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TRIP REPORT

Distributions: H. R. Hemmings
R. E. Lee
L. C. Maier

Visit to R. C. A., Lancaster, Pa. on February 21, 1955

Tube Personnel from General Electric Co.: H. R. Hemmings
J. M. Lang
R. E. Lee
L. C. Maier
J. C. Nonnekens

The demonstrations and discussions centered around the metal and glass - round and oval rectangular aperture mask tubes, the main purpose apparently being to convince us that R.C.A. feels that they have a manufacturable product.

Presently, 50,000 sq.ft. of manufacturing area is available for color production. This will be increased to 80,000 sq.ft. in an intermediate production plan and finally to 132,000 sq.ft.

Harry Seelen gave the main talk of interest for us as tube people. He admitted that the round tube could be improved but at least it was good enough providing the industry would get over the dead point and out of its present, somewhat difficult status. R.C.A. has available, also, a rectangular tube of the shadow mask type. Both round and rectangular can be made in glass or metal. He defended metal for the well known reasons. To this writer it was a pleasant surprise to hear R.C.A. admit that exaggerated use had been made of the theoretical advantages of the metal tube in monochrome with a result of soft tubes. The present schedule on exhaust is a 3 minute indexing giving a total of 30×3 plus $52 \times 3 = 246$ minutes between exhaust and after cooler.

On February 8th, shrinkage was 16.2% which is low indeed for a color tube which has been in semi-factory production only a couple of months.

Before lunch the writer had an opportunity of talking in more detail with Mr. Seelen. It should be mentioned here that the figures cited by Seelen did coincide with the ones which I was able to copy from various working sheets and I therefore have the impression that we were given exact figures and not (as on other occasions) exaggerated statements. May be the reason behind their frankness has to do with the statement that even R.C.A. can not go on indefinitely pouring more money in color and, therefore, would like other manufacturers to enter the field.

According to Seelen, 6% of the tubes sent out in the field have come back. 50% of these rejects could be proven to give difficulties only because the customer was

not familiar with the circuit elements, such as purity field, dynamic and static convergence, etc. This then leaves 3% of real defects, mainly low emission on one or more guns and grid cathode shorts. No mechanical transport difficulties have been experienced so far. Mr. Seelen found that this compared favorably with monochrome, considering the relative complexity of a color tube.

The writer was given a little private tour of those areas of interest in manufacturing the shadow mask tube.

R.C.A., for the time being, welds their own holding devices on the rim of the face panel. The vendor can now supply the panels with these in place and they have found the vendor's precision to meet their requirements.

A calibrated air pressure operated device measures internal face contour. Mr. Miller, who accompanied me, felt that the tolerances set on contour were rather high but might help if more brightness is required.

In the screen and test areas, he turned his back and allowed me to copy figures from the daily operation sheets.

Screening - R.C.A. has not yet made up their mind as to the preferred method of screening (settling or slurry). The girl in charge of the screening operation could not, by results, demonstrate any superiority of one over the other as far as shrinkage is concerned. Mottled screens (showing up at final test) amounted to an average of 0.1% over January and February.

In the screening operation, the number of panels screened, either partially or completely, is registered on counters for each of the three primary colors.

The shrinkage percentages which I copied are the tabulated ones in the last column and refer therefore to overall shrinkage. On the morning of our visit, the shrinkage was 11.7% which was considered above average. They had further experienced a bad day of 14.2% once in February which was traced to a bad batch of phosphor used on the second shift. A good average for February, from the working sheets, seemed to be 5 - 6%.

Note: The above figures are shrinkage prior to aluminizing.

Exposure Lighthouse - We in General Electric, were aware of the fact that an error in direct straight printing results with bigger deflection angles. An optical correction should be built into the lighthouse and R.C.A. admitted this. Therefore, the tolerances of 1.5 mil as given by Harry Seelen seem to be realistic if we assume reasonable values for beam diameter in the deflection plane.

Gun Seal - Positioning is done with the dimples on the sealing ring as reference. They think that they can hold from 1° - 1.5° taking into account heating of the fixtures. This is more than adequate.

Final Test - This is, of course, an important check point of the various causes for reject. I copied the following data:

- a. Dented masks average less than 2% during February.
- b. Poor cathodes: minimum per day 0.5%; maximum (one day in January 1%) average 1.5%
- c. Misregistration: Average 0.1% - Worst day 1.2% - Various days 0%

During lunch we were told that starting with 100 face panels they got an average of 65 completed (that is screened, aluminized, mask in place) assemblies to exhaust.

Equipment - Mr. Taylor confessed that he was rather unhappy about his inability to supply equipment. According to him the patent situation was not completely clear. I asked him about lighthouses and was told that he would appreciate getting a letter asking for prices, so that he could talk the matter over with the lawyers.

Note: The main item of interest for us would be the lighthouse if we want to evaluate a shadow mask tube.

Conclusions - The writer had, previous to our visit to R.C.A., given some thought to the various tubes under study and/or semi-production in the industry. Specifically our P.A. program is more than anything based on brightness and tolerances. If now brightness does not seem to be the overruling factor versus cost, then there are several points which, from a tube engineering and manufacturing point, should be realized.

In the P.A. tube the electrons do not travel in a straight path between grille and screen. We therefore make optical corrections in our obtaining a master, realizing also that the electronically exposed master is the ideal one. From this master we go back to optically made sub-masters, if we want to print P.V.A. We still would like to have three masters if we are shooting for the perfect screen, that is obtaining maximum tolerances. After printing we now take a grille which might, or might not be, identical with the one used for the original electron exposure or exposures.

In the shadow mask there is no difference between mask and screen potential, in other words there is no difference between a light and an electron exposure. Moreover, we print through the mask which will be built in the tube. This mask, by the way, is an item where vendors have had some reasonable amount of experience. It is a balanced structure against our grille structure which naturally must be kept mechanically rigid.

Admittedly we have not sufficient manufacturing or engineering experience to make definite statements but we should realize that when we made our 15" shadow mask tubes the engineering laboratory was finished and had it's equipment ready to go in September. In January we made some tubes in the factory. Shrinkage was certainly high but was mainly due to what we called misalignment and contamination. Our difficulties there were exactly the same as now in the P.A. tube, namely a

stressed structure (then a mask) interchangeable with a print made from a master and thereafter taking this assembly through exhaust.

It is interesting to note that a final summary of shadow mask tubes made in engineering up to and including February 8, 1954 looks as follows:

Tubes tested	439
Breakdown:	
good to fair	18.93%
Rejects:	
Screen defects, mis- alignment, contamination, slippage mask, etc.	53.98%
Gun defects	16.85%
Dirt or holes in mask	6.14%
Tube to air	<u>4.1 %</u>
Total	100 %

Also note that when we called a tube fair it still had either a mottled screen or the misalignment was not too bad.

From the above figures we can also see that screen and alignment caused 67.52% of our rejects.

These figures are not intended to be a guidance for our future work but are mainly intended to show that if screens can be made which will align and have acceptable contamination, the shrinkage figures which we obtained in a limited operation could certainly be improved.

J. C. Nonnekens, Manager
Color Design Engineering
CATHODE-RAY TUBE SUB-DEPT.

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