July 19, 1946

Report of Visit of Messrs. R. O. Poag, G. L. Case and R. W. Newman to the Cathode Ray Plant of R.C.A., at Lancaster, Pa. July 9-10

People visited included: John King, Manager of the whole factory
Earl Wood, Manager of manufacturing
Kent Burton, Superintendent of Cathode Ray Factory
Mr. Patterson, Chief Factory Engineer of Cathode Ray Tubes
Harry Fackert, General Foreman of mounting and finishing, including test
Mr. Sargent, , Charge of Cathode Ray Test
Ben Artau, General Foreman in charge of bulb preparation
Richard Ling, Wage, Rate & Planning Dept.

GENERAL FACTORY

Everyone was extremely anxious to give us any information we asked for, and volunteered some that we did not ask about.

The factory is completely air conditioned and kept at 85°F maximum temperature with a 50% relative humidity. The Bulb Screening Room is separately air conditioned and kept at 40% relative humidity. The whole factory is built on a 6" concrete base with 5/8" maple blocks surface held in place by metal fittings. The floor of the Bulb Screening Room is separated from the walls of the factory so as to keep vibration to a minimum. 64,000 sq. ft. out of the total of 192,000 sq. ft. of the factory are used for cathode ray tube production.

As soon as a new tube type is being developed a factory engineer is assigned to work with the development engineering group to carry the process over into the factory.

Shrinkage on the 5TP4 has been running about 35% gross, 22% net after reclaim from sealing to initial test. Similar figures on the 10BP4 are 30% gross 27% net.

BULB PREPARATION

Mr. Artau is General Foreman in charge of Bulb Preparation and Glass Work. Mr. Burton believes that two-thirds of the problems are in this section.

Extreme care is exercised in keeping the floors and benches clean. It is found that by following this procedure that not only is it possible to make satisfactory hole-free screens but also the impression is given to the operator to exercise proper precaution.

BULB PREPARATION Cont'd

During the time of the visit the plant was not operating due to screening difficulties. A large epidemic of minus yellow spots were showing up on the P4 and P6 screens in such volume that no good television tubes were being produced. A good deal of help was being obtained from the Design Engineering Section and about six engineers were working on this problem. The effor being put on this aspect of bulb shrinkage had caused the P1 screen shrinkage up to about 80%. It was believed that impurities in the sodium sulphite had been the cause. Sodium sulphite is added to fluorescent powders to peptize them. 240cc of one normal sodium sulphite is used in the 10" tubes with the P4 or P6 screens. Lithium hydroxide is used with P1 screens.

must mean blue spots

On the 10" tubes it takes two hours to screen and settle, and twelve minutes to pour. It takes seven minutes to tilt off the screen in the 5TP4.

On the screen bakeout oven the filtered air is brought through a rotary valve and preheated with stationary gas burners.

Aluminum backed tubes are made by adding about ½" water to the dried screen after saturating the solution with four drops of an <u>unknown material</u> and waiting six minutes (on the 5TP4's). Four drops of a nitrocellulose lacquer dissolved in amyl acetate and plasticized with 5% camphor is floated on the top of the solution. After waiting five minutes the water is poured out by a tilting rack in approximately five minutes. The nitrocellulose screen is backed at 390°C for about 40 minutes.

must be after al evap.

The aluminum is flashed on the 5" tube in a special bell jar vacuum exhaust unit, R.C.A. Model MB-1 ($3500.00) which holds six 5TP4's. A 265 liter per second silicone oil DPI, diffusion pump with no cold trap is used to exhaust the bell jar to .1 micron. This takes about ten minutes. The six filament with 40 mg. of a aluminum each are then flashed at 20 amperes and 12 volts. A .030 diameter aluminizing filament somewhat similar to a letter "E" on its side is used. The lighted length is about 7 cm. It is made of tantalum, since they have found that tungsten alloys with the aluminum too rapidly the tantalum filament however must be replaced each time. Flashing takes five minutes. Air is let in through a four way valve which permits,

a) Preliminary exhausting through the mechanical pump only.
b) Pumping through the diffusion pump or
c) Slow leakage of air back into the bell jar.

The valve is controlled by a small handle. The rubber bottomed plastic coated glass bell jar is raised hydraulically. At these high pumping speeds it is possible to use lucite for bulb holders in the bell jar. The aluminum film is opaque to the fluorescent celing lamps of the factory.

BULB PREPARATION Cont'd

A single head is being built experimentally on the standard 16 head exhaust machine to aluminize 10" direct view tubes. The head will permit the tube to rotate so that the off-center aluminizing filament can more easily cover the face of the tube with aluminum. The head is directly connected to a VMF50 DPI Pump.

A graphite silicate mixture is used for the inside bulb coating on the 5TP4. This is proving somewhat unsatisfactory for high voltage breakdown and Mr. M. Szdowski requested that we send him a sample of our silver-graphite mixture.

Face plates are preheated in an oven previous to being sealed.

Bulbs are salvaged by removing the base, breaking off the tip and mounting on a lathe where the neck is scratched with a diamond and heated with a small hydrogen flame. Then by blowing on the hot section a perfect round crack occurs which allows a small additional neck section spliced on so that the bulb can be reused.

Screens are removed from the defective tubes by shaking up with sand and then adding a small amount of hydrofluoric acid and washing.

Leaks are detected by using hot paladium sheet, connected to an ion gauge on an exhaust system. The suspect tube is then connected through rubber and "smelled" with hydrogen.

PARTS PREPARATION

A new double unit continuous dry hydrogen furnace has been built by the Lancaster Iron Works for R.C.A. This was Lancaster Works Shop Order 163-5. It is identical to R.E.L. Design with the exception of having very heavy cast boats. These boats are linked together and form the moving belt of the furnace. They are probably made of 80% chromium 20% nickel.

Cathodes are, at the moment, being hand sprayed although an automatic machine is being built. The cathode spray operator times her spraying rhythm with the use of a metronome.

Apertures are tumbled in a small cement mixer to remove burrs. 100 pounds of 1/8" "Honite" (looks like carefully selected silica pebble) with 2½ gallons of water and 20,000 apertures for 48 hours. After tumbling parts are inspected and gauged 100%.

MOUNTING

Cathode grid ~~spraying~~ spacing is measured by means of breakdown voltage. A 3 kv. d.c. source is put between the grid and cathode and slowly increased in potential. After the first arc is obtained the equipment is turned down and restruck. The point at which the arc extinguishes the second time is taken as an indication of this spacing. It was claimed that in the air conditioned factory this was a very accurate method of measuring cathode grid spacing it was done 100%. The arcing occurred at the very edge of the cathode and does not damage the surface.

Small lead stem shields are used over the tits of the glass stem and welded to leads between which leakage is important.

The mount and stem assembly is checked for continuity with a 3 ampere source. The filament is also measured 100% for continuity and shorts.

One welding control panel is being used for 30 welders in a similar fashion to the way Sylvania operates. This has proven quite satisfactory and a second panel is on order.

All shrinkage tubes are analyzed 100% by a Shrinkage Analysis Girl and the defect marked on a tag attached either to the bulb or gun structure. As every operator which handles the tube code marks it, the defect may be immediately called to the attention of the operator responsible.

SEALING

Previous to sealing the stem is preheated on a 20 position calrod heated rotary unit. The tubulation rests on a track and as the machine indexes the stem is slowly brought more and more down into the hot zone.

One sealing man and a girl run each sealing machine.

EXHAUST

5" and 7" Tubes are exhausted on rotary machines, which are being changed over to use the DPI VMF 20 silicone oil diffusion pump. This pump has an specially built baffle and no liquid air is used. Some difficulty was being experienced with these pumps as they were not apparently pumping as fast as it was felt they should.

The seventy foot long straight line exhaust was being rebuilt to make 10" to 20" television tubes. 35 to 40 small carts with individual VMF 20 pumps backed up with "baby" Welch's were used. It was anticipated that this machine would handle a tube every two to four minutes of the 10" type. Tubes could not be tipped at this exhaust speed using a glass exhaust tube. Therefore, a oxygen-free copper pinch seal, fernico to glass sealed tube .300 in diameter .010 thick is being used. No weld leaks are normally obtained when the hydraulically operated pinch-off is properly operated. The

EXHAUST Cont'd

straight line exhaust makes it a lot easier to repair individual defective ports.

On the sixteen position rotary exhaust, six Kinney pumps #CBD556 (15.2 cu.ft. per minute) are used as backups. In each of the last three positions individual Cenco pumps are used. A tilting type Ace McLeod Gauge (made by the Ace Glass Co. Inc., Vineland, N.J.) is used in each backup line. A pirani gauge is used on the backup in the final tipping position. 5microns to 10 microns is normally obtained in these backup lines. Should the pressure get over 30 microns the machine is shut down and the pump replaced or repaired. Using glass tipoffthe glass is cooled slowly after tip-off by placing successively in two pots controlled at 360°C and 250oC, for 5 minutes each (or according to index).

TEST & FINISH

The enclosed chart shows the data we were able to get on gactory test methods.

Following is the R.C.A. Schedule used for sparking on type 5TP4 to clean up leakage, breakdown, etc.

P1--G2	20 Sec. @ 10 kv a.c.
P1--KG1	20 Sec. @ 10 kv a.c.
G2--KG1	10 Sec. @ 5 kv a.c.
P2--all	2 Min. @ 50 kv d.c.

All bulbs are sprayed in a trisodium phosphate solution at 60°C and then washed in hot water previous to painting on the exterior.

R. W. Newman
BUFFALO TUBE WORKS

RWN:MHR
cc:VC Campbell-Tube Div.-Bldg. 269
GL Case
E Fehr-Tube Div.-Bldg. 269
RF Horvath
TO Moffit
WL Peters
RO Poag
LE Record-Tube Div.-Bldg. 269
PE Sullivan
GT Waugh-Tube Div.-Bldg. 269

CATHODE RAY TESTING AT R.C.A. (Factory Limits)

	5TP4 Ef	Raster Size	Ec1	Ic2	Ib2	Eb2	Ec2	Eb1	10BP4 Ef	Raster Size	Ec1	Ic2	Ib1	Ib2	Eb	Light	Ec2
Life Test	6.3	3x4	adjust	150ma	focus	30Kv	200	Focus		6x8					11Kv	20ftL	450
12-17,000cyx30-60 cy		10 meg	Rc1	H-K = 0v													
Short Test K-G, H-K				*								*					
Breakdown		(b1+b2)															
Field Emission				*													
Cut off				*	specified max.		200	spec. max.			29-60				9kv		
Color	L.O. & Color. read together. Vary Ec1 for standard microammeter reading with green filter over Weston cell then read with red filter. Must be within limits.										(5500 - 9000°K)						
Light Output												*					
Modulation				*								*					
K Current												150 ua max. for 12 ft.L					
Beam Strikes Neck		4 9/16R		200ua	Focus	20Kv	200	Focus				*					
Concentricity				(8mm Max.)													
Screen Defects												*					
Center Resolution		1½x2	(800 lines center, 750 corner) (actually using monoscope)								(actually using monoscope)						
Grid #1 Leakage				*								*					
Grid #2 Leakage				*								*					
Gas		(change Eb2 to -25, bias and read leakage)			Ib1 500ua	±25 Max.	250 .15					*					
Grid Emission												*			12kv		

*Means test is made.

Note: This data is not complete--but information we were able to see. R. W. N.

MHR