AD 636985

TWELFTH, THIRTEENTH, AND FOURTEENTH

QUARTERLY PROGRESS REPORT

CR-(XM-44)/U

Moderate Precision Glass Enclosed Crystals

1 January 1965 to 30 September 1965

Contract No. DA-36-039OSC-86717

Placed by:

UNITED STATES ARMY ELECTRONICS COMMAND

Philadelphia, Pennsylvania

MIDLAND-WRIGHT CORPORATION

3151 Fiberglas Road
Kansas City, Kansas 66117

UNCLASSIFIED

# CR-(XM-44)/U Moderate Precision Glass Enclosed Crystals

TWELFTH, THIRTEENTH, AND FOURTEENTH

QUARTERLY PROGRESS REPORT

COVERING PERIOD: 1 January 1965 to 30 September 1965

The object of this study is to establish capability to manufacture moderate precision crystal units in the HC-27/U (glass) crystal holder.

Contract No. DA-36-039-SC-86717

ELECTRONICS COMMAND SPECIFICATION SCS-120 (9 November 1961)

Report Prepared by:

Melvin Hammer and Stuart Radetsky

MIDLAND-WRIGHT CORPORATION

3151 Fiberglas Road
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ABSTRACT

This report covers three quarters because activity during the period of 1 April through 30 September 1965, was too limited to warrant issuance of an individual report.

The frequency measurement system used in the aging test set-up is described.

The pre-production samples were rejected due, mainly, to corrosion on the holder pins. Correction of this problem is discussed.

The glass sealing technique is described - including the equipment and process used, and crystal frequency change due to the heat generated by the seal process.

The Inspection and Quality Control Plan is represented by the use of various charts and data forms.

## PURPOSE

The purpose of this Production Engineering Measure is to prove Producibility on Crystal Units CR-(XM-44)/U as described in Signal Corps Technical Requirement SCS-120. Specifically, the capability to manufacture these crystals on a pilot line basis will be established. Techniques and facilities will be defined, which will make it possible to fabricate these units on a production basis. The primary problems to be solved are:

1) To design crystals as required by Contract No. 19039-PP-62-81-81.
2) To specify optimum manufacturing processes (Including tooling, labor, and required test equipment).

Two particular areas which will require considerable production engineering are:

1) Optimization of the glass sealing technique required for the HC-27/U holder to insure a good seal with a minimum of stress on the Quartz Crystal.
2) Establishing adequate techniques and equipment for measuring the aging characteristics of the crystals.

## II. NARRATIVE AND DATA

### A. DELIVERY SCHEDULE

Delays in the receipt of cultured quartz from suppliers has forced a change in the delivery schedule. This change is described in modification No. 3 of the contract.

### B. CRYSTAL PARAMETER TEST METHOD

In the Eleventh Quarterly Report, the operating specifications for and the mechanical layout of the proportional control oven that is used in the aging test set-up were fully described. The crystal frequency measurement system that is used with the oven is to be discussed now. Reference should be made to the block diagram given in drawing 1634-A on page 3.

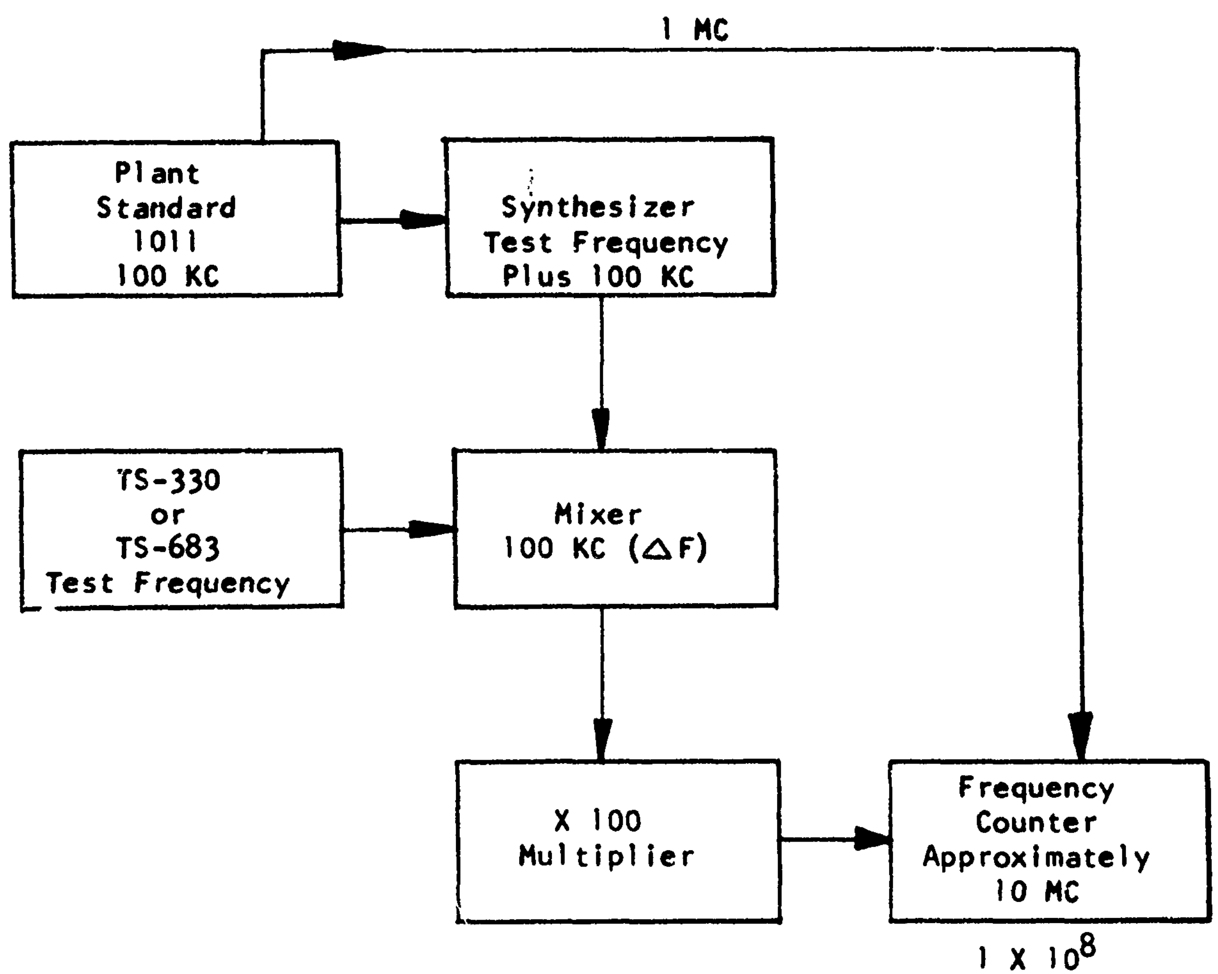
The plant standard is a Motorola Type 1011 Frequency Standard Model S-1065AR which has a drift rate of less than 5 parts in $10^{11}$ per day. The output of the plant standard is fed into a C.M.C. Model 738A Frequency Counter; and also, into a Rohde & Schwarz Type XUA-3N444462 Frequency Synthesizer which operates 100 KC above the required test frequency.

The test frequency is mixed with the synthesizer frequency and the difference is then multiplied by 100 in a Hewlett Packard Model 512B multiplier. The output is read on the Frequency Counter at approximately 10 megacycles. This gives the ability to read any frequency up to 300 megacycles to plus or minus one part in $10^8$.

| SIZE | DRAWING NUMBER | ISSUE |
|---|---|---|
| A | 1634-A | A |

**REVISIONS**

| | |
|---|---|
| A | ORIGINAL ISSUE |




| NO REQ | NEXT ASSEMBLY | MODEL |
|---|---|---|

**MIDLAND MANUFACTURING CO.**
DIVISION OF PACIFIC INDUSTRIES, INC.
3155 FIBERGLAS ROAD KANSAS CITY, KANSAS

# XM-44 AGING LAYOUT

| | | |
|---|---|---|
| MATERIAL | | |
| FINISH | DR RN | 7-66 |
| | CH | |
| UNLESS OTHERWISE SPECIFIED, DIMENSIONS IN INCHES. TOLERANCES: FRACTIONAL ± 1/64, DECIMAL ± .005, ANGULAR ± 1/2° | ENG | |

| SCALE | SIZE | DRAWING NUMBER | ISSUE |
|---|---|---|---|
| | A | 1634-A | A |

## C. PRE-PRODUCTION SAMPLES

### 1. Data and Specifications

The pre-production samples (thirty crystals) were shipped on April 15, 1965. Data on these, which include results on both natural quartz and cultured quartz, are given on Tables I, II, and III, on pages 6, 7, and 8. The tables are preceeded by a list of the crystal requirements specified in Military Specification SCS-120.

### 2. Government Test Results

On September 21, 1965, Midland-Wright was notified that the pre-production crystals were rejected due to corrosion on the holder pins which occurred after they were subjected to the salt spray and moisture resistance tests. The pin corrosion is shown in the photographs of rejected samples on pages 9 and 10.

Also, some units were rejected due to their being out of frequency tolerance.

## MILITARY SPECIFICATION SCS-120

## CRYSTAL UNIT SPECIFICATION CR-(XM-44)/U

| | |
|---|---|
| Holder | HC-27/U (Glass HC-6) |
| Frequency Range | 5.0 to 20.0 MC/s Incl. |
| Overall Frequency Tolerances: | |
| At reference temperature | ± 0.0005% |
| At room temperature | ± 0.008% |
| Stability within overall Frequency tolerance | ± 2 parts in $10^7$ per °C |
| Crystal Units Quality (Q)[1] | 250,000 minimum |
| Load Capacitance | 50.0 ± 0.5 pf |
| Mode | Third Mechanical Overtone |
| Reference Temperature | 85° ± 1° C |
| Temperature Ranges | |
| Operating (Controlled) | $80^{\circ}\,{}^{+0^{\circ}}_{-1^{\circ}}$ to $90^{\circ}\,{}^{+1^{\circ}}_{-0^{\circ}}$ C |
| Operable | $-55^{\circ}\,{}^{+0^{\circ}}_{-3^{\circ}}$ to $+80^{\circ}\,{}^{+3^{\circ}}_{-0^{\circ}}$ C |
| Test Set[2] | TS-330/TSM, Modified |
| Rated Drive Level | 50uW |
| Capacitance, Shunt | 2 pf Min. to 7 pf Max. |
| Aging[3] | ± .00001% Frequency Change Max. |
| Aging Temperature | 85° ± 0.5° C |

1. $Q = \dfrac{1}{4\,(\Delta F)\,(C_1)\,(R)}$

   $\Delta F = F_A - F_S$ (50 pf Load Cap.)

   $C_1 = C_o + C_L$

   R = Series Resonant Resistance

2. TS-330/TSM Modification: Part HB-16490, supplied by Radio Frequency Laboratories, Inc. Boonton, New Jersey.

3. Frequency change applies to measurement taken once each working day during one week of storage at the specified temperature. The aging rate shall be determined after a 24-hour stabilization period.

## TABLE I

**TYPE**

CR-(XM)-44/U

**FREQUENCY**

5.000MC

**DESIGN**

Plate Diameter - 0.550"
Electrode Diameter - 0.380"
Contour - #4 Diopter Plane Convex

**REQUIREMENTS**

Mode of operation - 3rd Overtone
Load Capacity - 50 pf
Frequency Tolerance - ±.008% @ room temperature
- ±.0005% @ 85° C
Q - 250,000 minimum
Static Capacity - 2pf minimum, 7pf maximum

| ROOM TEMPERATURE | | | | | | | 85° C | |
|---|---|---|---|---|---|---|---|---|
| Series Frequency | Series Resistance | Parallel Frequency | Parallel Resistance | Static Capacity | Inductance | Q | Parallel Frequency | Parallel Resistance |
| NATURAL QUARTZ | | | | | | | | |
| 5.000175MC | 50 OHMS | 5.000203MC | 62 OHMS | 4.26pf | 1.[illegible]hy | 1,049,000 | 5.000004 | 62 |
| 5.000133MC | 44 OHMS | 5.000164MC | 61 OHMS | 4.01pf | 1.52hy | 1,084,000 | 4.999986 | 40 |
| 5.000099MC | 45 OHMS | 5.000127MC | 54 OHMS | 4.04pf | 1.67hy | 1,165,000 | 5.000015 | 40 |
| 5.000140MC | 40 OHMS | 5.000168MC | 45 OHMS | 4.0 pf | 1.67hy | 1,311,000 | 5.000017 | 40 |
| 5.000133MC | 41 OHMS | 5.000162MC | 49 OHMS | 4.07pf | 1.61hy | 1,233,000 | 5.000013 | 35 |
| 5.000080MC | 42 OHMS | 5.000108MC | 53 OHMS | 4.02pf | 1.67hy | 1,249,000 | 5.000004 | 40 |
| 5.000144MC | 42 OHMS | 5.000176MC | 51 OHMS | 4.28pf | 1.46hy | 1,092,000 | 4.999992 | 45 |
| CULTURED QUARTZ | | | | | | | | |
| 5.000167MC | 110 OHMS | 5.000198MC | 125 OHMS | 4.12pf | 1.51hy | 431,000 | 4.999996 | 140 |
| 5.000080MC | 105 OHMS | 5.000107MC | 130 OHMS | 4.0 pf | 1.72hy | 541,000 | 4.999980 | 160 |
| 5.000205MC | 110 OHMS | 5.000236MC | 130 OHMS | 4.0 pf | 1.51hy | 431,000 | 4.999992 | 160 |

## TABLE II

**TYPE**

CR-(XM)-44/U

**FREQUENCY**

10.00000MC

**DESIGN**

Plate Diameter - 0.550"
Electrode Diameter - 0.360"
Contour - #6 Diopter Double Bevel
0.375 Flat

**REQUIREMENTS**

Mode of operation - 3rd Overtone
Load Capacity - 50 pf
Frequency tolerance - ±.008% @ room temperature
- ±.0005% @ 85° C
Q - 250,000 minimum
Static Capacity - 2pf minimum, 7pf maximum

| | ROOM TEMPERATURE | | | | | | | 85° C | |
|---|---|---|---|---|---|---|---|---|---|
| Unit No. | Series Frequency | Series Resistance | Parallel Frequency | Parallel Resistance | Static Capacity | Inductance | Q | Parallel Frequency | Parallel Resistance |
| | | | | NATURAL QUARTZ | | | | | |
| 100 | 10.000127MC | 16 OHMS | 10.000371MC | 17 OHMS | 6.16pf | .092hy | 361,000 | 9.999954MC | 12 OHMS |
| 101 | 10.000062MC | 19 OHMS | 10.000279MC | 20 OHMS | 6.04pf | .104hy | 343,700 | 10.000029MC | 22 OHMS |
| 102 | 9.999997MC | 15 OHMS | 10.000240MC | 18 OHMS | 6.08pf | .093hy | 389,300 | 10.000004MC | 15 OHMS |
| 103 | 9.999994MC | 20 OHMS | 10.000232MC | 22 OHMS | 6.07pf | .095hy | 298,300 | 9.999973MC | 22 OHMS |
| 104 | 10.000119MC | 16 OHMS | 10.000357MC | 20 OHMS | 6.06pf | .095hy | 372,800 | 10.000031MC | 18 OHMS |
| 105 | 9.999989MC | 16 OHMS | 10.000220MC | 20 OHMS | 6.01pf | .103hy | 404,300 | 10.000022MC | 15 OHMS |
| 106 | 10.000167MC | 16 OHMS | 10.000398MC | 20 OHMS | 6.0 pf | .098hy | 384,600 | 10.000017MC | 21 OHMS |
| | | | | CULTURED QUARTZ | | | | | |
| 107 | 10.000062MC | 14 OHMS | 10.000313MC | 18 OHMS | 6.06pf | .090hy | 403,700 | 9.999952MC | 15 OHMS |
| 108 | 10.000030MC | 13 OHMS | 10.000268MC | 19 OHMS | 6.05pf | .095hy | 458,900 | 9.999964MC | 15 OHMS |
| 109 | 9.999840MC | 19 OHMS | 10.000088MC | 23 OHMS | 6.08pf | .090hy | 297,470 | 9.999970MC | 20 OHMS |

## TABLE III

**TYPE**

CR-(XM)-44/U

**FREQUENCY**

20.00000MC

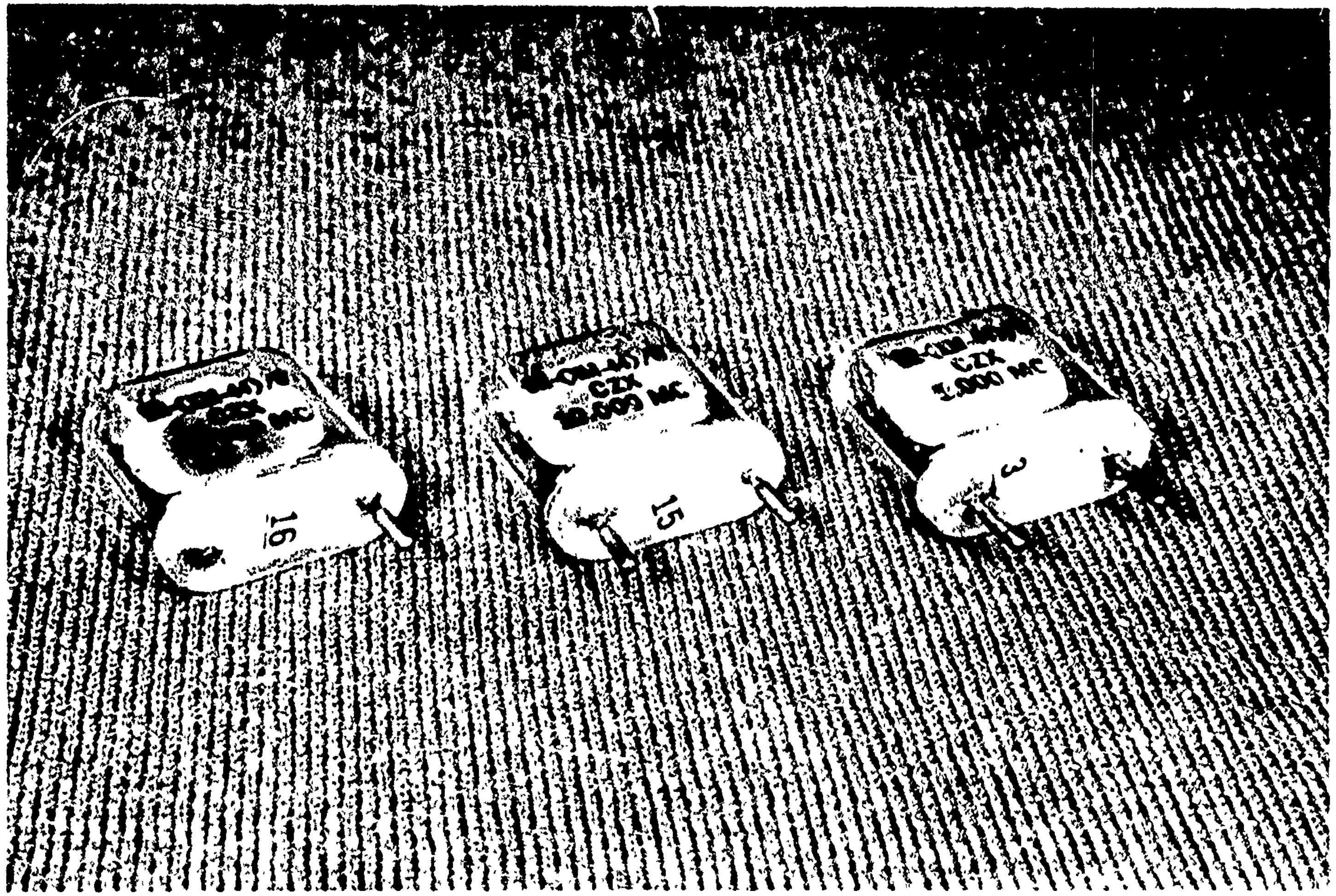
**DESIGN**

Plate Diameter - 0.495"
Electrode Diameter - 0.234"
Contour - #2 Diopter Double Bevel

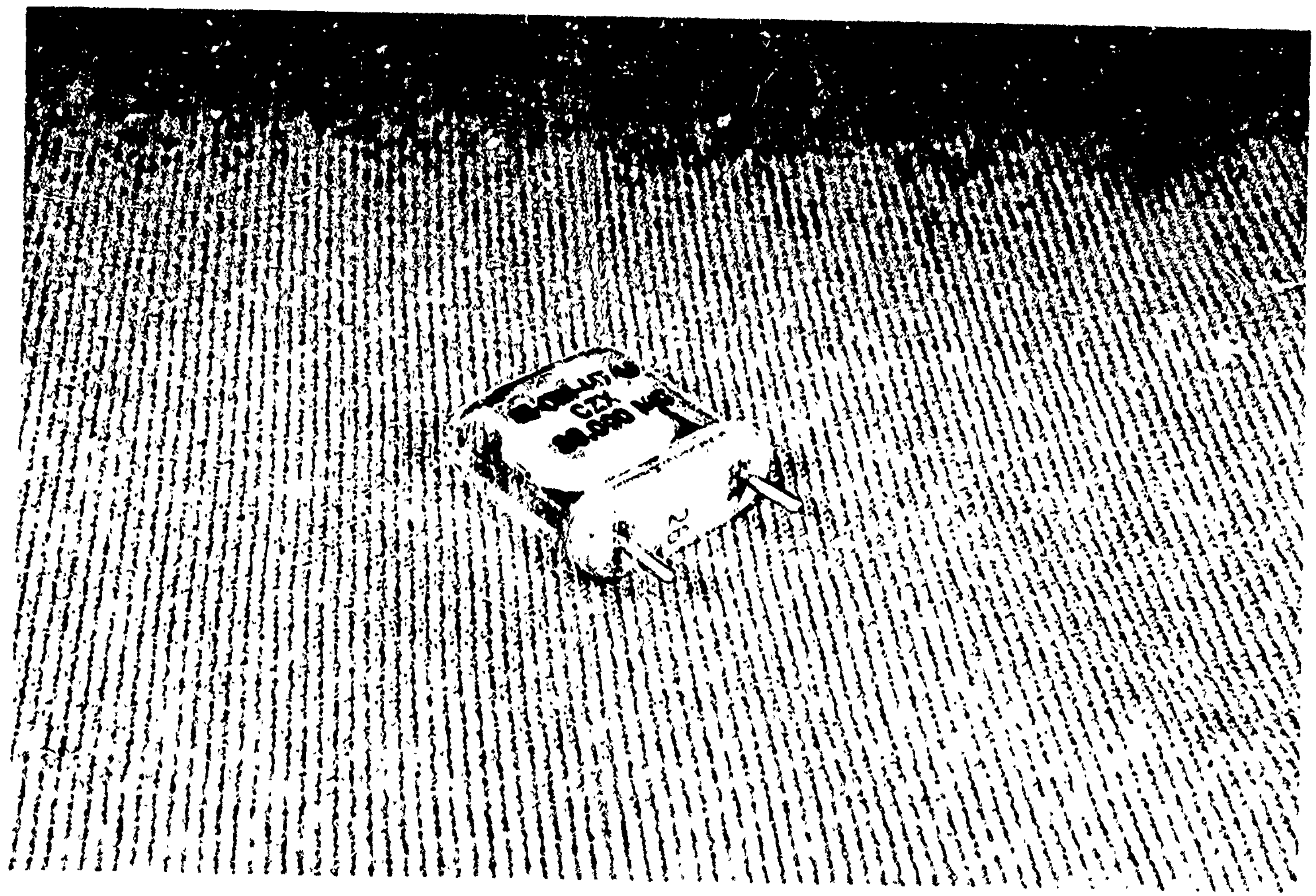
**REQUIREMENTS**

Mode of operation - 3rd Overtone
Load Capacity - 50 pf
Frequency tolerance - ±.008% @ Room temperature
- ±.0005% @ 85° C
Q - 250,000 minimum
Static Capacity - 2pf minimum, 7pf maximum

| | ROOM TEMPERATURE | | | | | | | 85° C | |
|---|---|---|---|---|---|---|---|---|---|
| Unit No. | Series Frequency | Series Resistance | Parallel Frequency | Parallel Resistance | Static Capacity | Inductance | Q | Parallel Frequency | Parallel Resistance |
| | | | | NATURAL QUARTZ | | | | | |
| 200 | 20.000487MC | 10 OHMS | 20.000860MC | 12 OHMS | 5.24pf | .031hy | 389,300 | 20.000018MC | 12 OHMS |
| 201 | 20.000550MC | 8 OHMS | 20.000928MC | 10 OHMS | 5.36pf | .030hy | 471,000 | 20.000090MC | 11 OHMS |
| 202 | 20.000499MC | 8 OHMS | 20.000894MC | 10 OHMS | 5.36pf | .029hy | 455,300 | 20.000002MC | 12 OHMS |
| 203 | 20.000476MC | 10 OHMS | 20.000888MC | 13 OHMS | 5.14pf | .028hy | 351,700 | 20.000093MC | 12 OHMS |
| 204 | 20.000401MC | 13 OHMS | 20.000804MC | 16 OHMS | 5.24pf | .028hy | 270,500 | 19.999902MC | 18 OHMS |
| 205 | 20.000326MC | 10 OHMS | 20.000716MC | 12 OHMS | 5.17pf | .029hy | 364,200 | 20.000077MC | 12 OHMS |
| 206 | 20.000123MC | 14 OHMS | 20.000527MC | 16 OHMS | 5.26pf | .028hy | 251,200 | 19,999944MC | 18 OHMS |
| | | | | CULTURED QUARTZ | | | | | |
| 207 | 20.000988MC | 9 OHMS | 20.001366MC | 10 OHMS | 5.20pf | .030hy | 418,600 | 20.000051MC | 13 OHMS |
| 208 | 20.000796MC | 9 OHMS | 20.001164MC | 11 OHMS | 5.32pf | .031hy | 432,600 | 19.999957MC | 15 OHMS |
| 209 | 20.000695MC | 10 OHMS | 20.001060MC | 11 OHMS | 5.34pf | .031hy | 389,300 | 19.999967MC | 13 OHMS |




PIN CORROSION



PIN CORROSION

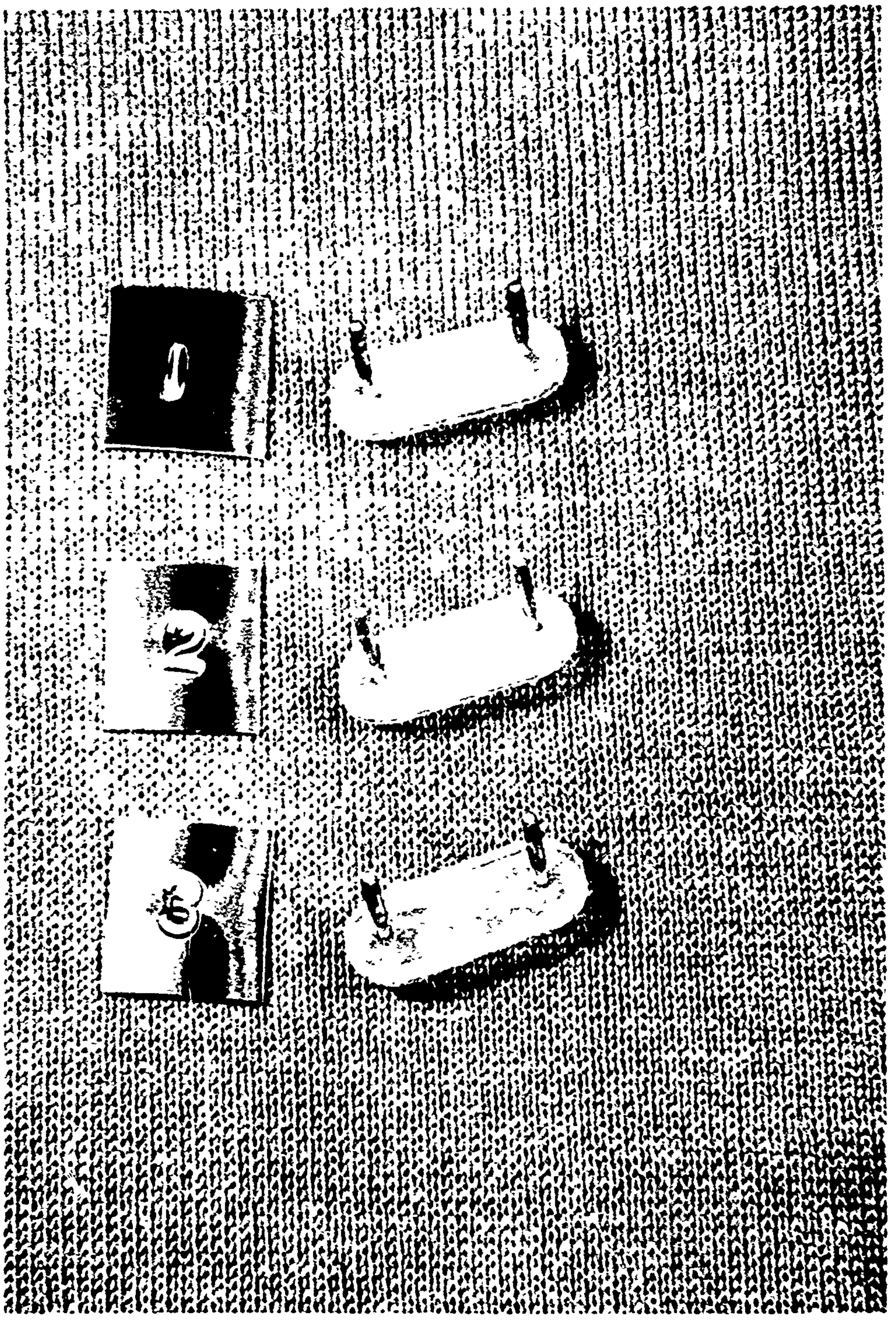
3. Corrective Action

Rejects other than pin corrosion were attributed to lack of angle control and to the problems involved in the technique of glass sealing. At present such difficulties are being investigated by thorough examination of the rejected samples.

Corrosion tests had been conducted at Midland-Wright on the pins prior to the fusion of the glass envelope to the holder without resulting failure, but not on units after fusion. This fact lead to the conclusion that the heat of the fusion process, that is glass holder seal, affects the pins in such a way as to make them vulnerable to corrosion when subjected to the salt spray and moisture resistance tests. To validate this conclusion, a second corrosion test was performed on a new set of holder pins before fusion; again, no pin corrosion occurred. As a result, it was decided that pin corrosion could be eliminated by electroplating the pins with a material that will be ingrained into the Kovar pin surface finish by the fusion heat.

Two materials, gold and nickel, were electroplated on separate holder pins. A photograph of these is shown on page 12. Item one shows the Kovar pin as received from the supplier; item two, the nickel plated pin; and item three, the gold plated pin. The gold plated pins were subjected to the salt spray and moisture resistance tests after fusion with no resulting corrosion. Therefore, no tests were made on the pins plated with nickel.

New pre-production units will be gold electroplated using the system described next.



ELECTROPLATED PINS

4. Gold Electroplate Method

Electroplate Materials

a. Electrolyte: Pure gold. Supplier - Hoover and Strong, Incorporated, Buffalo, New Jersey.

b. Anode: Stainless steel.

c. Cathode: Holder pins. (Electrical connection to the holder pins is made by gripping them with a flat copper clip at the points where the crystal mounting springs are welded. The copper clip, in turn, is connected by a wire to the negative terminal of the power supply).

Pin Preparation Prior to Electroplate

a. Submerge holders in an ultrasonic tank filled with alconox detergent and distilled water for 10 minutes (use perforated stainless steel trays to house the holders).

b. Rinse in three separate containers of boiling distilled water. Agitate holders during rinse.

c. Submerge in an ultrasonic tank filled with alcohol for 5 minutes.

d. Dry under infrared heat lamps.

e. Polish each holder pin with a linen cloth immediately prior to electroplate.

Electroplate Process

a. Maintain the electrolyte temperature at about 70° C and adjust the voltage across the electrodes so that a current of 80 microamperes flows through the electrolyte during plating.

b. Plate each holder for four (4) 15-second increments. Move the holder through the electrolyte laterally with a slow back-and-forth motion.

c. After each 15-second interval, rinse the holder pins in distilled water and then polish leads with the linen cloth.

D. GLASS SEALER

The glass sealer is now located in the "white room" facility and is used to fuse the glass cover (bulb) to the glass crystal holder (base). This is accomplished by the use of four basic components. These are: The vacuum system, the radiation thermometer, the RF induction heater, and the holding fixture. This equipment is shown in the photograph on page 15.

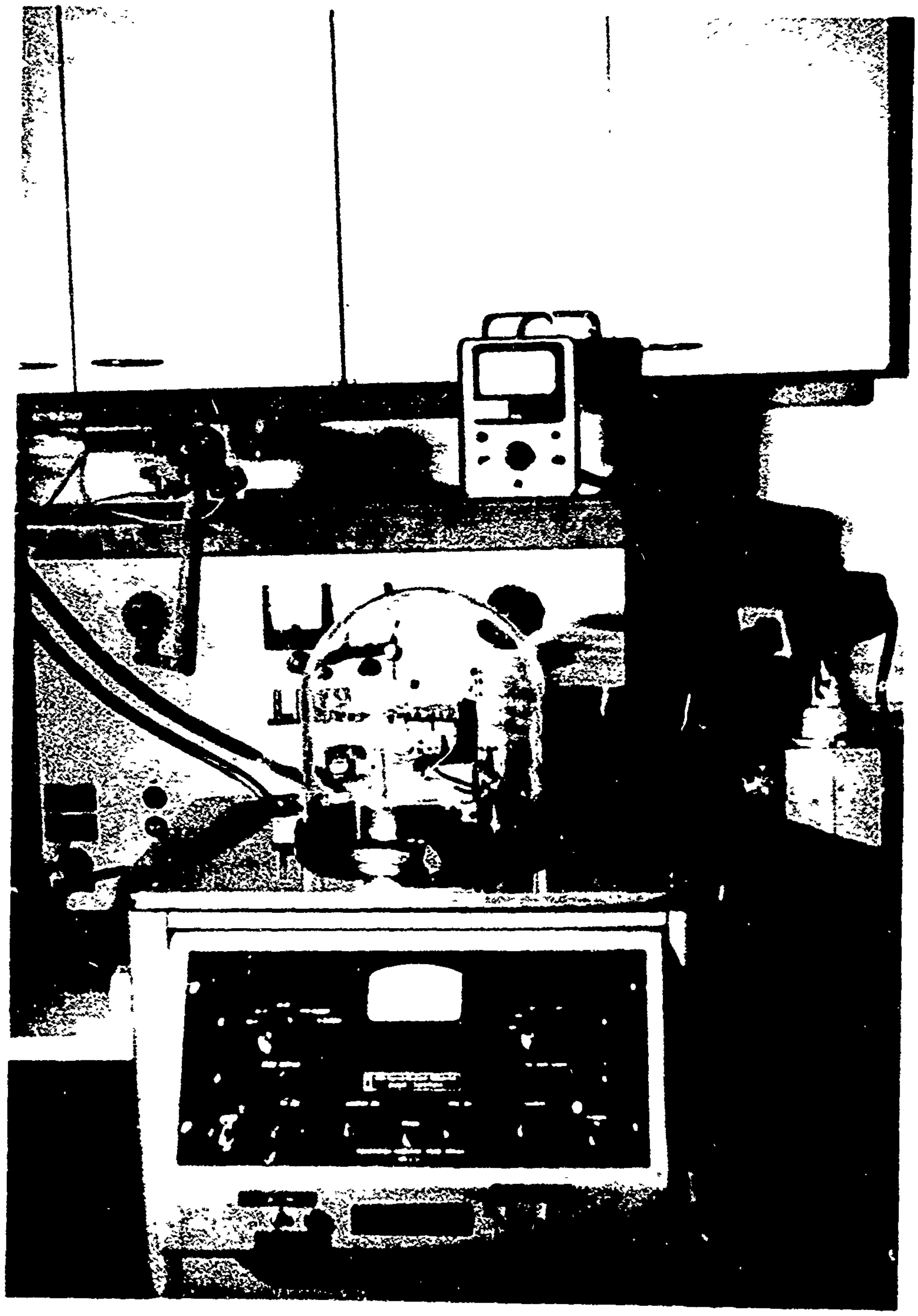
The discussion describing the sealing method will be divided into two main headings -- (1) Equipment, and (2) Process Sequence.

1. Equipment

The vacuum system is Model C-0012 made by the High Vacuum Equipment Corporation. It has a manual valve acuating system and is capable, with the holding fixture enclosed in its $11\frac{1}{4}$ inch diameter and $11\frac{1}{2}$ inch tall bell jar, of attaining a chamber pressure of less than 25 microns Hg during the seal operation.

The radiation thermometer Model TD-6B is manufactured by Infrared Industries, Incorporated. It consists of two major components, the optical head and the amplifier units, and operates by sensing the infrared portion of the energy spectrum radiated by a radiation source (target) upon which it is focused.

In this particular case, the target is the Kovar ring portion of the glass base; and the thermometer is used to determine relative changes in the temperature of the target during the seal process.



GLASS SEALING EQUIPMENT

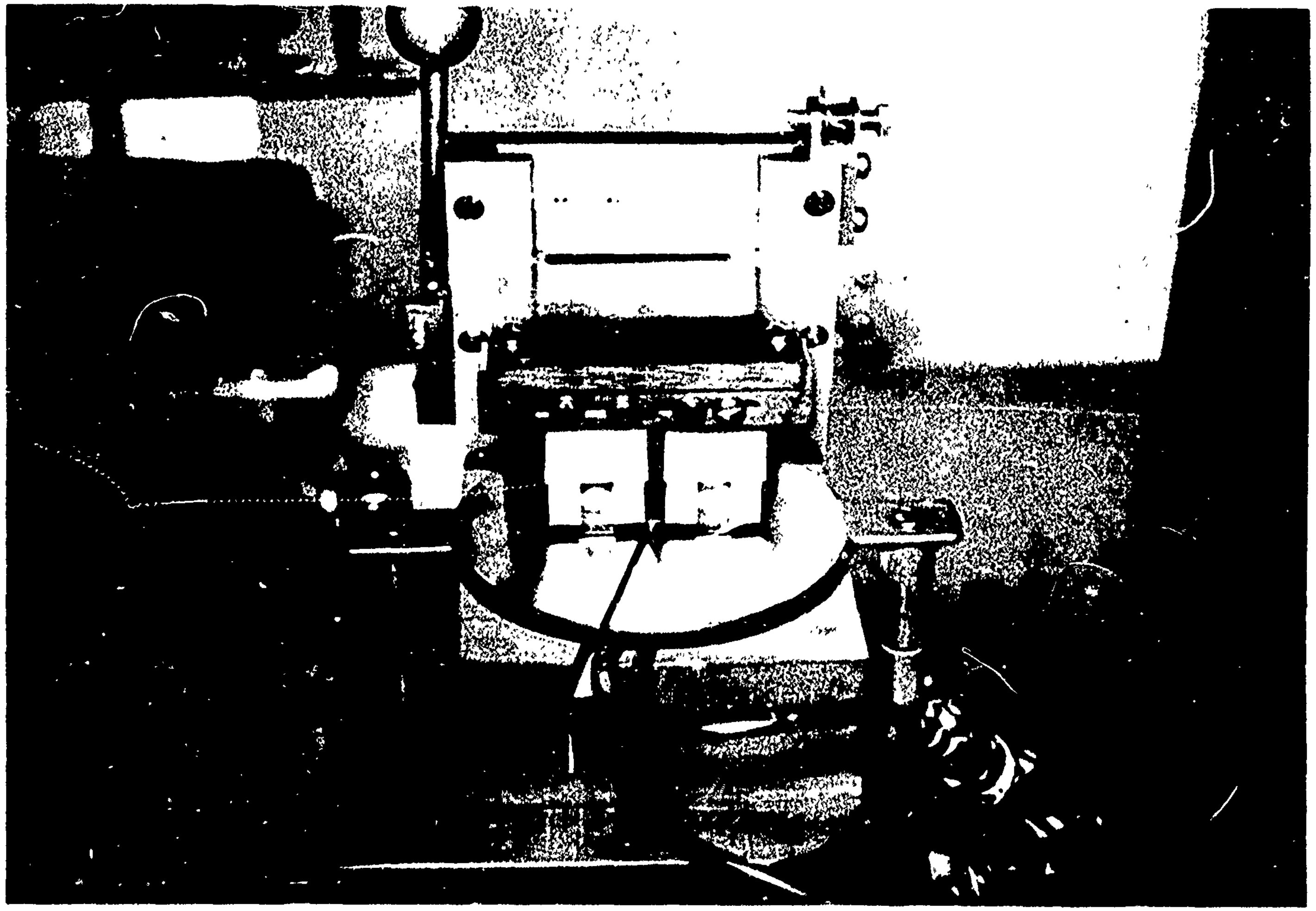
The RF induction heater consists of two main parts - the induction coil, which is a Midland-Wright development, and the Model T-2.5-1-KC-AB high voltage radio frequency power supply, which is manufactured by the Lepel High Frequency Laboratories, Incorporated.

The function of the power supply is simply to supply radio frequency energy to the induction coil and, in this application, is cycled to give two energy intensity levels - one to provide a gradual temperature change to the glass and the other to effect the seal.

The induction coil is effectively a 4-turn coil, three of which are helical. The fourth turn is somewhat unique in that it is physically a 0.130 inch thick disc split along its radius. Two holes - shaped to accomodate the base holders - are provided in its center for reasons that are given in the following discussion of the holding fixture.

The dual-head holding fixture is shown in the photograph on page 17. It has been re-tooled to accomodate two crystals at one time. This will double the sealing rate of the previous fixture.

One section consists of the glass base holders and, in a sense, the disc in that it is connected to the holding fixture. The machineable ceramic base holders, whose shape conforms to that of the glass base, are surrounded by the disc by virtue of their location inside the two holes in the center of it. This configuration allows inductive coupling of the RF energy from the induction coil to the Kovar ring which is manufactured into the glass base.



DUAL-HEAD HOLDING FIXTURE

The resulting heat generated in the Kovar ring is in turn conductively transferred to the glass portion of the base.

The other section is a vertically moveable head which, with the two aluminum covers, provides a spring-produced pressure on the glass bulbs during seal.

2. Process Sequence

a. Pre-heat the bulb and base to a temperature of 80° C for 30 minutes. This is done at atmospheric pressure.

b. Place the base in the ceramic base holder, the bulb on the base, and then bring the aluminum covers in contact with the bulbs.

c. Evacuate the chamber to a pressure of 200-microns Hg, and pre-heat for 2½ minutes by acuating the RF induction power supply to its low intensity energy level.

d. By this time the chamber pressure is less than 50-microns Hg and the glass is ready for sealing. This is done by cycling the RF power supply to its high intensity level until the temperature, as indicated on the radiation thermometer, reaches a pre-determined level. This usually takes about 45 seconds.

e. The output of the RF power supply is now set to its low intensity level for 45 seconds and then turned off.

f. The glass is then allowed to cool to a pre-determined temperature level as read on the radiation thermometer. This usually takes about 4 minutes.

g. The evacuated chamber is returned to atmospheric pressure and the sealed crystals are removed.

3. Frequency Change ($\Delta$ F)

The frequency at which the crystal is set at room temperature is determined, in part, by the amount that its frequency will change as a result of the heat that must necessarily be applied to it during the sealing operation previously discussed.

Consequently, tests are being made to determine the optimum frequency setting of the units before seal. Table IV on page 20 shows readings of some units before and after seal. These readings indicate an average frequency change of 77 cps in the plus direction for 10 MC units.

## E. INSPECTION AND QUALITY CONTROL PLAN

Prior to the start of the production run, the contract requires the submission and approval of an Inspection and Quality Control Plan. This plan, which must show the location of Quality Control inspection points throughout the production sequence, was approved in May, 1965. It is represented here in various charts and data forms. Chart I on page 21 shows the overall production process flow and the locations of QC inspection points within that flow. This is followed by Chart II on pages 22 through 26 inclusive, which gives a detailed outline of what occurs at each process in Chart I. Also, two typical data forms used at QC inspection numbers 12 and 24 are shown on pages 27 and 28 respectively.

TABLE IV

FREQUENCY CHANGE THRU SEAL

10 MC UNITS

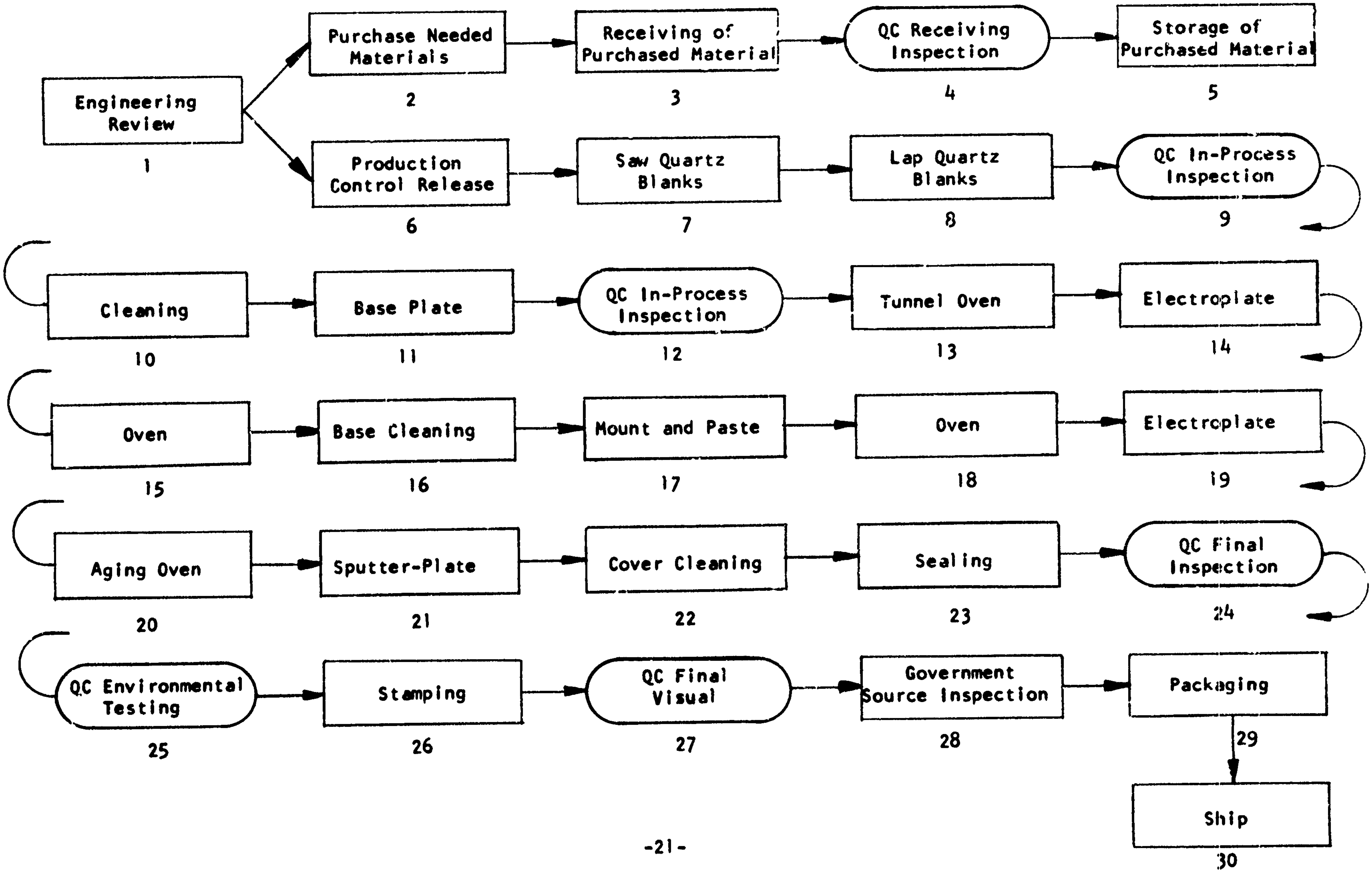
| UNIT NO. | FREQUENCY (cps) BEFORE SEAL @ 85° C | FREQUENCY (cps) AFTER SEAL @ 85° C | ΔF (cps) |
|---|---|---|---|
| 1 | 9846 | 9821 | - 25 |
| 2 | 9907 | 9932 | + 25 |
| 3 | 9904 | 9943 | + 39 |
| 4 | 9928 | 9987 | + 59 |
| 5 | 9887 | 9917 | + 30 |
| 6 | 9836 | 9881 | + 45 |
| 7 | 9885 | 9887 | + 2 |
| 8 | 9827 | 9888 | + 61 |
| 9 | 9906 | 9986 | + 80 |
| 10 | 9923 | 9965 | + 42 |
| 11 | 9862 | 9877 | + 16 |
| 12 | 9873 | 0092 | +219 |
| 13 | 9840 | 9906 | + 66 |
| 14 | 9893 | 9900 | + 7 |
| 15 | 9863 | 9914 | + 51 |
| 16 | 9905 | 9997 | + 92 |
| 17 | 9837 | 9888 | + 51 |
| 18 | 9906 | 0072 | +166 |
| 19 | 9893 | 0090 | +197 |
| 20 | 9820 | 9997 | +177 |
| 21 | 9870 | 9921 | + 51 |
| 22 | 9820 | 9895 | + 75 |
| 23 | 9922 | 0030 | +105 |

X M 44 PROCESS FLOW

GLASS ENCLOSED CRYSTAL UNITS

CHART I

Inspection and QC Plan



X M 44 DETAILED PROCESS FLOW - CHART II

| Op. No. | Dept. Resp. | Operation Name | Detailed Steps | Equipment Manf. & Model (Insp. & Test Only) | Remarks |
|---|---|---|---|---|---|
| 1 | 66 | Engineering Review | A. Study of Customer PO and Specifications<br>B. Preparation of Factory Work Orders and Specs.<br>C. Preparation of Specifications and Requisitions for Purchase | | |
| 2 | 61 | Purchase Needed Materials | A. Purchase Bases and Covers (Glass)<br>B. Use Engineering Specifications as Part of PO<br>C. Submit Bids only to those Suppliers Approved by QC and Engineering | | Operations #2 through #5 have to do with purchased material |
| 3 | 70 | Receiving of Purchased Material | A. Verify Count<br>B. Verify Price<br>C. Prepare Receiving Report<br>D. Forward Material to Quality Control | | Price verification responsibility of Purchasing & Accounting |
| 4 | 68 | QC Receiving Inspection | A. Visual<br>B. Mechanical<br>C. Leakage (Base Glass to Metal Seal)<br>D. Verify & file certifications required<br>E. Prepare Receiving Inspection Report (Stamp acceptable packages) | Sec.II,Proc.I A QC Manual<br>"<br>Veeco Helium Mass Spectrometer Model MS-9AB | Use Engr. Specs. as defined in Oper. #1 above<br><br>Sec. 1, Proc. 4 QC Manual (Rpt. Att) |
| 5 | 70 | Storage of Purchased Material | A. Place Accepted Material in Special Hold Area in Stores<br>B. Release Material to Project Engineer Only | | |

| Op. No. | Dept. Resp. | Operation Name | Detailed Steps - Chart II | Equipment Manf. & Model (Insp. & Test Only) | Remarks |
|---|---|---|---|---|---|
| 6 | 62 | Production Control Release | A. Log in Work Orders and establish Manufacturing due dates<br>B. Release Work Orders, Specifications and Traveler Envelopes to Saw Department<br>C. Establish Card System for Due date follow up | | |
| 7 | 10 | Saw Quartz Blanks | A. Grade Raw and Synthetic Quartz<br>B. Mount Quartz for Sawing<br>C. Saw Quartz Wafers<br>D. Dice Wafers | | |
| 8 | 20 | Lap Quartz Blanks | A. Rough Lap<br>B. X ray for Angle<br>C. Dimension Round<br>D. Intermediate Lap<br>E. Finish Lap<br>F. Bevel<br>G. Polish<br>H. Etch<br>I. Classify in Frequency Groups | | |
| 9 | 68 | QC In-Process Inspection | A. Visually inspect finished blanks for chips, scratches, and fractures<br>B. Prepare Inspection Report | | Report Form Attached |
| 10 | 30 | Cleaning | A. Chromic Wash<br>B. Ultrasonic Wash | | |
| 11 | 30 | Base Plate | A. Mount blanks in mask and insert masks in plater<br>B. Draw vacuum<br>C. Plate (evaporation process using silver) | | |
| 12 | 68 | QC In-Process Inspection | A. Mount sample of each plating batch<br>B. Read frequency and activity<br>C. Prepare Inspection Report | RFL TS 330 or TS 683 Crystal Impedance Meter Beckman 7370 Frequency Counter | Report Form Attached |

| Op. No. | Dept. Resp. | Operation Name | Detailed Steps - Chart II | Equipment Manf. & Model (Insp. & Test Only) | Remarks |
|---|---|---|---|---|---|
| 26 | 73 | Sampling | A. Ink stamp CR No., frequency, quartz type, date code, and manufacturer's code<br>B. Dry in oven (85° C. for 15 minutes) | | |
| 27 | 68 | QC Final Visual | A. Stamping<br>B. General workmanship | | |
| 28 | | Government Source Inspection | A. Contact: Mr. Jim Perry, BA 1-7000, Ext. 6306 15 days before shipment | | |
| 29 | 73 | Packaging | A. Pack 25 units to a box in cardboard nests<br>B. Place 1/8" layer of foam rubber on top and bottom of each crystal group<br>C. Label each box with quantity, type, and frequency | | |
| 30 | 73 | Ship | A. Ship to:<br>Commanding Officer<br>US Army Signal Corp<br>Research and Development Labs<br>Solid State and Frequency Control Division<br>Piezo Electric Crystal Circuit Branch<br>Fort Monmouth, New Jersey<br>B. Ship Air Express Prepaid<br>C. Include all Inspection and Test Reports with Shipment | | |

MIDLAND-WRIGHT, POST BASE PLATE FREQUENCY (CLASSIFICATION AND ADJUSTMENT)

FORM 12

Type________
Customer________ Freq.________ Mask Size________ C/O________ Post Base Plate Freq. Classification (FF) Tolerance

| | | | | | |
|---|---|---|---|---|---|
| Lot Size____<br>Plater #____ | Pellet____<br>Insert____ | Lot Size____<br>Plater #____ | Pellet____<br>Insert____ | Lot Size____<br>Plater #____ | Pellet____<br>Insert____ |
| Pre-Base Plate Freq. Classif. | Monitor Plate KC<br>Additional Plat. | Pre-Base Plate Freq. Classif. | Monitor Plate KC<br>Additional Plat. | Pre-Base Plate Freq. Classif. | Monitor Plate KC<br>Additional Plat. |
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| Lot Size____<br>Plater #____ | Pellet____<br>Insert____ | Lot Size____<br>Plater #____ | Pellet____<br>Insert____ | Lot Size____<br>Plater #____ | Pellet____<br>Insert____ |
| Pre-Base Plate Freq. Classif. | Monitor Plate KC<br>Additional Plat. | Pre-Base Plate Freq. Classif. | Monitor Plate KC<br>Additional Plat. | Pre-Base Plate Freq. Classif. | Monitor Plate KC<br>Additional Plat. |
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## CRYSTAL DATA - FORM 24

CUSTOMER________ PART NO.________ QUARTZ TYPE________ WO________

DRIVE LEVEL________ MODE________ RESISTANCE________ $C_o$________ $C_1$________

FREQUENCY________ FREQUENCY TOLERANCE________% ________ CPS________

TEMPERATURE RANCE________ TC FREQUENCY TOLERANCE________% ________ CPS________

BLANK SIZE________ SPOT SIZE________ BEVEL________ ANGLE________

OTHER REQUIREMENTS________

________

### TEST DATA

| UNIT NO. | Fs | Δ F | Fp | Rs | Co | TC FREQUENCY DEVIATION | | | VIS.& MECH. | LEAKAGE | Q |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ROOM | TURN | 85° C. | | | |
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## III. CONCLUSION

The occurrence of corrosion on the base pins has been successfully eliminated by electroplating the pins with gold prior to seal.

The glass sealer is working satisfactorily. The Dual-Head holding fixture will double the sealing rate of the previous single-head fixture. Additional tests are required to determine optimum frequency setting before seal.

## IV. PROGRAM FOR NEXT INTERVAL

The fabrication of the second set of pre-production sample crystals.

## V. PUBLICATIONS AND REPORTS

CONFERENCES:

| | |
|---|---|
| DATE: | 10 March 1965 |
| PARTICIPANTS: | Messrs. Ermon Jones and Ed Mason of the U.S. Army and Electronics Command |
| DISCUSSION: | The progress and terms of the contract. |
| DATE: | 21 September 1965 |
| PARTICIPANTS: | Messrs. Ermon Jones and Ed Mason of the U.S. Army and Electronics Command |
| DISCUSSION: | The pre-production sample crystals and the progress of the contract. |

## VI. IDENTIFICATION OF PERSONNEL

MAN-HOURS

1 January 1965 to 30 September 1965

| | |
|---|---|
| Dennis Reifel - Project Engineer | 29 |
| Melvin Hammer - Project Engineer | 48 |
| Dr. W. W. T. Crane - Physicist | 5 |
| Laboratory Personnel | 272 |

Mr. Dennis Reifel left Midland-Wright Corporation in June, 1965. Mr. Melvin Hammer was assigned as Project Engineer at that time.