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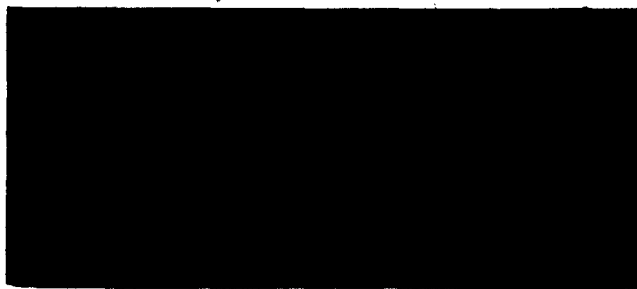
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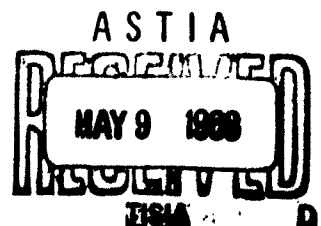
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**HI-Q**  
DIVISION

**AEROVOX CORPORATION**

Seventh Quarterly Report  
Production Engineering Measure for  
Rolled Ceramic Capacitors  
December 9, 1962 to March 9, 1963  
Signal Corps Contract No. DA-36-039-SC-85963  
Placed by USASSA  
Hi-Q Division of Aerovox Corporation  
Olean, New York



PRODUCTION ENGINEERING MEASURE FOR  
ROLLED CERAMIC CAPACITORS

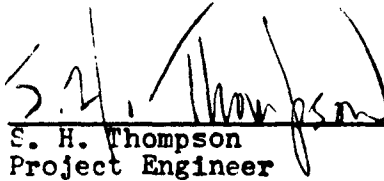
Seventh Quarterly Report

December 9, 1962 to March 9, 1963

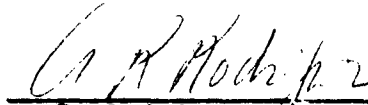
This study is to establish capability to manufacture Rolled Ceramic Capacitors by mass production techniques and with mass production facilities, and to produce and test preproduction and pilot run quantities of Rolled Ceramic Capacitors.

Signal Corps Contract No. DA-36-039-SC-85963

Written by:

  
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Project Engineer

Approved by:

  
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## SECTION 1

### ABSTRACT

During this quarter the method of electroding was changed from transfer wheel to silk screening. The operation of the silk screen machine was evaluated and sample units were, and are being, made using the existing equipment. These units are being evaluated to check the performance of the different pieces of equipment.

## SECTION 2

### PURPOSE

The purpose of this contract is as follows:

- a. To provide the production engineering to establish capability to manufacture Polled Ceramic Capacitors ranging from 0.1 mfd - 100 vdc to 2.2 mfd - 100 vdc.
- b. To design, develop, procure or manufacture special tooling required for successful pilot run production.
- c. To design and fabricate or procure limited production equipment capable of manufacturing 3,000 units per eight hour shift of the 0.1 mfd capacitor.
- d. Produce and submit for approval the Signal Corps preproduction samples prior to the initiation of the pilot run.
- e. To manufacture a pilot run of Polled Ceramic Capacitors consisting of the following 100 vdc rated units:

| <u>Capacitance</u> | <u>Size</u>   | <u>Quantity</u> |
|--------------------|---------------|-----------------|
| 0.1 MFD            | 0.18" x 0.66" | 2,000           |
| 0.22 MFD           | 0.23" x 0.66" | 500             |
| 0.47 MFD           | 0.32" x 0.66" | 500             |
| 1.0 MFD            | 0.45" x 0.66" | 500             |
| 2.2 MFD            | 0.37" x 1.41" | 500             |

- f. To provide monthly and quarterly progress reports.
- g. To prepare production engineering measure final reports in accordance with Step II of SCIFF No. 15, paragraph 3.8.

## SECTION 3

### NARRATIVE AND DATA

#### 3.1 Progress of Work to Date - Equipment Being Manufactured by Aerovox

##### 3.1.1 Sheet Forming Machine

As was noted in the previous report, we were experiencing periodic thin sections in the cast sheet from the casting machine. The surface of the pulley under the casting hopper was inspected to be sure that it was perfectly clean. If there is any dirt or other material on the pulley surface, it will cause a raised portion in the belt as it travels over the pulley, thus causing a thin spot in the cast sheet. However, even when the pulley surface was entirely clean, the thin spots were still present. It was determined that the distance between the thin spots corresponded to the distance between the ends of the spokes of the pulley. A surface indicator was used to check the roundness of the pulley, and it was found that the difference on the surface between the area opposite the end of the spokes and between the spokes was several thousandths of an inch, and would account for the thin spots. It is quite conceivable that the stress to which the pulley is subject could cause a deformation due to metal fatigue.

A new pulley was purchased and this pulley is of such construction that there are no spokes - the rim is supported by solid metal members. Before putting the new pulley into use the surface was checked with a gauge and there was one high spot found, so it was returned to the manufacturer where it was trued up. The pulley was then mounted in the casting machine, and more uniform tape can again be cast.

An additional innovation was applied to the casting operation which will help insure a high quality tape. An "in-line filter" was installed in the slip feed line between the slip storage tank and the pump which pumps the slip into the casting hopper. This filter consists of a totally enclosed 325 mesh screen thru which the slip must pass before being cast, which filters out any foreign and dried particles which may have gotten into the slip.

### 3.1.2 Winding Equipment

The problem of the tape not being precisely aligned at the point where the winding needles engage the tape, thus occasionally causing the needles to miss the tape completely, was still of major concern. Reducing the carrier speed helped some, but was not the answer. Of the several approaches to the problem, the method of attack decided upon was to modify the sequence of operation of the carrier.

The original carrier operation was as follows:

The leading end of the tape was held to the carrier head by vacuum thru small holes on the bottom surface. The carrier head moved horizontally a predetermined distance past the winding head or mandrel. As the carrier moved, it pulled the tape along a channel, and when the carrier reached the end of its travel, the vacuum would cut off so that the tape lay in the channel, and the carrier head returned to its original position. When the carrier reached its return position, the vacuum again came on pulling the tape under the head up to the head, thus causing the tape on that side of the winding needles to be under tension during winding.

When the carrier reached its original position, the winding needles emerged from the winding mandrel, straddling the tape, and rotated, thus causing the tape to wind in a tight roll.

The modified sequence of operation is as follows:

The original travel of the carrier is the same as previously noted; however, during the return travel the carrier head stops momentarily almost opposite the winding position. During this pause the vacuum comes on drawing the tape up to the carrier and positively aligning it with respect to the winding needles. The winding needles emerge and engage the tape (but do not rotate), the vacuum on the carrier again shuts off and the carrier returns to its original position. When the carrier reaches its original

position, the vacuum again comes on and the needles start to rotate and wind the tape.

This sequence modification has proved to be extremely successful.

### 3.1.3 Electroding Equipment

Due to the fact that the transfer wheel method of applying electrode material was not successful in depositing a pattern of high enough quality without depositing a considerable excess of material, it was decided to discard that method and use the silk screen method of application. Consequently a silk screen machine was built utilizing the drying portion and frame of the original machine. Test runs have been made on this machine and the electrodes were far superior to the previous method. This was to be expected from our previous experience with silk screening electrode patterns. This machine is essentially a hand operation process but is adaptable to automatic operation.

### 3.1.4 Color Coding - Final Test and Sort Machine

This machine performs satisfactorily. Sample units have been satisfactorily color coded. There had to be minor changes in the test circuit to increase the charging current so that the higher value capacitors could be tested within the interval of time they are in test position.

### 3.1.5 Silver Terminating Equipment

It has been decided to terminate with the same material as used for the electrodes. This material would also be applied before firing the ceramic. The equipment for accomplishing this termination on a production basis has not been built as yet.

### 3.1.6 Lead Attaching Equipment

The last of several designs for this equipment has been scheduled for shipment to our Olean plant toward the end of March. Basically the operation consists of attaching a looped lead onto the unit, solder dipping the unit to secure the lead to the unit body, and cutting the lead so that only a straight portion extends outward from each end of the body.

### 3.1.7 Life Test Equipment

These unit holding fixtures, etc. were used for the preproduction life test, and performed satisfactorily. There has been no need for additional work on this equipment.

### 3.1.8 Sheet Slitting Equipment

The only change required on this equipment was to make an additional cutting head and guide channel. This was required because the tape width used during silk screening of the electrodes was set up to take a tape width which we had not previously used.

### 3.2 Progress of Work to Date - Facility Items Not Manufactured by Aerovox

#### 3.2.1 The Kady Mill

The Kady mill has been used to prepare all the batches of slip, and has been performing satisfactorily. The rotor seal is subject to wear and must be replaced occasionally. The seal is lubricated with circulating oil, and when it gets worn, a small amount of oil gets homogenized into the slip. Since this is a bad condition, lubricating systems are being investigated utilizing water or water soluble lubricants which would not be deleterious to the slip.

#### 3.2.2 The Ball Mill

The ball mill performs satisfactorily and has been used for preparation of all the slurries used to make the casting slips.

#### 3.2.3 X-Ray Equipment

No problem has been encountered, and it is performing satisfactorily.

#### 3.2.4 Ceramic Firing Kiln

The ceramic firing kiln has been used extensively and is well suited for its function. The refractory tile upon which the units are situated during firing are to be ordered shortly when the best design has been determined. Tile with "U" shaped grooves appears to give the best results in maintaining roundness of diameter.

### 3.2.5 Life Test Ovens

These ovens were used for the preproduction tests and perform satisfactorily.

## SECTION 4

### CONCLUSIONS

Most of the equipment has been tested and used to make preliminary samples for evaluation. The pieces of equipment perform their physical functions satisfactorily; however, it is conceivable certain problems not immediately apparent will show up when evaluating finished units processed on the machines.

All the preproduction test samples have been approved.

The estimated percentages of the overall progress on the major elements of the program are as follows:

| <u>Factors</u>                                                                      | <u>Relative Weight</u> | <u>% Completion</u> | <u>Percentage</u> |
|-------------------------------------------------------------------------------------|------------------------|---------------------|-------------------|
| 1. Production Design Engineering & Design of Special Tooling                        | 10                     | 95                  | 9.5               |
| 2. Design & Fabrication of Pilot Line Equipment                                     | 25                     | 90                  | 22.5              |
| 3. Preproduction Sample Approval                                                    | 20                     | 100                 | 20.0              |
| 4. Pilot Run                                                                        | 25                     | 0                   | 0                 |
| 5. Monthly & Quarterly Reports                                                      | 10                     | 75                  | 7.5               |
| 6. Final Report, Step II Study, Freq. Study, Insp. Data Report, Ext. Life Test Data | 10                     | 0                   | 0                 |
| TOTAL                                                                               | 100                    |                     | 59.5              |

## SECTION 5

### PROGRAM FOR THE NEXT INTERVAL

Sample units will be prepared using the complete line of equipment, and when evaluation of these samples indicates that the process is satisfactory in its entirety, the pilot run will be started.

## SECTION 6

### IDENTIFICATION OF PERSONNEL

| <u>Personnel</u> | <u>Hours</u> |
|------------------|--------------|
| B. Sechrest      | 20           |
| F. Steffenhagen  | 16.5         |
| E. Thompson      | 392          |
| R. Wildfire      | 112          |
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