ITT INDUSTRIAL LABORATORIES

FORT WAYNE, INDIANA

Components and Instrumentation Laboratory

A DIVISION OF INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

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PRODUCTION ENGINEERING MEASURE FOR TYPE FW-202 BARRIER GRID STORAGE TUBE REPORT NO. 6 SIXTH QUARTERLY PROGRESS REPORT

October 1, 1962 to December 31, 1962

The objective of this contract is to initiate a production engineering measure for the FW-202 Barrier Grid Storage Tube in accordance with Steps I and II of SCIPPR No. 15 of 1 October 1958.

U. S. ARMY SIGNAL SUPPLY AGENCY
Contract No. DA-36-039-sc-85967
Order No. 6022-PP-61-81-81

Prepared by

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1.0 PURPOSE OF PROJECT

1.1 Contractual Objectives

The primary purpose of this contract is to conduct a Production Engineering Measure (PEM) for the FW-202 barrier-grid storage tube developed under Contract No. DA-36-039-sc-78953. The PEM program will be in three phases. The Preliminary Engineering phase will be performed at the Industrial Laboratories Division in Fort Wayne, Indiana, while the Preproduction and Pilot Production phases will be carried out at the ITT Components Division facility in Roanoke, Virginia.

1.2 Breakdown of Effort

1.2.1 Preliminary Engineering Phase

a.	Bulb subassembly	Improve composition and deposition of wall coatings. Design and fabricate a seal ring for mounting of collector-amplifier section.
b.	Write-read gun subassembly	Minimize the variation in cutoff and maximum beam current.
c.	Collector subassembly	Evaluate the processing of copper-beryllium dynodes as to SE yield and uniformity over the dynode area and obtain better reproducibility from dynode to dynode.
d.	Target subassembly	Evaluate new frits for use as a dielectric layer. Evaluate centrifuging procedure for depositing frit on target. Evaluate alloys as bonding agents between barrier grid and storage surface. Produce thickened barrier-grid mesh using an electronic evaporator. Investigate the use of other materials as the secondary emission layer.
e.	Overhaul test equipment	Each unit of the test equipment will be tested for performance. Modifications will be made where deemed necessary to improve reliability.

f.	Evaluation of production tube design	A number of engineering samples will be made to assure the compatibility of the production subassemblies with the over-all tube performance requirements.
g.	Compilation of manufacturing data for transfer	The detailed manufacturing drawings of the tube and special tooling, the manufacturing processes and procedures, and final detailed test procedure will be prepared.
h.	Transfer program to ITTCD	After completion of preliminary engineering phase, tube production will be transferred to Roanoke, Virginia. Production technology and inventorized equipment will be transferred at this time.

1.2.2 Preproduction Phase

a.	Build and production-test tubes	Preproduction sample tubes will be fabricated, exhausted, and tested.
b.	Run formal preproduction tests	Preproduction tubes will be tested.
c.	Life test preproduction samples	Life test of preproduction sample tubes.
d.	Set up pilot line	Fabrication of production fixtures and processing equipment to produce 200 gross tubes per month shall be set up.

1.2.3 Pilot Production — A pilot run of 69 acceptable tubes shall be made.

1.2.4 Reports

a.	Monthly narrative reports	Progress during the report period will be briefly described.
b.	Quarterly reports	Progress, analysis, and details on contract during the report period will be described.

c.	Final report - step I	The final report will cover all the work done to establish capability to manufacture the FW-202 Barrier-Grid Storage Tube on a pilot line basis using production methods and processes.
d.	General report - step II	The general report will cover all production planning necessary to expand to produce according to the planned production basis, short of procuring tooling, equipment (machinery and test equipments) and materials, and short of actual manufacture of the planned production schedule quantities.

2.0 ABSTRACT

The preproduction tubes have been fabricated and tested. The transfer of the test equipment and the manufacturing equipment will be made to the production facility in January 1963.

3.0 PUBLICATIONS, LECTURES, REPORTS, AND CONFERENCES

None.

4.0 FACTUAL DATA

4.1 Introduction

Testing was completed on the six engineering samples in preparation for transferring the project to the production facility at Roanoke, Va. Improved processes on the electrophoretic deposition of the SG-67 frit has appreciably reduced the number of blemishes on the target surface. The use of nickel seed mesh in place of the copper seed mesh has resulted in a greater yield of good targets.

4.2 Target Subassembly

4.2.1 General

The work to be carried out under the target subassembly task was divided into five phases:

a. Evaluate new frits for use as the dielectric layer.

b. Evaluate new alloys for use as the bonding agent between the barrier grid and the storage surface.

c. Produce thickened mesh for the barrier grid using the electron beam evaporator.

d. Evaluate a centrifuging technique for depositing the frit.

e. Investigate the use of the materials for use as the secondary emitting surface.

4.2.2 Dielectric Layer

The dielectric layer is made by electrophoretically depositing the SG-67 frit on the metal substrate, vitrifying the frit, settling the Corning 012 frit and vitrifying it. The electrophoretic deposition method has been improved by using a methyl alcohol carrier which has been distilled to remove foreign particles which caused blemishes in the final enamel layer. The process has also been moved into a positive flow cabinet, which will also tend to eliminate blemishes due to the fallout of dirt.

A problem was encountered in the vitrification cycle during the last report period. The enamel layer was found to contain ripples which were approximately 30 to 50 mils wide and bonding could not be achieved in these areas. The cause of this trouble was found to be in the calibration of the oven used for vitrification. The oven was 50 degrees C too low.

Six barrier grid tubes were built with targets which were fabricated using the correct temperature of 900 degrees C on the oven for vitrification and the improved method of electrophoretic deposition of the SG-67 frit. The tubes showed very few blemishes and no indication of ripples of the enamel layer.

4.2.3 Bonding the Barrier Grid Mesh to the Storage Surface

The bonding of the barrier grid screen to the storage surface has presented very few problems. One target was lost due to the bonding temperature being 480 degrees C in place of 460 degrees C and as a result the mesh was forced into the enamel layer.

4.2.4 Thickening of the Barrier Grid Mesh

At the start of this report period troubles were encountered with the 500-line mesh. Numerous screens tore either during the firing cycle or during the bonding process.

The screens showed numerous thin areas or areas of missing mesh. For this reason new nickel mesh was obtained of 400 lpi at 60 percent transmission. These screens were thickened with copper to the desired thickness of 0.8 mil and were bonded to targets with very good results.

4.3 Write-Read Gun Subassembly

Gun fabrication during this report period was very good with no major problems.

4.4 Test Data

A total of 18 experimental tubes were built for evaluation of gun design, target performance, and collector efficiency. The last six tubes built were of the final design.

Testing was done under conditions specified in SCL-5211 dated 13 December, 1955.

Table 1 shows the results obtained with the final version of the FW-202.

The resolution data was taken with sine wave modulation on the control grid and taken at 50 percent contrast. The shading of the output signal under the conditions of maximum resolution was less than 15 percent. The deflection defocusing correcting system looks very good.

The cancellation ratio is low due to the fact that a spike occurs when the beam passes from a stored area onto an unstored area. These spikes are taken into consideration when the ratio of the amplitudes of the moving pulse and stationary square wave are taken. The actual cancellation of the stationary square wave is approximately 15 to 1. This can be shown by moving the raster slightly and observing the large square wave output due to the area not being canceled.

The readaround test is much improved over the previous tube, a read-around ratio of 90 as compared to a readaround ratio of 10 was obtained. This is attributed to the 425 degrees C bake out of the tube during processing which gives much lower ion currents. The temperature was limited in the previous tube to 300 degrees C because lead was used as the bonding agent. The SG-67 solder glass now used permits use of a bake out temperature of 425 degrees C for 8 hours which is the standard bake out cycle for storage tubes.

5.0 CONCLUSIONS

The preproduction engineering was completed and the transfer of personnel to the production facility will begin in February 1963.

Table 1

Test Results on Experimental FW-202 Barrier Grid

Tube Number	Charge Factor	Discharge Factor	Resolution	Integration	Cancellation	Charge Factor	Discharge Factor	Resolution (240 x 240)	Readaround (120 x 120)
106210	66%	20% (down)	310 ~	6	6 to 1	100%	90% (down)	100%	80 @ 50%
106204	50%	28% (down)	320 ~	Equi. Broke	5 to 1	100%	90% (down)	80%	100 @ 50%
106201	59%	50% (down)	300 ~	5	5 to 1	100%	80% (down)	100%	96 @ 50%
106209	83%	15% (down)	300 ~	5	3 to 1	100%	93% (down)	100%	32 @ 50%
106207	60%	30% (down)	315 ~	5	4 to 1	100%	90% (down)	90%	90 @ 50%
116207	70%	27% (down)	310 ~	6	5 to 1	100%	85% (down)	95%	87 @ 50%

6.0 DATA OF PROJECT PERSONNEL

6.1 Time Charges on Key Technical Personnel

6.1.1 Administration Group

		Oct.	Nov.	Dec.
M. F. Toohig	Manager, Storage Tube Development Laboratory	0	10	0

6.1.2 Tube Design and Test Personnel

	Oct.	Nov.	Dec.
J. M. Abraham	179	120	112
C. J. Beuscher	21	67	59
L. G. Wolfgang	14	20	4
D. Carlo	18	4	0