Report of Visit to R.C.A. - Lancaster, Pennsylvania
January 31, 1951

The following persons were contacted:

D.Y. Smith - Manager of Manufacturing
W.H. Painter- General Production Mgr., Tube Dept.
H.M. Fackert - Production Mgr., Cathode-Ray Tubes
H.R. Seelan - Laboratory Manager
L.B. Headrick - Division Engineer
Mr. Swedlund
Mr. Kesser - Quality Control Engineer
M.R. Weingarten - Equipment Development Engineer
H.M. Hartman - Equipment Development Engineer
D.H. Wamsley - Chemistry & Physics Laboratory
R.H. Zachariason - " " " "
R.D. Faulkner - Senior Engineer, Glass-Metal Seals
Mr. Saunders - Engr., Electrostatic Focus Guns
and others too numerous to remember

When I first arrived at RCA, I was invited to join a conference which was being held on aluminizing. They are apparently considering the possible necessity of aluminizing the 21" metal rectangular tube and most certainly the 27" metal rectangular tube which is in their future plans. Two of the gentlemen present had previously visited us to learn of our progress in spray filming. They were interested in any new developments since that time. I was unable to give them any definite information since Mr. McKenzie, the engineer assigned to that project, has done most of the development work. However, they will most likely contact Mr. McKenzie in the near future and endeavor to arrange for another visit to our Syracuse plant.

I was then escorted through the factory by Dale Ludlum, a factory engineer, who was very cooperative and gave me any information I requested. We first saw incoming cone inspection.

Approximately 5 cones from each pallette are manually inspected for small end ID, lip height, inside diameter (width, inside diameter (height), inside diameter (diagonal), overall height at three different points, metal thickness at various points and radius of curvature at sealing lip. A group of scales, depth gauges, calipers and micrometers are specially fixed up to make this job easy and rapid. The operator keeps his results on a special form from which at the end of the shift the distribution of cones within the prescribed limits may be easily read. I have a copy of their Inspection Results Sheet which I shall keep available for anybody who would like to see it.

All 17" metal cones coming from ITE have been passivated by a hot nitric acid dip. No further details of this process were available but I was informed that passivation almost completely eliminates their corrosion problem. They have developed a "rust test" to check degree of passivation. This consists of filling the bulb assembly up to the usual level with the screening mixture minus phosphor and allowing it to stand for 48 hours. This approximates the condition that exists by allowing a wet bulb assembly to stand over the week-end. There should be no evidence of rusting or corrosion.

To make up for the lack of passivation of rework cones they are given a sodium dichromate treatment. This process was first developed to darken the inside of the cone for improving picture contrast, but it turned out to be even more valuable for inhibiting corrosion or, as will be seen, improving sealing qualities. The sodium dichromate treatment is also given to all new cones received from United Specialties.

This treatment is applied in either of two ways, spray or dip. The solution used for the application of dichromate by the spray method is prepared as follows. 16.7 pounds of technical grade sodium dichromate are dissolved in 7.6 liters of water. 1070 cc. of this stock solution are added to 2730 cc. of acetone in a one gallon safety can. The specific gravity of the mixture should be between 0.999 and 1.009. Adjustment is made by adding stock solution or acetone as required. This specific gravity was chosen because it formed the smallest crystals and most desirable oxide surface. The material should be checked periodically by the foreman to assure that no serious acetone evaporation has occured. This mixture is then sprayed on the previously sand-blasted sealing lip at a rate of about 180 cones per hour. After air drying, the cones are passed through an oven at 410°C so that the cones reach a temperature of 375-400° for at least 15 minutes. They are then hot water washed to remove any undesired chromium oxide (CrO_2) and are then ready for sealing. This process leaves the sandblasted area of the cone quite black but unblasted areas are not effected.

In the dip method which is being used only on a developmental scale, the cones are first sandblasted and are then dipped bodily in groups of about 10 at a time into molten sodium dichromate. They are submerged for approximately 13 minutes. Longer periods of time neither help or hinder, but if left for less than 10 minutes the dichromate tends to flake off. After dipping, the cones are removed from the bath, cooled in air until they dry and large crystals of sodium dichromate form on the cone surfaces, and are then plunged into cold water. This tends to break up the excess dichromate crystals into small bits which can be removed easily. If warm water is used, the crystals do not break up and then must be dissolved which, of course, takes much longer. After the cold water, they are then washed in warm water at about 100°F to complete the removal of the excess dichromate. They are then air-dried and are ready for sealing. Although, as stated, the dichromate treatment was started in an attempt to increase picture contrast, it has been found that it also has cut their glass shrinkage, resulting from poor seals, from 18% to about 5%. This factor alone, of course, is why they are now using the dichromate treatment in regular production.

I next saw the machine which makes their glass neck-glass funnel seals. There is nothing revolutionary about this machine, but it was interesting to note that they used a simple cold-rolled steel wheel, preheated, to roll over these sealed surfaces to attain a greater smoothness.

As we know, RCA is making their cone-neck seals in the inverted position. The machines which they have developed for this purpose have four simultaneously-operated holders fof the large end of the cone. As the operator loads the machine, she pushes on any one of these holders with the cone, thus automatically pushing out the other three too. When she releases the cone, the four holders come back into position and automatically center the cone on the machine. The neck is then placed on the center spindle, which is so designed as to hold the reference line at a given position with respect to the lip of the large end of the cone. Thus when the cone and neck are sealed, variations in cone height are taken up in the amount of " "push up", and a constant distance from end of cone to reference line is maintained. Two 8-position machines are used, each operating on a 30 second index. On each machine two positions are used for preheat, two for sealing and two for annealing. Overall, the process does not differ from the manner in which we perform neck sealing in our factory, except, of course, for the equipment used.

Faceplates are sealed in on either of three machines with eight heads or a machine with sixteen heads. The outstanding feature of these machines is the incorporation of "pins" to limit cone expansion during the sealing process. These "pins" are nothing more than pieces of type 446 stainless, nichrome, or a material which they described as 50-50, bar stock about 3/4" x 3/8" in cross section. The cone is suspended from the top end of these "pins" so that two pins on each of the long sides and one pin at the center of each short side helps to keep the cone from expanding outwards as it is heated. The top ends of the pins are beveled somewhat to reduce the interference to the flame. They have not yet decided on the best design for these pins. I saw some described as above and also others which fit just under the sealing lip, but in any case the purpose is the same. RCA claims that if it were not for these pins they would not be able to manufacture the rectangular tube economically. I shall not describe the fire set-up for the faceplate sealing machines, as this has already been done in previous reports. Incidentally, I ascertained that they use only tempered faceplates and do not run into the trouble which we have experienced in our factory with annealed faceplates, namely, breaking in preheat. After sealing, the cones are placed on a conveyor which is coompletely closed in and which has several hot air draw-off ducts. There is a cooling loop on the conveyor which permits the assemblies to cool for 45 minutes before bulb washing.

At bulb washing a 6-8% solution of ammonium bifluoride is used followed by a deionized water rinse. The bulbs are washed with ammonium bifluoride on the inside only. Rework assemblies which contain inside paint are washed manually by using a brush and a somewhat more concentrated bifluoride solution.

They are doing their screening both on screen conveyors and on tilt tables, followed by vacuum drying of the screened assemblies. The vacuum drier has roughly 10-15 positions per manifold so that 10-15 assemblies are dried at one time. The assembly rests neck down into a rubber ring. Some heat is applied by means of a coil to the lower end of the cone to help in removing water which might hang on the lip. I overheard that they are having some trouble with "drying lines" which I presume to be the same as our water marks, but did not obtain any further information about it.

Lancaster is having its greatest trouble with bakeout. After inside paint the assemblies are air dried and then passed face down through a regular lehr. Their trouble comes about by the cone expanding away from the faceplate as heat is applied. Fortunately, we do not have this trouble since we are able to preheat the faceplates before the assembly enters the bakeout ovens.

In their inline exhaust oven the tube is marked with the buggy number. A record is kept of rejects and after three rejects from the same buggy, that buggy is removed from maintenance.

Their present production of 17CP4's is approximately 3,000 a day. Right now they are not producing any other tube type at Lancaster.

I was able to get into their Development Laboratory to see a 21" metal rectangular bulb sealed. There were no outstanding differences from the methods used for the 17" bulb nor from the general procedure which we are using here, except, of course, for the use of the restraining pins previously mentioned. I did notice, however, that they seem to be using a higher gas pressure than we have here, thus enabling them to get a longer gas-oxygen flame.

I was informed that ITE had sent them some unannealed 21" rectangular cones but that RCA intends to return them for restamping since they are quite a bit out of limits. Apparently ITE has assumed that since RCA can (but not necessarily likes to) accept unannelaed 17" cones, they can get away without annealing the larger cone but this has yet to meet RCA approval. In my talks with Mr. Faulkner I learned that they are extremely pressure-test conscious, and are of the opinion that metal tubes should be tested at a higher pressure than that used for glass types. This is so because of the residual compression in the glass of the unexhausted metal bulb assemblies. The 5-7 pounds of residual compression must be overcome before fatigue conditions are set up. It is their feeling that these extra 5 - 7 pounds should be taken into account in their pressure test.

I had quite a talk with Mr. Austin E. Hardy on colorimetry. Their method of color control is as follows. Spectroradiometer curves with subsequent ICI calculation are performed on five tubes of each new phosphor batch. Corrections and adjustments are made on the phosphor as required. In the factory a system is used which consists of two photronic cells, one of which is equipped with an eye-response filter, the other with a wratten #47 filter which peaks in the blue. The output of each of these cells is read directly on a microammeter. The brightness of the tube is adjusted until a given reading is obtained from the cell equipped with the eye-response filter. A reading is then made of the other microammeter. By means of a chart these latter readings may be converted to degrees Kelvin. Two disadvantages of this system are (a) variations in color away from the black body line can not be detected and (b) a fair degree of inaccuracy is introduced in the setting of the tube brightness since the microammeter used in connection with the eye-response cell is not one which can be read too accurately. Mr. Hardy feels that the best accuracy that can be expected from this system is $\pm$ 500°K.

A few miscellanous bits of information which I picked up on my visit are given below.

They are converting to glass tubulation stems. Their Equipment Development Works is preparing an automatic tip off for these stems. They also plan to eliminate three of the unused stem leads.

They are working on a 17" rectangular color tube but have not been able to make one so far. On this tube they are using a coplanar faceplate sealing lip so as to enable the screen to be placed as close to the faceplate as possible.

The factory uses a system of bulb identification which they recommend very highly. Immediately before bulb wash an operator paints on the bulb face the symbol or number which identifies that particular assembly. All bulbs, test or production, are identified. The paint used is a white chalky substance which has no deleterious effect on the faceplate, even in bakeout, and which does not flake or chip off, yet when desired it can be removed relatively easily with a dry cloth and leaves no permanent marks or scratches on the glass, clear or etched. In cases where it is necessary to identify the cone before cone sealing, the identifying symbol is painted with regular paint on the side of the cone. Before bulb wash the appropriate symbol is also painted on the faceplate by the same operator mentioned above.

Operators treat all bulbs like regular production bulbs unless they are given special instructions concerning a given test.

They are welding some small threaded studs directly onto the metal cone of finished tubes. So far they have only done this with the 21" rectangular tube which is still in development. The welding is accomplished by means of electrical discharge of 68,000 mfd. condenser charged to 100 volts. This welds the stud on securely even without precleaning that portion of the cone. No indication of the weld can be seen on the other side of a .100" thick piece of metal. I was told that the depth of the weld is .0001". They plan to use these studs for mounting the cone. The studs can be placed to suit any particular set manufacturer. The equipment for performing the welding is made by Graham Mfg. Corp, Detroit, Michigan. I have a few of the studs in case anybody wants to see them.

In passing, I might mention that I think their policy of periodically broadcasting music has a high morale uplifting value on the operators.

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