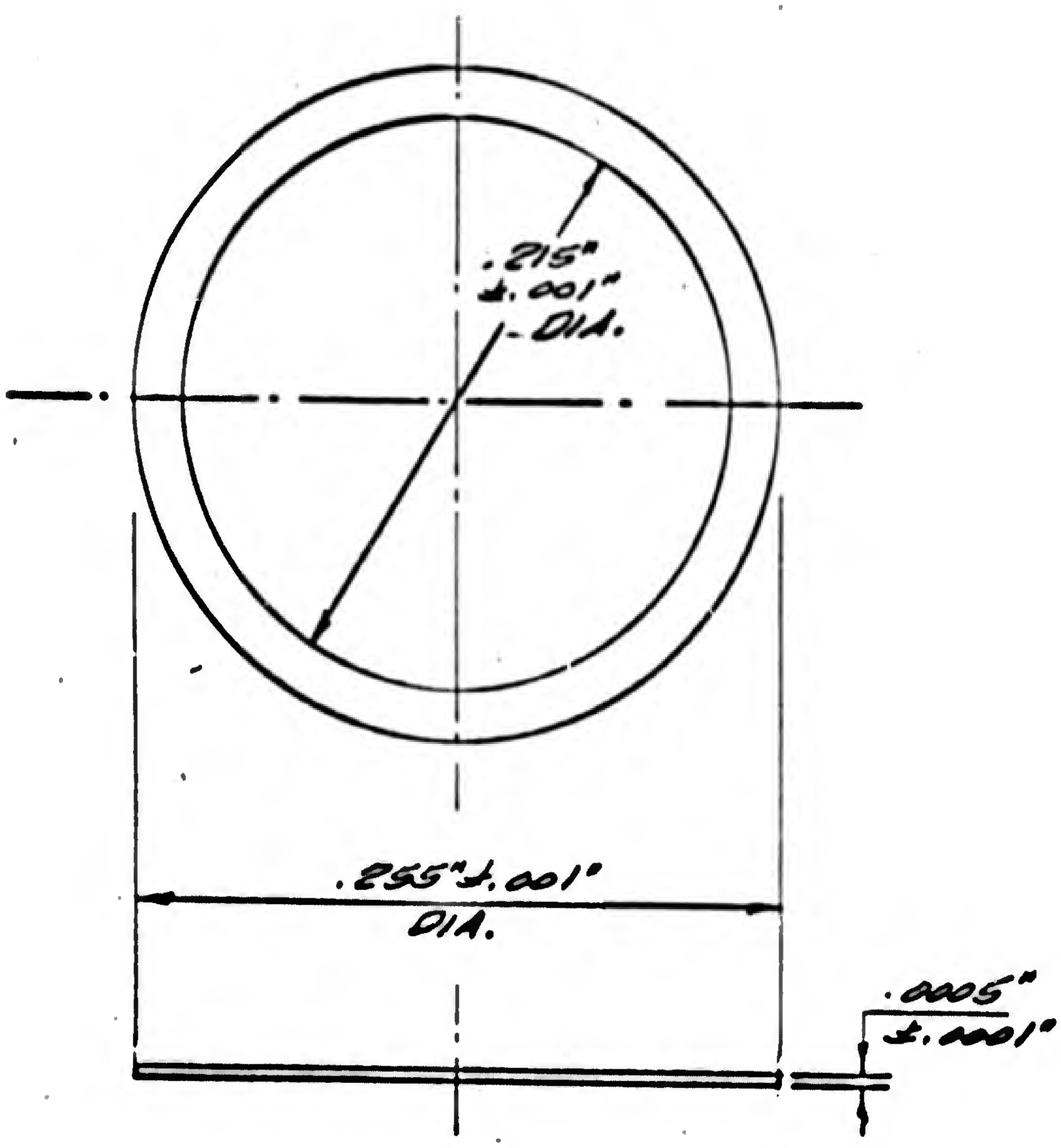
MATERIAL: TUNGSTEN, 3% RHENIUM
COIL: .002" DIA.
MANDREL: .008" DIA.

CATHODE RING - KR70185



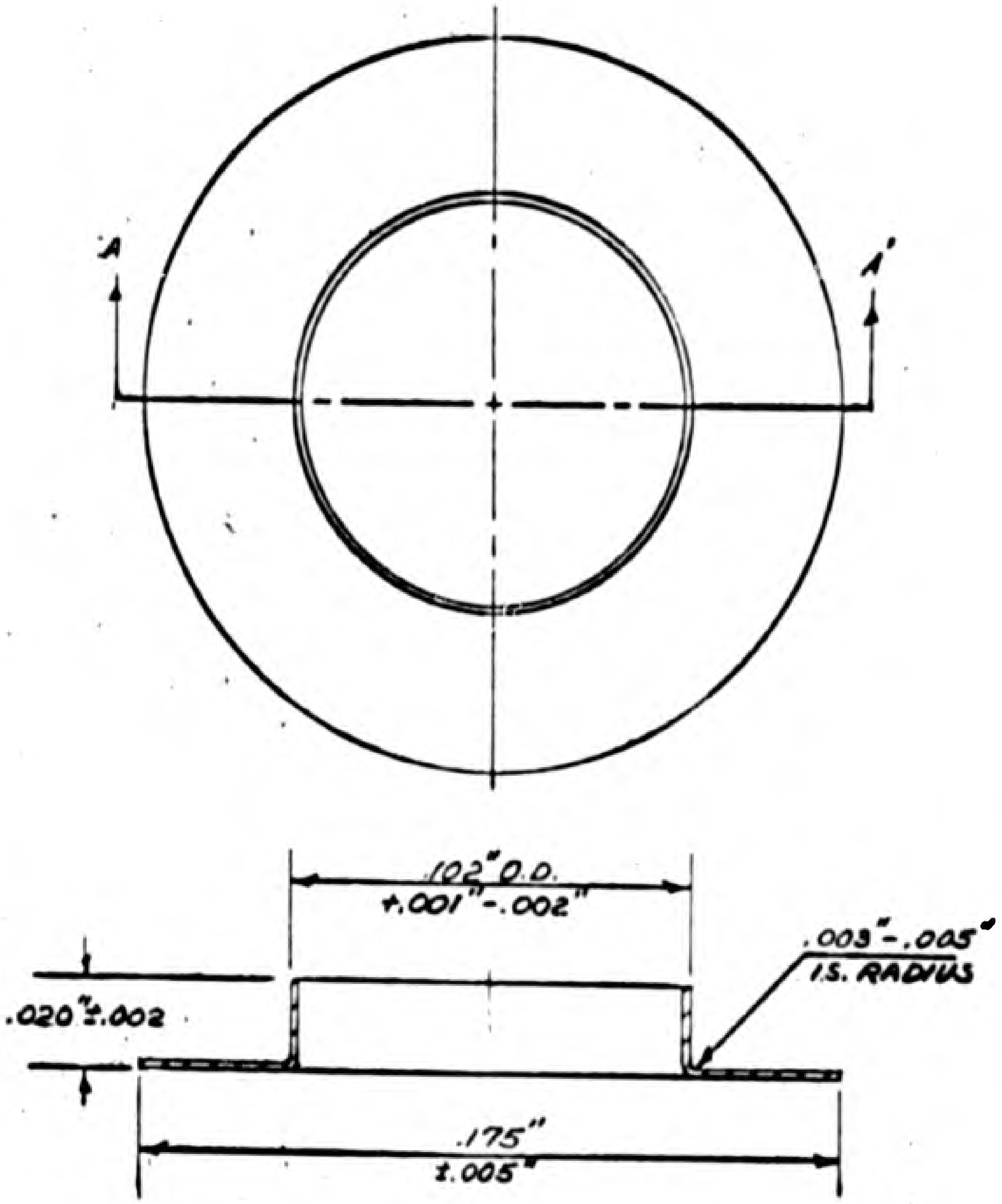
MATERIAL: TITANIUM

SOLDER RING - KR70293



MATERIAL: NICKEL

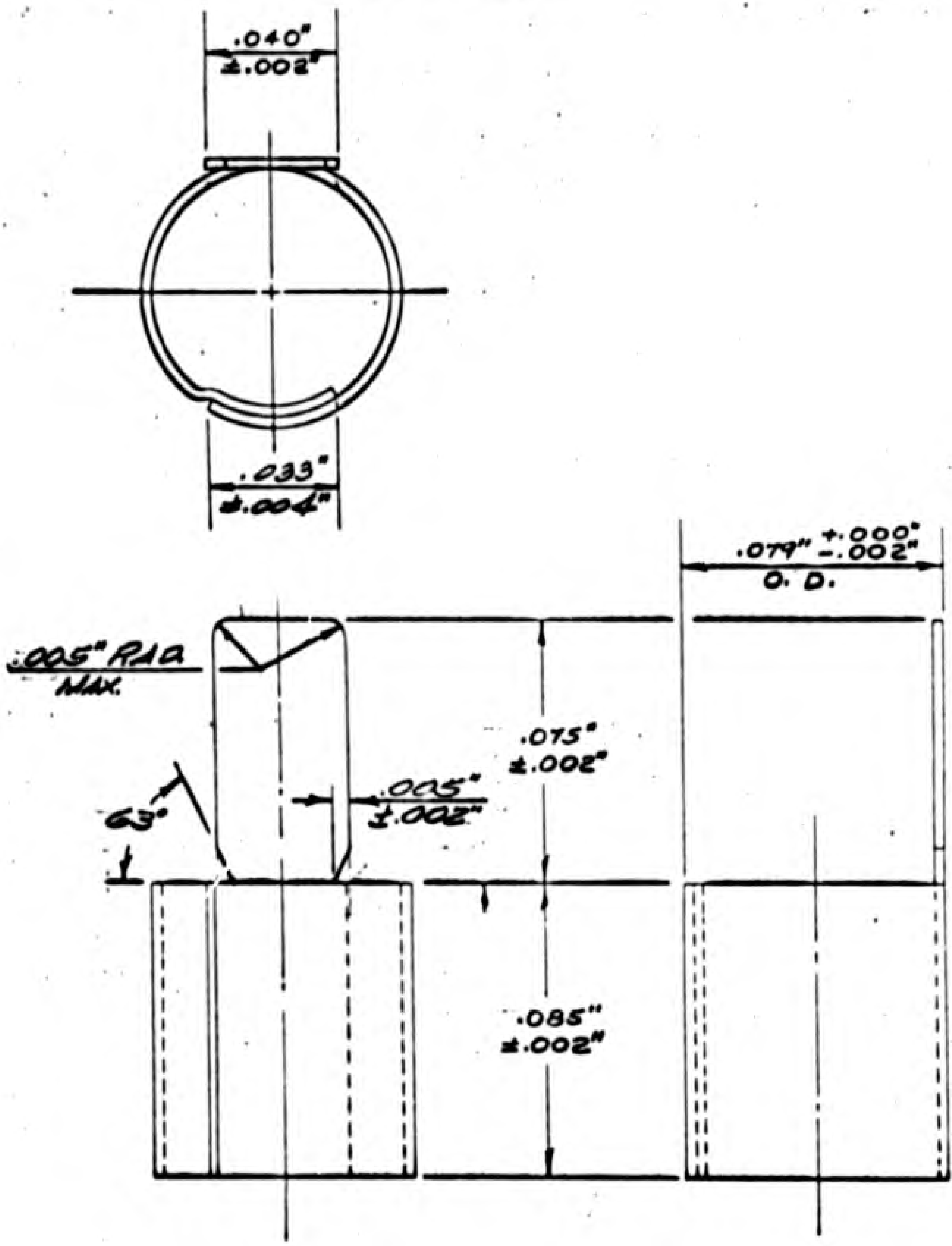
CATHODE WALL BUFFER - KR70134



SECTION A-A'

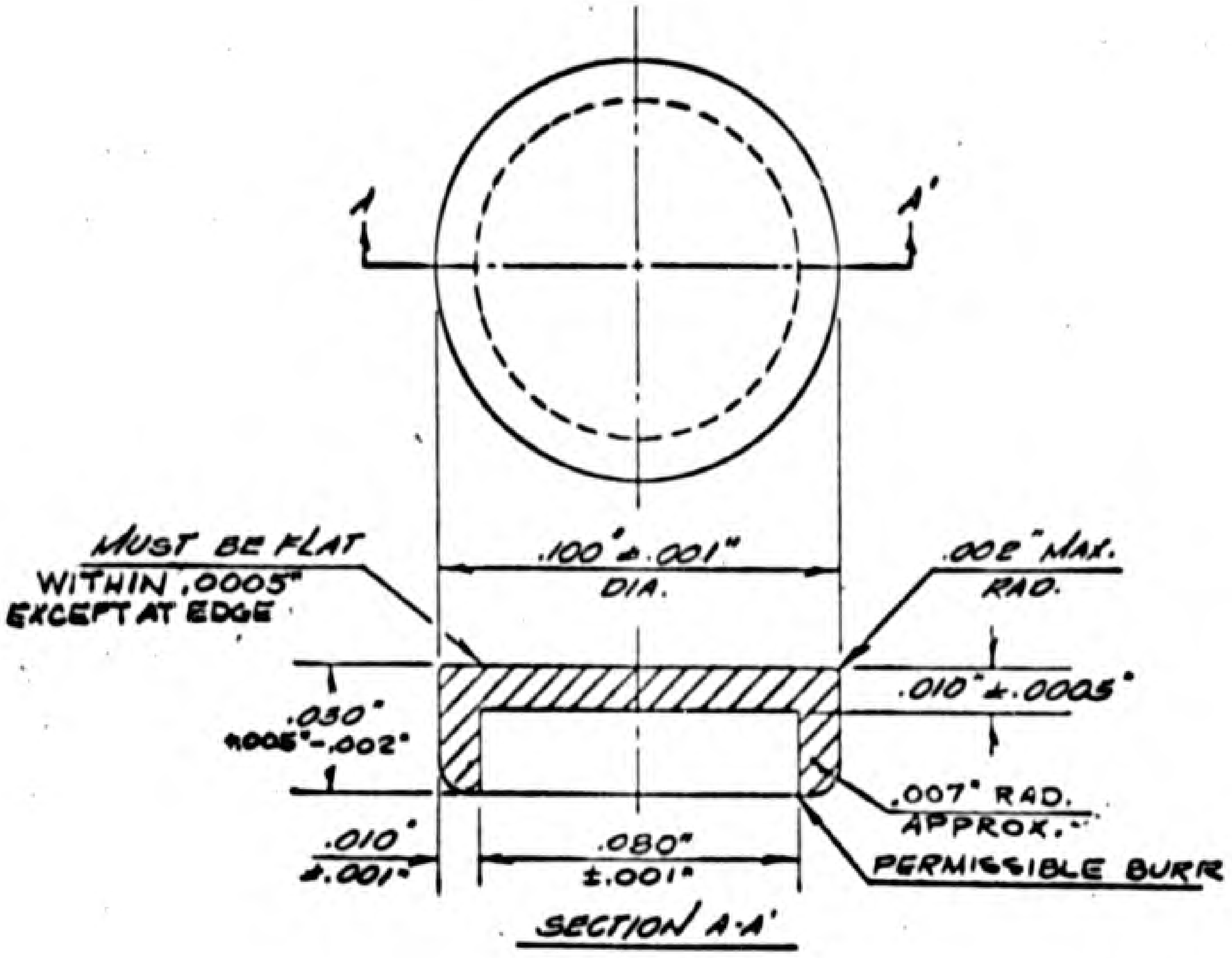
MATERIAL: .001" THICK STAINLESS STEEL

HEAT SHIELD - KR75024



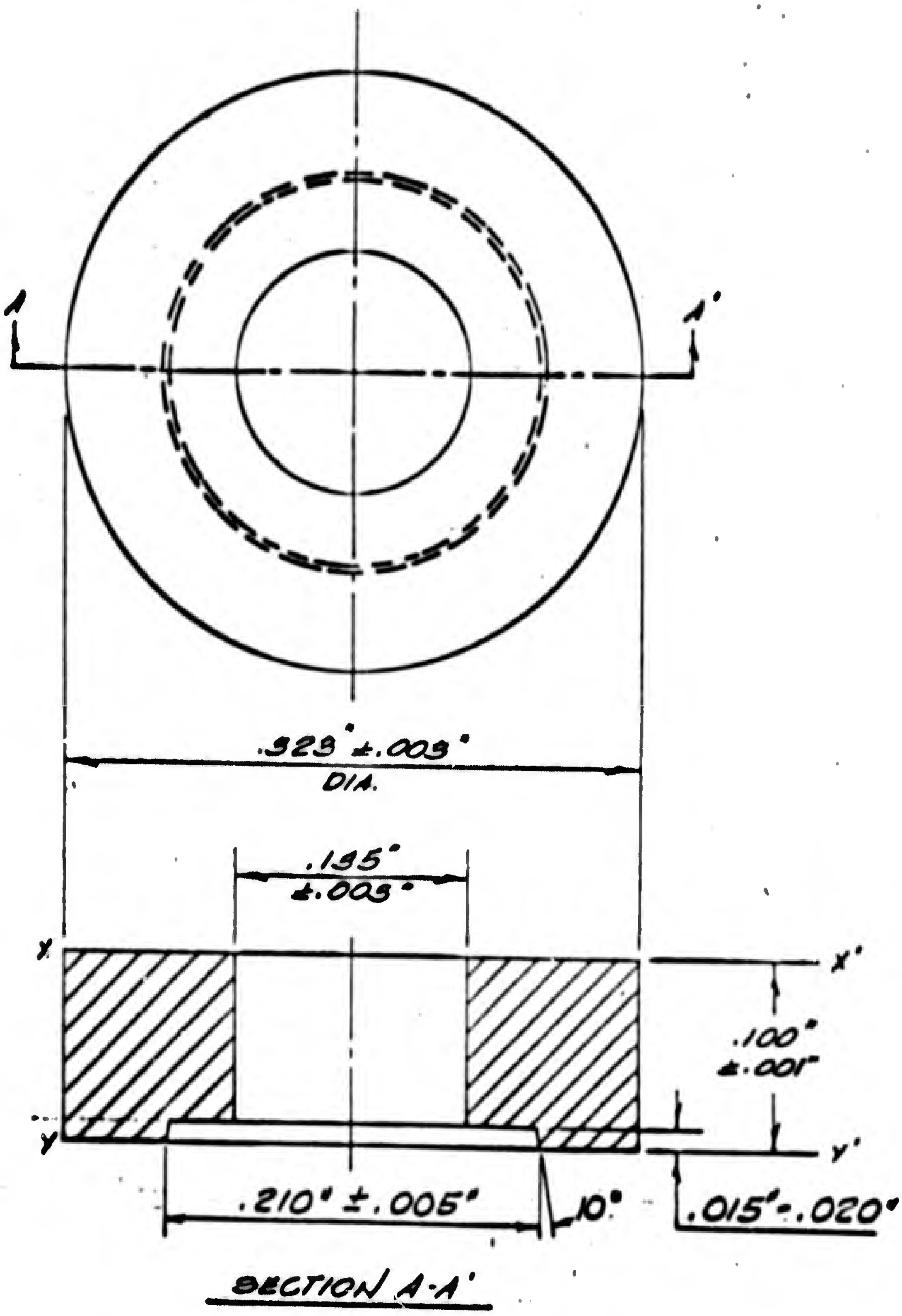
MATERIAL: .003" THICK NICKEL

CATHODE - KR70174



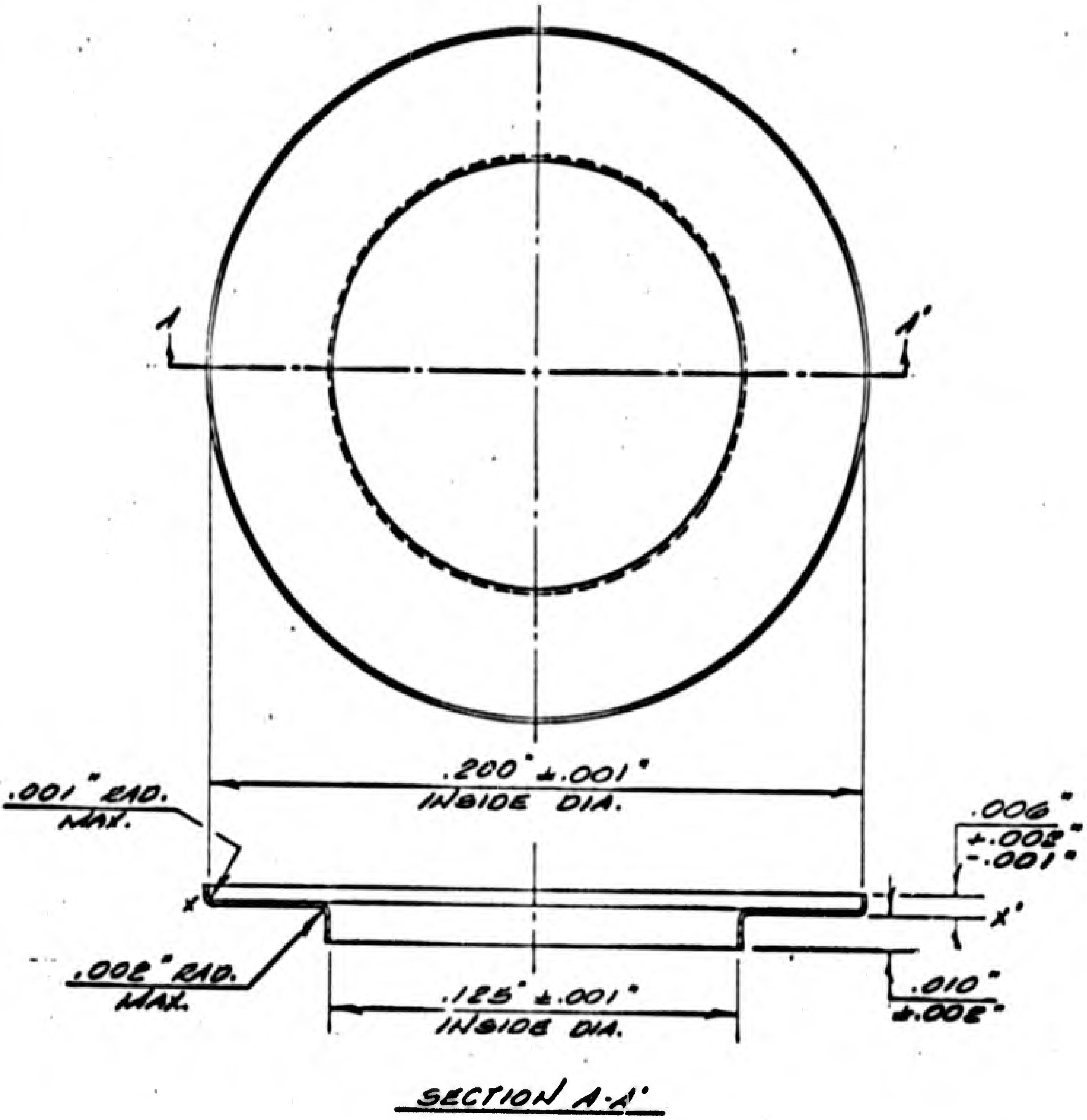
MATERIAL: NICKEL

INSULATOR - KR383



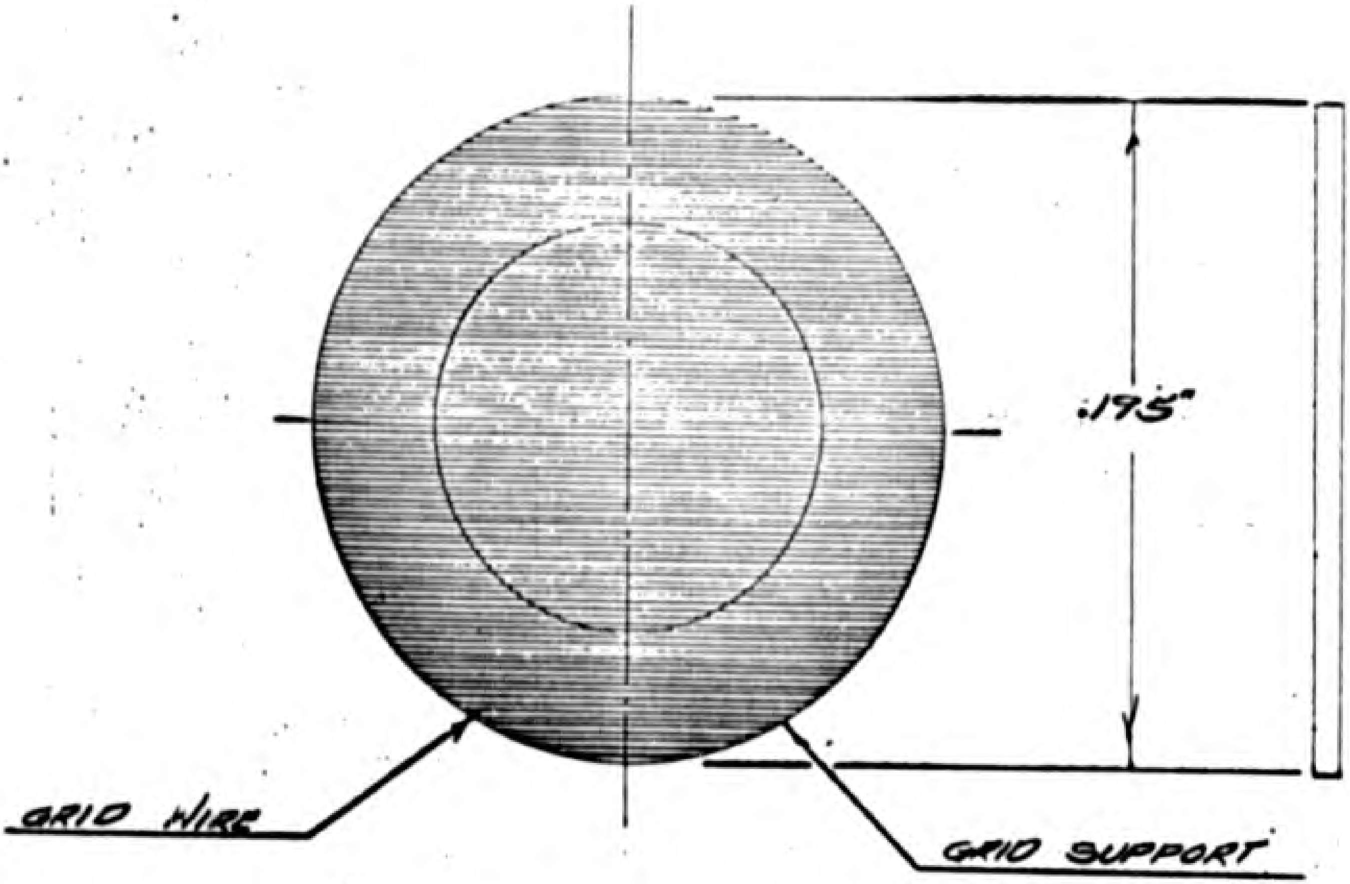
MATERIAL: FORSTERITE CERAMIC

SPACER CAP - KR70113



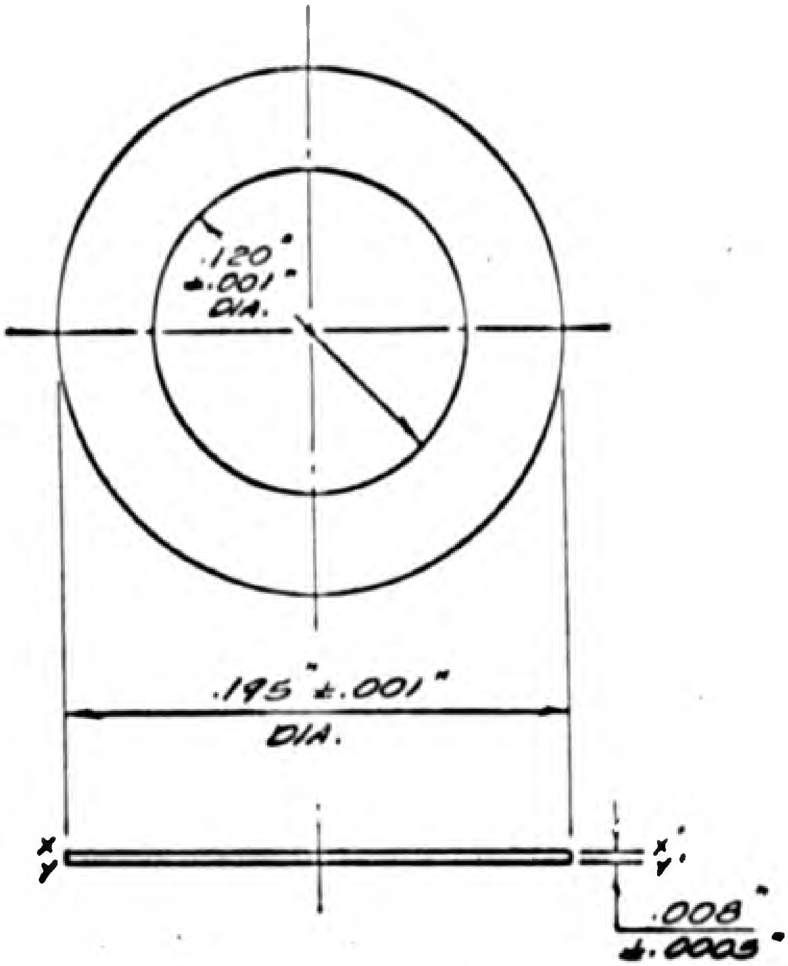
MATERIAL: .0015" THICK MOLYBDENUM

GRID ASSEMBLY - N13502GA



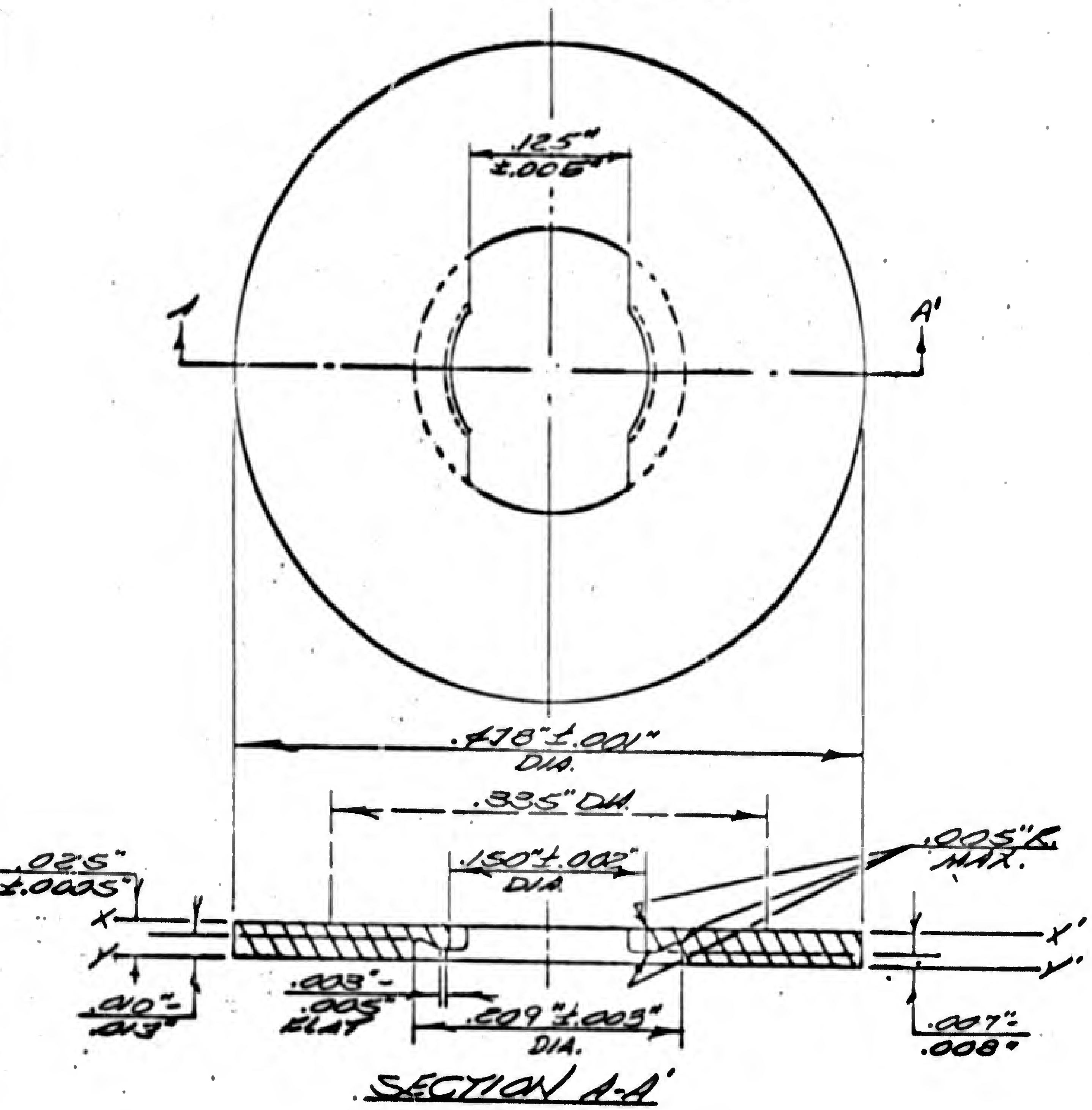
T.P.I. - 736
T.T. - 143

GRID SUPPORT - KR88091



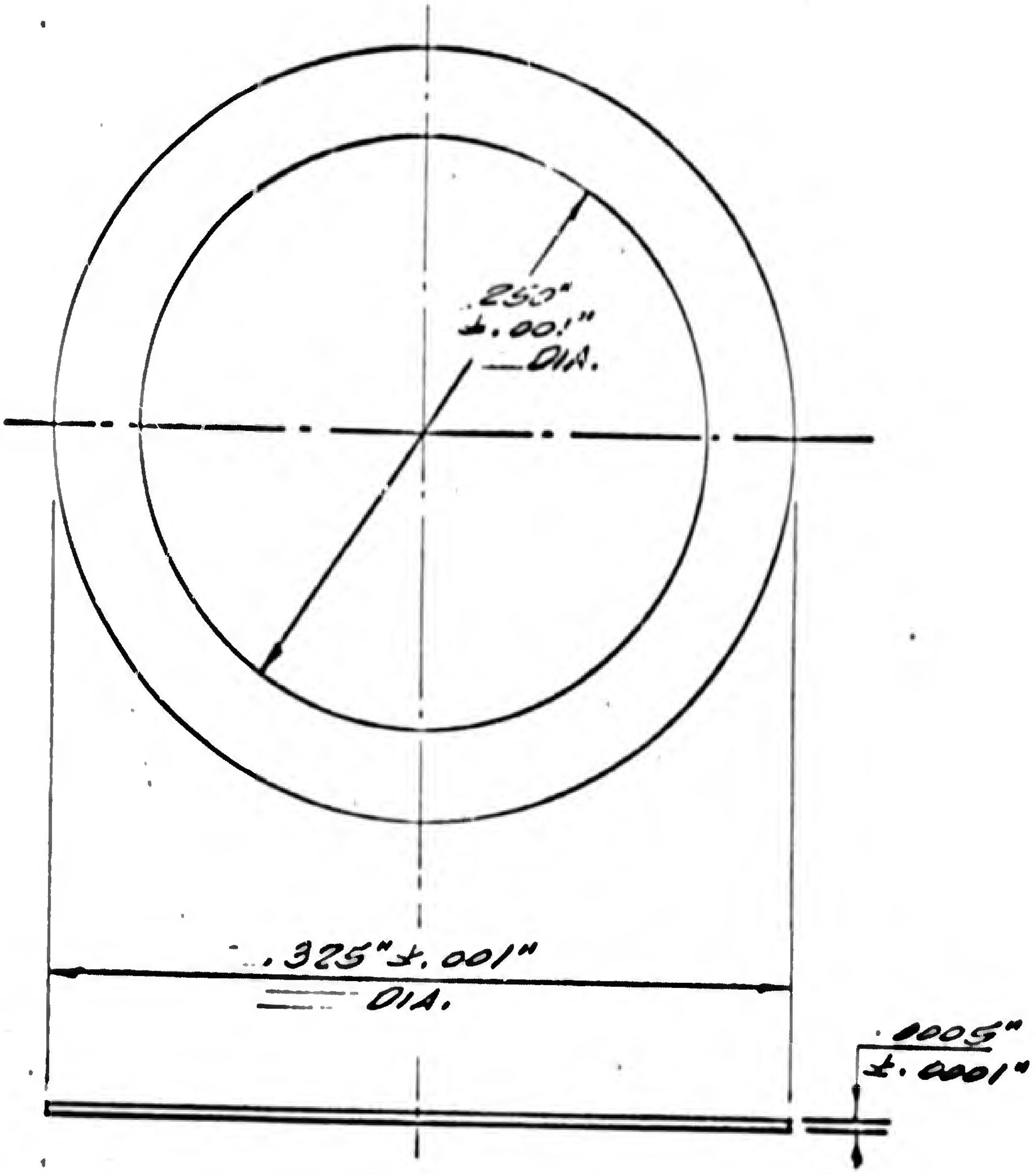
MATERIAL: TUNGSTEN

GRID RING - KR70159



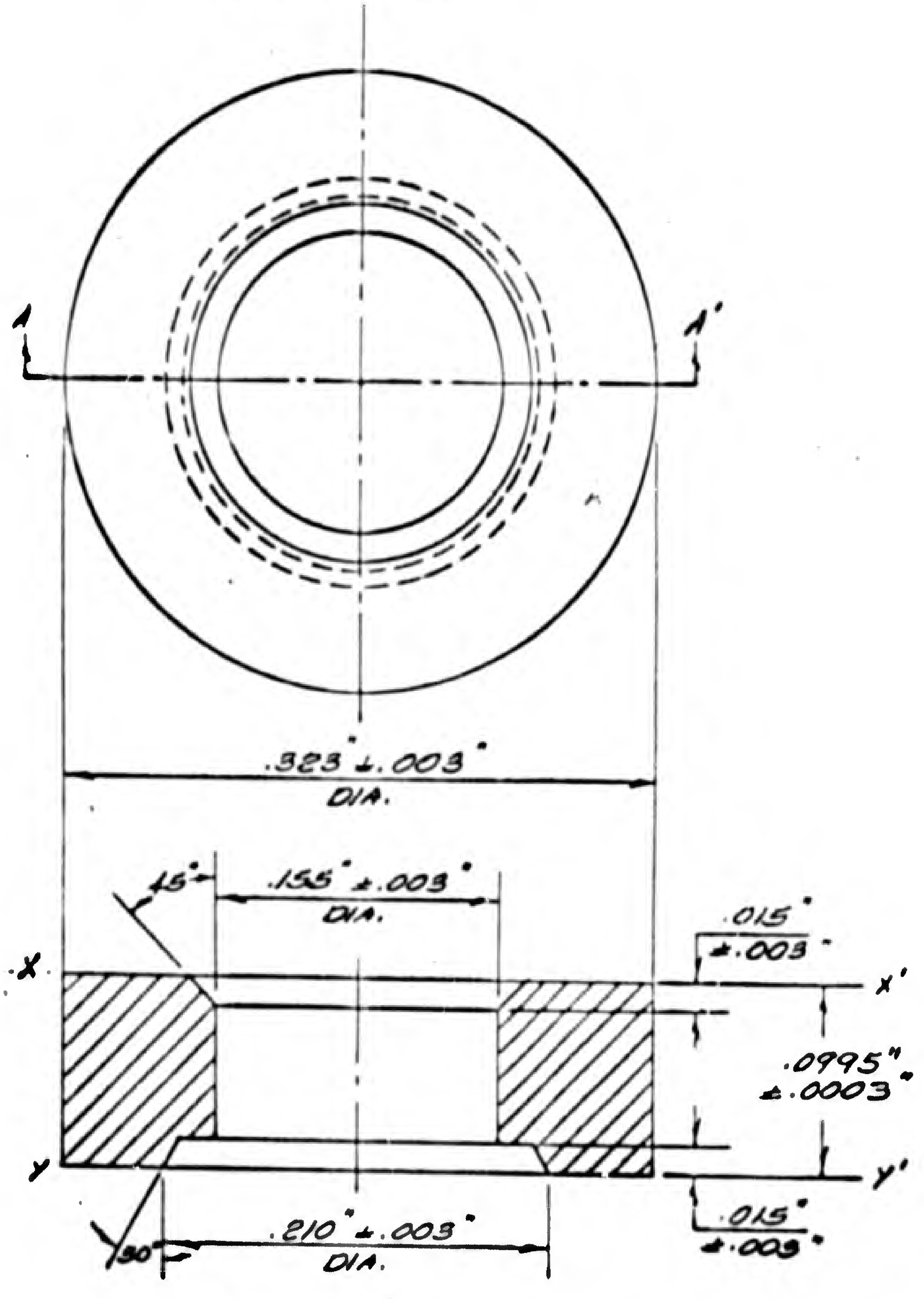
MATERIAL: TITANIUM

SOLDER RING - KR70294



MATERIAL: NICKEL

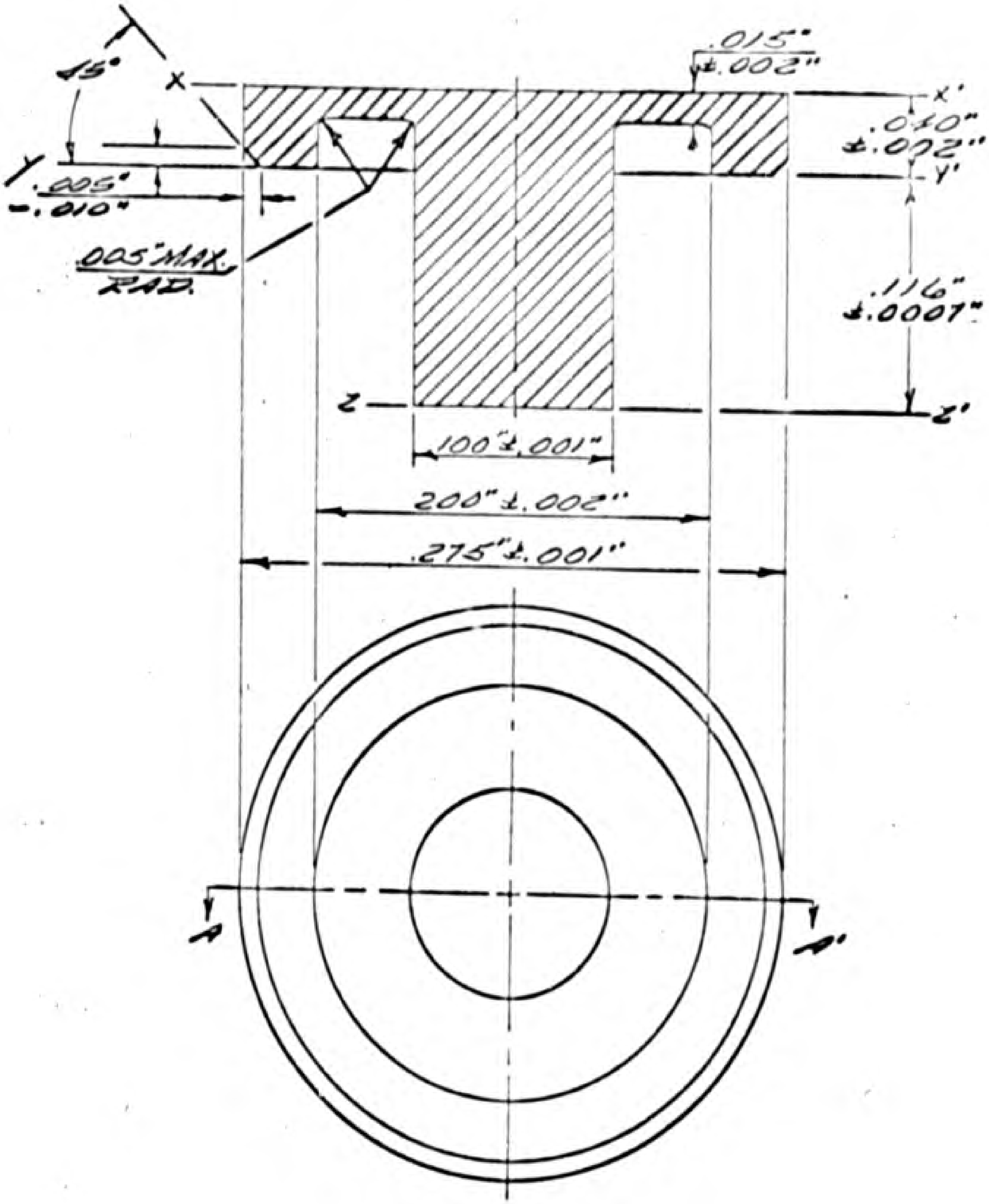
INSULATOR - KR384



SECTION A-A'

MATERIAL: FORSTERITE CERAMIC

ANODE - KR60877



MATERIAL: TITANIUM

APPENDIX III

Serial Number ______

MANUAL OF INSPECTION AND QUALITY CONTROL PROCEDURES COVERING ELECTRON TUBE TYPE 7486

Order Number 19060-PP-62-81-81
Contract Number DA-36-039-SC-86738

GENERAL ELECTRIC COMPANY
ELECTRONIC COMPONENTS DIVISION
TUBE DEPARTMENT
OWENSBORO, KENTUCKY

R E Moe
R. E. Moe, Manager-Engineering, Tube Department

J. F. Madole
J. F. Madole, Manager-Engineering Administration, Tube Department

HL Thorson
H. L. Thorson, Manager-Planar Tube Product Design, Tube Department

QUALITY CONTROL MANUAL

TABLE OF CONTENTS

INTRODUCTION

The electron tube type 7486 is a high-mu triode of ceramic-and-metal planar construction primarily intended for use as an oscillator and as a radio high frequency power amplifier in the ultra high frequency range; its electrical characteristics of high level transconductance, low interelectrode capacitance, and low lead inductance are all favorable for good UHF performance. The 7486 is of small size and is rugged in construction, and is especially suited where unfavorable conditions of mechanical shock, mechanical vibration, and nuclear radiation are encountered.

This manual covers the inspection and quality control procedures for this electron tube as required by a PEM contract, Order Number 19060-PP-62-81-81. The objectives of the first phase of this contract consist of the following:

(a) To provide improved tube processing equipment capable of producing 100 tubes, type 7486, per day;

(b) To increase tube life expectancy by improved tube design features;

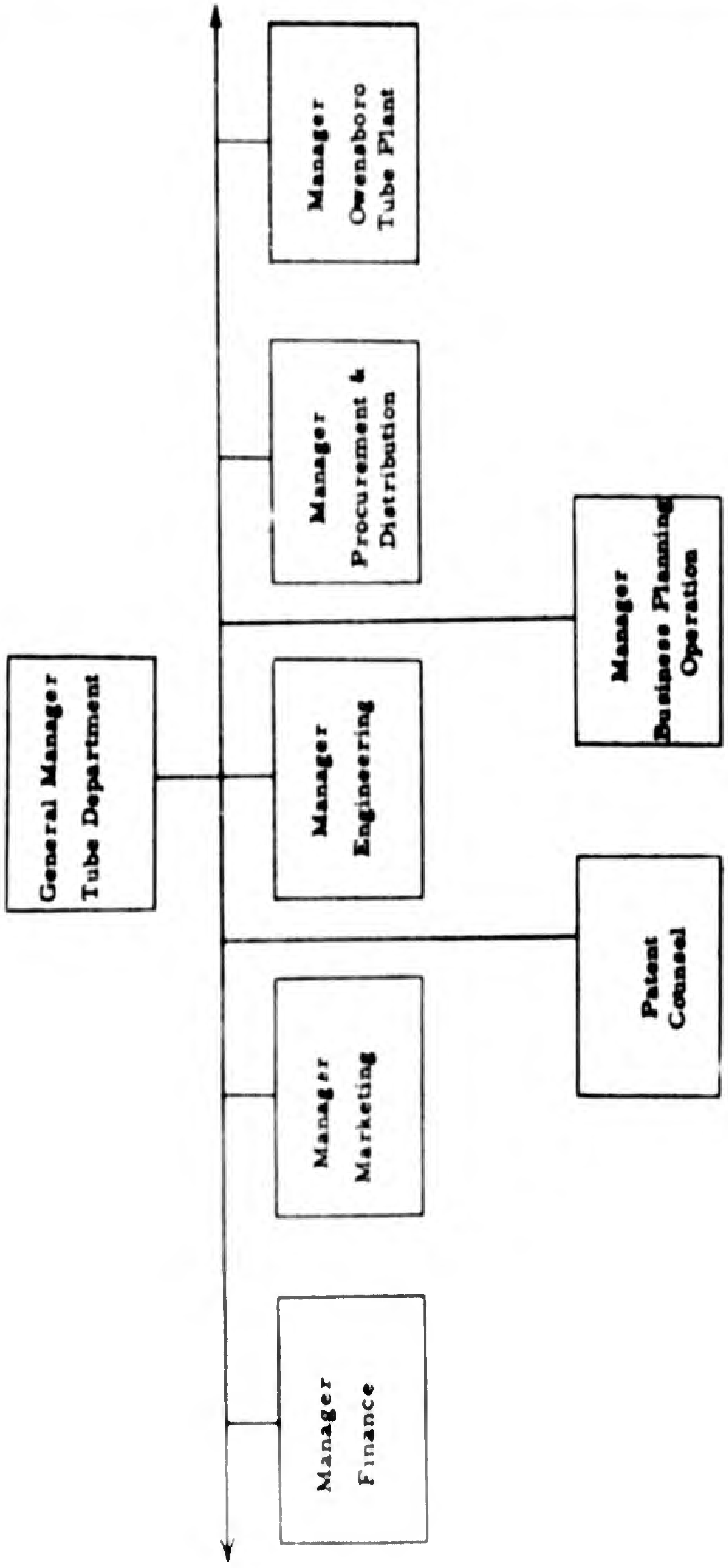
(c) To improve tube ratings by evaluation on new test equipment.

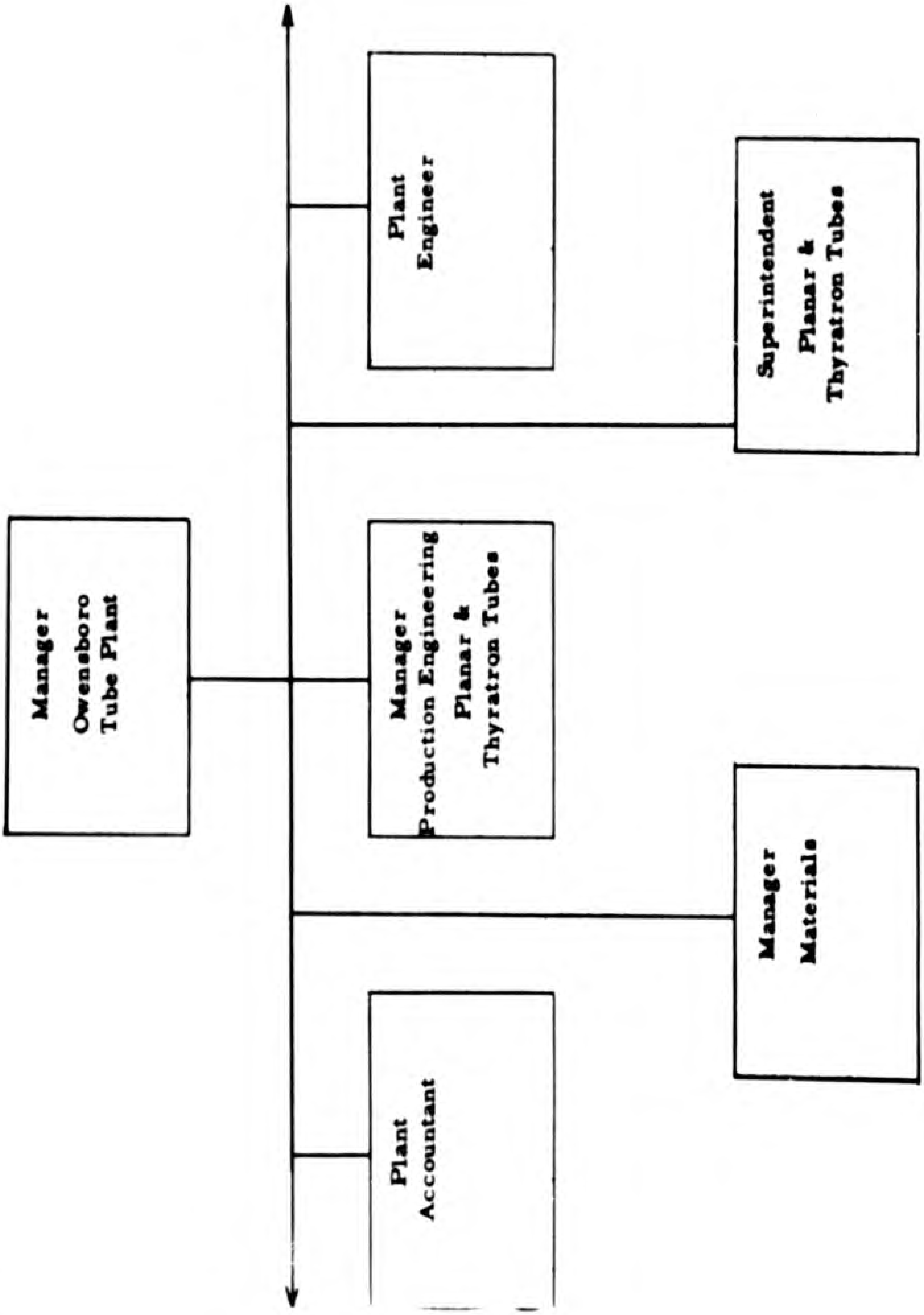
A second phase of this contract will present information relative to increasing the manufacturing capability to 10,000 tubes per month.

This manual, along with those Standing Instructions and Process Instructions incorporated herein by reference, will serve as a guide for the Quality Assurance Representative in appraising the quality controls placed on this tube type, and as an outline for Section management in the effective maintenance and improvement of these controls.

The General Electric Company will manufacture electron tube type 7486 in compliance with electrical and mechanical specifications and will take necessary steps to keep shrinkage to a minimum.

GENERAL ORGANIZATION

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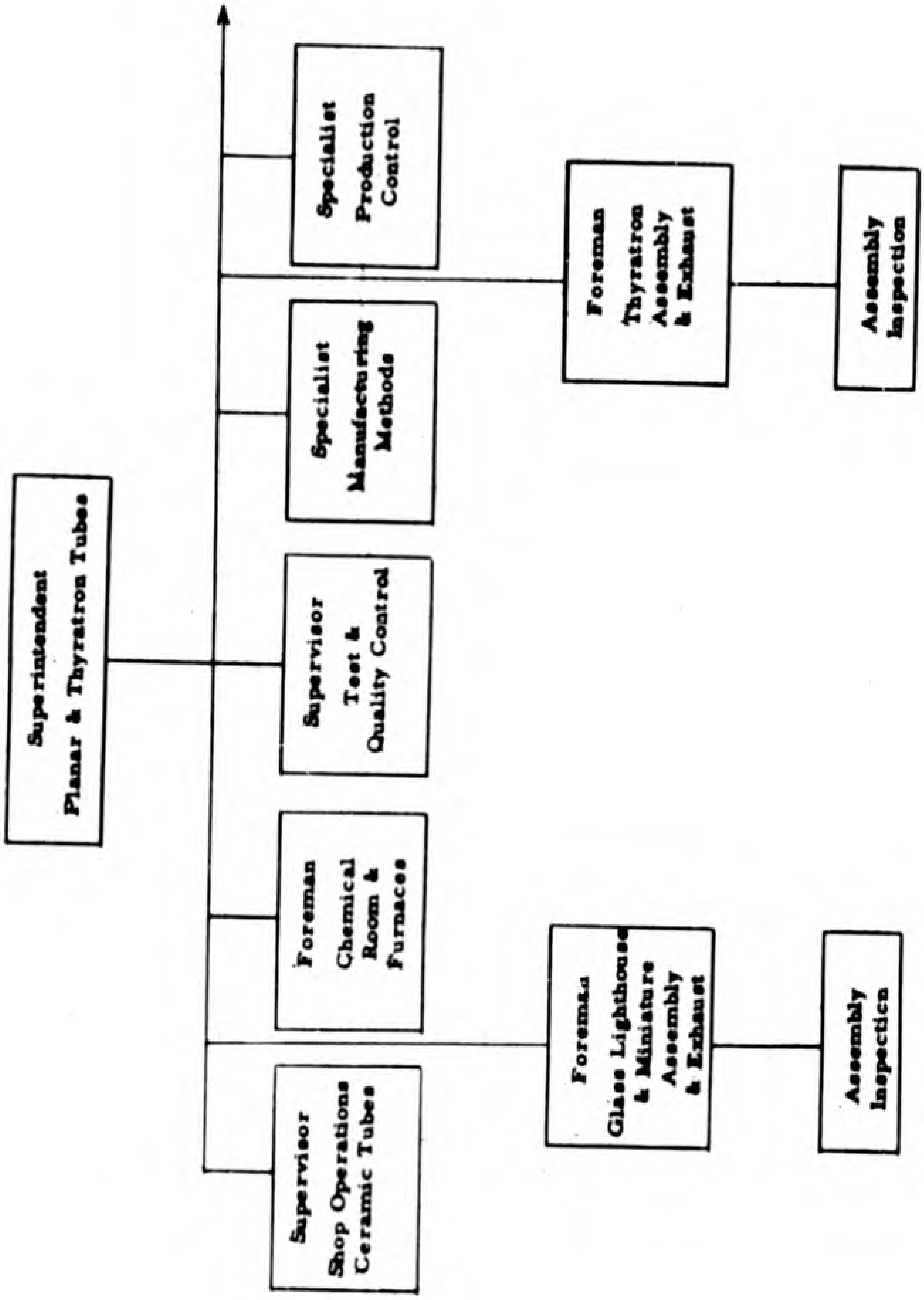
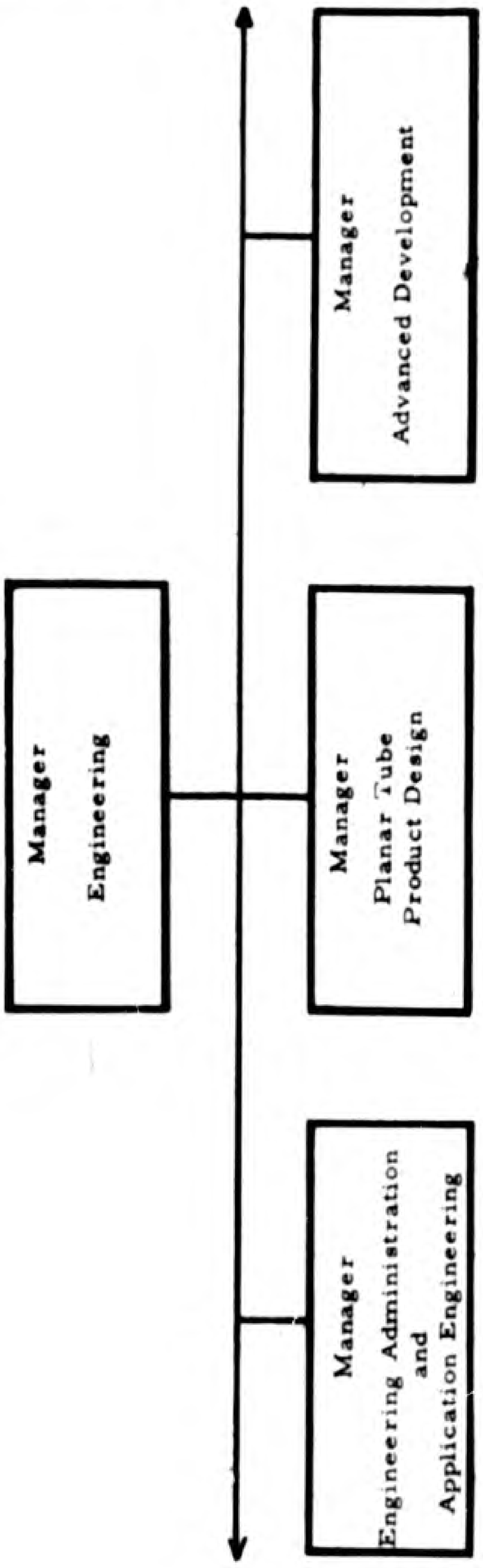
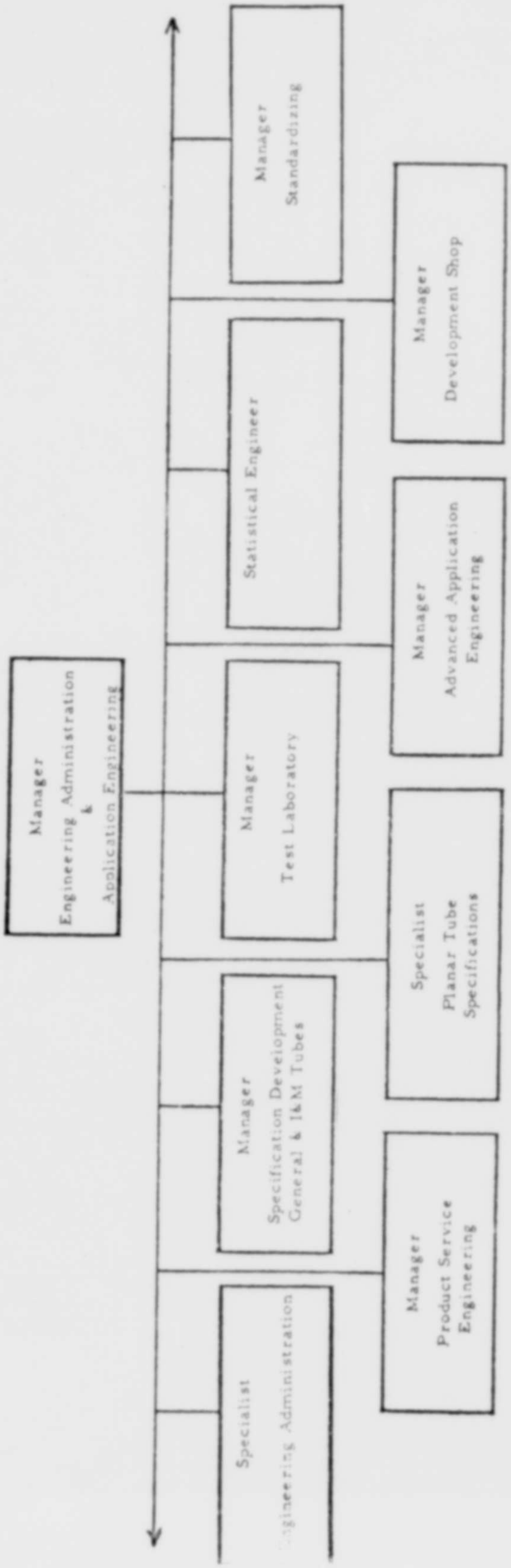
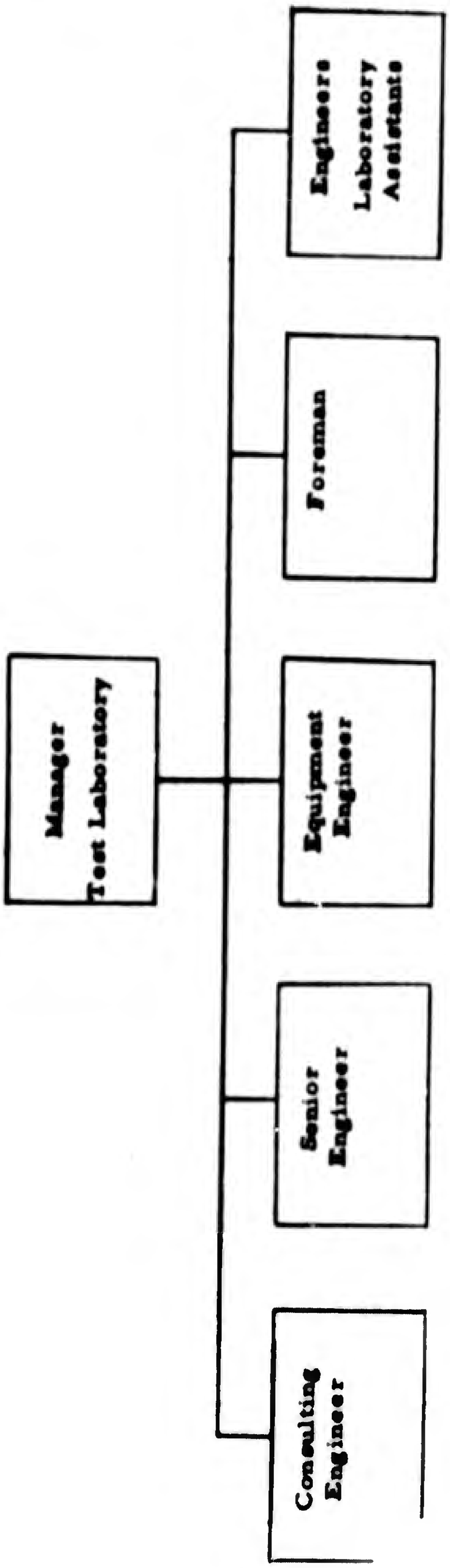
Owensboro
Tube Plant
Plant
Engineer
Superintendent
Planar &
Thyratron Tubes
Manager
Production Engineering
Planar &
Thyratron Tubes
Manager
Materials
Plant
Accountant


Superintendent
Planar & Thyratron Tubes
Supervisor
Shop Operations
Ceramic Tubes
Foreman
Chemical
Room &
Furnaces
Supervisor
Test &
Quality Control
Specialist
Manufacturing
Methods
Specialist
Production
Control
Foreman
Glass Lighthouse
& Miniature
Assembly
& Exhaust
Assembly
Inspection
Foreman
Thyratron
Assembly
& Exhaust
Assembly
Inspection


Manager
Advanced Development
Manager
Engineering
Manager
Planar Tube
Product Design
Manager
Engineering Administration
and
Application Engineering


Manager
Standardizing
Manager
Development Shop
Statistical Engineer
Manager
Advanced Application
Engineering
Manager
Engineering Administration
&
Application Engineering
Manager
Test Laboratory
Specialist
Planar Tube
Specifications
Manager
Specification Development
General & I&M Tubes
Manager
Product Service
Engineering
Specialist
Engineering Administration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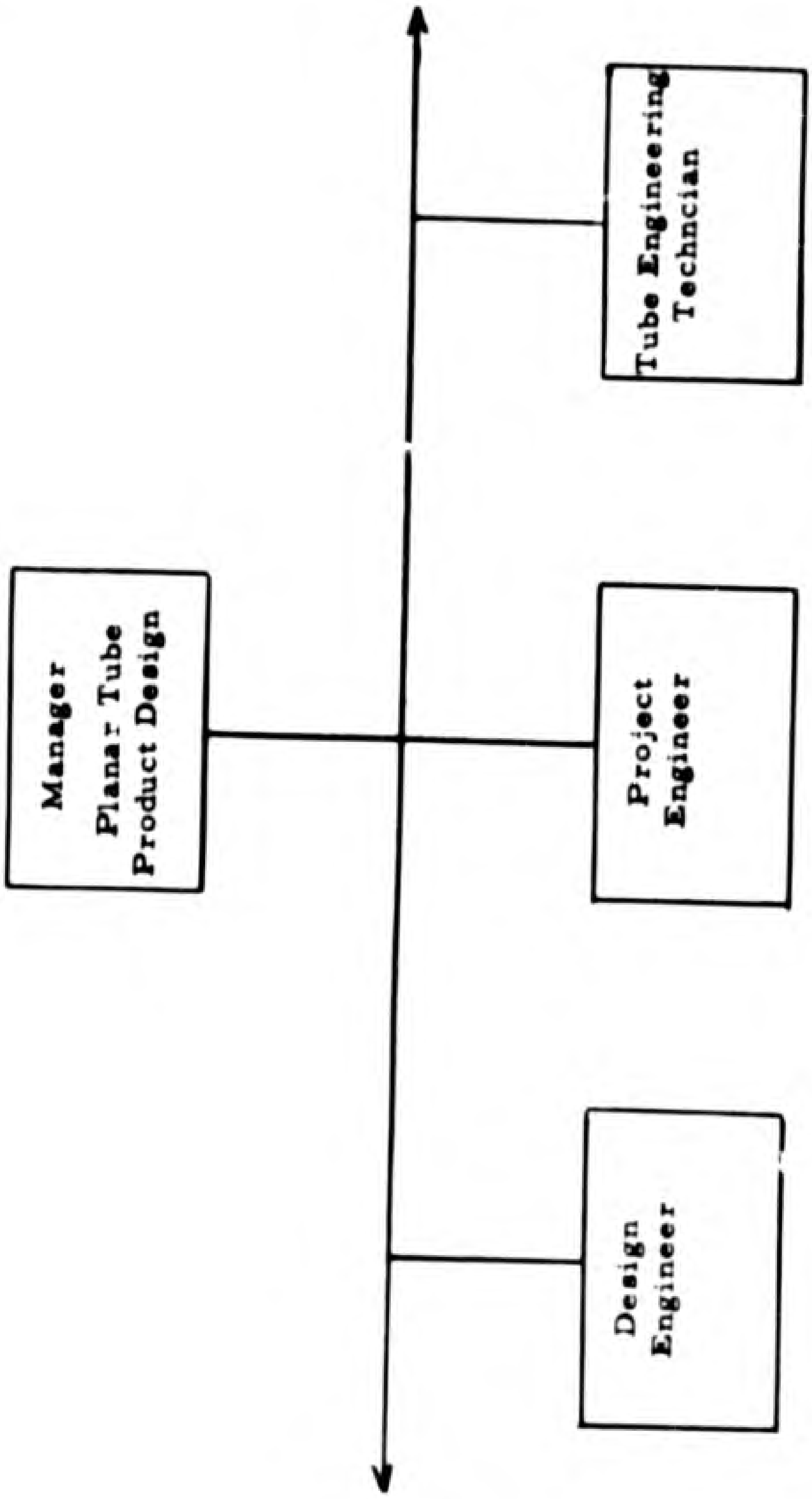
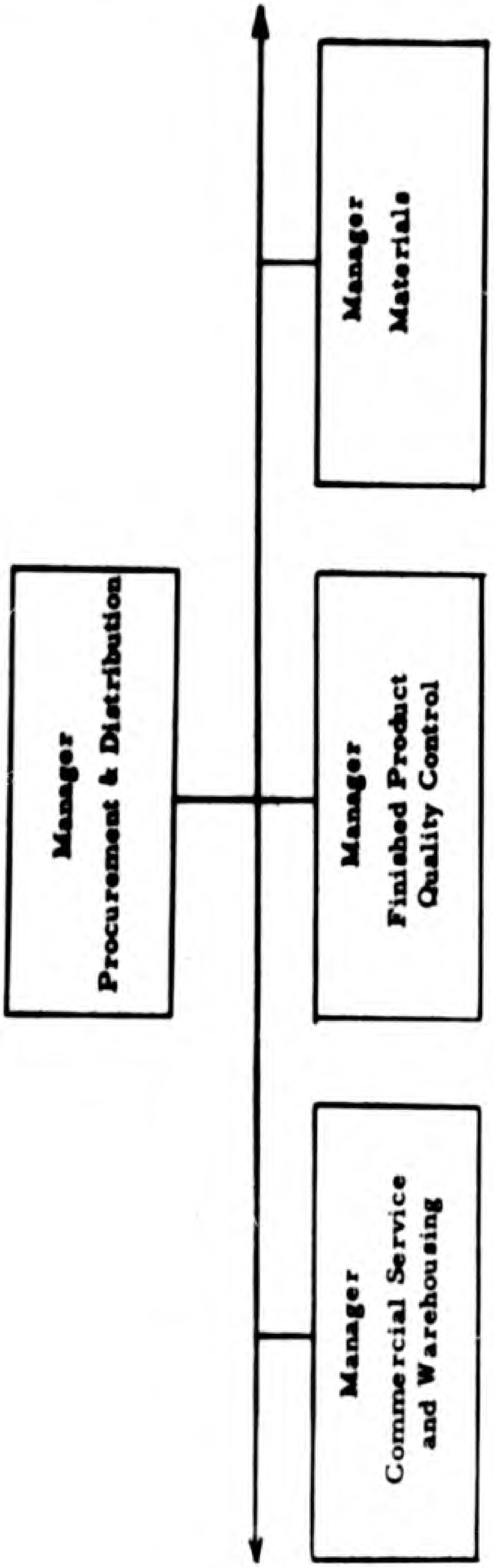
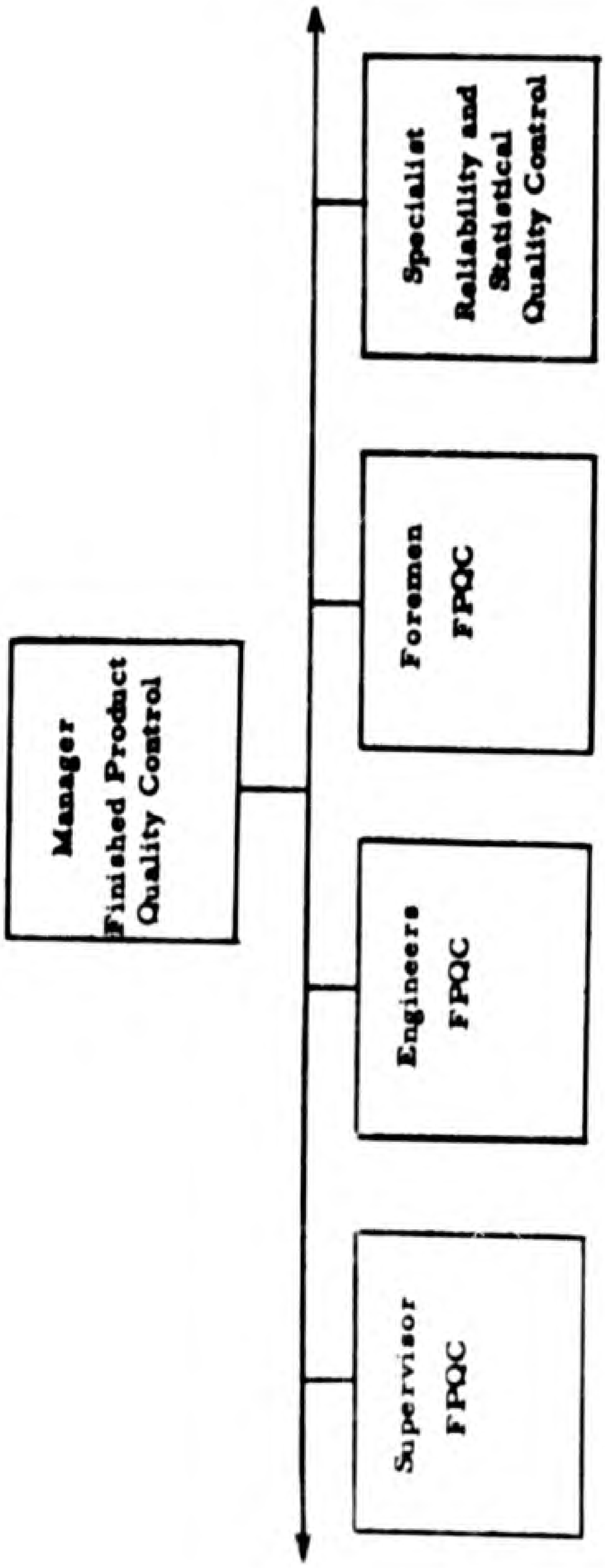
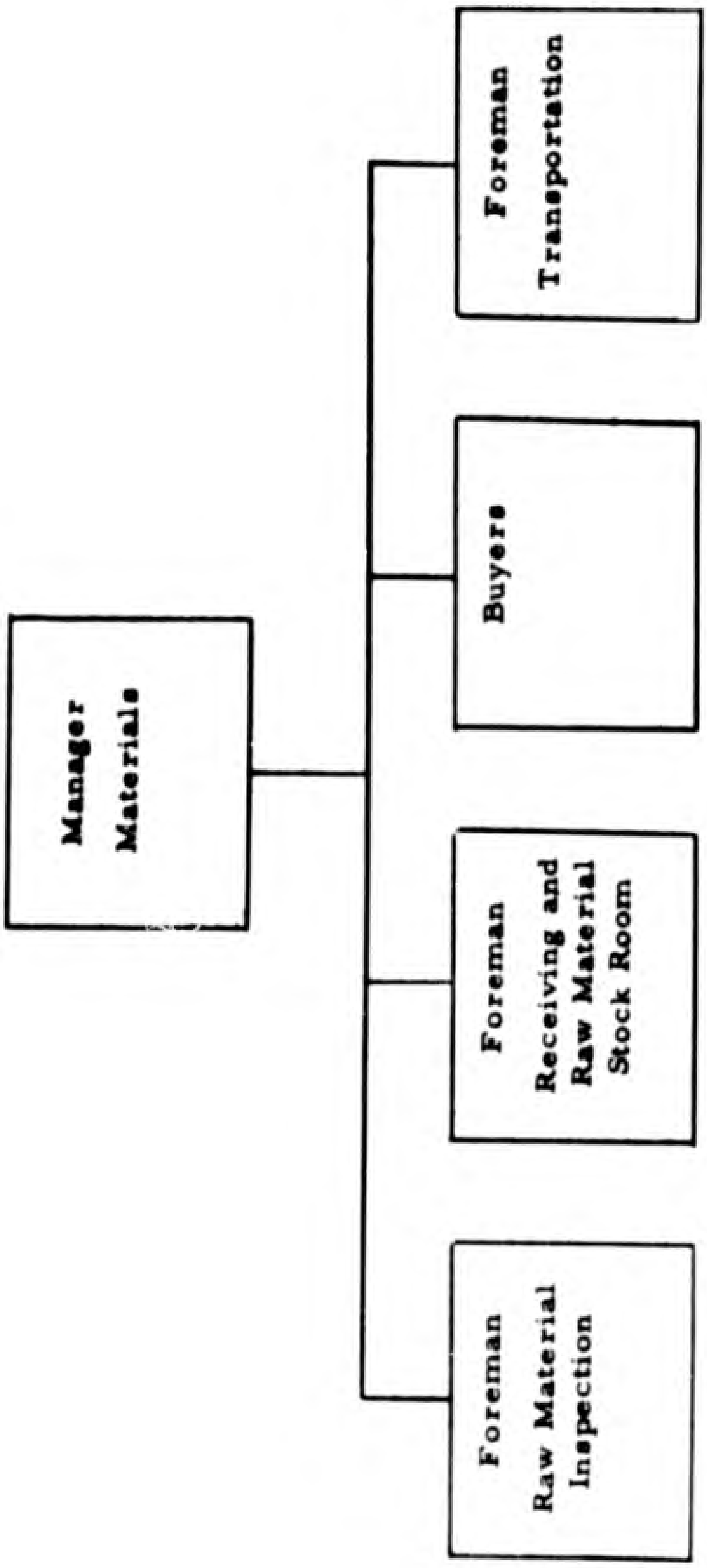
Test Laboratory
Engineers
Laboratory
Assistants
Foreman
Equipment
Engineer
Senior
Engineer
Consulting
Engineer

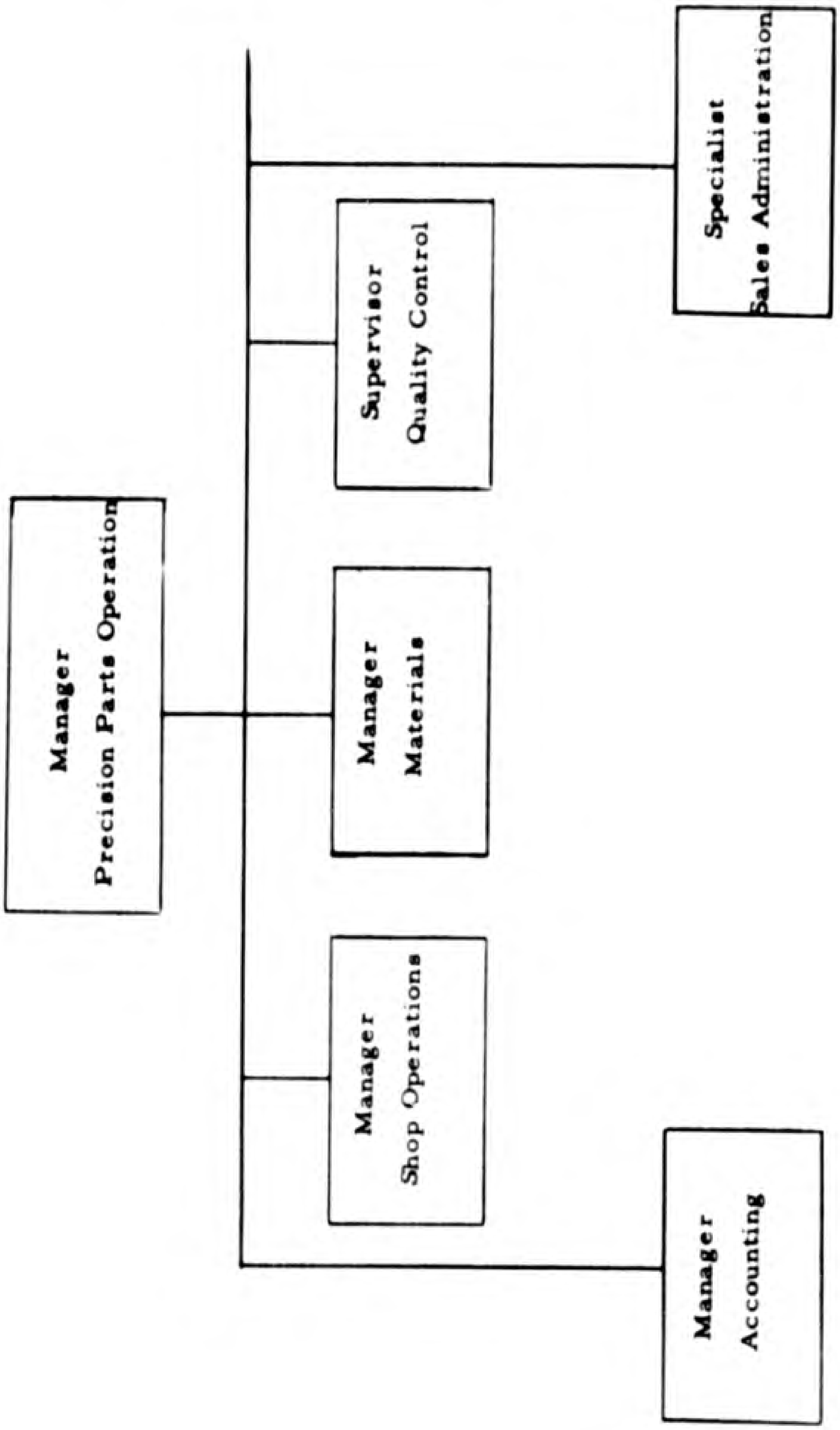

Manager
Planar Tube
Product Design
Tube Engineering
Technician
Project
Engineer
Design
Engineer

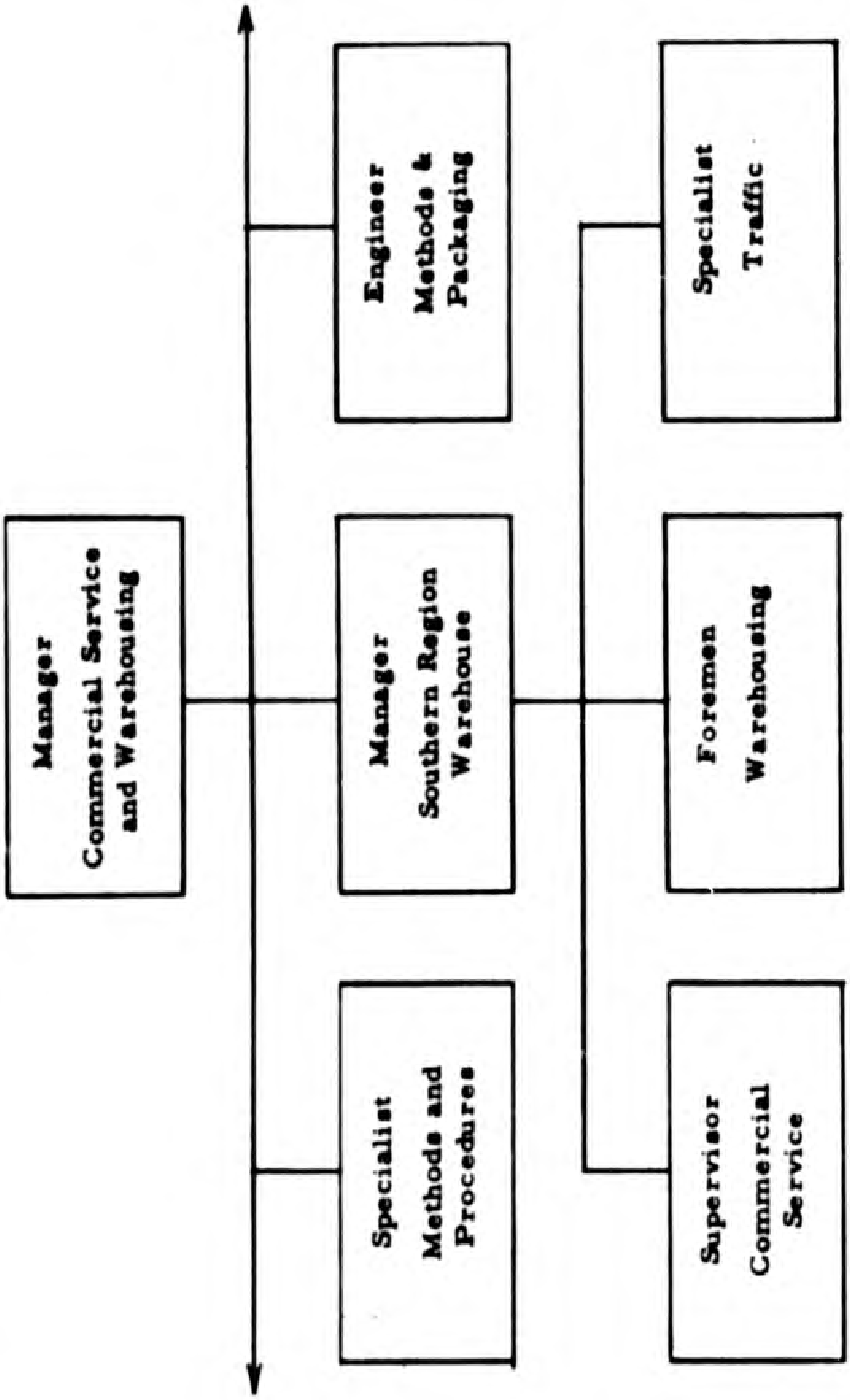

Manager
Procurement & Distribution
Manager
Commercial Service
and Warehousing
Manager
Finished Product
Quality Control
Manager
Materials

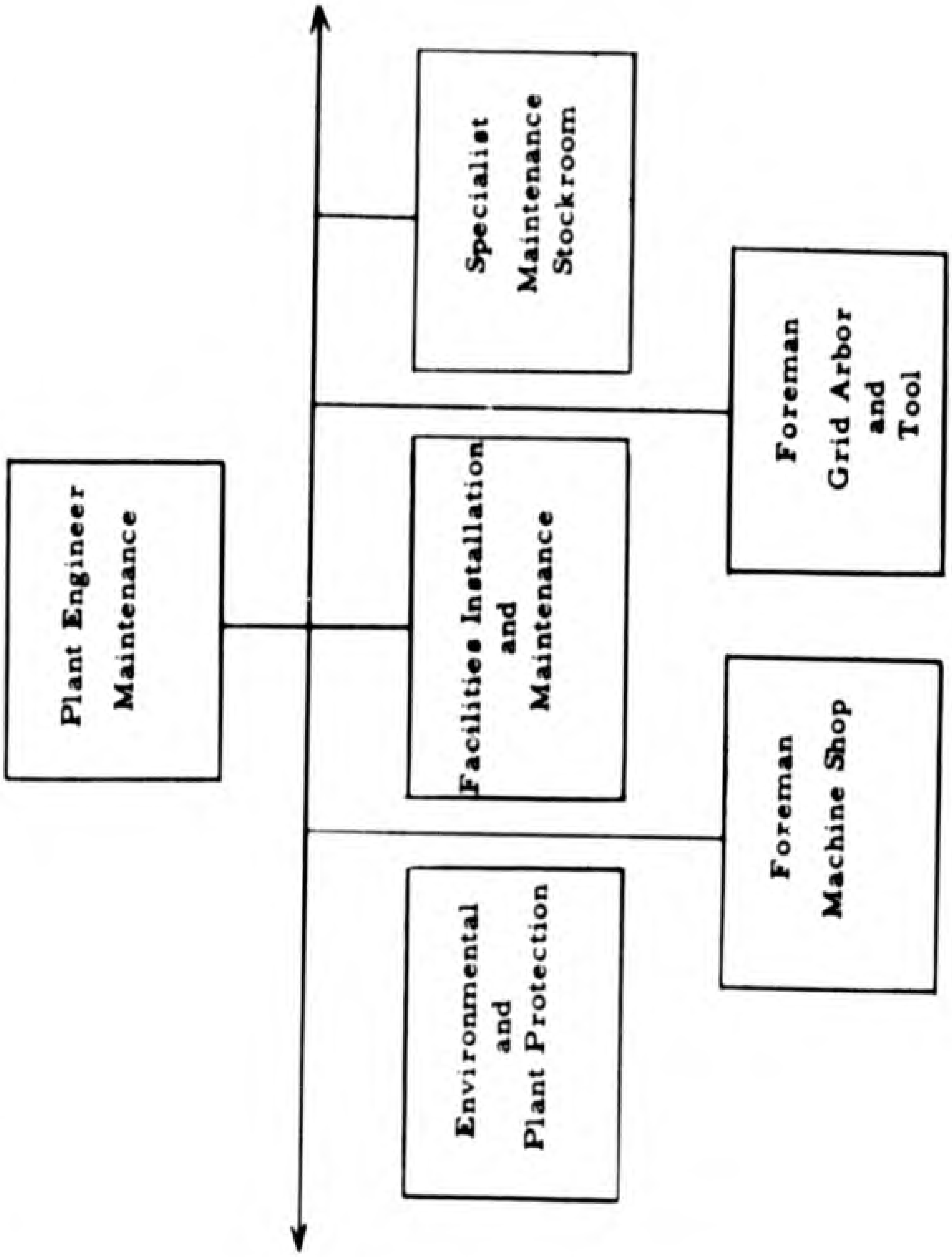
QUALITY CONTROL MANUAL




Manager
Materials
Foreman
Transportation
Buyers
Foreman
Receiving and
Raw Material
Stock Room
Foreman
Raw Material
Inspection


Manager
Precision Parts Operation
Specialist
Sales Administration
Supervisor
Quality Control
Manager
Materials
Manager
Shop Operations
Manager
Accounting


Manager
Commercial Service
and Warehousing
Engineer
Methods &
Packaging
Manager
Southern Region
Warehouse
Specialist
Methods and
Procedures
Specialist
Traffic
Foremen
Warehousing
Supervisor
Commercial
Service


Plant Engineer
Maintenance
Specialist
Maintenance
Stockroom
Facilities Installation
and
Maintenance
Environmental
and
Plant Protection
Foreman
Grid Arbor
and
Tool
Foreman
Machine Shop

GENERAL NOTES

I. QUALITY CONTROL DATA FEEDBACK AND ANALYSIS

A. Test records from the Engineering Test Laboratory and Finished Product Quality Control are fed back to development engineering and management for product control.

II. TEST EQUIPMENT

A. Each section is responsible for the maintenance and calibration of its test equipment.

III. TOOLS AND GAGES

A. Each section is responsible for the maintenance and calibration of the tools and gages used within the section.

IV. ENGINEERING CONSTRUCTION AND TEST SPECIFICATION CHANGES

A. Alteration Notices (AN's) and Temporary Alteration Notices (TAN's) on construction and test specifications are issued, and controlled by a positive integrated system as covered in Department Instruction #7.1-8 (Classification Engineering).

V. TUBES REQUIRING MILITARY QUALIFICATION INSPECTION

A. When it is necessary to have samples available for "In-plant" qualification testing the Engineering Administration Section is responsible for:

1. Securing the necessary data;
2. Testing tubes in the Engineering Test Laboratory and Finished Product Quality Control;
3. Writing design - and - construction information;
4. Obtaining construction photographs;
5. Informing the Quality Assurance Representative in Charge when "In-plant" qualification testing is requested;

6. Making arrangements with the Quality Assurance Representative in Charge to witness "In-plant" tests when such tests have been authorized by proper authority;

7. Preparing the qualification test report.

B. The Project Engineer is responsible for supplying Engineering Administration with photographic samples and up to date construction details.

VI. INDUSTRIAL SECURITY

A. The plant Security Officer is responsible for maintenance of industrial security and, where required, military security.

VII. MILITARY COGNIZANCE

A. Quality assurance cognizance: (U.S. Army), Cincinnati Procurement District, U.S. Army, 550 Main Street, Federal Office Building, Cincinnati 2, Ohio.

B. Security cognizance: (U.S. Navy), Inspector of Naval Material, 4300 Goodfellow Blvd., Building 101, St. Louis 20, Missouri.

C. Contract auditing cognizance: (U.S. Air Force), Cincinnati Air Procurement District, 3rd Floor, Swift Building, 9th and Sycamore Streets, Cincinnati 2, Ohio.

VIII. RESPONSIBILITIES OF PROJECT ENGINEER - CERAMIC TUBES

1. Plan, schedule and effectively utilize facilities and technical manpower assigned to best meet the scheduled objectives.

2. Keep abreast of new developments of materials, processes, production techniques and other competitive tubes and devices.

3. Assign work so as to make the most effective use of personnel and facilities.

4. Design and develop a line of ceramic tubes which meet the objective specifications and which can be manufactured at an optimum cost.

5. Redesign and improve existing ceramic tube designs to meet new application requirements, resolve customer complaints, improve reliability, and maintain a competitive product.
6. Investigate new materials and processes for improving the product.
7. Determine that construction and test specifications for new or redesign types are compatible and adequate.
8. Supply Application Engineering with samples of new or redesigns for field or customer evaluation.
9. Initiate, with the approval of his Manager, orders for parts, tooling and equipment required for assigned projects and evaluate and approve sample parts from new dies or other tooling.
10. Prepare data and reports on assigned projects.
11. Obtain patent infringement opinions on new or redesigns.
12. Maintain a patent notebook and prepare disclosure letters as deemed necessary.
13. Assist Superintentent - Planar-Thyratron with new or redesigns put into production or with other unusual production engineering problems.
14. Monitor, evaluate, interpret and report on factory design changes.
15. Devise and establish measuring systems and media for measuring success of operation.
16. Counsel and supply technical direction to personnel assigned to him for work on these projects.
17. Confer with Application, Development and Manufacturing Engineering, Equipment Development Operation, Product Evaluation and Manufacturing regarding assigned projects.

IX. IDENTIFICATION OF REJECTED MATERIAL

A. Rejected material, in Shop Operations, Ceramic Tubes, is tagged, analyzed and scrapped.

X. STANDARDS CALIBRATION PROCEDURE AND SCHEDULE

A. Primary standards are in general checked once a year by a laboratory traceable to the Bureau of Standards.

B. The primary standard for measuring voltages and currents is a standard cell and is calibrated as per "A" above.

C. The secondary standards are meters calibrated by using the standard cell. This is done approximately every 3 months.

D. Meters are calibrated periodically against the secondary standards. Meters are tagged with their date of calibration. All removable meters are calibrated monthly. The permanently located meters are calibrated every 90 days with an additional calibration at seasonal changes, such as summer to winter, and in the event of any question on results.

INSPECTION NOTES

The first phase of this contract specifies a production rate of 100 tubes per day. In-process inspection is accomplished by trained operators in a bench inspection set-up under the Supervisor - Shop Operations, Ceramic Tubes and under the surveillance of the process engineer.

The following additional information is presented:

I. Reference Documents are:

  A. Standardized construction drawings for type 7486.

  B. Standardized process specifications for type 7486.

II. Chages in parts, tolerances, limits, processing instructions, and inspection procedures are authorized by Engineering TAN's or AN's .

FLOW CHART LEGEND (Per SIG 434 SIP 3016 SPL)

○ Manufacturing Process

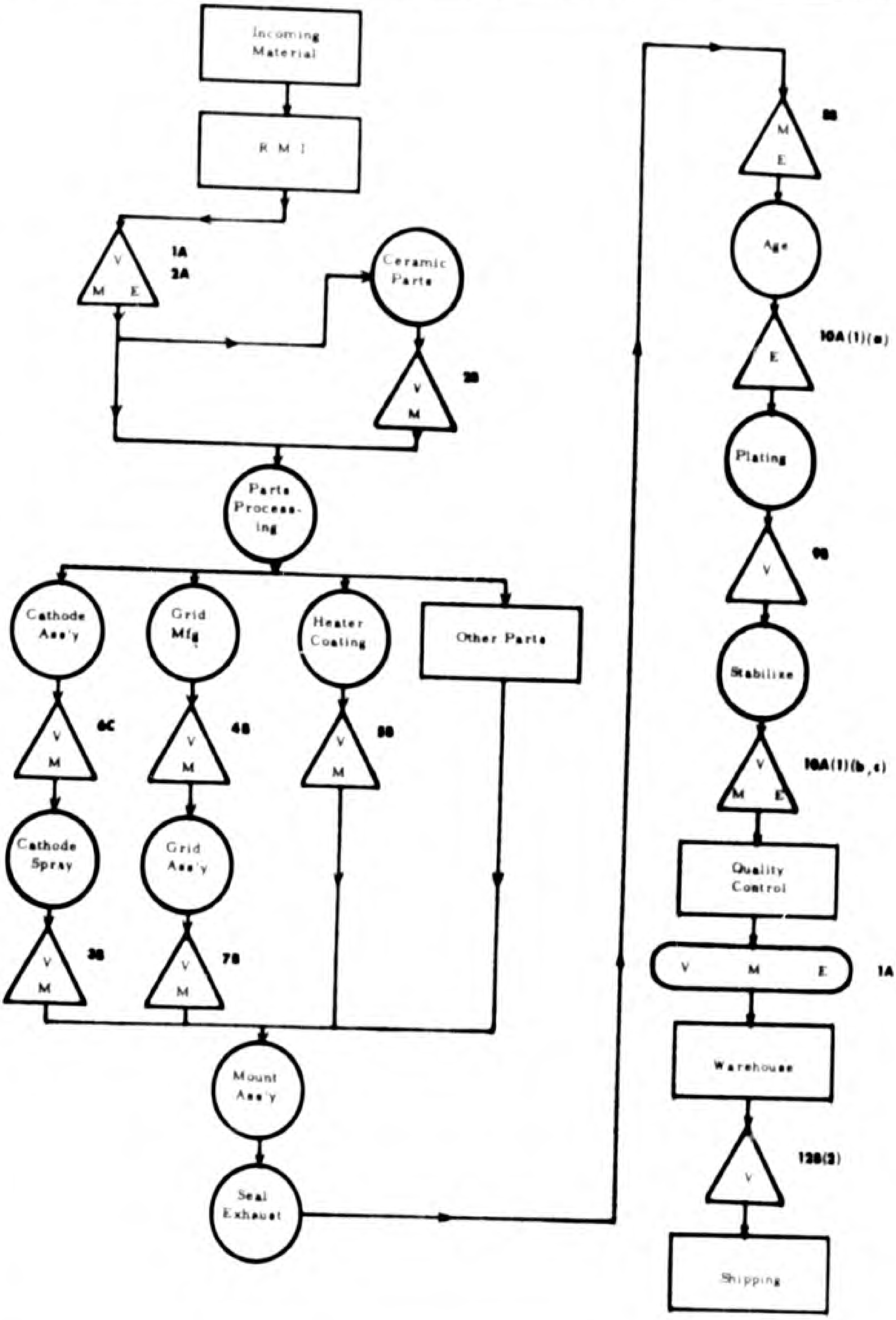
▭ Holding Period

△ *Product Inspection

⬭ * Quality Check

V - Visual
M - Mechanical
E - Electrical
O - Operator

*Letters and numbers refer to Inspection Stations in Section II.


Incoming Material
R M I
V
M
E
1A
2A
Ceramic Parts
V
M
2B
Parts Process-ing
Cathode Ass'y
Grid Mfg
Heater Coating
Other Parts
V
M
6C
V
M
4B
V
M
5B
Cathode Spray
Grid Ass'y
V
M
3B
V
M
7B
Mount Ass'y
Seal Exhaust
M
E
8B
Age
E
10A(1)(a)
Plating
V
9B
Stabilize
V
M
E
10A(1)(b,c)
Quality Control
V
M
E
1A
Warehouse
V
13B(2)
Shipping

INSPECTION STATIONS

1. RECEIVING MATERIALS INSPECTION

A. Process: Collect, inspect, and distribute incoming parts and raw materials.

(1) Inspection Procedure: Incoming stock is identified according to purchase order or contract. Material is sampled in accordance with internal specification SI 13700-K-N-O and/or inspection specification, (see index). Visual and mechanical inspection is performed in accordance with this specification. Material is either accepted to stock or returned to supplier.

(2) AQL's and sample sizes: See SI 13700 and/or inspection specification, (see index).

(3) Classification of defects: See SI 13700 and/or inspection specification, (see index).

(4) Calibration of test equipment: Calibration is conducted in accordance with TM-100 .

(5) Reference document: SI 13700-K-N-O , inspection specification index, and TM-100 .

(6) Changes in parts, tolerances, limits, etc., are authorized by: Alteration Notices or Temporary Alteration Notices originated by the Senior Design Engineer, Planar Tubes.

(7) Changes in inspection procedures are authorized by: Senior Design Engineer, Planar Tubes.

B. Exhibits: Section III , exhibits 1 through 10 .

2. CERAMIC PARTS

A. Process: Ceramic Parts

(1) Finished ceramic parts received from RMI.

(2) Inspection procedure: inspection conducted in RMI, see par. I.

B. Process: Ceramic Parts

(1) Ceramic parts manufactured in shop operations.

(2) Finished ceramic parts inspection procedure:

(a) Finished parts are collected into lots; samples are taken from each lot and the diameter, thickness and recess measured. Visual defects are also noted. Lots are accepted or rejected on the basis of sampling results.

1- AQL's and sample sizes: AQL = 1% per item; sample size = 50 pieces.

2- Classification of defects: Outside and inside diameter; thickness, recess. Visual defects include cracks, chips, depressions or holes.

3- Inspection instruments: Hand micrometers, depth gages, plug gages.

4- Forms used: Ceramic parts verification, Exhibit 11 .

(b) Ceramic parts are measured and sorted according to size with a roller micrometer. A determination of which parts need to be measured on this micrometer is made from data taken at finished parts inspection, above.

1- AQL's and sample sizes: This is a 100% check.

2- Classification of defects: Thickness and outside diameter.

3- Inspection instruments: Roller micrometer.

4- Forms used: None.

3. CATHODE SPRAY

A. Cathode Spray Process

B. Inspection Procedure:

(1) Each coated cathode is placed under a 10X microscope and inspected for visual defects.

(2) AQL's and sample sizes: 100% inspection.

(3) Classification of defects: Tilted cathodes, off centered cathodes, thin coating, insufficient coating, chipped coating.

(4) Inspection Instruments: 10X Microscope.

(5) Forms used: None

4. GRID MAKING

A. Grid Manufacturing Process

B. Inspection Procedure:

(1) After winding, grids are placed under a 10X microscope, inspected and trimmed.

  (a) After the grids have been trimmed, they are inspected 100% with a Shadowgraph for visual defects.

(2) AQL's and sample sizes: 100% inspection.

(3) Classification of defects: Windows, copper balls, poor spacing, overlapped wires.

(4) Inspection instruments: 10X Binocular microscope, Shadowgraph.

(5) Forms used: None.

5. HEATER COATING

A. Heater Coating Process

B. Inspection Procedure:

(1) Coated heaters are placed in boats holding 200 heaters. After firing, samples are taken from each boat and gaged for coated diameter. The sampling plan is a cumulative plan, the detailed procedures of which are on file in the production section.

(2) AQL's and sample sizes:

(a) Individual lot acceptance: AQL = 8%, Sample Size = 10.

(b) Process Acceptance: AQL = 5%, Sample Size = 50.

(c) Clearance Sample acceptance: AQL = 4%, Sample Size = 30.

(3) Classification of Defects: Coated Diameter.

(4) Inspection Instruments: Go-No Go Hole Gage.

(5) Forms used: "Data for Heater Sampling Plan" record, see Exhibit #12.

6. CATHODE ASSEMBLY

A. Cathode Subassembly Process

B. Cathode Assembly Process

C. Inspection Procedure:

(1) After the cathode has been welded to the cathode subassembly, the finished assembly is gaged with a dial gage for proper cathode spacing.

(2) AQL's and sample sizes: 100% gaging.

(3) Classification of Defects: Cathode Spacing.

(4) Inspection instruments: Dial gage.

(5) Forms used: None.

7. GRID ASSEMBLY

A. Grid Assembly Process

B. Inspection Procedure:

(1) All grids are inspected with a 10X microscope for visual defects, vacuumed and covered.

(2) AQL's and sample sizes: 100% inspection.

(3) Classification of defects: Windows, copper balls, poor brazing, poor spacing, overlapped wires, lint and dirt.

(4) Inspection instruments: 10X Microscope.

(5) Forms used: None.

8. EXHAUST, SEALING, AND AGING

A. Exhaust, Sealing, and Aging Process.

B. Inspection Procedure:

(1) (a) After exhaust and sealing the tubes are measured for the characteristics assigned by the process engineer; the readings are plotted on the Daily Median and Exhaust Unit Check Sheet. Defects are analyzed and the process engineer uses this information as a trouble indication.

(b) All tubes are tested for inoperative defects and checked for proper alignment prior to aging.

(2) AQL's and sample sizes:

(a) No AQL; this is a control sample, sample size = 30.

(b) 100% test.

(3) Classification of Defects:

(a) Characteristics specified by process engineer; inoperative defects include Shorts, Opens, or Air.

(b) Shorts, Open, Air, and Misalignment.

(4) Inspection instruments:

(a) Various electrical test sets.

(b) Inoperatives test set, alignment gages.

(5) Forms used: Lot Identification Tickets, Exhibit 13;
Daily Median and Exhaust Unit Check, Exhibit 14;
Inoperative Analysis Chart, Exhibit 15.

9. PLATING

A. Plating Process

B. Inspection Procedure:

(1) After the metal parts of the tube have been plated they are inspected for visual defects.

(2) AQL's and sample sizes: 100% inspection.

(3) Classification of defects: Discolored plating, peeled plating, blistered plating, chipped ceramic.

(4) Inspection instruments: None

(5) Forms used: None.

10. FINAL TEST AND INSPECTION

A. Inspection Procedure:

(1) (a) All tubes are tested for inoperative defects again after aging.

(b) All tubes are tested for characteristics assigned by the process engineer after stabilizing.

(c) All tubes are inspected for visual defects after stabilizing.

(2) AQL's and sample sizes:

(a) 100% inspection.

(b) 100% inspection.

(c) 100% inspection.

(3) Classification of defects:

(a) Shorts, Opens, Air.

(b) Specified Electrical Characteristics.

(c) Mechanical defects.

(4) Inspection Instruments:

(a) Inoperatives test set.

(b) Applicable electrical test sets for specified characteristics.

(c) None

(5) Forms used: Ceramic Tube Lot Card, Exhibit 16.

11. ACCEPTANCE TESTS

A. Process: Finished Tube Acceptance Test

(1) Inspection procedure:

(a) After factory tests, tubes shall be submitted to Finished Product Quality Control for complete electrical and mechanical tests in accordance with the applicable MIL-E-1 test specification, MIL-STD-105, and other referenced documents.

(2) AQL's and sample sizes: AQL's and sample sizes shall be in accordance with the applicable test specification.

(3) Classification of defects: Defects are defined by limits on the applicable test specification sheet.

(4) Inspection equipment used: The conventional equipment used for testing tube type 7486 has received approval and is described in a Statement of Facilities and Production Capabilities dated March 16, 1959 and a supplement dated June 1, 1959.

The special equipment required for testing according to SCL-7001/74, Contract No. DA-36-039-SC-86738, is described as follows:

RF GAIN AND POWER OUTPUT TEST SET

SERIAL NUMBER TL-067

DESCRIPTION OF EQUIPMENT

The basic test set consists of power supplies and provision for metering currents and voltages. Two RF power meters are provided and are normally used with coaxial thermistors having a frequency range of 10Kc to 10Gc and a maximum power capability of 10mW. Plug-in facilities are provided for any test oscillator or amplifier operating within the set's ratings. The set contains an RF driver.

TESTS MADE ON EQUIPMENT

7486 - 5900 Mc Power Output

7486 - 2200 Mc Power Gain and Frequency

ACCURACY

Power Meter - ±3%

Frequency - ±.1%

FREQUENCY OF CALIBRATION

This set is calibrated every six months.

MEASUREMENT STANDARDS

(a) Refer to "A Statement of Facilities and Production Capabilities" dated 16 March 1959 and Supplement, dated 1 June 1959.

(b) Attenuation Calibrator
Weinschel Engineering
Model BA-5, Serial No. 496
Accuracy 0.1 db per 10 db or 0.1 db whichever is greater.

(c) Hewlett-Packard Model 524C Frequency Counter Serial No. TL-158 and Model 540B Transfer Oscillator SN TL-159.
Accuracy 1 part per 10,000,000.

LIFE TEST EQUIPMENT

(a) 450 Megacycle Oscillator Life Test
50 individual units mounted on 3 life test racks.
Each individual oscillator may be adjusted to operate at cathode currents ranging from 10 mA to 28 mA.

60 Cycle Life Test

100 sockets mounted on one life test rack.

50 of these sockets provide for testing tubes at the maximum ratings required by test specification SCL-7001/74.

The additional 50 sockets provide for testing at higher levels of cathode current and plate dissipation, 20 mA and 2.0 watts, respectively.

(5) Forms used:

(a) Product Acceptance Sampling Record, see Exhibit 17;

(b) Median Control Data, see Exhibit 18;

(c) Life Test Data, see Exhibit 19.

12. COMMERCIAL SERVICE AND WAREHOUSE

A. Commercial Service

(1) Order Service: Orders requiring government inspection are received from customers or via other sales offices and edited by Commercial Service clerks.

(2) Order Service clerks release material for inspection and shipment as required by purchase orders. Copies of this release authorize inspection of material, as indicated, and packaging/packing and shipment of material.

- (a) Instructions for tube branding are furnished the Branding Department and Warehouse by Commercial Service.
- (b) Instructions for packaging and unit packaging marking, when required, are furnished the Packaging Department and Warehouse by Commercial Service.
- (c) Container marking labels are prepared by Commercial Service and furnished to the Shipping Department.
- (d) Packing lists, invoices, shipping documents, etc., are prepared for each shipment by commercial Service.

(3) Reference documents: Commercial Service and Warehouse Procedures 2.7, 2.12-1, 2.15, 2.15-1, 2.13-1, 3.1-1, SI 13700K.

B. Warehouse

(1) Tubes that require completion of life test prior to shipment, are transferred to Warehouse after all other tests have been completed. These lots are placed in "life-held" status until a notice of satisfactory completion of life test is received.

(2) Prior to branding, tubes are inspected 100% by branding operator for type. Each set-up is checked for accuracy and legibility by the set-up operator. After branding, spot checks are made for proper brand. Marking permanency tests

are made on tubes branded for government use, in accordance with method 1105, MIL-E-1.

(3) Tubes are either bulk packaged or unit packaged as required by purchase order.

(4) Shipping Department places labels on shipping containers, places invoices, packing lists, etc., inside the containers, seals containers and releases material to carriers for shipment.

(5) Reference documents: Commercial Service and Warehouse Procedures (see paragraph 12. A. 3).

C. Exhibits: Section III , Exhibits 20 thru 22 .

REFERENCE DOCUMENTS NOT ATTACHED:

Drawing List N13508, drawings on type 7486.

Acceptance Specification for type 7486.

Commercial Service and Warehouse Procedures.

Basic Section, MIL-E-1.

MIL-STD-105.

MIL-E-75.

INCOMING MATERIAL INSPECTION RECORD

DATE

NUMBER

SIZE

LOT DATA

INSPECTION RECORD

DISP

FIRST SAMPLES

PCS REJ.

INSP. LEVEL

USE IN CONJUNCTION WITH DRWG. NO.

PART NAME

AREA

MANUFACTURE

1.

2.

3.

4.

5.

6.

PREPARED BY: DATE

INSPECTED BY

INSPECTION APPROVAL

USAF COORDINATION:

DIMENSION

EXHIBIT 1

DATE ACCEPTED

A.I.R.T. NO.

INSPECTOR

INSPECTION PROCEDURE SHEET

DRAWING NO.

NERAL ELECTRIC
WENSBORO TUBE PLANT
MATERIALS SECTION
OWENSBORO, KY.

PRINTED BY THE STANDARD REGISTER COMPANY, U. S. A. [illegible]

SERIAL NO. 1871

RAW MATERIAL INSPECTION REPORT

DATE

aterial Inspected For:

Approval of Regular Shipment ☐

pproval of Test Lot ☐

Approval of Die Samples ☐

ngineering Complaint ☐

actory Complaint ☐

Date Rec'd
Part No.

Amt. Rec'd
Order No.

Vendor
Mfg. Dates

Tube Type
Melt No.
Die No.
Lot No.

Description

Sample Size
Sampled By
Inspected By

Summary of Inspection Results

EXHIBIT 2

Disposition of Material

ejected ☐ Criticized ☐ Disapproved ☐ Approved ☐ Waived ☐

ount cted
Number Spools
Spool Size
Requisition Number

ection ived By:
Returned to Stock
Report Approved by:

OTICE TO VENDOR: Please sign and return one copy indicating your approval of the return of rejected material indicated ove. Unless copy is returned or reason for disapproval received within thirty (30) days, material will be automatically urned.

Material May Be Returned For Credit ☐

Approved By:

Remarks

Vendors Return Address

GENERAL ELECTRIC
OWENSBORO TUBE PLANT
MATERIALS SECTION
OWENSBORO, KY.

RAW MATERIAL INSPECTION REPORT

SERIAL NO.

DATE

Material Inspected For:

Approval of Regular Shipment ☐

Approval of Test Lot ☐

Approval of Die Samples ☐

Engineering Complaint ☐

ictory Complaint ☐

Inspection Time

Date Rec'd
Part No.
Amt. Rec'd
Order No.
Vendor
Mfg. Dates
Tube Type
Melt No.
Die No.
Lot No.
Description
Location
Sample Size
Sampled By
Inspected By

Summary of Inspection Results

EXHIBIT 3

Disposition of Material

Rejected ☐ Criticised ☐ Disapproved ☐ Approved ☐ Waive ☐

Amount Rejected
Number Spools
Spool Size
Requisition Number

Rejection Waived By:
Returned to Stock
Report Approved by:

SUMMARY OF D INSPECTION
R. M. I. SECTION

INSPECTOR

DATE

EXHIBIT 4

PART NUMBER	MATERIAL	SUPPLIER	NUMBER OF PARTS INSPECTED					DATE RECEIVED	QUANTITY RECEIVED	SUMMARY OF DEFECTS
			VISUAL	MEASURED	GAUGED	TESTED	THICKNESS			

TUBE   VENDOR RATING   PER D

CLASS VENDOR	CURRENT MONTH Amount Rec'd	 Amount Def.	 % Def.	YEAR-TO-DATE Amount Rec'd	 Amount Def.	 % Def.
1. GETTERS Getter Elec.						
Kemet						
King						
R.C.A						
2. GLASS BULBS Pitney						
Cleve. Bulb						
Corning						
3.GLASS TUBING Bridgeville						
Logan						
4.MOLY W. BARE Dover						
5.MOLY W.PLTD Sigmund Cohn						
Dover						
Sylvania						
6. NI. W.BARE Driver-Harris						
W.B. Driver						
Ky. Elec.						
Kemet						
Sylvania						
Haynes						

EXHIBIT 61

CLASS VENDOR	CURRENT MONTH Amount Rec'd	 Amount Def.	 % Def.	YEAR-TO-DATE Amount Rec'd	 Amount Def.	 % Def.
7.NI.WIRE PLTD						
W.B. Driver						
Ky. Electronic						
Driver-Harris						
Sylvania						
8. T.GRID WIRE						
Dover						
Sigmund Cohn						
Cleve. Wire						
Kassel						
Rembar						
Luma						
9. SUPP.W.NI. W.B. Driver						
Techaloy						
10. SUPP.W.NPS Cleve. Welds						
Carolina Welds						
R.C.A						
Ky. Elec.						
Sylvania						
# 510						
11. SUPP. W. CU.CLAD STEEL						
Sylvania						
Ky. Elec.						

EXHIBIT 62

CLASS VENDOR	CURRENT MONTH Amount Rec'd	CURRENT MONTH Amount Def.	CURRENT MONTH % Def.	YEAR-TO-DATE Amount Rec'd	YEAR-TO-DATE Amount Def.	YEAR-TO-DATE % Def.
12.SUPP.W.CU. Pltd Steel S67						
Sylvania S-68						
Ky.Electronic						
#510						
13.SUPP.W.CU. Tube Clad C-37						
Ky.Electronic						
Sylvania						
#510						
14.SUPP.W.CR.-CU.						
W. B. Driver						
#510						
15.SUPP.W.MISC						
Cleveland Weld						
W. B. Driver						
Carolina Weld Keystone						
16.FRAME GRID MOLY - SUPP.						
200. M14						
Dover - Cut Rod						
Dover - Coils						
17. STRIP W. B. Driver						
Driver-Harris						
Sylvania						
Thomas						
Gen. Plate						
R. C. A.						

CLASS VENDOR	CURRENT MONTH Amount Rec'd	CURRENT MONTH Amount Def.	CURRENT MONTH % Def.	YEAR-TO-DATE Amount Rec'd	YEAR-TO-DATE Amount Def.	YEAR-TO-DATE % Def.
17. STRIP(Cont) Kassel						
18. RIBBON W. B. Driver						
Driver-Harris						
Sylvania						
Dover Chi. Dev. Corp.						
A.V. Doran Co.						
19.MOLY FRAME GRID, RIBBON & SHEET						
Elmet						
Dover						
Cleveland Wire						
20.CUT WIRE- RIBB						
#510						
Dover						
21.FIL. RIBBON						
Sigmund Cohn						
22.MICA SPACER						
American						
Asheville						
Ford						
Huse						
Industrial						
Micacraft						
Reliance						
Sylvania						

TUB [illegible] VENDOR RATING [illegible] PERIOD [illegible]

CLASS VENDOR	CURRENT MONTH			YEAR-TO-DATE		
	Amount Rec'd	Amount Def.	% Def.	Amount Rec'd	Amount Def.	% Def.
22.MICA SPACER CON'T						
United Mineral						
Victory						
23.INSULATORS American Lava						
Coors Porc.						
Mansol						
Diamonite						
G. E.						
Corborundum						
24.HEATER WIRE Cleveland Wire						
Sylvania						
Elec. D. Corp.						
25.CATHODES Precision						
Superior						
Sylvania						
26.STEM LEADS Carolina Weld						
Cleveland W.						
American Elec.						
Elec. Bases						
DKE Elec.						
G.E. Co.						

CLASS VENDOR	CURRENT MONTH			YEAR-TO-DATE		
	Amount Rec'd	Amount Def.	% Def.	Amount Rec'd	Amount Def.	% Def.
27. COILS Precision Fil.						
Sylvania						
R. C. A.						
Elec. D. Corp.						
Union City						
28. PLATES,RAD SHIELDS & ETC.						
Precision						
Truelove						
#510						
Micro Stamping						
Sylvania						
R. C. A.						
J.& H.						
Art Wire						
Dover						
Haydu						
Qual.Tool &Die						
Sunair						
Ramco						
Romac						
Superior						
Western Gold						
Engelhard						
Fansteel						
Handy & Harmon						
Hunter Springs						
Cleveland Tung.						
S.& F. Metals						
Cleveland Weld						
Amer. Panicor						
Fab. Metal						

EXHIBIT 63

TUBE

CLASS	CURRENT MONTH			YEAR-TO-DATE			CLASS	CURRENT MONTH			YEAR-TO-DATE		
VENDOR	Amount Rec'd	Amount Def.	% Def.	Amount Rec'd	Amount Def.	% Def.	VENDOR	Amount Rec'd	Amount Def.	% Def.	Amount Rec'd	Amount Def.	% Def.
29. BASE PINS Bead Chain													
30. BASES Loranger													
#510 National Elec.													
Pioneer Elec.													
Mech. Instron													
31. SOLDER													
Handy & Harmon													
Western Gold													
32. WIRE MESH Newark Wire ft													
Newark Pieces													

EXHIBIT 64

RAW MATERIAL INSPECTION SECT.
S-4060 Rev. 3-52

MATERIAL INSPECTION SUMMARY

Date____________________

EXHIBIT 5

PART NUMBER	CODE NUMBER	SUPPLIER	AMOUNT	ORDER NUMBER ETC-	NOTES

RAW MATERIAL PARTS SUMMARY SHEET MONTH________________

1. GETTERS	Getter Elec.	Kemet	King	R.C.A.		
KR-05000 KR-10000 Pieces						
2. GLASS BULBS	Pitney	Cleveland Bulb	Corning			
KR-11000 KR-11900 Pieces						
3. GLASS TUBING	Bridgeville	Logan				
KR-15000 KR-20000 In Pounds						
4. MOLY WIRE BARE	Dover					
KR-20000 KR-21000 M13A-B Meters						

EXHIBIT 7

2

RAW MATERIAL PARTS SUMMARY SHEET MONTH________________

MOLY WIRE PLATED	Sigmund Cohn	Dover	Sylvania			
-20000 A-21000 M13C M13J 13C M13H 13L M13D M13P M13R 13K						
eters						

NI. WIRE BARE	Driver-Harris	W.B. Driver	Kentucky Electronics	Kemet	Sylvania	Haynes Stellite
N11A-N N17A N21A-B-N N25A N27A						
Meters						

EXHIBIT 7²

NI. WIRE PLATED	W.B. Driver	Kentucky Electronics	Driver-Harris	Sylvania		
N11E-F-L-N N21E N25E						
Meters						

TUNGSTEN GRID WIRE	Dover	Sigmund Cohn	Cleveland Wire	Kassel	Rembar	Luma

RAW MATERIAL PARTS SUMMARY SHEET **MONTH** ____________________

SUPP.WIRE NI.	W.B. Driver	Techaloy				
In Pounds						

SUPP.W. NPS	Cleveland Welds	Carolina Welds	Sylvania	Kentucky Electronics	#510	R.C.A.
I-23 S-65 In Pounds						

EXHIBIT 7^{3}

SUPP.W. CU.C.STEEL	Sylvania	Kentucky Electronics				
C-38 In Pounds						

SUPP.W. CU.PLTD.S.	Kentucky Electronics	#510				
S-67 S-68 In Pounds						

RAW MATERIAL PARTS SUMMARY SHEET MONTH ____________________

SUPP.W.CU. TUBE CLAD	Kentucky Electronics	Sylvania	#510			
L-37 In Pounds						
SUPP.W. CR. CU.	W.B. Driver	#510				
C-92 In Pounds						
SUPP.W. MISC.	W.B. Driver	Carolina Welds	Keystone			
I-27 S-63 In Pounds						
FRAME C. SUPP.ROD	Dover (Pieces)	Dover (Coils)				
M14.						

EXHIBIT 7

RAW MATERIAL PARTS SUMMARY SHEET MONTH ________________

STRIP	Driver-Harris	Sylvania	Thomas	General Plate	R.C.A.	Rembar
-27000 -27300 n Pounds						
STRIP CON'TD	Kassel					
R-27000 R-27200 n Pounds						
RIBBON	W.B. Driver	Driver-Harris	Sylvania	Dover	Chi.Dev.Corp.	A.V. Do
R-27000 R-27200 In Feet						
MOLY F.C. RIBBON & LY SHEET	Elmet	Dover	Cleveland Wire			
M31 M41						

EXHIBIT 7^5

RAW MATERIAL PARTS SUMMARY SHEET

MONTH____________________

CUT WIRE-RIBBON	#510	Dover				
-26000 R-26200 R-26000 R-28200 ieces						

FIL. RIBBON	Sigmund Cohn					
R-41000 R-44000						

EXHIBIT 76

MICA SPACERS	American	Asheville	Ford	Huse-Liberty	Industrial	Miscor
R-30000 R-37000 M51 Pieces						

MICA CON'TD	Reliance	Sylvania	United Mineral	Victory		

RAW MATERIAL PARTS SUMMARY SHEET

MONTH ____________________

3. INSULATORS	American Lava	Coors Porcelain	Mansol	Diamonite	G.E.	Corburu
-37000 -39000 ces						

HEATER WIRE	Cleveland Wire	Sylvania	Elec.Dev.Corp.			
KR-44000 -46000 Heaters						

EXHIBIT 7

CATHODES	Precision		Superior	Sylvania		
R-48000 KR-50000						

6. STEM LEADS	Carolina Welds	Cleveland Welds	American Electric	Elec. Bases Inc.	DKE Electric	G.E.
KR-51000 KR-56000 ces						

RAW MATERIAL PARTS SUMMARY SHEET

MONTH ____________________

EXHIBIT 7 8

2 Engelhard	Handy & Harmon	Hunter Spring	Cleveland Tungsten	S & F Metals	Cleveland Welds	America Panicor
28. Fabricated Metal						
29. BASE PINS	Bead Chain					
KR-87013 KR-87014 KR-87015 KR-87017 Pieces						
30. BASES	Loranger	#510	National Elec.	Pioneer Elec.	Mechanical Instron	
KR-80000 KR-83000 Pieces						

RAW MATERIAL PARTS SUMMARY SHEET

MONTH ____________________

31. SOLDER	Handy & Harmon	Western Gold			
Troy Oz.					
3 WIRE MESH	Neward Wire	Newark Wire			
	(Pounds)	(Pieces)			

EXHIBIT 79

Report No.

Materials Section

RESTRICTED MATERIAL REPORT

Date

Distribution:

NOTICE: The Materials Section is holding in Restricted Stock the following material which cannot be used in regular production and is not returnable to vendor. Unless material can be disposed of in some other way, please initiate a Scrap Order so we may clear our records.

PART NUMBER REVISION MATERIAL

VENDOR DATES RECEIVED

MANUFACTURING DATES TUBE TYPES

DESCRIPTION

AMOUNT RESTRICTED DATE RESTRICTED REQ. NO.

EXHIBIT

REASON FOR RESTRICTION:

DISPOSITION OF MATERIAL:	S.O. Number	By

MATEPIAL MOVE SHEET

DATE ____________________

S-143 FROM ____________________ SECTION TO ____________________ SECTION ____________________ PLANT

EXHIBIT 9

PART#	DESCRIPTION	TYPE										TOTAL

DEFECTIVE MATERIAL SUMMARY Year 19________

Rej. Serial No.	Seq. No.	Date Rej.	Supplier	Part No.	Amount Rejected	Defect	No. Sp.	Disposition		Shipping Memo No.
									Date	

EXHIBIT 10

S-3200

Allow 1 per item

Reject 2 or more

CERAMIC PARTS VERIFICATION

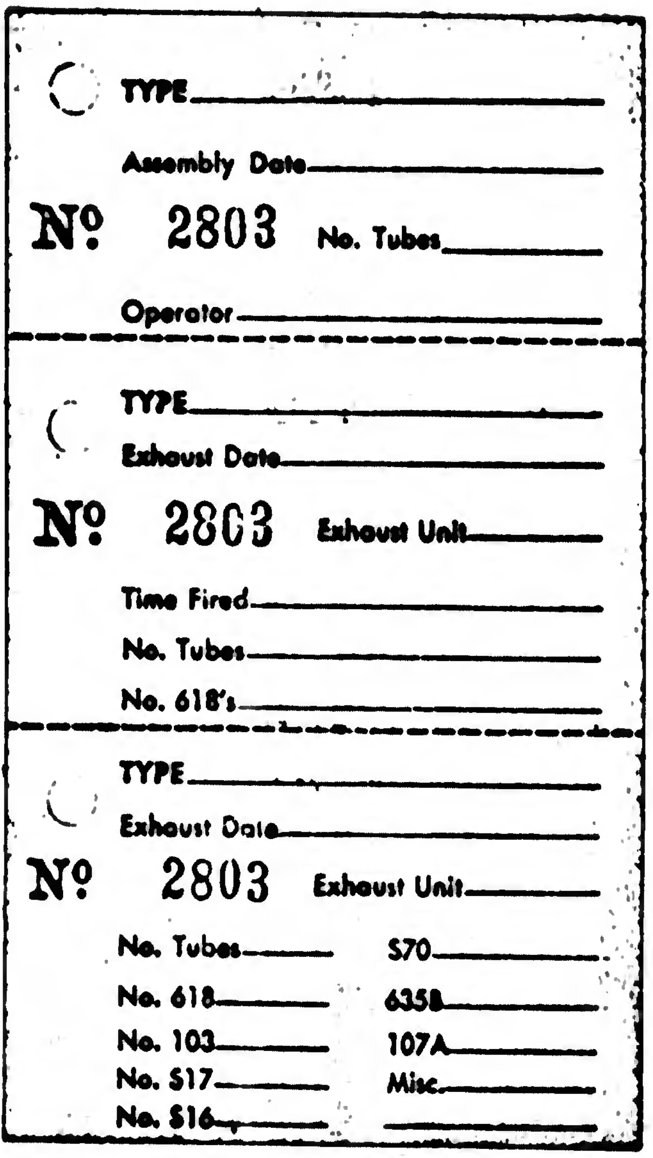
Date	Lot #	NP. -		O.D.			Thickness			Recess		Visual	Action
			# OK	# Large	# Small	OK	Large	Small	OK	Under	Over		

EXHIBIT 11

DATA FOR HEATER SAMPLING PLAN

Identification			Lot Sample			Cumulative	Clearance Sample			Lot Disposition			COMMENTS
Date	Boat #	Coating Time	Sample Size	# High	# Low	# Defects Current Plus Preceding 4	Second Sample Size	# Defects	Total Defects	Acc.	Rej.	100% Insp.	

EXHIBIT 12



TYPE __________

Assembly Date __________

Nº 2803 No. Tubes __________

Operator __________

TYPE __________

Exhaust Date __________

Nº 2803 Exhaust Unit __________

Time Fired __________

No. Tubes __________

No. 618's __________

TYPE __________

Exhaust Date __________

Nº 2803 Exhaust Unit __________

No. Tubes ______ 570 ______

No. 618 ______ 635B ______

No. 103 ______ 107A ______

No. 517 ______ Misc. ______

No. 516 ______ ______

EXHIBIT 13

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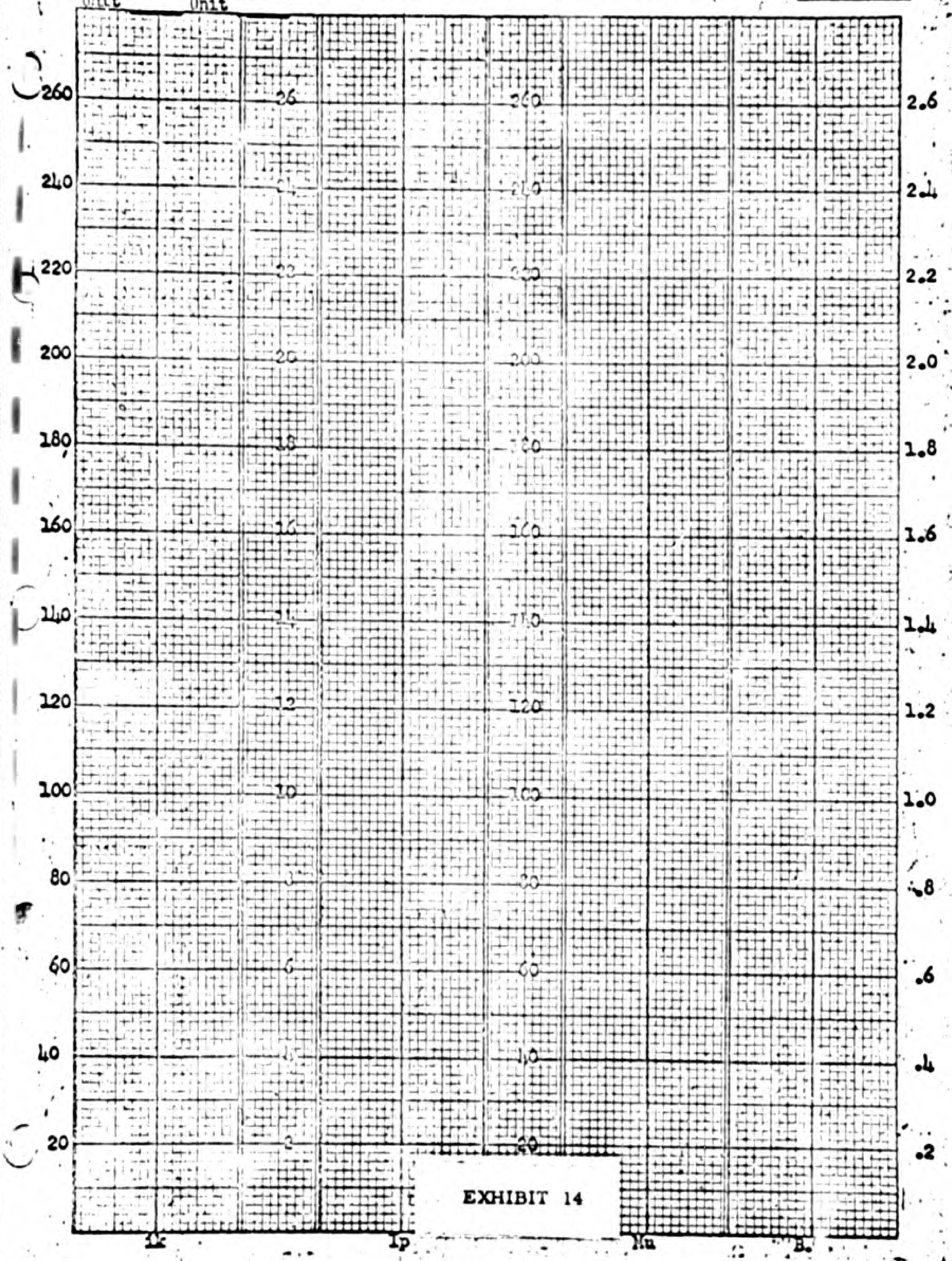
Type ______ Type ______
Lot# ______ Lot# ______
Unit ______ Unit ______

DAILY MEDIAN & EXHAUST UNIT CHECK   Date ____________



GENERAL ELECTRIC COMPANY SCHENECTADY, N.Y. U.S.A.

EXHIBIT 14

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INOPERATIVE ANALYSIS CHART

DATE __________ TYPE __________

S-2319 103 No. Analyzed __________

Cracked No. Ceramic	Dye bomb 30 min. - wash in running tap water 5 min.		
	P	K	H

Crack tube at point of leak

No.	A	B_1	B_2	C_1	C_2	D	
Gaps							

Crack tube at Point of leak

	1	2	7	8	9	10
Incomplete Solder Flow						

Crack tube at Point A S & T17 No. Analyzed __________

Broken or Loose Turns	Lint or Particles	Mis Aligned	Wrong Grid Orientation	Unknown		

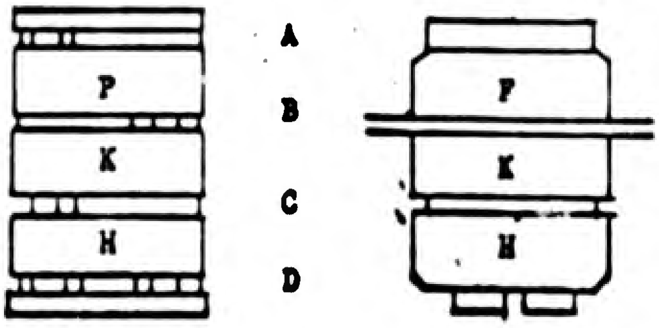
Crack tube at Point C S & T17

	1	2	7	8	9	10
Alloyed Cathodes						
Solder Flow Onto Grids						

S16 & S67 No. Analyzed __________

Crack tube at Point C

Loose or Broken Turns	Solder Flow onto Grid	Mis Aligned	Grid Up Side Down	Wrong Grid Orientation	Unknown



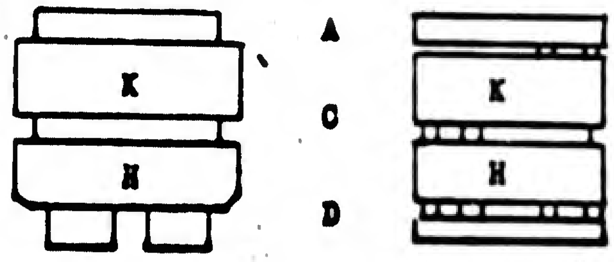


EXHIBIT 15

CERAMIC TUBE LOT CARD

TUBE TYPE NO. ________ EX. DATE ________

AFTER EXHAUST	AFTER AGE & ADJUST	AFTER STABILIZING	
103 ________	103 ________	103 ________	925A ________
S-17 ________	900 ________	210 ________	925B ________
S-16 ________	Short ________	900 ________	925C ________
S-70 ________	To Plate ________	933 ________	921A ________
S-67 ________	Chips ________	901A ________	921B ________
S-00 ________	Broken ________	901B ________	909 ________
200 ________	Replate ________	DC Shts. ________	931 ________
618 ________	________ ________	901F ________	950 ________
107A ________	To Stab. ________	919A ________	906A ________
________ ________	Timer ________	902A ________	Icp ________
To Age ________	Timer ________	902B ________	________ ________
		NET OK AFTER TEST ________	

SPECIAL DATA:

FINAL INSPECTION:
Chips ________
Replate ________
Net OK ________

EXHIBIT 16

QUAL[illegible] [illegible]CTIC

PRODUCT ACCEP[illegible] SAMPLING RECORD

☐ RESUBMITTED

TEST DATE

SAMPLED BY

LOT SIZE

MFG. DATE

DATE

TYPE

TEST GROUP	MECHANICAL	ISOPERATIVE INSP. LEVEL II	ELECTRICAL INSP. LEVEL II	ELECTRICAL INSP LEVEL II	ELECTRICAL INSP. LEVEL I
SAMPLE SIZE	FIRST SECOND	FIRST SECOND	FIRST SECOND	FIRST SECOND	FIRST SECOND
ACC. NO.	AQL 1.0 2.5 6.5	AQL 0.4	AQL 0.65 1.C	AQL 2.5 6.5	AQL 2.5 6.5
	NOR	NOR	NOR	NOR	NOR
	STR	STR	STR	STR	STR
	DEFECTS 1 2 T	DEFECTS 1 2 T	DEFECTS 1 2 T	DEFECTS 1 2 T	DEFECTS 1 2 T
		S-SHORT	-Ig1 (GAS)	RPM	THERMOSHOCK
		T-SHORT	If	AFN, Hum	INSULATION
		HIGH GAS	Ihk	NkM	VIBRATION
		AIR LEAKS	Ip	EIkf	RPM
		MIXED TYPES	Ig2	-Ig1 (gas)	AFN, HUM
		BROKEN TUBES	Sm Po Sc Io	Ig2, ACA	NkM
		OPEN HEATER	ACA ARC	SmR, PoR	-Ig1 (GAS)
		SHORTED HEATER	Ipco Smco	Ipco Smco	ΔSm Po Io
		NO ETCH	IpDiff	IpDiff	Ip Diff
		PIN OUT			Ipco Smco
	TOTAL	TOTAL	TOTAL	TOTAL	TOTAL
	TESTED BY	TESTED BY	TESTED BY	TESTED BY	TESTED BY
	DATE	DATE	DATE	DATE	DATE
	ACCEPTED	ACCEPTED	ACCEPTED	ACCEPTED	ACCEPTED
	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED

EXHIBIT 17

B-560

GENERAL ELECTRIC CO.

QUALITY CONTROL SECTION
MEDIAN CONTROL DATA

TYPE 7486

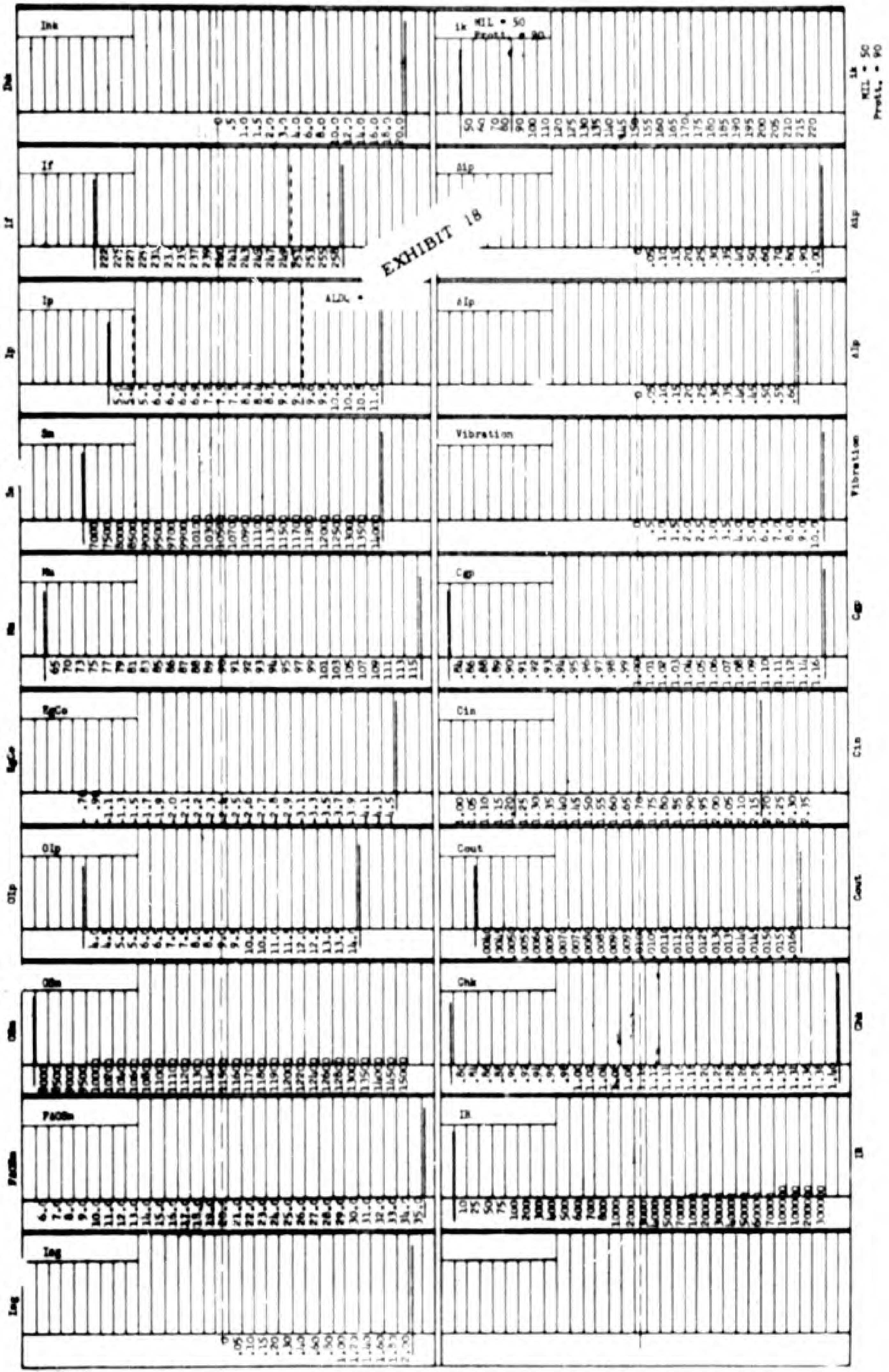
TESTED BY ____________

DATE MFGR ____________

☐

DATE ____________ OWENSBORO PLANT ☐ TELL CITY PLANT ☐ REG PROD ☐ RECOV. ☐

EXHIBIT 18



B-F926 - 178 New 8/61

LIFE TEST DATA

TYPE ____________ LOT No. ____________ PROD. DATE ____________

REGULAR PRODUCTION ☐ ENGINEERING TEST ☐ GRID Is ☐ 500 HR. ☐ 1000 HR. ☐

EXHIBIT 19

TUBE No.	HOURS																
	DATE READ																

5-4034

LIFE TEST END POINT LIMITS ____________ ____________

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SHIPPING COPY
[illegible]

MATERIAL INSPECTION AND RECEIVING REPORT

1.

2. FLOW CHART OR PROCEDURE NO. | [illegible] NO. | NO. OF SHEETS

OFFICE ADMINISTERING CONTRACT

6. INSPECTION OFFICE

7. CREDIT VOUCHER OR FILE NO.

8. AGENCY PLACING ORDER ON SUPPLIER—CITY—STATE

9. PRIME CONTRACT OR P. O. NO.

10. NAME OF PRIME CONTRACTOR—CITY—STATE

11. SUPPLEMENTS AND CHANGE ORDERS

12. MANUFACTURER OR WAREHOUSE SHIPPED FROM—CITY—STATE

13. ORDER NO. ON SUPPLIER

14. SHIPPED TO—MARK FOR

15. PROC. DIR. OR REQUISITION NO.

16. SHIPMENT ORDER NO.

17. SHIPMENT NUMBER ON CONTRACT
A. PARTIAL B. FINAL

18. GROSS WEIGHT

19. NET WEIGHT

(Consignee if other than above)

20. DATE SHIPPED

21. SEAL NUMBERS

22. B/L OR REGISTRATION NO.

23. CAR NO.

24. ROUTING

CONTRACT ITEM NUMBER 25	STOCK AND/OR PART NUMBER AND DESCRIPTION OF ARTICLES (Indicate no. of shipping containers—type of container—container no.) 26	UNIT OF MEAS. 27	QUANTITY SHIPPED 28	QUANTITY RECEIVED 29	UNIT COST 30	TOTAL COST 31

EXHIBIT 20

32. APPROPRIATION

C. ARTICLES SHOWN IN COLUMN 29 HAVE BEEN RECEIVED IN APPARENT GOOD CONDITION, EXCEPT AS NOTED
DATE RECEIVER

33. INVOICE ROUTING

34. CLASS—CODE

35. [illegible]

36. DEBIT VOUCHER OR [illegible] NO.

A. I CERTIFY THAT THE ITEMS LISTED HEREIN HAVE BEEN INSPECTED BY ME OR UNDER MY SUPERVISION, THEY CONFORM TO CONTRACT, AND HAVE BEEN ACCEPTED, EXCEPT AS NOTED.

DATE SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE

(Typed name of inspector)

B. I CERTIFY THAT I HAVE RECEIVED AND/OR ACCEPTED THE ARTICLES SHOWN HEREIN (For use as Contract #) EXCEPT AS NOTED.

DATE

DD FORM 1 DEC 53 250

PREVIOUS EDITIONS MAY BE USED

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GENERAL ELECTRIC
OWENSBORO, KENTUCKY

CONTROL NO.

SHIP TO

SOLD TO

CUST. NO.

[illegible]

CONTRACT NO.

SHIPPED FROM OWENSBORO, KENTUCKY

P - PREPAID
C - COLLECT
1 - FOB DESTINATION
2 - FOB PT. OF SHIPMENT

[illegible]	[illegible]	[illegible]	L C	[illegible]	[illegible]	[illegible]	T	CD	FC	FOB	[illegible]	[illegible]	[illegible]

DATE TYPED

DO

CUST. ORD. DATE

CUSTOMER ORDER NO.

BRAND

PACKING

INSPECTION

CARRIER

	TUBE TYPE	[illegible]	EST. DELIVERY	QUANTITY ORDERED	QUANTITY SHIPPED	UNIT PRICE
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						

EXHIBIT 21

CONTRACT OR
ORDER NO. ____________________

____

FROM: GENERAL ELECTRIC COMPANY
OWENSBORO, KENTUCKY

TO:

FSN ____________________

ELECTRON TUBES

QUANTITY ____________________

TYPE NO. ____________________

PKG./PK. LEVEL ____________________

DATE PKD. ____________________

GROSS WT. __________ CF. __________

CONTAINER NO. OF

____

CONTRACT OR
ORDER NO. ____________________

____

FROM: GENERAL ELECTRIC COMPANY
OWENSBORO, KENTUCKY

TO:

EXHIBIT 22

FSN ____________________

ELECTRON TUBES

QUANTITY ____________________

TYPE NO. ____________________

PKG./PK. LEVEL ____________________

DATE PKD. ____________________

GROSS WT. __________ CF. __________

CONTAINER NO. OF

____

CONTRACT OR
ORDER NO. ____________________

____

FROM: GENERAL ELECTRIC COMPANY
OWENSBORO, KENTUCKY

TO:

FSN ____________________

ELECTRON TUBES

QUANTITY ____________________

TYPE NO. ____________________

PKG./PK. LEVEL ____________________

DATE PKD. ____________________

GROSS WT. __________ CF. __________

CONTAINER NO. OF

____

[illegible]

APPENDIX IV

IN PLANT PREPRODUCTION TESTING

10, 11, 12 December 1963

on TUBE TYPE 7486

PEM Contract

Contract No. DA-36-039SC-86738

Order No. 19060-PP-62-81-81

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PRE-PRODUCTION TEST REPORT
NON-GOVERNMENT TEST LABORATORY

DATE 13 December 1963
REPORT NUMBER

SPECIFICATION TITLE:

MILITARY SPECIFICATION
ELECTRON TUBES AND CRYSTAL RECTIFIERS

SPECIFICATION MIL-E-1D **DATED** 31 March 1958 **AMENDMENT** 5 **DATED** 24 April 1961

SHEET NUMBER Proposed SCL-7001/74 **DATED** 10 October 1963

MANUFACTURER Tube Department, General Electric Company

MAIN OFFICE ADDRESS
316 East Ninth Street
Owensboro, Kentucky

PLANT NAME AND ADDRESS WHERE PRODUCT WAS MANUFACTURED
Owensboro Tube Plant
Owensboro, Kentucky

DESCRIPTION OF PRODUCT, MIL DESIGNATION, AND MANUFACTURER'S TYPE NO:

Electron Tube Type 7486 with essential features indicated in Inclosures 4 - 5 herein.

NAME AND LOCATION OF TEST LABORATORY:

Owensboro Tube Plant
Owensboro, Kentucky

MONITORED BY: William E Turner
William E. Turner, OAR
Signature (Government Representative)
TITLE Cincinnati Procurement District

Simon Zucker
Simon Zucker, Electronic Engineer
Signature (Responsible Official or authorized representative of test laboratory)
TITLE Production Eng. Div. U.S.A. EMSA

SERIAL NUMBER AND DATE OF ASESA AUTHORIZATION LETTER:
PED #1 dated 13 November 1963

PURPOSE OF TESTS:
PEM Pre-Production Tests

INCLOSURES:

(1) Summary of Test Data.
(2) Summary of Environmental Test Data.
(3) Summary of Life Test Data.
(4) Design-and-Construction Information.
(5) Photograph showing construction details.
(6) Specification to which tube was tested.

Q-90
(Mar 61)

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REFERENCES:

PEM #1, dated 13 November 1963
PED #2, dated 22 November 1963
TAR #1, dated 29 November 1963

EXTENT OF TESTING PERFORMED:

Complete Pre-Production Testing.

SUMMARY OF RESULTS:

Results will be reviewed by U. S. A. EMSA.

TEST PERSONNEL:

Edith Smith - Shock Tester
Perry Stephens - Laboratory Technician
Kathleen Cole - Tester
Mary James - Tester
Martha Scott - Tester
Thelma Trogden - Tester
Katherine Bray - Tester
Pearl Hagan - Tester
Mabel Ambrose - Tester
W. G. Boultinghouse - Specialist, Quality Service
Eugene Estes - Test Laboratory Foreman

REMARKS:

The tests required 5 working days and 3 nights for completion.

ADDENDA:

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ABSTRACT OF RESULTS OF TESTS

MANUFACTURER Tube Department, General Electric Co.

SPECIFICATION Proposed SCL-7001/74

PRODUCT Electron Tube Type 7486

TEST REPORT NUMBER dated 10 October 1963

TEST	PAR. NO.	NO. TESTED	NO. PASSED	NO. FAILED	REMARKS
Power Output	---	8	8	0	
Resonant Frequency	---	8	8	0	
Heater Current	4.10.8	62	62	0	
Heater Cathode Leakage	4.10.15	62	62	0	
Plate Current	4.10.4.1	62	62	0	
Transconductance(1)	4.10.9	62	62	0	
Pulse Cathode Current	4.10.7.5	62	62	0	
Continuity and Short	4.7.5	62	62	0	
Mechanical	4.9.1	62	62	0	
Insul. of Electrodes	4.8	15	15	0	
Transconductance(2)	4.10.9	15	15	0	
Grid Voltage	4.10.5.2	15	15	0	
Amplification Factor	4.10.11.1	15	15	0	
Power Oscillation(1)	4.10.2.2	15	15	0	
Power Oscillation(2)	4.10.2.2	15	15	0	
Grid Emission	4.10.6.2	15	15	0	
Grid Recovery	---	15	15	0	
Direct Int. Capac.	4.10.14	15	15	0	
Low Pressure Volt. Breakdown	4.9.12.1	15	15	0	
Variable Frequency Vibration	---	4	4	0	
Low Frequency Vibration	4.9.19.1	15	15	0	
Shock	4.9.20.5	4	4	0	
Fatigue	4.9.20.6	4	4	0	
Envelope Strain	4.9.6.3	15	15	0	

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ABSTRACT OF RESULTS OF TESTS

MANUFACTURER Tube Department, General Electric Co.

SPECIFICATION Proposed SCL-7001/74

PRODUCT Electron Tube Type 7486

TEST REPORT NUMBER dated 10 October 1963

TEST	PAR. NO.	NO. TESTED	NO. PASSED	NO. FAILED	REMARKS
Heater Cycling Life Test	4.11.7	15	15	0	
Int. (Operation-1) Life Test	4.11.5	25	24	1	1-low IR at 500 Hrs.
Int. (Operation-2) Life Test	4.11.5	5	---	---	

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DESCRIPTION OF TEST EQUIPMENT:

SPEC PARA	EQUIPMENT	MANUFACTURER	TYPE OR MODEL	SERIAL OR INVENTORY #	DATE OF CALIBRATION
4.10.8 4.10.15 4.10.4.1 4.10.9 4.10.5.2 4.10.11.1 4.10.6.2	Universal Lab. Test Set Plug-in meters used in this equipment were calibrated on or after 12-9-63.	General Electric Company	Lab.	TL-017	8-1-63
4.10.7.5	Pulse Test Set Plug-in meters used in this equipment were calibrated on or after 11-8-63.	General Electric Company	Lab.	TL-001	8-3-63
4.7.5	Continuity and Short Test Set Plug-in meters used in this equipment were calibrated on or after 12-9-63.	General Electric Company	Lab.	TL-030	12-6-63
4.8	InsulationResistance Set Plug-in meters used in this equipment were calibrated on or after 11-19-63.	Macleod and Hanopol, Inc.	Lab.	TL-035	10-24-63
4.10.2.2	450Mc P.O. Test Set Plug-in meters used in this equipment were calibrated on or after 12-5-63.	General Electric	Lab.	TL-054	11-21-63
4.10.2.2	5900Mc P.O. Test Set Plug-in meters used in this equipment were calibrated on or after 12-6-63.	General Electric	Lab.	TL-068	12-6-63
---	Grid Recovery Test Set	General Electric	Lab.	TL-036	7-26-63

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DESCRIPTION OF TEST EQUIPMENT:

SPEC PARA	EQUIPMENT	MANUFACTURER	TYPE OR MODEL	SERIAL OR INVENTORY #	DATE OF CALIBRATION
	Grid Recovery Test Set (Cont'd)				
	Plug-in meters used in this equipment were calibrated on or after 11-8-63.				
4.10.14	Interelectrode Capacitance Bridge	Sylvania Model modified by General Electric Company	A	TL-023	9-30-63
---	2200Mc P.O. Test Set	General Electric Company	Lab.	TL-069	12-6-63
4.9.12.1	Low Pressure Voltage Breakdown Test Unit	General Electric Company	Lab.	TL-065	
4.9.19.1	Low-frequency Vibration Test Set	General Electric Company built around MB Co. Vibrator	Lab.	TL-010	12-6-63
	Plug-in meters used in this equipment were calibrated on or after 11-18-63.				
---	Variable-frequency Vibration Test Set	General Electric Company built around Unholtz-Dickie Co. Vibrator	Lab.	TL-012	12-5-63
4.9.20.5	High Impact Shock Machine	Taft & Peirce Company	Navy	447	9-5-63
4.9.20.6	Variable-frequency Vibration Fatigue Unit	Ling Sine-O-Matic Vibration Testing System		TL-045	12-6-63

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GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT

TYPE 7486
Date: 12 December 1963

Tubes Tested in Accordance with Proposed SCL-7001/74 Specification for Electron Tube Type 7486 dated 10 October 1963

Reference	Test		Tube Numbers								Limits		Unit
			1	2	3	4	5	6	7	8	Min.	Max.	
	Acceptance Inspection, Part 1 (Production)												
4.10.8	Heater Current	If:	250	235	250	250	250	240	240	250	222	258	mA
4.10.15	Heater Cathode Leakage	Ihk(+):	0	0	0	0	0	0	0	0	---	20	µAdc
		Ihk(-):	0	0	0	0	0	1	1.5	0	---	20	µAdc
4.10.4.1	Plate Current	Ib:	7.6	8.1	8.2	6.5	7.0	8.0	6.5	7.0	4.5	11.0	mAdc
4.10.9	Transconductance	Sm:	9660	11300	10300	9200	10600	13400	10200	10400	8000	---	µmho
4.10.7.5	Pulse Cathode Current	ik:	110	140	120	100	120	160	120	120	90	---	ma
4.7.5	Continuity & Short (Inoperative)		OK	OK	OK	OK	OK	OK	OK	OK	---	---	
4.9.1	Mechanical		OK	OK	OK	OK	OK	OK	OK	OK	---	---	
	Acceptance Inspection, Part 2 (Design)												
4.8	Insulation of Electrodes	R(g-all):	100K	100K	10CK	100K	100K	100K	100K	100K	100	---	Meg
		R(p-all):	300K	300K	300K	180K	300K	300K	300K	300K	100	---	Meg
4.10.9	Transconductance(2)	$\Delta \frac{Sm}{Ef}$:	9.31	6.19	8.64	10.43	8.86	8.95	8.52	10.19	---	20	%
4.10.5.2	Grid Voltage	Ec:	-2.8	-3.0	-2.8	-2.8	-2.85	-2.9	-2.5	-2.9	---	-4.5	Vdc
4.10.11.1	Amplification Factor	Mu:	89.1	76.7	89.9	91.9	89.2	86.4	97.1	93.1	65	115	
4.10.2.2	Power Oscillation(1)	Po:	2.0	1.6	2.1	2.05	2.05	2.0	2.0	2.1	1.2	---	W
4.10.2.2	Power Oscillation(2)	Po:	33	27	39	36	38	33	42	36	10	---	mW
4.10.6.2	Grid Emission	Ic:	0	0	0	0	0	0	0	0	---	-2.0	µAdc
---	Grid Recovery	ΔIb:	0	0	0	0	0	0	0	0	---	0.6	mA
		Δib	0	0	0	0	0	0	0	0	---	1.0	ma
4.10.14	Capacitance	Cgp:	0.94	1.02	0.90	0.87	.91	.97	.86	.885	0.84	1.16	pf
4.10.14	Capacitance	Cin:	1.77	1.75	1.58	1.75	1.69	1.73	1.68	1.55	1.25	2.15	pf

Reference	Test		Tube Numbers								Limits		Unit
			1	2	3	4	5	6	7	8	Min.	Max.	
4.10.14	Capacitance	Cout:	.0077	.0095	0072	.0075	.007	.0091	.0078	.0072	.004	.016	pf
4.10.14	Capacitance	Chk:	1.27	1.31	1.26	1.25	1.27	1.05	1.05	1.27	1.00	1.60	pf
4.9.12.1	Low Pressure Voltage Breakdown		OK	OK	OK	OK	OK	OK	OK	OK	---	---	
4.9.19.1	Low-frequency Vibration (2)	Ep(Y):	1	3	1	2	3	2	2	1	---	10	mVac
		Ep(X2):	1	1	1	1	2	1	1	1	---	10	mVac
	<u>Periodic-Check Tests</u>												
---	Power Output	Po:	530	460	570	410	510	540	360	540	350	---	mW
---	Resonant Frequency	F:	2213	2191	2219	2249	2223	2201	2256	2222	2050	2350	Mc
---	Band Width	ΔF:	15	17	15	15	19	14	13	17	---	---	Mc
---	Gain		10.25	9.65	10.60	9.15	10.10	10.35	8.60	10.35	---	---	db

Page Number 8

Reference	Test		Tube Numbers										Unit
			49	50	51	52	53	54	55	56	57	58	
	Acceptance Inspection, Part 1 (Production)												
4.10.8	Heater Current	If:	250	249	245	250	252	250	250	231	248	235	mA
4.10.15	Heater Cathode Leakage	Ihk(+):	0	0	0	0	0	0	0	0	0	0	µAdc
		Ihk(+):	0	0	0	0	0	0	0	0	0	0	µAdc
4.10.4.1	Plate Current	Ib:	9.0	8.2	6.0	7.5	8.5	9.0	9.6	6.2	8.0	7.0	mAdc
4.10.9	Transconductance	Sm:	10600	12200	8460	10700	9710	10900	10200	8930	10400	9510	µmho
4.10.7.5	Pulse Cathode Current	ik:	120	140	100	120	110	130	120	100	120	120	ma
4.7.5	Continuity & Short (Inoperative)		OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	
4.9.1	Mechanical		OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	

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Reference	Test		Tube Numbers										Unit
			59	60	61	62							
	Acceptance Inspection, Part 1 (Production)												
4.10.8	Heater Current	If:	250	241	242	245							mA
4.10.15	Heater Cathode Leakage	Ihk(+):	0	0	0	0							μAdc
		Ihk(-):	0	0	0	0							μAdc
4.10.4.1	Plate Current	Ib:	8.5	8.5	8.0	8.3							mAdc
4.10.9	Transconductance	Sm:	9220	11200	9650	11300							μmho
4.10.7.5	Pulse Cathode Current	ik:	120	130	100	130							ma
4.7.5	Continuity & Short (Inoperative)		OK	OK	OK	OK							
4.9.1	Mechanical		OK	OK	OK	OK							

These tests witnessed by the undersigned personnel:

Signed: Simon Zucker
Simon Zucker, Electronic Engineer
Production Engineering Division, U. S. A. EMSA
Date: 12/13/63

Signed: William E. Turner
William E. Turner, CAR
Cincinnati Procurement District, U. S. Army
Date: 12/13/63

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Electronic Components Division
Tube Department
General Electric Company
Owensboro Tube Plant

Tube Type: 7486

Fatigue: in a/w Proposed SCL-7001/74 dated 10 October 1963

Reference	Description	Symbol	Tube Number				Limits		
			97	98	99	100	Min.	Max.	Unit
	Fatigue Test Sample								
	Before Fatigue								
4.9.19.1	Low-frequency	Ep(Y):	1	1	1	2	---	10	mVac
	vibration	Ep(X2):	1	1	1	1	---	10	mVac
4.10.15	Heater-cathode	Ihk(+):	0	0	0	0	---	20	µAdc
	leakage	Ihk(-):	0	0	0	0	---	20	µAdc
4.10.8	Heater Current	If:	247	247	255	249	222	258	mA
4.7	Short & Continuity		OK	OK	OK	OK	---	---	
	After Fatigue								
4.9.19.1	Low-frequency	Ep(Y):	1	1	1	1	---	15	mVac
	vibration	Ep(X2):	1	1	1	1	---	15	mVac
4.10.15	Heater-cathode	Ihk(+):	0	1	0	0	---	20	µAdc
	leakage	Ihk(-):	1	1	1	0	---	20	µAdc
4.10.8	Heater Current	If:	249	247	255	250	222	258	mA
4.7	Short & Continuity		OK	OK	OK	OK	---	---	

These tests witnessed by the undersigned personnel:

Signed: Simon Zucker
Simon Zucker, Electronic Engineer
Production Engineering Division, U.S.A. EMSA
Date: 12/13/63

Signed: William E. Turner
William E. Turner, OAR
Cincinnati Procurement District, U.S. Army
Date: 13 DEC, 1963

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Electronic Components Division
Tube Department
General Electric Company
Owensboro Tube Plant

Tube Type: 7486

Shock: in a/w Proposed SCL-7001/74
dated 10 October 1963

Reference	Description	Symbol	Tube Number				Limits		
			110	111	112	113	Min.	Max.	Unit
	<u>Shock Test Sample</u>								
	<u>Before Shock</u>								
4.9.19.1	Low-frequency	Ep(Y):	1	2	1	1	---	10	mVac
	vibration	Ep(X2):	2	2	1	1	---	10	mVac
4.10.15	Heater-cathode	Ihk(+):	0	0	3	1	---	20	µAdc
	leakage	Ihk(-):	0	0	1.5	1	---	20	µAdc
4.10.8	Heater Current	If:	252	250	255	252	222	258	mA
4.7	Short & Continuity		OK	OK	OK	OK	---	---	
	<u>After Shock</u>								
4.9.19.1	Low-frequency	Ep(Y):	1	1	1	2	---	15	mVac
	vibration	Ep(X2):	1	1	1	1	---	15	mVac
4.10.15	Heater-cathode	Ihk(+):	0	0	2.5	1	---	20	µAdc
	leakage	Ihk(-):	0	0	1.5	1	---	20	µAdc
4.10.8	Heater Current	If:	251	251	254	251	222	258	mA
4.7	Short & Continuity		OK	OK	OK	OK	---	---	

These tests witnessed by the undersigned personnel:

Signed: Simon Zucker
Simon Zucker, Electronic Engineer
Production Engineering Division, U.S. A. EMSA
Date: 12/13/63

Signed: William E. Turner
William E. Turner, OAR
Cincinnati Procurement District, U. S. Army
Date: 13 DEC, 1963

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GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT
OWENSBORO, KENTUCKY

13 December 1963

LIFE TEST DATA IN ACCORDANCE WITH PROPOSED SCL-7001/74 SPECIFICATION FOR ELECTRON TUBE TYPE 7486 DATED 10 OCTOBER 1963

HEATER CYCLING LIFE TEST

Conditions: E_f = 7.0 Vac; E_{hk} = +70 Vdc; R_k = 0; E_b = E_c = 0.

Production Lot	Tube No.	Ihk(μAdc) at 0 Cycles		Ihk(μAdc) at 2000 Cycles	
		Positive	Negative	Positive	Negative
Pre-Production	465-1	0	1	0	1
	465-2	0	1.5	0	1
	465-3	0	1.5	0	1
	465-4	0	1	0	1
	465-5	0	2	0	1
	465-6	0	3	0	1
	465-7	0	1.5	0	1
	465-8	0	0	0	0
	465-9	0	0	0	0
	465-10	0	0	0	0
	466-1	0	0	0	0
	466-2	0	0	0	0
	466-3	0	0	0	0
	466-4	0	0	0	0
	466-5	0	2	0	1

No Open Elements

The foregoing is a true transcript of the Life Test Records of the General Electric Company.

Signed: C. E. Albrecht
C. E. Albrecht, Manager
Specification Development

Date: 13 December 1963

Signed: William E. Turner
William E. Turner, OAR
Cincinnati Procurement District, U.S. Army

Date: 13 DEC. 1963

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INTERMITTENT LIFE TEST

Operation-1

Type 7486

500 Hours

Tube No.	Heater Current (mA)	Transconductance (1) (µmhos)	Transconductance (2) (%)	H-K Leakage (µAdc)		Insulation of Electrodes (Meg.)	
				Heater Positive	Heater Negative	Rg-all	Rp-all
264-1	240	10300	12.71	0	0	100K	300K
264-2	240	10900	9.17	0	1	100K	300K
264-3	242	11200	8.92	0	1	100K	300K
264-4	243	8930	10.3	0	0	100K	300K
264-6	241	9460	9.72	0	1.5	100K	300K
264-7	231	9150	16.06	0	0	100K	300K
264-8	237	11500	11.3	0	0.5	100K	300K
264-9	237	9920	10.78	0	1	100K	300K
264-10	240	10300	9.41	0	0.5	100K	300K
263-1	240	12100	11.57	0	0	100K	300K
263-2	240	9300	9.03	0	0	100K	300K
263-3	245	10800	10.55	0	0	100K	300K
263-4	245	10300	12.91	0	1	100K	300K
263-5	240	12100	11.57	0	1	100K	300K
263-6	234	9510	11.98	0	1	100K	300K
263-7	244	13500	12.59	0	0	100K	300K
263-8	240	11200	12.85	0	0	10	300K
263-9	240	10500	10.66	0	0	100K	300K
263-10	235	12800	15.62	0	0.5	100K	300K
262-1	245	12300	8.94	0	1	100K	300K
262-2	240	8620	9.97	0	1	100K	300K
262-3	234	9050	8.72	0	0	100K	300K
262-4	241	10700	10.37	0	0	100K	300K
262-5	230	10200	12.25	0	0	100K	300K
262-6	237	10700	10.28	0	0.5	100K	300K

No inoperatives

K denotes 1000

GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT
OWENSBORO, KENTUCKY

12 December 1963

LIFE TEST DATA IN ACCORDANCE WITH PROPOSED SCL-7001/74 SPECIFICATION FOR ELECTRON TUBE TYPE 7486 DATED 10 OCTOBER 1963

INTERMITTENT LIFE TEST

Operation-1

Production Lot: GC1-4

Conditions: Ef=6.3Vac; Ebb=180Vdc; Rk=0; Eg=6.0Vac; F=60cps; Ehk=-70Vdc; Rg=1200ohms; Rb=3300ohms; TA=Room.

0 Hours

Tube No.	Heater Current (mA)	Transconductance (1) (μmhos)	Transconductance (2) (%)	H-K Leakage (μAdc) Heater Positive		Insulation of Electrodes (Meg.) Rg-all	
				Heater Positive	Heater Negative	Rg-all	Rp-all
264-1	234	10700	13.08	0	1	100K	300K
264-2	234	11200	9.82	0	1	100K	300K
264-3	230	11100	9.0	0	1	60K	300K
264-4	236	9100	9.89	0	1	100K	300K
264-6	232	9130	7.99	0	1.5	100K	300K
264-7	230	9770	7.88	0	1	100K	300K
264-8	230	11400	10.52	0	1	100K	300K
264-9	227	9760	9.22	0	1	100K	300K
264-10	233	9880	8.4	0	1	100K	300K
263-1	232	11700	9.4	0	1	100K	300K
263-2	230	9000	8.88	0	0.5	100K	300K
263-3	236	10500	8.95	0	1.5	100K	300K
263-4	231	9600	12.5	0	1	100K	300K
263-5	231	11800	9.32	0	1	100K	300K
263-6	230	9600	12.08	0	0.5	100K	300K
263-7	234	13100	9.92	0	1	100K	300K
263-8	231	11100	11.08	0	1	100K	300K
263-9	229	9900	9.29	0	1	100K	300K
263-10	229	12900	11.62	0	1	100K	300K
262-1	235	11600	7.75	0	1.5	100K	300K
262-2	235	9070	9.59	0	1.5	100K	300K
262-3	231	8800	9.09	0	1	100K	300K
262-4	232	10600	10.09	0	2	100K	300K
262-5	221	9900	14.64	0	0.5	100K	300K
262-6	231	10700	10.28	0	1	100K	300K

K denotes 1000

INTERMITTENT LIFE TEST

Operation-1

Type 7486

1000 Hours

Tube No.	Heater Current (mA)	Transconductance (1) (µmhos)	Transconductance (2) (%)	H-K Leakage (µAdc) Heater Positive	H-K Leakage (µAdc) Heater Negative	Insulation of Electrodes (Meg.) Rg-all	Insulation of Electrodes (Meg.) Rp-all
264-1	244	11700	7.69	0	1	100K	300K
264-2	241	11100	9.00	0	1	100K	300K
264-3	245	12100	9.09	0	1.5	100K	300K
264-4	246	9300	5.37	0	1	100K	300K
264-6	245	10000	10.00	0	1	100K	300K
264-7	240	10600	6.60	0	1	100K	300K
264-8	239	12000	8.33	0	1	100K	300K
264-9	242	10500	9.52	0	1	100K	300K
264-10	241	10500	9.52	0	1	100K	300K
263-1	244	13000	7.69	0	1	100K	300K
263-2	246	10500	9.52	0	1	100K	300K
263-3	245	11200	9.64	0	1	100K	300K
263-4	245	10400	12.50	0	1	100K	300K
263-5	242	13000	10.00	0	1	100K	300K
263-6	242	11000	10.90	0	2	100K	300K
263-7	244	14000	10.00	0	1	100K	300K
263-8	246	12800	8.59	0	1	6	300K
263-9	242	11000	9.09	0	1.5	100K	300K
263-10	240	14000	11.42	0	1.5	100K	300K
262-1	249	13400	10.44	0	2	100K	300K
262-2	242	9200	5.43	0	1.5	100K	300K
262-3	241	9400	9.57	0	1	100K	300K
262-4	243	10900	10.09	0	1	100K	300K
262-5	237	11600	9.48	0	2	100K	300K
262-6	240	11500	10.43	0	2	100K	300K

No inoperatives

K denotes 1000

INTERMITTENT LIFE TEST
Operation-1

Type 7486

The foregoing is a true transcript of the Life Test Records of the General Electric Company.

Signed: C. E. Albrecht
C. E. Albrecht, Manager
Specification Development
Date: 12 December 1963

Signed: William E. Turner
William E. Turner, OAR
Cincinnati Procurement District, U.S. Army
Date: 12 DEC. 1963

GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT
OWENSBORO, KENTUCKY

12 December 1963

RECENT LIFE TEST DATA IN ACCORDANCE WITH PROPOSED SCL-7001/74 SPECIFICATION FOR ELECTRON TUBE TYPE 7486 DATED 10 OCTOBER 1963

INTERMITTENT LIFE TEST

Operation-2

Production Lot: GC

Conditions: Ef = 6.3 Vac; Ebb = 250 Vdc; Rg/Ib = 15 mAdc; Ig = 5-7 mAdc; Freq = 475±25 mc; TA = Room.

0 Hours

Tube No.	Heater Current (mA)	Power Oscillation(1) (W)	Power Oscillation(2) (mW)	H-K Leakage(μAdc) Heater Positive	H-K Leakage(μAdc) Heater Negative	Insulation of Electrodes (Meg.) Rg-all	Insulation of Electrodes (Meg.) Rp-all
266-21	232	2.2	44	0	1	100K	300K
266-22	235	2.3	44	0	1	100K	300K
266-23	230	2.2	41	0	1.5	100K	300K
266-24	225	2.15	39	0	1	100K	300K
266-25	232	2.25	37	0	1.5	100K	300K

K denotes 1000

INTERMITTENT LIFE TEST

Operation-2

Type 7486

500 Hours

Tube No.	Power Oscillation(1) (W)	Change in Power Oscillation(1) from Initial (%)
266-21	2.25	2.27
266-22	2.3	0
266-23	2.2	0
266-24	2.2	2.33
266-25	2.2	2.22

INTERMITTENT LIFE TEST

Operation-2

Type 7486

1000 Hours

Tube No.	Heater Current (mA)	Power Oscillation(1) (W)	Change in Power Oscillation(1) from Initial (%)	Power Oscillation(2) (mW)	Change in* Resonant Freq. from Initial(%)	H-K Leakage(μAdc) Heater Positive	H-K Leakage(μAdc) Heater Negative	Insulation of Electrodes (Meg.) Rg-all	Insulation of Electrodes (Meg.) Rp-all
266-21	245	2.25	2.27	43	---	0	1	100K	300K
266-22	249	2.35	2.17	36	---	0	1	70K	60K
266-23	243	2.2	0	40	---	0	1	100K	300K
266-24	245	2.2	2.32	32	---	0	1	100K	300K
266-25	246	2.3	2.22	36	---	0	1	100K	300K

*Due to equipment breakdown, Resonant Frequency test could not be made. This test will be performed during the next 8 weeks.

No inoperatives

K denotes 1000

The foregoing is a true transcript of the Life Test Records of the General Electric Company.

Signed: C E Albrecht
C. E. Albrecht, Manager
Specification Development

Date: 13 December 1963

Signed: William E Turner
William E. Turner, OAR
Cincinnati Procurement District, U. S. Army

Date: 13 Dec. 1963

DESIGN-AND-CONSTRUCTION INFORMATION

(MATERIALS AND STRUCTURAL FEATURES)

RECEIVING AND TRANSMITTING TUBES
under Military Specification MIL-E-1D

DATE 10 December 1963

TUBE TYPE 7486 **MANUFACTURER** General Electric Company

PLANT LOCATION Owensboro, Kentucky

1. **HEATER:**

Folded ______ **Double Helical** ______ **Coiled Coil** ______ **Series Connected** ______

Parallel Connected ______ **Material Used** ______

Reverse Helix X

Other Details ______

FILAMENT:

No. of Filament Strands ______ **How Supported** ______

Support Material ______ **Damper Bar** ______

Series Connected ______ **Parallel Connected** ______

Material Used ______

Other Details ______

2. **UNIPOTENTIAL CATHODE**

Cylindrical ______ **Oval** ______ **Rectangular** ______ Planar X

Material Used Carbonate Coated Nickel

Other Details ______

3. **GRIDS**

Grid No.	**1**	**2**	**3**	**4**	**5**	**6**	**Beam Plates**
Planar:	X						
Formed:							
Oval:							
Rectangular:							
Cylindrical:							

Material Used Copper brazed tungsten

How Supported Grid support ring

Other Details The grid assembly is held in place by grid ring and ceramic insulators.

ANODE

No. of Section 1 Material Used Titanium

Shape of Anode Disc shaped How Supported Ceramic

If water cooled or air cooled transmitting type - explain method employed in securing envelope to anode and radiator.

SHIELDING

Explain method of shielding, type of support, where connected, and material used in Shield, Supports, and Connector.

BASE

JAN OR EIA TYPE NO.______ Material Used______

Approved: Yes___ No___ Source of Supply______

If Base is not a part of envelope, explain how same is secured to envelope and type of cement, if used.

ENVELOPE TYPE

Class and Grade Metal-Ceramic X

Other Details Metal Envelope Material - Titanium

EXTERNAL CONNECTIONS

TYPE	MATERIAL	PLATING
Base Pins		
External Leads		

Top Cap or Other Element Connection______

Other Details Titanium with nickel and gold plating.

Identity of external connections (including pins, etc., to which no external connection is made):

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9. INTERNAL INSULATORS

TYPE NUMBER

Mica______ Ceramic X Glass______

Where located and purpose Between plate and grid, grid and cathode, cathode and heater buttons - for insulation and support.

Other Details______

10. GENERAL CONSTRUCTION ITEMS

Type of Stem______

Mount Support to Envelope______

Location of Getter No conventional getter - Electrodes are of reactive material.

Getter Connected to______

Getter Construction and Material______

11. OTHER FEATURES

Q-41
(Jul 59)

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ELECTRONIC TUBE

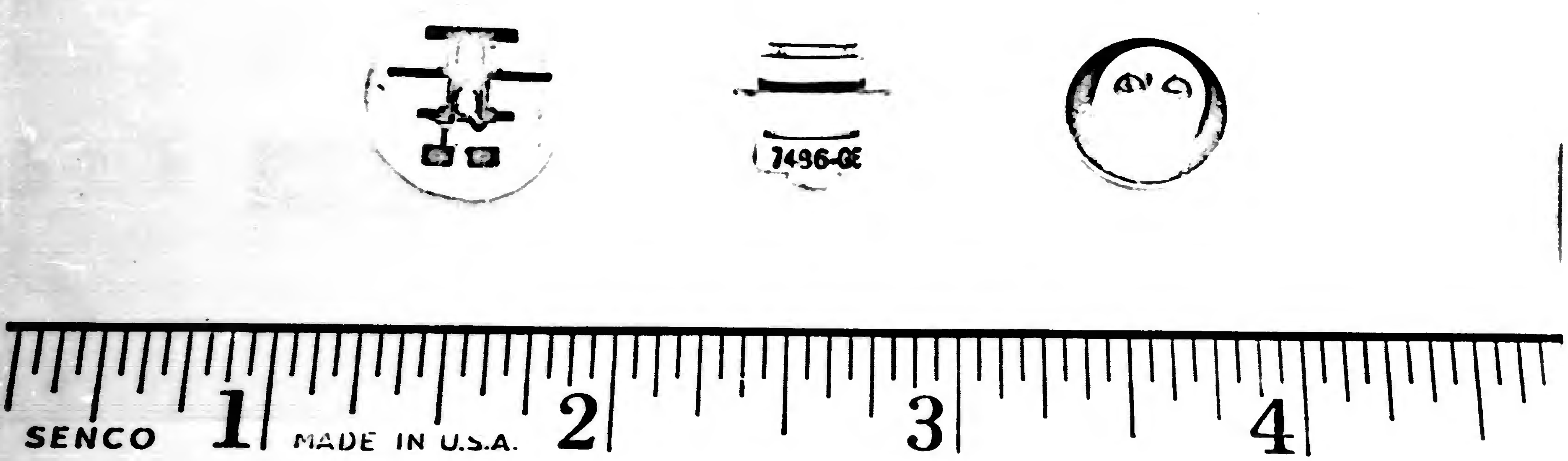
7486

OWENSBORO TUBE PLANT

GENERAL ELECTRIC COMPANY

OWENSBORO, KY.

10 December 1963



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Proposed by
General Electric Co.
10 October 1963

TENTATIVE

REVISED SCL-7001/74 SPECIFICATION

ELECTRON TUBE, TYPE 7486

The requirements and tests of the latest issue of Specification MIL-E-1 shall apply, except as otherwise required herein.

DESCRIPTION: UHF Triode, Oscillator and Radio-frequency Power Amplifier, Ceramic.

ABSOLUTE RATINGS:

Parameter:	Ef	Eb	Ec	Ehk	Rk	Rg	Ik	Ic	Pp	T Envelope	Alt.
Units:	V	Vdc	Vdc	v	ohms	Meg	mAdc	mAdc	W	°C	ft.
Maximum:	6.6	250	0 -50	+50 -50	---	.01	20	5.0	1.5	250 (see note 1)	100,000
Minimum:	6.0	---	---	---	---	---	---	---	---	---	---
TEST COND.:	6.3	150	0	---	82	---	---	---	---	---	---

CATHODE: Coated Unipotential

ENVELOPE: Ceramic, per figure 1

For the purpose of inspection, use the applicable reliable paragraphs of Specification MIL-E-1.
For miscellaneous requirements, see paragraph 3.6 of MIL-E-1.

Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	General											
3.1	Qualification	Required	---	---	---	---	---	---	---	---	---	---
3.7	Marking	(see note 35)	---	---	---	---	---	---	---	---	---	---
3.6	Performance	(see note 36)	---	---	---	---	---	---	---	---	---	---
4.5	Holding Period	168 hours (min)	---	---	---	---	---	---	---	---	---	---
	Periodic-check test (see note 4)											
---	Power Output	F=2200 Mc approx; Ebb=200 Vdc; Pd=50mW; Vary Rk for Ib=15 mAdc; (see note 33)	---	---	Po	350	---	---	---	---	---	mW
---	Resonant Frequency	(Power Output test conditions; see note 33)	---	---	F	2050	---	---	---	2350	---	Mc

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Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	<u>Acceptance Inspection Part 1 (Production) (see note 5)</u>											
4.10.8	Heater current		0.65	II	If	222	---	240	---	250	---	mA
4.10.15	Heater-cathode leakage	Ehk=+100 Vdc Ehk=-100 Vdc	0.65	II	Ihk Ihk	--- ---	--- ---	--- ---	--- ---	20 20	--- ---	μAdc μAdc
4.10.4.1	Plate current		---	---	Ib	---	5.7	7.5	9.3	---	4.0	mAdc
4.10.4.1	Plate current		0.65	II	Ib	4.5	---	---	---	11.0	---	mAdc
4.10.9	Transconductance(1)	Eb=100Vdc; Rk=0	0.65	II	Sm	8000	---	11500	---	---	---	μmho
4.10.7.5	Pulse Cathode Current	Ec=-10Vdc; egk=+7v; Rk=1.0 ohm (see note 6)	0.65	II	ik	90	---	---	---	---	---	ma
4.7.5	Continuity and shorts for reliable tubes	(see note 7)	0.4	II	---	---	---	---	---	---	---	---
4.9.1	Mechanical-production tests	(per figure 1)	---	---	---	---	---	---	---	---	---	---
	<u>Acceptance Inspection Part 2 (Design)</u>											
4.8	Insulation of electrodes	E(g-all)=-100 Vdc E(p-all)=-300 Vdc	2.5	I	R R	100 100	--- ---	--- ---	--- ---	--- ---	--- ---	Meg Meg
4.10.9	Transconductance(2)	Ef=6.0; Eb=100 Vdc; Rk=0	2.5	I	$\frac{\Delta Sm}{Ef}$	---	---	---	---	20	---	%
4.10.5.2	Grid Voltage	Rk=0; Ec/Ib=0.1 mAdc	2.5	I	Ec	---	---	-2.4	---	-4.5	---	Vdc
4.10.11.1	Amplification factor	Ck=1000 μf	2.5	I	Mu	65	---	90	---	125	---	---
4.10.2.2	Power Oscillation(1)	F=450 mc. Ebb=250 Vdc; Rg=1000 ohms; Ib=15mAdc; (See note 8)	2.5	Code G	Po	1.2	---	---	---	---	---	W
4.10.2.2	Power Oscillation(2)	F=5900 mc; Ebb=200 Vdc; Rg=470ohms; Vary Rk for Ib=15 mAdc; (See note 9)	2.5	Code G	Po	10	---	---	---	---	---	mW

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Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	Acceptance Inspection Part 2 (Design) (Cont'd)											
4.10.6.2	Grid emission	Ef=7.0V; Ecc=-20 Vdc; Rg=0.1 Meg (see note 10)	2.5	I	Ic	0	---	---	---	-2.0	---	µAdc
---	Grid Recovery	Ebb=250 Vdc; Ec/Ib=3.0 mAdc; Rp=.01 Meg (see note 11)	6.5	I			(see note 11)					
4.10.14	Direct interelectrode capacitance	(see note 12)	6.5	Code E	Cgp Cin Cout Chk	0.84 1.25 .004 1.20	--- --- --- ---	1.00 1.70 .010 1.30	--- --- --- ---	1.16 2.15 .016 1.60	--- --- --- ---	pf pf pf pf
4.9.12.1	Low pressure voltage breakdown	Pressure=8±1 mm Hg; potential=300 Vac; (see notes 13 & 14)	6.5	Code F	---	---	---	---	---	---	---	---
---	Variable frequency vibration (1)	Ebb=150 Vdc; Rk=82 ohms; Ck=1000 µf; Rp=10,000 ohms (see notes 14 & 15)	---	(see note 16)	Ep	---	---	---	---	15	---	mVac
4.9.19.1	Low-frequency vibration (2)	Ebb=150 Vdc; Rk=82; Ck=1000 µf; Rp=10,000; G=15; F=40 cps; (see note 17)	6.5	Code I	Ep	---	---	---	---	10	---	mVac
	Acceptance Inspection Part 3 (Degradation Rate) (see note 18)											
4.9.20.5	Shock	Acceleration=450g, Eb=150 Vdc; Ec=0 Vdc, Rk=82 ohms; Ehk=+100 Vdc; (see notes 14 & 19)	---	(see note 20)	---	---	---	---	---	---	---	---
4.9.20.6	Fatigue	G=10; Ef=6.3V; No other voltages applied; Variable frequency (see notes 14 & 21)	---	(see note 22)	---	---	---	---	---	---	---	---

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Par. No.	Test (See Note 2)	Conditions	AQL (%)	Insp. Level or Code	Sym.	LIMITS (See Note 3)						Units
						Min	LAL	Bogie	UAL	Max	ALD	
	Acceptance Inspection Part 3 (Degradation Rate (see note 18) (Cont'd)											
---	Post shock and fatigue test end points	Vibration (2)	---	---	Ep	---	---	---	---	15	---	mVac
		Heater-cathode leakage										
		Ehk = +100 Vdc	---	---	Ihk	---	---	---	---	20	---	µAdc
		Ehk = -100 Vdc	---	---	Ihk	---	---	---	---	20	---	µAdc
		Heater current	---	---	If	222	---	---	---	258	---	mA
4.9.6.3	Envelope strain		2.5	I	---	---	---	---	---	---	---	---

Par. No.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defects per Characteristic	Sym	LIMITS		Units
							Min	Max	
	Acceptance Inspection Part 4 (Life) (see note 18)								
4.11.7	Heater-cycling life test	Ef=7.0; Ehk=+70; Rk=0; Ec=Eb=0; (see note 24)	---	---	---	---	---	---	---
4.11.4	Life test end points (heater-cycling)	Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	---	Ihk	---	40	µAdc
		Ehk=-100 Vdc	---	---	---	Ihk	---	40	µAdc
4.11.5	Intermittent life test	(see note 25)							
	Operation-1	Ebb=180Vdc, Rk=0 Eg=6.0Vac;F=60cps; Ehk=-70Vdc;Rg=1200 ohms;Rb=3300ohms; TA=Room;(see note 26)	---	---	---	---	---	---	---
	Operation-2	F=475±25mc;Ebb=250 Vdc; Vary Rg for Ib=15 mAdc; Ig=5-7 mAdc TA=Room;(see note 27)	---	---	---	---	---	---	---
4.11.4	Life test end point (stability) (2 & 20 hours)	Change in Transconductance (1) of individual tubes	---	---	1	ΔSm t	---	15	%
4.11.3.1 (b)	Life test end point (survival-rate) (100 hours)	Inoperatives (see note 28)	---	---	0	---	---	---	---
		Transconductance (1)	---	---	1	Sm	7000	---	µmho

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Par. No.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defects per Characteristic	Sym	LIMITS		Units
							Min	Max	
	Acceptance Inspection Part 4 (Life) (see note 18) (Cont'd)								
4.11.4	Intermittent life test end points (500 hours)	(see note 29)							
	Operation -1	Inoperatives (see note 30)	---	---	1	---	---	---	---
		Heater current	---	---	1	If	222	262	mA
		Transconductance(1)	---	---	1	Sm	7000	---	µmho
		Transconductance(2)	---	---	1	Sm	---	25	%
		Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	1	Ihk	---	20	µAdc
		Ehk=-100 Vdc	---	---		Ihk	---	20	µAdc
		Insulation of Electrodes							
		g-all	---	---	1	R	60	---	Meg
		p-all	---	---		R	60	---	Meg
		Total Defectives			3				
	Operation -2	Power Oscillation (see note 31)	---	---	1	ΔPo t	---	25	%
4.11.4	Intermittent life test end points (1000 hours)	(see note 29)							
	Operation-1	Inoperatives (see note 30)	---	---	1	---	---	---	---
		Heater current	---	---	1	If	222	264	mA
		Transconductance(1)	---	---	1	Sm	6500	---	µmho
		Transconductance(2)	---	---	1	ΔSm Ef	---	25	%
		Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	1	Ihk	---	20	µAdc
		Ehk=-100 Vdc	---	---		Ihk	---	20	µAdc
		Insulation of Electrodes							
		g-all	---	---	1	R	50	---	Meg
		p-all	---	---		R	50	---	Meg
		Total Defectives			4				

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Par. No.	Test	Conditions	AQL (%)	Insp. Level or Code	Allowable Defects per Characteristic	Sym.	LIMITS Min.	LIMITS Max.	Units
	Acceptance Inspection Part 4 (Life) (see note 18) (Cont'd) Intermittent life test end points (1000 hours) (Cont'd)								
	Operation-2	Inoperatives (see note 30)	---	---	---	---	---	---	---
		Heater Current	---	---	---	If	222	264	mA
		Power Oscillation (see note 31)	---	---		$\frac{\Delta Po}{t}$	---	30	%
		Power Oscillation (2)	---	---	---	Po	5	---	mW
		Change in Resonant Frequency (see note 32)	---	---	---	$\frac{\Delta F}{t}$	---	20	mc
		Heater-cathode leakage							
		Ehk=+100 Vdc	---	---	---	Ihk	---	20	µAdc
		Ehk=-100 Vdc	---	---	---	Ihk	---	20	µAdc
		Insulation of Electrodes							
		g-all	---	---	---	R	50	---	Meg
		p-all	---	---	---	R	50	---	Meg
		Total Defectives			1				
4.9.18	Container drop	(see note 34)							
5.1	Preparation for Delivery	(see note 36)							

Note 1: Operation below the rated maximum temperature is recommended for application requiring the longest possible tube life.

Note 2: The sequence of tests listed hereon is the suggested order in which tests should be conducted.

Note 3: Variables Sampling Procedure (see 4.1.1.7).

Note 4: Periodic-check test listed hereon shall be performed during qualification and at 6-month intervals during production.

Note 5: The AQL for the combined defectives for attributes in Acceptance Inspection Tests, Part 1, excluding Inoperatives and Mechanical shall be 1.0 percent.

Note 6: Positive portion of the grid pulse shall be a rectangular wave meeting pulse shape requirement of MIL-E-1, paragraph 4.10.7.5 and, in addition, the maximum amplitude shall occur within the first 20% of tp; tp = 10μs and prr = 1000 pps. The pulse shall be applied to the grid by means of a driving circuit which produces the specified peak pulse voltage directly at the grid terminal with respect to cathode. Grid resistance, not exceeding 50 ohms may be inserted to prevent oscillation, provided readjustment of grid drive is made to maintain the specified pulse amplitude directly at the grid terminal. Peak currents shall be measured by means of high impedance oscilloscope or equivalent device connected across a cathode resistor of 1.0 ± .01 ohms. The specified limit refers to the maximum of the pulse amplitude.

Note 7: The testing and acceptance procedure for this test shall be as specified in 4.7.7 and 4.7.5 with the following exceptions:

4.7.7 (a) through 4.7.7(c):	Replace with the following: "The tube shall be inserted into adaptor socket in the shorts test equipment and the tube and socket assembly shall be tapped three times in each of two planes 90° ± 10° apart. The tapping device shall be so designed and adjusted that it will deliver an impulse of approximately one-half sine wave of 300 ± 50 μs duration, as measured at 10 percent of the amplitude of the halfwave, and have a minimum average amplitude equivalent to 80g peak acceleration."
4.7.5(d):	Replace with the following: "Air Leaks shall be rejected as evidenced by high Heater Current of 300 mA or more."

Note 8: The Power Oscillation (1) test shall be performed on the tube in a cw oscillator circuit as shown on GE Drawing 13700K-T6-11-6. The output coupling and feedback shall be adjusted for maximum power output with Ib= 15 mA.

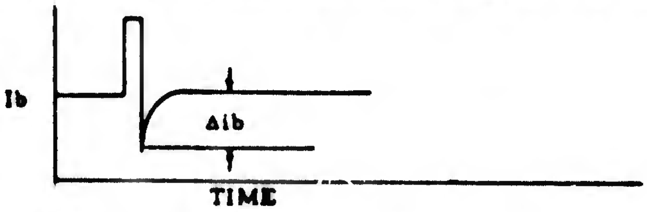
Note 9: The Power Oscillation (2) test shall be performed on the tube in a cw oscillator circuit as shown on GE Drawing 13700K-T6-11-7. The output coupling and feedback shall be adjusted for maximum power output with Ib= 15 mA.

Note 10: Prior to this test, tubes shall be preheated a minimum of five minutes at the conditions indicated below. Three minute test is not permitted. Test within 3 seconds after preheating. Grid Emission shall be the last test performed on the sample selected for the grid emission test.

Ef V	Ecc Vdc	Eb Vdc	Rk ohms	Rg Meg
7.0	0	150	82	0.1

Note 11: The Grid Recovery test shall be performed as follows:

(a) With TUT operating under specified conditions, adjust Ec for Ib = 3.0 mAdc.
(b) Apply 5 volt pulse, 20 μsec duration, 60 pps to the grid.
(c) With application of pulse, measure undershoot (Δib) and change in average current (ΔIb).



(d) Test limits are as follows:
Change in average plate current (ΔIb) = 0.6 mA.
Undershoot below quiescent plate current (Δib) = 1.0 ma.

Note 12: Test in fixture as shown on GE Drawing CIGA-653.

Note 13: The tube shall be tested as specified in 4.9.2.1 with the exception that the specified voltage shall be applied between the anode and grid.

Note 14: This test shall be conducted on the initial lot and thereafter on a lot approximately every 30 days. Once a lot has passed, the 30-day rule shall apply. In the event of lot failure, the lot shall be rejected and the succeeding lots shall be subjected to this test until a lot passes.

Note 15: The Vibration (1) test shall be performed as follows:

(a) The frequency shall be increased from 100 to 3000 cps with approximately logarithmic progression in 3 ± 1 minutes. The return sweep (3000 to 100 cps) is not required.

(b) The tube shall be vibrated with simple harmonic motion in each of two planes: Y and X1 as defined in Figure 2. At all frequencies from 100 to 3000 cps, the total harmonic distortion of the acceleration wave form shall be less than 5%.

(c) The peak acceleration shall be maintained at 15 ± 1.5 g throughout the test.

(d) The value of the alternating voltage, Ep, produced across the resistor, Rp, as a result of the vibration shall be measured with a suitable device having a response to the RMS value of a sine wave voltage to within ±0.5 db of the response at 100 cps over the frequency range of 50 to 5000 cps, and having a frequency cut-off such that the response is down a minimum of 12 db at 10,000 cps. The meter shall have a dynamic response characteristic equivalent to or faster than a VU meter (operated in accordance with Standard ASA No. C16.5-1954).

Note 16: Variable vibration test sampling procedure and acceptance criteria shall be as follows: First sample (n1) shall consist of 4 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 8 tubes with an acceptance number (cc) equal to one (1) for the cumulative sample.

Note 17: The tube shall be vibrated with simple harmonic motion in each of two planes Y and X2 as defined in Figure 2.

Note 18: Destructive tests.

Tubes subjected to the following destructive tests are not to be accepted under this specification:

4.9.20.5	Shock
---	Fatigue
4.11.7	Heater-cycling life test
4.11.5	Intermittent life test

Note 19: Tube shall be subjected to 5 blows in each of 4 positions as follows: Y1, Y2, X1, and X2 as defined in Figure 2. Use fixture as shown on GE Drawing 13700K-T6-11-106.

Note 20: Shock test sampling procedure and acceptance criteria shall be as follows: first sample (n1) shall consist of 4 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 8 tubes with an acceptance number (cc) equal to four (4) for the cumulative sample.

Note 21: The tubes shall be rigidly mounted to a table vibrating at a constant peak acceleration level of 10g. The frequency of vibration shall be varied from 30 to 2000 cps and back to 30 cps with the period of the sweep cycle being 10 minutes. The tubes shall be vibrated for a total of 6 hours, that is, 3 hours in each of two planes Y and X1 as defined in Figure 2.

Note 22: Fatigue test sampling procedure and acceptance criteria shall be as follows:

First sample (n1) shall consist of 4 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 8 tubes with an acceptance number (cc) equal to one (1) for the cumulative sample.

Note 23: Envelope Strain Procedure.

Tubes shall be tested as specified in 4.9.6.3. Tubes having high Heater Current of 300 mA or more shall be rejected as evidence of air leaks.

Note 24: Heater-cycling life test sampling procedure and acceptance criteria shall be as follows: First sample (n1) shall consist of 15 tubes with an acceptance number (c1) of zero (0). Second sample (n2) shall consist of 15 tubes with an acceptance number (c_c) equal to one (1) for the cumulative sample. Electrical rejects, other than inoperatives and heater-cathode leakage failures, may be used in performance of this test.

Note 25: Intermittent Life Test

Sampling procedure and acceptance criteria for this test shall be as specified in 20.2.5.3 of Appendix C with the following exceptions:

(a) The intermittent Life Test sample shall consist of a combination of 25 tubes under Operation-1 conditions and 5 tubes under Operation-2 conditions.

(b) The life test sample shall be read for the specified characteristics at the following times:

0 hours (Operation-1 and Operation-2 samples)
2 ± 1/2 hours (Operation-1 sample only)
20 ± 4 hours (Operation-1 sample only)
100^{+26}_{-16} hours (Operation-1 sample only)
500^{+48}_{-24} hours (Operation-1 and Operation-2 samples)
1000^{+48}_{-24} hours (Operation-1 and Operation-2 samples)

Additional reading periods may be used at the discretion of the tube manufacturer.

(c) The early-life stability acceptance criteria shall be applied to the 25-tube Operation-1 life test sample at the 2 and 20 hour reading periods.

(d) The survival-rate acceptance criteria shall be applied to the 25-tube Operation-1 life test sample at the 100 hour reading period.

(e) Eligibility for reduced testing of Operation-2 life test shall be as follows: No lot failure due to the regular 1000 hour Operation-2 life test has occurred in the preceding 3 consecutive lots. Reduced testing shall then consist of one lot tested for Operation-2 life test each 30 days approximate.

Note 26: The specified Rg is unbypassed and is in series with the signal source and the grid.

Note 27: Operation-2 life test shall be performed on tubes operated in self-excited oscillator units as shown on GE Drawing 13700K-T6-11-10. Grid resistor, feed back, and output coupling shall be optimized for maximum power output.

Note 28: Tubes shall be tested at 100 hours for Continuity and Shorts (Inoperatives) under the same conditions as for the initial test. When any tap short indication is obtained, the test shall be repeated. When any short indication is again obtained, the tube shall be rejected as inoperable.

Note 29: Order for Evaluation of Life Test Defects: (See 4.11.3.1.2)

Note 30: An inoperative as referenced in life test is defined as a tube having one (1) or more of the following defects: discontinuity (continuity and short test conditions except tube and socket assembly shall not be tapped), permanent short (continuity and short test conditions except tube and socket assembly shall not be tapped), air leak as evidenced by high Heater Current of 300 mA or more.

Note 31: Oscillator power output measured under the Operation-2 life conditions shall not exceed the maximum limit for $\frac{\Delta Po}{t}$.

Note 32: The 2200 Mc Resonant Frequency test shall be applied to the Intermittent Life Test (Operation-2) samples on a periodic-check basis, that is, during qualification and at 6-month intervals during production. The change in Resonant Frequency (0-1000 hours) shall not exceed the specified life test end point limit.

Note 33: The Power Output and Resonant Frequency tests shall be performed on the tube inserted in a grid separation amplifier test cavity as shown on GE Drawing 13700K-T6-11-10. The amplifier test cavity contains a low loss fixed frequency plate resonator in the one-quarter wave mode at 2200 Mc and is adjusted for 2200 Mc ± 10 Mc using a reference tube selected for Cgp and Cgk within 2% of bogie. The output loop must be adjusted for maximum gain and shall remain fixed. The 3 db band width, resonant frequency, power output and gain of the amplifier shall be recorded simultaneously for each tube tested. Acceptance shall be based on specified test limits for Power Output and Resonant Frequency.

Note 34: Not required for qualification approval of the end product.

Note 35: Tubes shall be marked "USA-7486".

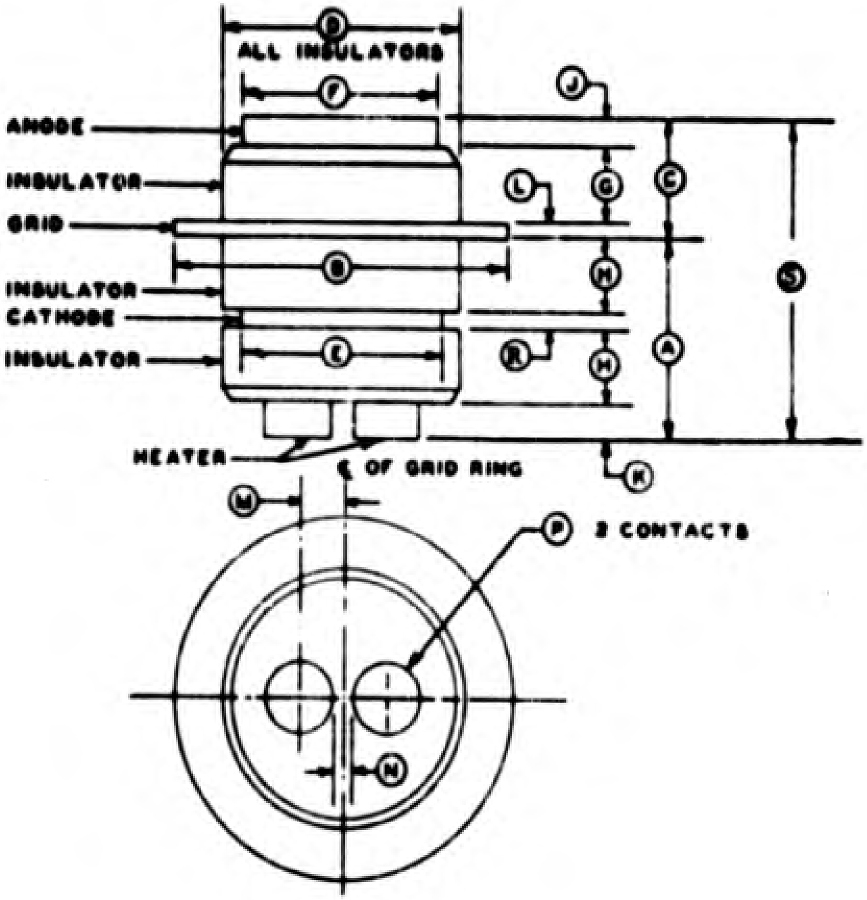
Note 36: In addition to the paragraphs specified hereon, the following tests and requirements listed in 3.6 shall apply: 3.3, 3.3.1, 3.4.1, 4.7, 3.8, 4.1, 4.3, 4.5, 4.6, 4.7, 4.9, 4.9.2, and 4.9.21.

Note 37: Preservation, Packaging and Packing.

Unless otherwise specified in the contract or order, preservation, packaging, and packing shall be as follows:

(a) Preservation and packaging shall be sufficient to afford adequate protection against corrosion and deteriorating during shipment from the supply source to the using activity and until installation.

(b) Packing shall be accomplished in a manner which will insure acceptance and protection against physical or mechanical damage during direct shipment from the supply source to the using activity.



DIM.	AQL (PERCENT DEFECTIVE)	INSPECTION LEVEL	LIMITS	
			Min	Max
ACCEPTANCE INSPECTION, PART I (PRODUCTION)				
A	(See note b)	I	0.268	0.292
B			0.476 dia	0.484 dia
C			0.156	0.174
D			---	0.335 dia
E			0.281 dia	0.289 dia
F			0.271 dia	0.279 dia
G			0.094	0.104
H			0.095	0.105
J			0.034	0.046
K			0.047	0.063
L			0.024	0.030
M			0.055	0.081
N			0.030	---
P			0.086 dia	0.094 dia
R			0.022	0.028
S			0.430	0.460

a. All dimensions in inches.

b. The AQL for the combined mechanical defectives in acceptance inspection, part 1 (production), shall be 1 percent.

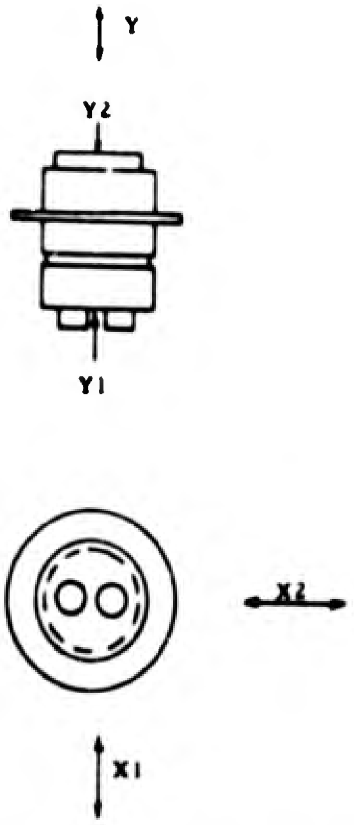
c. Eccentricity of anode, grid, and cathode with respect to centerline shall be 0.005 maximum.

d. Eccentricity of insulators with respect to centerline shall be 0.010 maximum.

e. Centerline of grid ring shall be reference life for horizontal tolerances.

f. Bottom surface of grid ring shall be reference plane for vertical tolerances.

Figure 1 Outline drawing.



The directions of the accelerating force for the specified vibration, fatigue, and shock tests shall be in accordance with the definitions above.

FIGURE 2

APPENDIX V

PILOT RUN TEST REPORT
NON-GOVERNMENT TEST LABORATORY

DATE 28 May 1964
REPORT NUMBER

SPECIFICATION TITLE: MILITARY SPECIFICATION
ELECTRON TUBES AND CRYSTAL RECTIFIERS

SPECIFICATION MIL-E-1D **DATED** 31 March 1958 **AMENDMENT** 5 **DATED** 24 April 1961

SHEET NUMBER SCL-7001/74B **DATED** 28 October 1963

MANUFACTURER Tube Department, General Electric Company

MAIN OFFICE ADDRESS
316 East Ninth Street
Owensboro, Kentucky

PLANT NAME AND ADDRESS WHERE PRODUCT WAS MANUFACTURED
Owensboro Tube Plant
Owensboro, Kentucky

DESCRIPTION OF PRODUCT, MIL DESIGNATION, AND MANUFACTURER'S TYPE NO:

Electron Tube Type 7486 with essential features as indicated in the Design- and Construction Information and Photograph showing construction details included in the previous PreProduction Test Report.

NAME AND LOCATION OF TEST LABORATORY:

Owensboro Tube Plant
Owensboro, Kentucky

MONITORED BY: William E. Turner
William E. Turner, QAR
Signature (Government Representative)
TITLE Cincinnati Procurement Dist.

C E Albrecht
C. E. Albrecht, Mgr.
Signature (Responsible Official or authorized representative of test laboratory)
TITLE Specification Development
Tube Engineering

DATE OF USAEMSA AUTHORIZATION LETTER:
TAR #1 (ActionV) dated 8 January 1964

PURPOSE OF TESTS:
PEM Pilot Run Tests

INCLOSURES:
(1) Summary of Test Data
(2) Summary of Environmental Test Data
(3) Summary of Life Test Data

Page 1

DESC FORM 36F JUN 62

REFERENCES:

PED#1, dated 13 November 1963
PED#2, dated 22 November 1963
TAR#1, dated 29 November 1963

EXTENT OF TESTING PERFORMED:

Complete Pilot-run Testing

SUMMARY OF RESULTS:

Pilot-run lots passed all specification requirements, except Intermittent-1 life test.

TEST PERSONNEL:

Edith Smith-Shock Tester
Perry Stephens-Laboratory Technician
Kathleen Cole-Tester
Mary James-Tester
Martha Scott-Tester
Katherine Bray-Tester
Pearl Hagan-Tester
Nancy Wilson-Tester
L. F. Jeffrey-Engineer, Test Laboratory
J. E. Templet-Engineer, Test Laboratory
Eugene Estes-Foreman, Test Laboratory
Z. H. Clark-Foreman, Quality Control

REMARKS:

ADDENDA:

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ABSTRACT OF RESULTS OF TESTS

MANUFACTURER GENERAL ELECTRIC COMPANY
SPECIFICATION SCL-7001/741
PRODUCT ELECTRON TUBE, IMPROVED TYPE 748
TEST REPORT NUMBER

	TEST	PAR. NO.	NO. TESTED	NO. PASSED	NO. FAILED	REMARKS
Part 1	Continuity & Shorts	4.7.5	110	109	1*	0.4% AQL, Insp Lev II n=110, c=2
	Heater Current	4.10.8	110	110	0	
	Heater Cathode Leakage	4.10.15	110	110	0	
	Plate Current	4.10.4.1	110	110	0	0.65% AQL, Insp LevI
	Transconductance (1)	4.10.9	110	110	0	n=110 c=2
	Pulse Cathode Current	4.10.7.5	110	110	0	
	Mech-prod. Tests	4.9.1	110	110	0	
Part 2	Insulation of Electrodes	4.8	50	50	0	
	Transconductance (2)	4.10.9	50	49	1	
	Grid Voltage	4.10.5.2	50	49	1	2.5% AQL, Insp Lev I n=50, c=3
	Amplification Factor	4.10.11	50	50	0	
	Grid Emission	4.10.6.2	50	50	0	
	Grid Recovery	----	50	50	0	6.5% AQL, Insp Lev I n=50, c=6
	Power Oscillation(1)	4.10.2.2	25	25	0	2.5% AQL, Code Ltr G n=25, c=1
	Power Oscillation(2)	4.10.2.2	25	25	0	2.5%AQL, Code LtrG n=25, c=1
	Direct Interelectrode Cap.	4.10.14	10	10	0	6.5% AQL, Code Ltr E n=10, c=1
	Low-press. Voltage Bkdn	4.9.12.1	15	15	0	6.5% AQL, Code Ltr F n=15, c=2
	Var.-frequency Vib(1)	----	4	4	0	$n_1=4, c_1=0, n_2=8, c_c=1$
	Low-frequency Vib(2)	4.9.19.1	50	50	0	6.5%AQL, Code Ltr I n=50, n=6
Part 3	Shock	4.9.20.5	4	4	0	$n_1=4, c_1=0, n_2=8, c_c=4$
	Fatigue	----	4	4	0	$n_1=4, c_1=0, n_2=8, c_c=1$
	Envelope Strain	4.9.6.3	50	50	0	2.5%AQL, Insp Lev I n=50, c=3

(*) - Tube which failed Continuity & Shorts test was removed from electrical test sample and replaced by random selected tube to retain specified sample size for acceptance tests, part 1.

ABSTRACT OF RESULTS OF TESTS

MANUFACTURER GENERAL ELECTRIC COMPANY

SPECIFICATION SCL-7001/74B

PRODUCT ELECTRON TUBE, IMPROVED TYPE 7486

TEST REPORT NUMBER

Part 3

TEST	PAR. NO.	NO. TESTED	NO. PASSED	NO. FAILED	REMARKS
Heater Cycling Life Test	4.11.7	15	15	0	
Int. (Operation-1) Life Test	4.11.5	25	17	8	3-If 1-H K Short, 5-low Sm
Int. (Operation-2) Life Test	4.11.5	5	5	0	
Power Output	----	10	10	0	
Resonant Frequency	----	10	10	0	

Periodic Check

MONITORED BY:

John H. Baldrige.

John H. Baldrige, OARep

Signature: Authorized Government Representative

Title: Cincinnati Procurement District, U. S. Army

9-90
(Mar 61)

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DESCRIPTION OF TEST EQUIPMENT:

SPEC PARA	EQUIPMENT	MANUFACTURER	TYPE OR MODEL	SERIAL OR INVENTORY #	DATE OF CALIBRATION
4.10.8 4.10.15 4.10.4.1 4.10.9 4.10.5.2 4.10.1 4.10.6.2	Universal Lab Test Set Plug-in meters used in this equipment were calibrated on or after 3-2-64	General Electric Company	Lab	TL-015	10-2-63
4.10.7.5	Pulse Test Set Plug-in meters used in this equipment were calibrated on or after 2-3-64.	General Electric Company	Lab	TL-001	8-3-63
4.7.5	Continuity and Short Test Set Plug-in meters used in this equipment were calibrated on or after 2-5-64.	General Electric Company	Lab	TL-073	12-6-63
4.8	Insulation Resistance Test Set Plug-in meters used in this equipment were calibrated on or after 2-6-64.	Maclead and Hanopol, Inc	Lab	TL-035	10-24-63
4.10.2.2	450Mc P. O. Test Set Plug-in meters used in this equipment were calibrated on or after 2-3-64.	General Electric Company	Lab	TL-054	11-21-63
4.10.2.2	5900Mc P.O. Test Set Plug-in meters used in this equipment were calibrated on or after 2-7-64	General Electric Company	Lab	TL-068	12-6-63

Q-90
(Mar 61)

DESCRIPTION OF TEST EQUIPMENT:

SPEC PARA	EQUIPMENT	MANUFACTURER	TYPE OR MODEL	SERIAL OR INVENTORY #	DATE OF CALIBRATION
4.10.14	Interelectrode Capacitance Bridge	Sylvania Model A modified by General Electric Company	Lab	TL-023	3-3-64
---	Grid Recovery Test Set	General Electric Company	Lab	TL-036	1-6-64
	Plug-in meters used in this equipment were calibrated on or after 2-11-64				
---	2200Mc P.O. Test Set	General Electric Company	Lab	TL-069	12-5-63
4.9.12.1	Low Pressure Voltage Breakdown Test Unit	General Electric Company	Lab	TL-065	
4.9.19.1	Low-frequency Vibration Test Set	General Electric Co. built around M B Co Vibrator	Lab	TL-010	2-11-64
	Plug-in meters used in this equipment were calibrated on or after 3-3-64.				
---	Variable-frequency Vibration Test Set	General Electric Co. built around Unholtz-Dickie Co. Vibrator	Lab	TL-012	12-6-63
	Plug-in meters used in this equipment were calibrated on or after 2-12-64				
4.9.20.5	High Impact Shock Machine	Taft & Pierce Company	Navy	A47	9-5-63
4.9.20.6	Variable-frequency Vibration Fatigue Unit	Ling Sine-O-Matic Vibration Testing System	Lab	TL-045	12-5-63

Electronics Components Division
Tube Department
General Electric Company
Owensboro Tube Plant

3 March 1964

Test Results of 7486 (PEM Pilot-Run) Tubes
Acceptance Inspection, Part 1 and Part 2

A summary of attributes testing in accordance with Specification SCL-7001/74B and the Acceptance Sampling Plan by Attributes of MIL-STD 105C is as follows:

1. Acceptance Inspection Tests, Part 1

Test	Sample Size	No. of Def.	AQL-Insp Lev.
Heater Current	110	0	0.65%-II
Heater Cathode Leakage	110	0	0.65%-II
Plate Current	110	0	0.65%-II
Transconductance (1)	110	0	0.65%-II
Pulse Cathode Current	110	0	0.65%-II
Continuity and Shorts	110	1	0.40%-II
Mech-Production Tests	50	0	1.0 %- I

2. Acceptance Inspection Tests, Part 2

Test	Sample Size	No. of Def.	AQL-Insp Lev.
Insulation of Electrodes	50	0	2.5%-I
Transconductance (2)	50	1	2.5%-I
Grid Voltage	50	1	2.5%-I
Amplification Factor	50	0	2.5%-I
Power Oscillation (1)	25	0	2.5%-Code G
Power Oscillation (2)	25	0	2.5%-Code G
Grid Emission	50	0	2.5%-I
Grid Recovery	50	0	6.5%-I
Direct Interelect. Capac.	10	0	6.5%-Code E
Low-Press Voltage Bkdn	15	0	6.5%-Code F
Variable-freq Vibration	4	0	n=4/8, c=0/1
Low-freq Vibration (2)	50	0	6.5%-CodeI

MONITORED BY

John H. Baldrige

John H. Baldrige, OARep
Signature, Authorized Government Representative
Cincinnati Procurement District, U.S. Army

GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT

TYPE 7486 (PEM Pilot-Run)
20 February 1964

Tubes Tested in Accordance with Specification SCL-7001/74B
Dated 28 October for Electron Tube Type 7486

Page Number 1

Reference	**Test**		**Tube Numbers**								Limits		**Unit**
			1	2	3	4	5	7	8	9	Min	Max	
	Periodic-Check Tests												
-----	Power Output	Po:	560	550	550	550	580	550	540	560	350	---	mW
-----	Power Gain	Gain:	10.5	10.4	10.4	10.4	10.7	10.4	10.3	10.5	---	---	db
-----	3db Band Width	BW:	21	20	19	19	19	20	18	19	---	---	mc
-----	Resonant Frequency	F:	2223	2222	2212	2231	2215	2228	2222	2224	2050	2350	mc

GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT

TYPE 7486 (PEM Pilot-Run)
20 February 1964

Tubes Tested in Accordance with Specification SCL-7001/74B Dated
28 October 1963 for Electron Tube Type 7486

Page Number 2

Reference	Test	Tube Numbers								Limits		Unit
		10	11							Min	Max	
	Periodic-Check Tests											
-----	Power Output Po:	560	570							350	---	mW
-----	Power Gain Gain:	10.5	10.6							---	---	db
-----	3db Band Width BW:	19	15							---	---	mc
-----	Resonant Frequency F:	2226	2206							2050	2350	mc

MONITORED BY

John H. Baldrige

John H. Baldrige, OARep
Signature, Authorized Government Representative
Title, Cincinnati Procurement District, U.S. Army

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Electronics Components Division
Tube Department
General Electric Company
Owensboro Tube Plant

3 March 1964

Tube Type: 7486
(Pilot-Run Lot)

Shock: in a/w SCL-7001/74B
dated 28 October 1963

Reference	Description	Symbol	Tube Number				Limits		
			121	122	123	124	Min.	Max.	Unit
	Shock Test Sample								
	Before Shock								
4.9.19.1	Low-frequency	Ep(Y)	2.0	2.0	1.0	1.0	---	10	mVac
	Vibration (2)	Ep(X2)	3.0	1.0	1.0	1.0	---	10	mVac
4.10.15	Heater Cathode	Ihk(+)	0	0	0	0	---	20	µAdc
	Leakage	Ihk(-)	0	0	0	0	---	20	µAdc
4.10.8	Heater Current	If	256	254	253	254	222	258	mA
4.7.5	Continuity & Shorts		OK	OK	OK	OK	---	---	---
	After Shock								
4.9.19.1	Low-frequency	Ep(Y)	1.0	1.0	2.0	1.0	---	15	mVac
	Vibration(2)	Ep(X2)	1.0	1.0	1.0	1.0	---	15	mVac
4.10.15	Heater-Cathode	Ihk(+)	0	0	0	1.0	---	20	µAdc
	Leakage	Ihk(-)	0	0	0	1.5	---	20	µAdc
4.10.8	Heater Current	If	257	255	254	252	222	258	mA
4.7.5	Continuity & Shorts		OK	OK	OK	OK	---	---	---

MONITORED BY:

John H. Baldrige

John H. Baldrige, QARep
Signature, Authorized Government
Representative
Cincinnati Procurement Distric
U. S. Army

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Electronic Components Division
Tube Department
General Electric Company
Owensboro Tube Plant

3 March 1964

Tube Type: 7486
(Pilot-Run Lot)

Fatigue: in a/w SCL-7001/74B
dated 28 October 1963

Reference	Description	Symbol	Tube Number				Limits		
			117	118	119	120	Min.	Max.	Un
	Fatigue Test Sample								
	Before Fatigue								
4.9.19.1	Low-frequency	Ep(Y)	1.0	1.0	2.0	1.0	---	10	mVac
	Vibration(2)	Ep(X2)	3.0	1.0	1.0	1.0	---	10	mVac
4.10.15	Heater-Cathode	Ihk(+)	0	0	2.0	0	---	20	µAdc
	Leakage	Ihk(-)	0	0	0	0	---	20	µAdc
4.10.8	Heater Current	If	255	253	255	255	222	258	mA
4.7.5	Continuity & Shorts		OK	OK	OK	OK	---	---	---
	After Fatigue								
4.9.19.1	Low-frequency	Ep(Y)	1.5	0.5	0.5	1.0	---	15	mVac
	Vibration(2)	Ep(X2)	0.8	1.0	0.6	1.0	---	15	mVac
4.10.15	Heater-Cathode	Ihk(+)	0	0	0	0	---	20	µAdc
	Leakage	Ihk(-)	0	0	0	0	---	20	µAdc
4.10.8	Heater Current	If	253	250	253	253	222	256	mA
4.7.5	Continuity & Shorts		OK	OK	OK	OK	---	---	---

MONITORED BY

John H. Baldrige

John H. Baldrige, QARep
Signature, Authorized Government Representative
Cincinnati Procurement District, U.S. Arm

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GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT
OWENSBORO, KENTUCKY

RECENT LIFE TEST DATA IN ACCORDANCE WITH SCL-7001/74B FOR ELECTRON TUBE TYPE 7486 DATED 28 OCTOBER 1963

HEATER CYCLING LIFE TEST

Conditions: Ef = 7.0 Vac; Ehk = +70 Vdc; Rk = 0; Eb = Ec = 0

Production Lot	Tube No.	Ihk (μAdc) at 0 Cycles		Ihk(μAdc) at 2000 Cycles	
		Positive	Negative	Positive	Negative
Pilot-run	863-1	0	0	0	0
	863-2	0	0	0	0
	863-3	0	0	0	0
	863-4	0	0	0	0
	863-5	0	0	0	0
	863-6	0	0	0	0
	863-7	0	0	0	0
	863-8	0	0	0	0
	863-9	0	0	0	0
	863-10	0	0	0	0
	864-1	0	0	0	0
	864-2	0	0	0	0
	864-3	0	0	0	0
	864-4	0	0	0	0
	864-5	0	0	0	0

The foregoing is a true transcript of the Life Test Records of the General Electric Company.

Signed: John H. Baldrige.
John H. Baldrige, QARep
Cincinnati Procurement District,
U.S. Army

Date: 22 May 1964

GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT
OWENSBORO, KENTUCKY

LIFE TEST DATA IN ACCORDANCE WITH SCL-7001/74B SPECIFICATION FOR ELECTRON TUBE TYPE 7486
DATED 28 OCTOBER 1963
INTERMITTENT LIFE TEST
Operation - 1

Production Lot: Pilot-Run

Conditions: Ef=6.3 Vac, Ebb=180Vdc; Rk=0; Eg=6.0 Vac; F=60cps; Ehk=-70Vdc; Rg=1200 ohms; Rb=3300 ohms.

0 Hours

Tube No.	Continuity and Short	Heater Current (mA)	Transconductance (1) (µmhos)	Transconductance (2) (%)	H-K Leakage (µAdc)		Insul. of Elect (Meg.)	
					Heater Positive	Heater Negative	Rg-all	Rp-all
891 -1	OK	253	9000	4.44	0	0	100K	300K
-2	OK	254	11500	13.04	0	0	100K	300K
-3	OK	252	13600	11.76	0	0	100K	300K
-4	OK	250	10500	7.61	0	0	100K	300K
-5	OK	251	10300	8.73	0	0	100K	300K
-6	OK	250	11000	9.09	0	0	100K	300K
-7	OK	252	12000	8.33	0	0	100K	300K
-8	OK	252	10000	7.00	0	0	100K	300K
-9	OK	254	11000	9.09	0	0	100K	300K
-10	OK	253	10600	8.86	0	0	100K	300K
892 -1	OK	251	11000	9.09	0	0	100K	300K
-2	OK	250	10300	8.73	0	0	100K	300K
-3	OK	250	9700	4.12	0	0	100K	300K
-4	OK	254	12000	8.33	0	0	100K	300K
-5	OK	252	10700	10.28	0	0	100K	300K
-6	OK	254	9300	6.45	0	0	100K	300K
-7	OK	247	11000	9.09	0	0	100K	300K
-8	OK	248	9600	8.33	0	0	100K	300K
-9	OK	254	10300	6.79	0	0	100K	300K
-10	OK	253	11700	9.40	0	0	100K	300K

K denotes 1000

Operation-1

0 Hours (Continued)

Type 7486

Tube No.	Continuity and Short	Heater Current (mA)	Transconductance (1) (μmhos)	Transconductance(2) (%)	H-K Leakage (μAdc)		Insul. of Elect. (Meg.)	
					Heater Positive	Heater Negative	Rg-all	Rp-all
893 -1	OK	252	10200	5.88	0	0	100K	300K
-2	OK	251	9600	6.25	0	0	100K	300K
-3	OK	251	9600	8.33	0	0	100K	300K
-4	OK	253	12000	8.33	0	0	100K	300K
-5	OK	250	9600	11.45	0	0	100K	300K

K denotes 1000

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INTERMITTENT LIFE TEST

Type 7486

Operation - 1

500 Hours

Tube No.	Continuity and Short	Heater Current (mA)	Transconductance (1) (µmhos)	Transconductance (2) (%)	H-K Leakage(µAdc)		Insul. of Elect. (Meg.)	
					Heater Positive	Heater Positive	Rg-all	Rp-all
891 -1	OK	260	8700	6.89	0	0	100K	300K
-2	OK	263	13000	1.53	0	0	100K	300K
-3	OK	260	13000	8.46	0	0	100K	300K
-4	OK	256	11000	9.09	0	0	100K	300K
-5	OK	259	10000	8.00	0	0	100K	300K
-6	OK	253	11200	8.92	0	0	100K	300K
-7	OK	256	11400	7.89	0	0	100K	300K
-8	OK	262	7500	8.00	0	0	100K	300K
-9	OK	262	10700	11.21	0	0	100K	300K
-10	OK	259	10400	7.69	0	0	100K	300K
892 -1	OK	256	11700	14.53	0	0	100K	300K
-2	OK	254	9900	13.13	0	0	100K	300K
-3	OK	260	7000	7.14	0	0	100K	300K
-4	OK	257	11000	7.27	0	0	100K	300K
-5	OK	260	10400	10.57	0	0	100K	300K
-6	OK	266	8800	4.54	0	0	100K	300K
-7	OK	250	10000	11.00	0	0	100K	300K
-8	OK	251	9900	11.11	0	0	100K	300K
-9	OK	264	10000	10.00	0	0	100K	300K
-10	OK	259	11000	2.72	0	0	100K	300K
893 -1	OK	265	10600	7.55	0	0	100K	300K
-2	OK	260	9000	7.77	0	0	100K	300K
-3	OK	255	8800	9.09	0	0	100K	300K
-4	OK	261	12000	10.83	0	0	100K	300K
-5	OK	260	9300	7.52	0	0	100K	300K

No inoperatives
K denotes 1000

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INTERMITTENT LIFE TEST

Operation 1

Type 7486

1000 Hours

Tube No.	Continuity and Short	Heater Current (mA)	Transconductance (1) (μmhos)	Transconductance (2) (%)	H-K Leakage (μAdc) Heater Positive	H-K Leakage (μAdc) Heater Negative	Insul. of Elect. (Meg.) Rg-all	Insul. of Elect. (Meg.) Rp-all
891-1	OK	260	6150	12.03	0	0	100K	300K
-2	H-K Short	--	--	---	--	--	--	--
-3	OK	260	10400	8.26	0	0	100K	300K
-4	OK	257	10800	11.94	0	0	100K	300K
-5	OK	259	9420	8.91	0	0	100K	300K
-6	OK	254	10800	11.75	0	0	100K	300K
-7	OK	256	10300	9.90	0	0	100K	300K
-8	OK	260	4890	8.38	0	0	100K	300K
-9	OK	260	9640	14.73	0	0	100K	300K
-10	OK	259	8670	11.30	0	0	100K	300K
892-1	OK	252	10800	16.01	0	0	100K	300K
-2	OK	253	9200	13.15	0	0	100K	300K
-3	OK	257	5200	8.26	0	0	100K	300K
-4	OK	260	9440	10.91	0	0	100K	300K
-5	OK	260	9530	11.64	0	0	100K	300K
-6	OK	265	6550	9.00	0	0	100K	300K
-7	OK	250	8490	11.18	0	0	100K	300K
-8	OK	251	9920	11.79	0	0.5	100K	300K
-9	OK	264	7710	10.37	3.5	2	100K	300K
-10	OK	259	9660	9.73	0	0	100K	300K
893-1	OK	265	8140	7.86	0	0	100K	300K
-2	OK	260	6210	9.17	0	0	100K	300K
-3	OK	256	6390	10.03	0	0	100K	300K
-4	OK	261	10700	11.86	0	0	100K	300K
-5	OK	261	7350	8.84	0	0	100K	300K

No inoperatives
K denotes 1000

The foregoing is a true transcript of the life test records of the General Electric Company.

Signed: John H. Baldrige

Date: 28 May 1964

GENERAL ELECTRIC COMPANY
OWENSBORO TUBE PLANT
OWENSBORO, KENTUCKY

RECENT LIFE TEST DATA IN ACCORDANCE WITH SCL-7001/74B SPECIFICATION FOR ELECTRON TUBE TYPE 7486. DATED 28 OCTOBER 1963

INTERMITTENT LIFE TEST

Operation - 2

Production Lot: Pilot-run

Conditions: Ef=6. 3 Vac; Ebb=250 Vdc; Rg/Ib=15 mAdc; Ig=5-7 mAdc; Freq=475±25mc; TA=Room.

0 Hours

Tube No.	Continuity and Short	Heater Current (mA)	Power Oscillation-1 (W)	Power Oscillation-2 (mW)	H-K Leakage(μAdc)		Insul. of Elect. (Meg.)	
					Heater Positive	Heater Negative	Rg-all	Rp-all
862 -1	OK	252	1.6	45	0	0	100K	300K
-2	OK	250	2.1	44	0	0	100K	300K
-3	OK	250	2.1	38	0	0	100K	300K
-4	OK	249	1.9	44	0	0	100K	300K
-5	OK	250	2.0	44	0	0	100K	300K

K denotes 1000

INTERMITTENT LIFE TEST

Type 7486

Operation - 2

500 Hours

Tube No.	Power Osc (1) (W)	Change in Power Osc. (1) from Initial (%)
862-1	1.75	9.37
-2	2.15	2.38
-3	2.10	0
-4	1.95	2.63
-5	2.00	0

INTERMITTENT LIFE TEST
Operation 2

Type 7486

1000 Hours

Tube No.	Continuity and Short	Heater Current (mA)	Power Osc. (W)	Change in Power Osc. (1) from Initial (%)	Power Osc. (mW) (%)	Change in Resonant Frequency (mc)	H-K Leakage(μAdc) Heater Positive	Heater Negative	Insul. of Elect. (Meg.) Rg-all	Rp-all
862-1	OK	260	1.7	6.25	38	-4	0	0	100K	300K
-2	OK	262	2.1	0	45	-2	0	0	100K	300K
-3	OK	255	2.1	0	-42	0	.5	0	100K	300K
-4	OK	245	1.95	2.63	43	0	0	0	100K	300K
-5	OK	260	1.95	2.56	37	+4	0	0	100K	300K

No inoperatives
K denotes 1000

The foregoing is a true transcript of the life test records of the General Electric Company.

Signed: John H. Baldrige QC

Date: 28 May 1964

GENERAL ELECTRIC COMPANY
ELECTRONIC COMPONENTS DIVISION
TUBE DEPARTMENT
OWENSBORO, KENTUCKY

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