T-1,0

TRIP REPORT

V. L. Campbell

CATHODE RAY TUBE DEPARTMENT

TRIP REPORT: Rauland Corporation

DATE: October 29, 1954

PURPOSE: Observe combined screening & filming operation

G. E. PERSONNEL: W. Bertrand
P. Dee
C. Dichter

RAULAND PERSONNEL: W. Phillips - General Manager
J. O'Callaghan - Chief Engineer
Dr. Szegho - Director Research
F. Zartner - Works Manager
J. Baily - Works Superintendant
N. Levin - Chief Chemist

TOPICS COVERED - 1) Combined screening & Filming
2) Aluminizing
3) Tip-off
4) Cathode loading and life test

I. - COMBINED SCREENING & FILMING

SUMMARY

Screening

DI H_2O (Pre treated)	22 liters
$Ba(NO_3)_2$	400 cc (1.6%)
Kasil #122 (DuPont)	225 cc (28%)
Phosphor 82B2TD1	7.5 grams (in 105 cc H_2O + 300 cc rinse)

FILMING

Nitrocellulose	2.26 gms (dry weight)	16± 1/2 Sec	RS in absolute ethenol
Amyl Acetate	49.67 cc	Malinkrodt AR grade	
n - butyl acetate	10.0 cc	Comm. grade	
n - butanol	20.0 cc	"	"
Toluene	20.0 cc	"	"
2 - ethyl hexyl acetate	0.33 cc	"	"
dibutyl phthalate	1.25 cc	"	"

PREPARATION:

1. - Full pound jar nitrocellulose dissolved by rolling overnite in amyl acetate
2. - Dry weight determined of above solution.
3. - Dry weight adjusted to proper value
4. - Other materials added.
5. - Entire preparation put through filter press
6. - Viscosity measured and material bottled for factory use (Viscosity 17 cps ± 1/2 # 1 Spindle 60 RPM (Filter press - sparkler pressure filter 2 liter capacity).

Processing for 21" sphurical bulb

Screened as indicated under screening	
Cushion temp.	78° F to 80° F
Amount Lacquer	0.8 cc
Room temp.	78° F to 80° F
Screening to syphon	12 1/2 minutes
Screening to Lacquering	16 minutes
Screening to Tilt	19 minutes
Pour-off time	6 1/2 minutes
Drain time	45 minutes
Dry time (off conveyor)	12 minutes
Temp.	113 - 133° F
Low velocity high volume air (centrifugal blowers)	

Shrinkage (Oct. 28, 1954)

	Tilt - table (40% alum. Prod.)	Conveyor (60% alum. Prod.)
Film inspec.	8.1%	3.3%
Alum. inspec.	29.3%	12.1%
Vac-cluck	20.1%	11.9%

Figures indicated as normal shrinkage.

Inside Paint

Made to Rauland specifications in 50 gal. lots
Continuously rolled
Hand brushed.

Aluminizing

Pump oil DC 708 silicone
Tungsten coil single strand (Sylvania)
Aluminium - .125" with pinch (200 mg.)
O-Ring seal at funnel
Pump time 5 minutes
Flash time 35 secs.
Bleed time 30 secs.

Bake out

Lehr 3 3/4 hrs.
glass peak 420° C for 12 min.

OBSERVATIONS OF SINGLE CUSHION PROCESS

1. Use of the undiluted (28%) silicate in the screen formula was strongly advocated as a means of obtaining better adhesion since they feel that diluted silicate loses "stability" on standing. The quality of Dupont #122 potassium silicate is considered better than that of Philadelphia Quartz Kasil 22 .

2. They are presently using a premixed water and barium nitrate solution from a separate tank on their 17" Nonaluminized bulbs and are considering use of such a premixed electrolyte in the single cushion process. No change is contemplated in type of electrolyte used. Screen appearance was good and distribution looked good.

3. The phosphor is given a ten minute wet ball milling just prior to use to break up passible agglomerates-not to reduce particle size.

4. The 300cc water rinse in the screen pouring is not combined with the silicate and powder. It is used strictly as a funnel rinse. The dispenser has a spherical steel tip with one row of holes 45° apart. The shank is of flexible plastic and the funnel at the top is very similar to ours. As will be noted from the quanteties used the complete cushion comes up nearly to the anode button.

5. Siphoning was done in two stages....a reduction from 22 to 10 liters of water in the first step followed by a second siphon that "shaved" the cushion to 8 liters. The fine siphoning in the second phase was necessary due to the very close spacing required between pipette and water level during lacquer dispensing. Initially a gear pump siphon mechanism was tried but discarded because of liquid drainback at the end of the cycle. Then a water aspirating system with (venturiis was used having tap water as the working liquid. This resulted in building inside the lines for reasons unknown to them. The siphoning system as it now stands is a continuously flowing water aspirator type using discarded screen cushion water as the working liquid. This prevents pipe clogging. The siphon tip is a simple tube and cup affair.

6. Lacquer dispensing is by a mechanism similar to ours. The dispenser is all stainless steel with a teflon valve seat. The distance the piston will rise and subsequently drop when the solenoid is de-energenized is controlled by small ears swedged on upper end. This helps to minimize any surging or jetting of the final portion of lacquer from the pipette tip.

Only the lower 6" of the discharge tubing has capillary dimensions (0.060"). Early pipette designs had an 0.030" I.D. discharge tube. This combined ID with the low viscosity lacquer (17 CPS) was causing the lacquer to submerge beneath the water due to the surge produced by the closing of the pipette valve. The submerging of lacquer gave large bare areas. To overcome this a slight constriction of the order of the capillary opening was placed in the wider I. D. portion of the tube above the capillary to absorb the shock of the valve closing, and the capillary was enlarged to the present 0.060" I. D., .

No constant gas pressure is used. The lacquer falls by gravity only (atmospheric pressure) and a dropwise discharge results. To convert this dropwise discharge into a steady stream, the pipette tip must be within 1/16 - 3/32" from the water surface.

One man is stationed at pouroff all the time and maintains a uniform color interference pattern in the film by slight adjustments in the lacquer volume.

7. In both aspirating and lacquer dispensing the levels of the tube ends are referenced from vertically fixed plates. All motive power is hydraulic and is activated by cam displacement. Centering devices are loose inverted cones very similar to those on our Buffalo automatic lacquer pipettes.

8. They stressed the importance of temperatures and attempt to keep room and water temperature equivalent in the range of 78-80° F. Temperature control is facilitated by having no dry rods under the settling conveyor. Drying is done on a separate conveyor. Further, the room is not broken up into decks or compartments that can restrict air circulation.

9. Films have rough edges as noticed at aluminizing and the use of as much cushion water as possible is advantageous. Film streaks noticed before pouroff were at least as heavy as any we have encountered in our own development work but were not visible after aluminizing. Visible streaks after aluminizing has been our major defect to the present moment.

10. The delay in the starting of drying for almost 45 min. after pouroff (necessitated by equipment height) is not considered detrimental. They have tested this by taking bulbs from pouroff and drying immediately. The comparison showed no differences. This is in line with what has been found in our own work: that a delay after pouroff is not as important as the speed and continuity of drying once it has started.

11. Some screens are very heavily mottled with dark edges and are exactly similar to what has been seen during our combined procedure tests and considered rejectable at vacuum check. However, they do not reject such heavily mottled bulbs at vacuum check. They report that the second heat cycle at exhaust causes the mottling and dark edges to disappear. The particular example we viewed was quite cool at vacuum check. Other bulbs viewed at the same station were not heavily mottled. Since no extensive number of tubes were seen at vacuum check or initial test the true extent of the mottling problem was not discernible.

12. When bulbs were viewed at aluminizing, pinholing was observed. This was of the same type as we have encountered in our tests but was only one-tenth or so the intensity. It was definitely a much more severe pinholing than we get in our present filming operation. No large film holes were observed at either aluminizing or vacuum check.

13. As mentioned previously streaks were not visible at aluminizing or vacuum check to any great degree. Two slight streaks were noticed at vacuum check, either of which would be possable by our standards and were by theirs.

COMMENTS:

1. From questions asked and examples seen, it would appear that screen mottling and dark edges is a major problem. They were surprised to know that mottling in a bulb will lighten with life of a tube. They report decreasing mottling some by reduction in screen component concentrations but had obviously not been able to tie it down to any one cause.

2. As to the desirability of the combined operation there was one illuminating exchange of comments. The chemist who is intimately connected with screen and lacquer makeup plus the screen quality, observed that separate operations would definitely be desirable. This remark was quickly commented on by the chief engineer and works manager that such separate operations would constitute a "luxury" and their limited space conditions precluded any such "luxury". Their present filming lacquer is the eighth modification of their fourth distinct lacquer.

3. Development of the process on tilt tables took a year and a half before being started on a conveyor. It was noticed that no automatic dispensing was used on tilt tables even though there seemed to be no reason for not using such a system.

4. The complete processing instructions together with lacquer has been supplied by Rauland to National Video. The Rauland people report, that National Video, however, has been unsuccessful in converting their help into a useable process. This help included sending Rauland's chief chemist to N. V. for awhile.

II ALUMINIZING

Tungsten coils and aluminium slugs are almost identical to those used by General Electric. Rauland is successfully using silicone oil & life test data bears this out. A shield is used during flashing to improve uniformity. However, the filament is about 1 1/2" closer to the screen than we place it, so thus, is necessary. They report getting 10 to 12 flashes per filament. The preheat and evaporation cycle takes only 35 seconds. No sputtering was observed. Bleeding is accomplished through one of the electrodes used to support the filament. The power lead-through electrodes are 1/4" copper tubing. One of these tubes has a series of small holes drilled in it near the filament chuck. In addition to bringing power into the system this one electrode is externally connected to a needle valve. The system is let down to air at a point above the yoke reference line through the electrode.

Some difficulty has been encountered with loss of silicone oil. They report losing 25cc per week per pump. Most of this loss appears to be to the roughing pump. By insertion of a water cooled copper-wool filled tower between the fore pump and diffusion pump this loss has been cut to 5cc per month. They appear to be satisfied with this approach and intend to convert all their pumps over to having a tower for recondensation of the oil.

III TIP-OFF

The radiant tip-off oven now being used by Rauland is made for them by a former employee. These ovens are available to other tube manufacturers.

The address: Hussman Shawfrank Engineering Corp.
Attn: R. W. Shawfrank
6895 Mannheim Rd.
Desplaines, Ill.

The oven consists of an enameled stainless steel shell in which the heater is held in place by a castable refractory. They report having had only one oven replacement in a year. Tip-off shrinkage is reported as virtually non-existant. Some difficulty had been experienced with cracked presses before they went to the all stainless steel case. Tip-off schedule has been changed from a 2 minute preheat, 4 minute seal, 2 minute anneal to 6 minutes seal and 2 minutes of anneal. O'Callaghan feels that the success of their tip-off operation is contingent upon careful control by the ceramic engineer. The 1st shift MA saves the tubulation from each buggy on the first go-around. These are placed on a peg board so that the engineer can quickly examine each tip and note the oven that it came from.

An adjustment of not over 0.1 watts up or down is then made on the ovens showing to cold or to warm a seal. The tubulations are saved from any oven where a readjustment has been made. If an oven shows a history of three consecutive readjustments it is removed and carefully checked over. They feel that this painstaking care is more than paid for in low shrinkage at tip-off.

IV - CATHODE LOADING AND LIFE TEST.

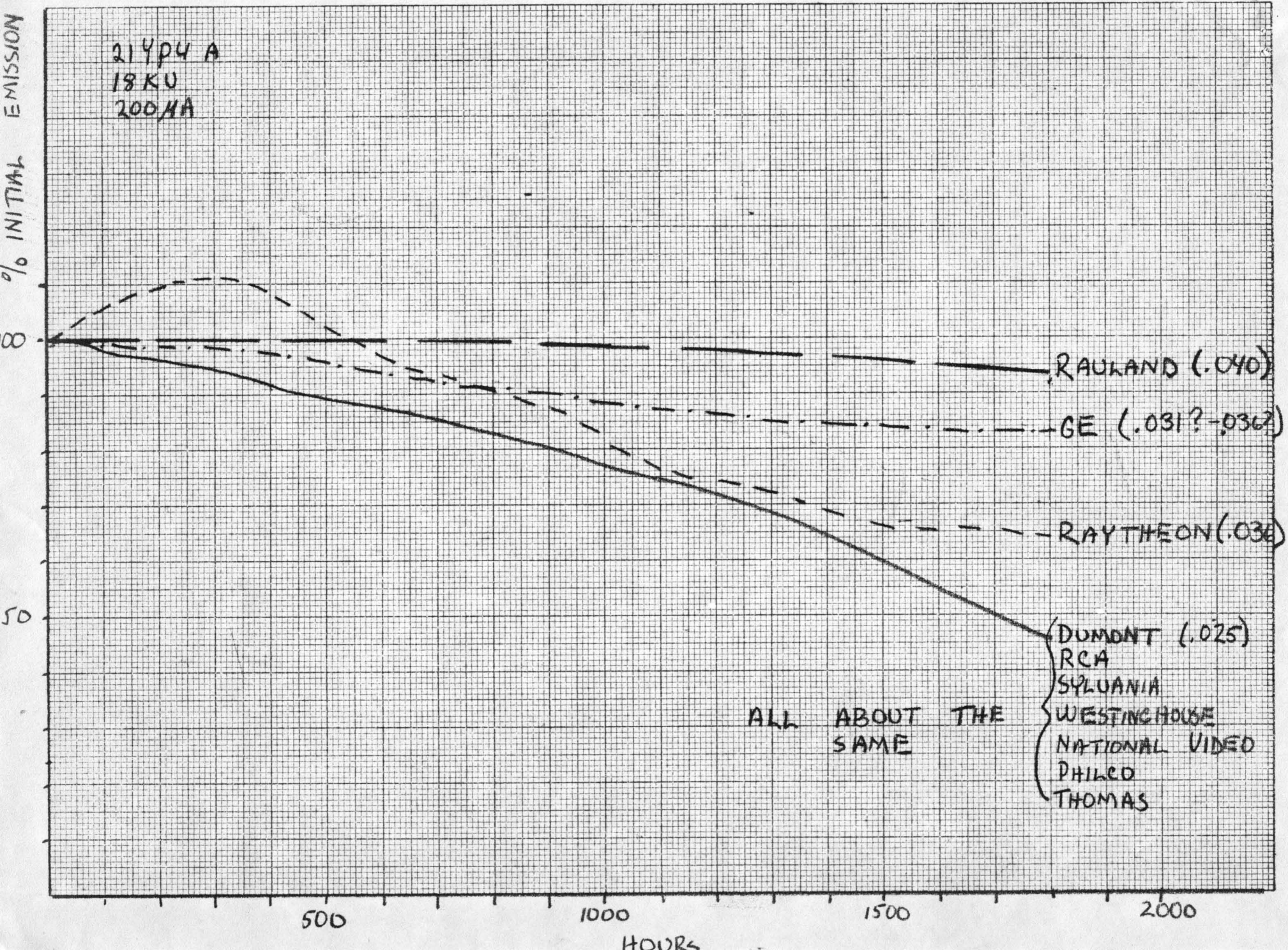
A very interesting discussion was had with Mr. Phillips, Dr Szegho and Mr. O'Callaghan concerning the problems involved in using ultra-vision type filters and high resolution electro-static guns. They all felt that in view of the one year warranty period (which they believe to be completely unrealistic) we are going to regret going to smaller grid one aperatures. Phillips felt that the in-warranty low emission returns were going to increase considerably. Rauland had some cogent life test data to augment this feeling. I was shown life test results on 21YP4A's made by ten different manufacturers. This data fell into three distinct groups. The attached graph gives the results quite roughly. It can be seen that Rauland is best, G. E. and Raytheon next and then a cluster of the other manufacturers. It is also interesting to note that Rauland uses a .040" grid aperature. Raytheon .036", G. E. .036" (? - this was news to me) and all others .025" or .031". The information on the .036" aperature was a surprise, and from the conversation I gathered that the gun had been x-rayed and the measurements obtained from the x-ray. If this is the case then it is my belief that the coined section did not show up and led to the erroneous conclusion that we were using a .036 grid. However, this life data would tend to substantiate our claim that the coined grid, in effect, reduces the Cathode loading by the manner in which the cathode-grid field is shaped. The effect then, is that our .025" aperature in terms of cathode loading, is equivalent to a regular flat .010" thick grid and the .031" coined about the same as a regular .036".

Mr. Phillips and his Quality Control group would like to discuss the warranty and life test situation still further (Norman and Campbell please note). It is my feeling that we could benefit by such an exchange.

P. Dee
W. Bertrand
C. Dichter
Materials and Processes
CATHODE RAY TUBE SUB DEPARTMENT

CD/ib

Distribution:
R. H. Berg
V. C. Campbell
H. J. Elias
I. Halt
H. R. Hemmings
W. L. Jones
L. C. Kunz
R. E. Lee
R. T. MacKenzie
L. C. Maier
W. L. Male
R. A. Norman
M. J. Ozeroff
S. S. Sadowsky
L. E. Swedlund
J. A. Steele
P. N. Taggert


21YP4 A
18 KV
200 μA
% INITIAL EMISSION
100
50
500
1000
1500
2000
HOURS
RAULAND (.040)
GE (.031? -.036?)
RAYTHEON (.036)
DUMONT (.025)
RCA
SYLVANIA
WESTINGHOUSE
NATIONAL VIDEO
PHILCO
THOMAS
ALL ABOUT THE SAME