V.C. Campbell

MEMORANDUM ON THE VISIT OF G. L. CASE AND W. L. JONES TO THE LANCASTER, PENNSYLVANIA FACTORY OF R. C. A. ON JANUARY 31ST AND FEBRUARY 1ST, 1949

People seen:		
	D. Y. Smith	Factory Manager
	J. K. Burton	Superintendent, Cathode Ray Tubes
	B. E. Artau	Assistant Superintendent, Cathode Ray Tubes
	George Phelps	Leader of Engineering group on adapting new equipment for manufacturing use, etc.
	James Quinn	Leader of Engineering group, following tubes from mounting through packing.
	W. B. Miller	Type Engineer on 16AP4
	Robert Crone	Leader of Engineering group following bulb preparation and screening.
	William Harrington	Type Engineer on 5TP4
	A. Cooper	Glass Engineer on 16AP4 face plate and neck sealing.
	John Zimmerman	Plating room supervisor
	Henry Weiss	Assistant Foreman in mounting

GENERAL:

They were in production on six types of Kinescopes and twelve Oscilloscope types (out of 35 to 40 types total) during January.

The volume of Kinescopes produced during the period of January 2 through January 27, 1949 is as follows:

Type	Approx. No. Produced	Net Scrap
10BP4	40,000	7%
7JP4 7GP4	12,000	12%
16AP4	5,000	10%
5TP4	3,300	22%
1816P4	100	20%
12AP4	?	?
	63,300	9.5%

The overall production for January was approximately 75,000 Kinescopes at a net loss of 8.5%. The production for the month on 10BP4 was 45,000 and on the 16AP4 was 6000.

The actual manufacturing area was 70,000 to 80,000 square feet. The warehousing facilities have been increased during the past year.

The total personnel numbered approximately 600 of which 400 were direct workers. (Maintenance, etc. not included.)

An over all breakdown on scrap from shrinkage charts would be:

Type	Test	Floor	Gross	Retest	Salv.	Net Scrap
10BP4	12	5	15-20	2-3	10	5-10
5TP4	30-40	5	35-42	7	12-20	20-30
7GP4	25-30	5-10	30-40	10	10-15	20-30

10BP4 Processing

Button Insertion

They are inserting all of their second anode buttons. Beaded buttons are used only on the types where they are to be inserted using gas heat (5TP4, 7JP4, etc.) On the 10BP4 the bulbs are unboxed and inspected at this operation. The bulb necks are gauged 100%.

The machine rate is 72 bulbs per hour, and the buttons are sealed in by the use of HF. The bulbs are transferred off the machine to an overhead annealer, and then to the bulb conveyor, all automatically.

The shrinkage at buttoning is running between one and two percent, with approximately half of this shrinkage due to inherent bulb defects.

Bulb Wash

The bulbs are carried by conveyor to the bulb wash operation.

Two machines of twelve heads each are in operation using a 23 second index (approximately 160 bulbs per hour each.) The machines are used exclusively for new bulbs or screen salvage. Bulbs with coated necks are washed by hand.

The machine cycle is as follows:

Position	Operation
1.	Unload and load bulb. Lock bulb(all type bulbs will fit in the same holders without adjustment.)
2.	Idle - Used to realign bulb if necessary. Buttoned bulbs are oriented so that later a single spray on the jets will impinge on the button.
3.	Caustic Wash - 6 to 8% sodium hydroxide solution, maintained slightly above room temperature by the heat of the incoming bulbs. This tank is maintained at strength by specific gravity measurements taken twice per shift. Standard make-up is added to compensate for carry-off. The tank is dumped and cleaned at two week intervals.
4.	Tap water rinse - tempered to 100°F.
5.	Hydroflouric Acid Wash - 1½% to 12% solution. The concentration depends upon screening results. Titrations are run twice a shift and make-up acid is added as required. The tank is dumped and cleaned at two week intervals.

Position	Operation
6.	Tap Water rinse - unheated
7.	Caustic Wash - repeat of Position 3
8.	Tap water rinse - unheated
9.	Tap water rinse - unheated
10.	Distilled water rinse - approximately 1 quart per bulb
11.	Drain
12.	Drain

The actual operating time per position is 8 to 9 seconds. The distilled water rinse is limited to approximately one second (to conserve distilled water).

Screening

After bulb wash the bulb assemblies are replaced on the conveyor and are transported to the screening room.

Screen Material Preparation

Distilled Water - Water from Illcodemineralizers is fed into Barnstead stills. The distribution system uses aluminum piping, although they prefer stainless steel. Porous stainless steel filters are used. The copper content of the water runs 1 part per 175 million.

The temperature of the water for 10BP4 screening is held 1.5°C below room temperature. (The temperature of the water used to screen the 16AP4 is held at 15°C, approximately 6 to 8°C below room temperature.)

Silicate - Diluted to a10% solution and purified by the Zinc Sulfide treatment. Alsop filters are used.

Mr. Crone mentioned their use of a special Zinc Sulfide which apparently has a higher exchange capacity (through the control of grain size and activation of surfaces) than regular CP Zinc Sulfide. This material is specially prepared by their phosphor plant and is a component used in phosphor preparation.

(For more details on this method refer to Mr. Case's trip report of February 24th and 25th, 1948)

Sulfate - IN sulfate is purified by the Zinc Sulfide treatment. Alsop filters are used.

Powder Suspensions - Phosphors are milled for 20 minutes in a No 4 jar, using distilled water and 1¼" diameter Pyrex balls, to a 5-7 micron crystal size. The master suspension is made at 50 mg per cc and is kept mixing in 10" diameter jars, being drawn off as required. (This mixing time is not controlled.) The master suspension is diluted to 12.8 mg/cc for use in dispensers.

Dispensers - Dispensers are in use on the 10BP4 and 16AP4. The liquid tanks are made of methacrylate. The supplies are transported in bottles to a location below the dispenser tanks and blown up into the tanks by low pressure air. (For further details of the dispensers refer to Mr. Case's trip report of February 24th and 25th, 1948.

Procedures
10BP4 The materials used in the screening process, the quantities and sequence of additions are as follows:

1200
250
150
143
400
2143

1. 1200 cc cushion water (1.5°C below room temp.)
2. 250 cc sulfate -1N — 11.7%
   150 cc silicate -10% — 7%
   143 cc phosphor suspension-(12.8 mg/cc) — 1.84 grams
3. 400 cc rinse water (1.5°C below room temp)
   Spray tips are used and are identical with those previously noted.

   Settling time is one hour on the conveyor. The pour off time (total time from vertical until empty) is 6½ to 7 minutes.

   Scrap from the screen room on the 10BP4 is approximately 15%, being mainly holes and machine lines. Mr. Crone stated that elimination of machine lines is always a matter of machine maintenance.

Screening Conveyors

At present they have three screening conveyors. Two are in production use, one with three bulbs per panel, and the other with four bulbs per panel. The newer (four bulbs per panel) is running approximately 2.5 times the shrinkage of the older one. The output of the three bulb per panel conveyor is 60 per hour and the four bulb per panel conveyor is producing 80 per hour.

The third conveyor is now being tested for screening the 16AP4 bulb assemblies. This is a three bulb per panel conveyor. They are attempting to settle the screens for two hours. The shrinkage is very high due to the difficulty of holding the bulbs during pour-off.

The conveyors are 25 feet long (center-to-center of the wheels) and the wheels are approximately 4 feet in diameter. The loading platform and pour-off pans are isolated from the conveyor.

The conveyors have the appearance of being very ruggedly and precisely built and of having considerable weight. They are rigidly mounted to the floor which is practically vibrationless. The floor is made up of a 12 inch thick concrete slab poured onto an 8 inch thick cork pad supported by a 12 inch thick concrete slab. This floor is isolated from the building on all sides with cork.

The water during settling and pour-off does not have any noticeable movement.

After pour-off and drain the bulb necks are given a short water wash. This is followed by a low pressure, room temperature air drying cycle. The air jets index under four panels at a time.

During pour-off the panels are held to the pour-off wheel by a roller bearing pressing against a rubber covered circular track. The panels are supported by two roller bearings on each end moving along a steel track.

The bulb assemblies are held onto the panels by a three point suspension. Two of these points are rounded metal nubs and the third is screw adjusted and is rubber tipped on the 10" conveyors. The 16" conveyor has a metal surface on each suspension. The face of each suspension is tapered to conform to the cone surface upon which it rests.

On all conveyors the materials are loaded into the bulb assemblies by use of a dispenser. The dispenser is operated from an overhead platform.

Light Box Check

When the bulb assemblies are unloading from the screening conveyors all bulbs are placed on the conveyor where they are transported through a light box station where the screens are checked.

Bulb Coating

After the light box check the bulb assemblies with passable screens are removed from the conveyor and placed in a R.C.A. standard coating chuck where the inside paint (33G32) is applied.

Bake

After the graphite has been applied the bulbs are loaded into an in-line oven where an unusually large amount (approximately 150 cu. feet per hour per bulb) of drying air is used. The maximum faceplate temperature is 405°C with a bake of approximately 11 minutes above 400°C, as represented by the following curve:

Time Minutes	Temperature $^{\circ}$C	Time Minutes	Temperature $^{\circ}$C	Time Minutes	Temperature $^{\circ}$C
0	20	22	285	44	405
2	50	24	305	46	405
4	80	26	330	48	405
6	100	28	350	50	405
8	110	30	365	52	400
10	125	32	375	54	398
12	160	34	380	56	397
14	190	36	385	58	395
16	205	38	390	60	395
18	230	40	395	62	390
20	260	42	400	64	385
				66	380
				68	380

The temperature at unload is less than 100°C. The total time in the oven is two hours and twenty minutes. The production rate is 120 per hour.

This in-line oven is used for all 10" production, the rotaries are being used for smaller tubes only.

Final Inspection

When the bulb assemblies are removed from the bake oven the screens are given a final check in a rotary inspection unit utilizing ultra violet light. The shrinkage at this 100% inspection is 7 to 10%, being mainly paint splashes, holes and glass defects.

Gun Sealing

Two standard rotaries are used for this operation. Each machine can produce 60 tubes per hour.

The bulb holders are adjustable so that either 10" or 16" tubes can be sealed in without readjusting the location of the sealing fires.

Exhaust

At present there are 1½ straight line exhaust machines (3 units) in operation. Each machine has two units or ovens. Each unit's output is 40 or more tubes per hour, depending upon the index time (40 per hour at 1½ minute index). One operator can load two units or one machine.

The index time is usually determined by the number of implosions. They consider 3 or 4 per day normal, and decrease the index until this number occur. When too many occur they lengthen the index.

A typical curve for an 80 second index on 10" bulbs is as follows:

Time Minutes	Temperature °C	Time Minutes	Temperature °C
0	90	24	365
2	115	26	345
4	140	28	320
6	180	30	305
8	220	32	290
10	250	34	280
12	275	36	240
14	315	38	220
16	345	40	205
18	365	42	190
20	385	44	175
22	370	46	160

There are 32 positions in the oven, the activation being as follows:

Position	If - amp	G1 - Volts
25	.4	
26	.5	
27	.6	
28	.7	
29	.8	5
30	.8	5
31	.8	10
32	.8	10
33	.6	5
34	.6	5

The pinch-off unit is so adjusted that it will not operate when the tube in the tip-off position is gas or air.

The pinch-off jaws are made of ¼" diameter drill rod which work hardens with use and requiresreplacement at regular intervals. The jaws are lubricated between each operation and they stressed that this, as well as regular maintenance, was important.

The automatic unloader after pinch-off has not been converted to handle both the 10" and 16" but this is contemplated. At that time the 10" and 16" can be run indiscriminately without equipment adjustment or change over.

Whenever an implosion occurs on any type the two tubes prior to and the two bulbs after are subjected to a pressure test.

A port check is run twice a day. The gas readings are carefully watched.

Base Age, etc.

Basing aids are in use, one for each exhaust machine. All baking is done on rotary machine with infra-red lamps.

The getters are flashed off the exhaust machine in an interlocked HF unit.

A new overhead conveyor is used for hot shot, age, spark, short check and preheat. The bulbs are suspended face down in a cradle type hanger, slide contacts being made to four bus bars mounted on a bakelite sheet running beside the conveyor.

The aging schedule is :

Time	Grid	Heater	Grid 2	Anode
2 min	-	12V	-	-
30 "	+5V	6.8V	+500V	-140V

Mr. Burton considered the above schedule a minimum, since they have considerable low emission shrinkage that will reage satisfactorily.

Sparking is 12 to 15 KV DC as follows:

Step 1	Cathode to all	15 seconds
Step 2	Anode to all	60 seconds

Testing

A number of new sets are in use, the cabinets being similar to the old sets. The following tests are made on all 10BP4 tubes.

1. Beam Centering
2. Breakdown @ .020 maximum
3. Color and Screen Condition (Allow six total defects,/two of which may be within the $4\frac{1}{2}$" diameter center circle.)
4. Cathode Condition
   (a) Light output - limit 150 ua @ 20 feet L.
   (b) Anode Current
   (c) Modulation (limit is 30V.)
5. Cut-off
6. Leakages
   (a) I HK
   (b) I b_2
7. Gas (limit is 0.4)

Record readings are taken on five tubes per shift.

Finishing Operations

After test the tubes are placed on a conveyor and sent to bulb wash, spray, brand and pack.

Cathode Processing

The cathode assembly at present is composed of three parts. The cathode cap is drawn without a flange because the present lot of N34 material cannot be drawn without cracking. The flange is made of N7 nickel.

The individual parts are degreased, water washed, air dried, hydrogen fired, etc. before assembly. The parts are welded together and the assembly is then sized, dry hydrogen fired, ether washed and sprayed. One cathode is measured for thickness out of each rack sprayed. All cathodes are inspected 100% under a microscope for cathode appearance.

The ceramics are next assembled. Poor ceramics are a major source of trouble.

Two tabs made of N7 material are welded, one on top of the other.

These assemblies are gauged and separated into groups. Sized spacing rings are matched with the assemblies according to the desired spacings required.

Film Spray (Aluminized Tubes)

Methacrylate films are being sprayed on R.C.A's original equipment. Shrinkage on 5" bulbs is 25% (mainly dirt and lint) and on 10" bulbs is 5%. The schedule is as follows (for 5"):

Stock solution

600 gm isolbutylmathacrylate
2500 ml toluene
5 gm acryloid B72
Roll until dissolved

Spray solution

925 gm stock solution
2660 ml toluene

1. Screen is wetted and drained for a short interval (time not controlled but is approximately 5 seconds).
2. Spray is applied for 1 second using Eclipse gun; bulb rotation 50-60 rotations per minute.
3. Bulb is centrifuged @ 500 rotations per minute for 5 seconds.
4. Bulb is allowed to stand face up for 10 minutes.
5. Sides are cleaned using a sponge swap which is fed with a continuous water stream through the handle.
6. Dry on air jet.

   The film is very glossy and apparently much thicker than is our practice on 10" bulbs.

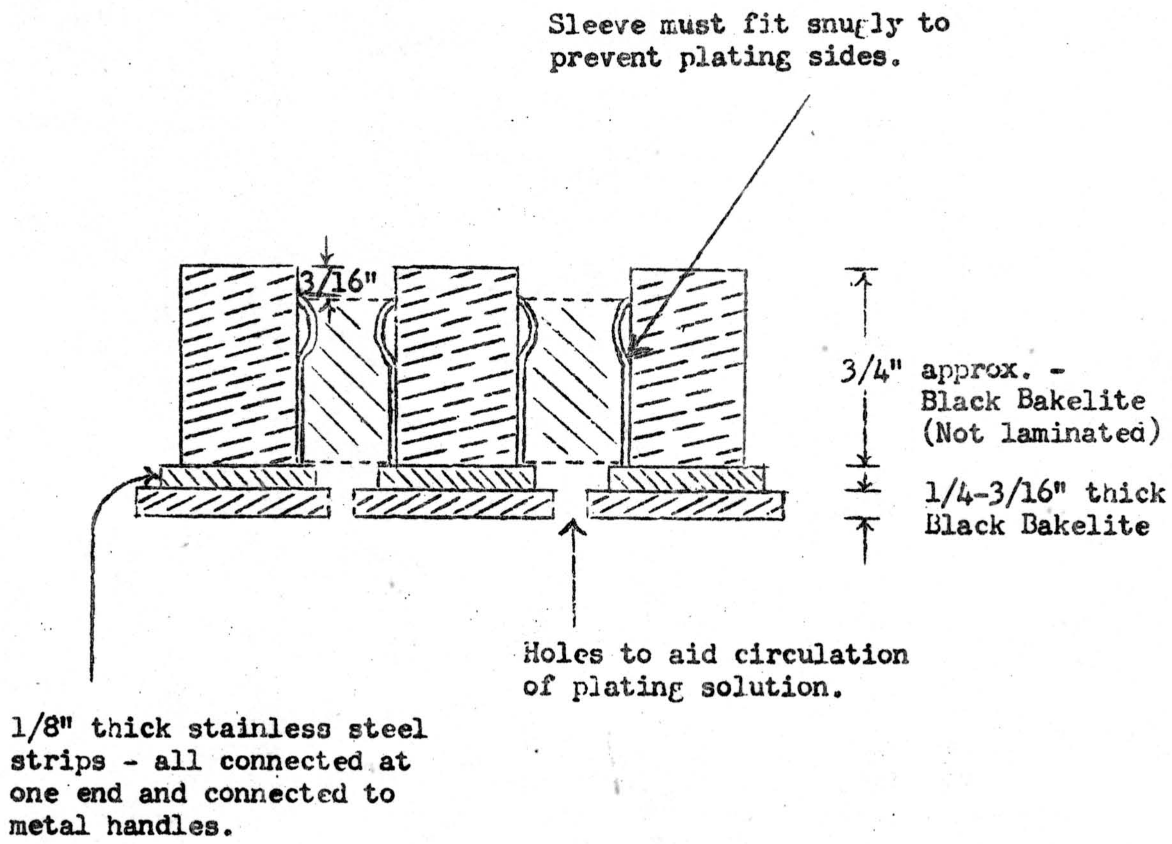
Metal exhaust tubulation stem

Parts preparation

1. Copper exhaust tubing - cut to length by parts department. At present they are deburring in a lathe but hope to improve cutoff technique and remove remaining burr by tumbling. The part is then given the standard degrease, water wash and hot air dry.
2. Collar - given standard degrease, water wash and hot air dry.
3. Chrome iron sealing sleeve
   - (a) Standard degrease, water wash and hot air dry.
   - (b) Dry hydrogen fire at 1000°C for 10 minutes.
   - (c) Nickel plate.
   - (d) Acid clean.
   - (e) Dry hydrogen fire at 1100°C for 20 minutes.
   - (f) Wet hydrogen fire at 1200°C for 60 minutes.
   - (g) Plating adherence test.
   - (h) Oxide adherence test.

The nickel plating is described in their notices 34-36-64 and 34C-36-67. The plating adherence test and oxide adherence test are also described in 34C-36-67. The plating process uses basically the Watts type plating solution. Two racks (described below) are placed in a 350 gallon koroseal-lined steel tank and agitated. The solution is heated to about 120°-130°F. Three bagged anodes are suspended near the center of each rack and a current of 60 amperes per rack is used. The total plating time is approximately 1 3/4 hours and the thickness of the nickel plate on the sealing portion of the sleeve is .006 ".

The plating rack has 26 rows of 26 holes each. Since five holes are used for mounting bolts 671 sleeves can be plated in each rack.



The parts are removed from the plating rack and acid cleaned as follows:

(a) Nitric acid dip (30% to 50% by volume) 5-10 seconds at room temperature.
(b) Cold tap water rinse - 10 seconds minimum.
(c) Hydrochloric acid dip (25% by volume) at 66°C to 71°C - 45 seconds to 1 minute.
(d) Cold tap water rinse - 10 seconds minimum

The copper exhaust tubulation, collar and plated sealing sleeve are assembled and placed in an 8-position jig. The jig is placed under an air operated arbor press and the parts pressed together. The jig is set to automatically space the sealing sleeve so that the end of the copper exhaust tubulation extends .015" above the sealing sleeve. This same jig is used in the brazing bell. The spacing between the copper tube and bottom of coil is .050" -.065". The jig is rotated under the rf coil inside a bell jar filled with hydrogen and when the copper melts a phototube turns off the rf power. The jig is rotated and another braze is made.

The brazing operation requires slightly more than one second. To purge bell jar requires approximately five seconds and to allow parts to cool before removing requires approximately three seconds.

A pressure test is applied to the brazed assembly by gripping the sealing sleeve in a rubber port. A small amount of alcohol is applied to the brazed area and a pressure of 180 pounds of tank nitrogen is applied.

A visual inspection under a microscope is applied to the brazing zone on all tubulation assemblies.

The tubulation assemblies are prebeaded in an 8-position beading machine. The glass is held to a weight tolerence of .1 gram.

The 24 head stem machine was producing 350 stems per hour. They have run 500 stems per hour. Two operators were loading the machine which had an automatic transfer to the annealer. After this cooling anneal the stems were checked 100% by an operator who loaded them into large shallow asbestos covered annealing trays for an anneal through the regular lehr. This results in a "dead" anneal with a strain of 5' millimicrons or less, tension or compression. They feel the strain pattern is not too critical, provided the strain does not exceed 50 millimicrons.

The next operation was to clean the inside of the copper tubulation by pushing it over a rapidly revolving brass bristlebrush. Two stems were brushed at a time. The loose oxide on the outside of the stem was wiped off by the operators gloves and then the entire stem was air blown.

A final inspector gives the stems a spot check before passing them to mounting.

The production figures on the bulletin board at the stem machine was as follows:

Shift	Metal		Glass	
-	% Scrap	Total Prod.	% Scrap	Total Prod.
1	.47	2300	10.4	2030
2	10.3	1450	5.2	3000
3	3.3	2389	18.3	2304

They report the glass stem averages 7 to 12% scrap while the metal stem averages 5 to 8% scrap.

16AP4 Processing (16"metal)

Metal Cone

The metal cones are inspected for mechanical tolerances and surface imperfections. They are becoming more critical on these surface marks and continually pressing vendors to clear up this condition.

The metal cone is next given a caustic clean. This cleaning is done in the following steps:

1. Actusol (DuBois Soap Co.)
2. Water rinse
3. Phosphate cleaner-Terj
4. Water rinse
5. Hot air dry

These steps are performed in a straight line machine but the actual machine was not seen in operation.

The sealing edges were being blasted in small blasting units as separate operations. The aluminum oxide used was carburundum No. 80TP and the air pressure was from 60 to 85 pounds.

There is a new Pangborn rotary sandblasting unit being installed but no information could be obtained.

Faceplate

The faceplates are inspected 100%. Initial losses were from 4% to 30% but present losses are about 3%; major defect-scratches with a few bubbles.

The faceplates are not washed unless too dirty to use. Fingerprints were bad at start but vendors have cleaned this up.

Neck Assembly

The funnel and neck pieces are purchased separately and sealed on a vertical lathe. The assemblies are annealed in the standard lehr.

Assembly of Cone and Neck Assembly

The neck is sealed to the metal cone on an 8-position machine operating at an index speed of one minute per position.

The cone rests on an inside support near the top and is gripped by an inside chuck in three places. The neck is suspended around a spindle running through the cone. The sealing head revolves approximately 30 to 40 rotations per minute.

Position #1 Unload them. Load cone, position and clamp. Load neck. There is about ½" spacing between parts.

Position #2 Cone drops about 2" to 3". A bunsen burner, located slightly off center warms the glass funnel to about 100°C at the end of the index.

Position #3 A bunsen burner, located slightly off center plays on the glass funnel. The temperature at the end of the index is 380°C-400°C. This temperature is critical in preventing checks in the glass as the funnel passes through fires into the next position.

The metal cone is heated in the seal area by two manifolds of 5-6 burners each (AGF 1142) oxygen and gas to about 1100°C at the end of the index.

Position #4 The funnel is lowered at the start of this step down until it rests on the sealing lip.

The metal cone is heated in the seal area by two manifolds of 4 and 6 burners each. (American Gas Burner 1301A) oxygen and gas to heat metal to approximately 1130°C at the end of the index.

Position #5 The sealing that started in position 4 is completed in this step. The metal cone is heated in the seal area by two manifolds of 6 burners each with oxygen and gas. An excess of oxygen serves to clean the seal area. The metal cone is at 1100°C at index.

Position #6 Low pressure air is directed through a bunsen burner onto the metal cone near the seal.

Position #7 & #8 A temperature of 430°C is maintained on the glass funnel in these two positions by applying a bunsen burner flame about one inch above seal.

Since the speed of this machine is twice the speed of the face plate sealing equipment several heads were blocked off.

Usually the cone and neck assembly is placed on the faceplate sealing machine as soon as soon after sealing as possible.

<u>Faceplate sealing</u>

The faceplate is sealed onto the cone and neck assembly on an 8-position machine, the last four positions being an annealing oven. The machine operates at an index speed of two minutes per position.

Position #1 The cone and neck assembly is placed on the sealing head. The neck fits over a tapered plug. The faceplate is lifted by use of a vacuum cup and placed into the cone lip and centered. The vacuum cup is removed. The height of the center of the faceplate is gauged and adjusted by raising or lowering the head. This is a most critical adjustment as fire positions in later steps are important.

Position #2 Preheat. A ribbon burner, approximately 3½" long is spaced 2 to 3" from the side of the cone just below the sealing lip. A second ribbon burner is directed downward on the faceplate on the opposite side. A bunsen burner flame plays from one side toward the center of the faceplate. The temperature of the sealing lip is approximately 250°C at the end of the index.

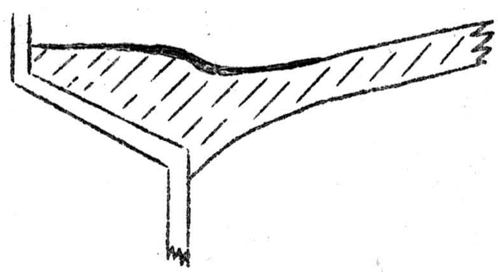
Position #3 Two bunsen burners play on the faceplate, one near the edge and the other near the center. Two manifolds of 10 burners each are located near the rim on opposite sides. Near the end of the index the rim reaches 950°C and the faceplate reaches 400°C. This position is critical as to face plate cracking.

Position #4 Eight manifolds of 5 burners each are equally spaced around the faceplate rim. These burners are mounted on a circular form which hinges and raises on one end to clear the bulb before index. Due to the machine limitation the back group of burners are spaced closer to the rim and are directed slightly higher than the front group. The front burners play on and a slight amount below the rim.

The rim reaches 1140°C before the burners are turned off. This temperature is varied according to results over the range of 1150°C ±25°C but they have found 1140°C to be the best temperature.

At approximately 80 seconds air pressure is applied inside the bulb. The amount of pressure is determined by an operator. The manifold fires are tuned off at 90 seconds and the manifold raises so that the operator can see the sealing lip.

The operator allows the faceplate to definitely sag down about 1/8" (out from edge of cone about one inch) and then air pressure is applied until the faceplate shows a tiny ridge. This position is held until the bulb assembly indexes into the annealer. The pressure applied is approximately that of a 10" water column. Experience indicates that the faceplate continues to sag a slight amount in the annealing over and for this reason the faceplate is blown a little higher than required. A typical cross section of the lip seal is as follows:



Position 5-6-7-8

These four positions are enclosed in an electrically heated oven operating at 540°C.

The bulb is removed from the machine and placed in a rack for a period of 5 to 10 minutes and then loaded on the conveyor to bulb washing or stored in racks until space is available on the conveyor.

A pressure test of 60 pounds gauge is applied to one bulb assembly from each head of the face plate sealing machine every two hours. If a failure occurs continued testing is applied to bulbs from that head until the trouble has been cleared up.

If the bulb neck is broken after the faceplate has been sealed in and cannot be spliced, then all of the neck glass is cracked off by using a mallet and another neck assembly sealed on in a horizontal lathe. If the faceplate is cracked or broken, all glass is removed and the cone reprocessed. They are trying to obtain an autoclave to remove the glass.

Bulb Wash

After bulb wash the bulb assembly is returned to the conveyor where it is transported to the screening room.

Screening

(See 10BP4 Screening for conveyor)

Production is being run on racks. A two position movable table is mounted under a dispenser. The bulbs are filled using a spray funnel and then two girls attach a handle to the neck and transport the bulb to a rack where it is settled for two hours and then poured off in 12 minutes. (Total time from vertical until empty.)

The materials used in the screening process, the quantities and sequence of additions are as follows:

1.	Cushion water -	1800	CC	at 15°C
2.	Sulfate -IN	250	CC	room temperature (21°- 23°C)
	Silicate -10%	275	CC	room temperature
3.	Rinse water	200	CC	at 15°C
4.	Cushion water	1800	CC	at 15°C
5.	Sulfate-IN	250	CC	room temperature
	Silicate-10%	275	CC	room temperature
6.	Rinse water	200	CC	at 15°C
7.	Cushion water	1800	CC	at 15°C
8.	Sulfate-IN	250	CC	room temperature
	Silicate-10%	275	CC	room temperature
	Phosphor suspension	343	CC	(12.8 mg/cc)
9.	Rinse water	200	CC	at 15°C

The shrinkage due to screening is approximately 40% - mainly due to poor uniformity.

Screen Inspection, Neck Anneal, etc.

After the screening operation has been completed the bulb assemblies are replaced on the conveyor. The next operation is a light box check and an overall contour check. The bulb assemblies with satisfactory screens have the necks graphited and warm air dried. The bulb assembly is next placed on a ring holder face down with neck covered and run through a 100 foot lehr with the hot zone operating at 415°C -425°C. This is to anneal the neck.

The resultant strain left in the face plate is compression (120-140 millimicrons.) The neck has a ring strain about 1/4" to 5/16" below the metal cone (120-140 millimicrons).

After neck anneal the bulb assemblies are returned to the conveyor where they are given an ultra violet light check which results in a further loss of 7 to 8%.

Gun Sealing

The next operation is gun sealing. The 16AP4 gun is the same as the 10BP4 except two instances. The No. 2 grid cup has a rolled edge attached and the aperture on the anode cylinder is approximately ½" closer to the cathode.

Exhaust, Age, Test (See 10BP4 for more details)

The 16" tubes are being exhausted on a straight-line exhaust machine with the same schedule as the 10BP4. Inasmuch as the 16" is more susceptible to gas, the schedule is sometimes increased five seconds per index.

The tubes are now based. The rim is polished by a wire brush that revolves against the rim as the tube is rotated on a turntable.

The tubes are aged, sparked, short tested and preheated on an overhead conveyor which delivers the tube to test. (There are anode rings to accomodate a 12" metal on this conveyor.)

At test the major shrinkages are arcover, stray emission, poor screens, (due to inspection difficulties on the bulb assembly) cracked stems, open filaments and some cut-off shrinkage.

Finishing Operations

After test the tubes are placed on another conveyor where the tubes are transported to the finishing operations. The tubes are branded, painted, and boxed. At the present three different paints are being applied. The cleaned rim is sprayed with a conductive paint, the remainder of the metal cone is sprayed with a black decorative paint and the glass from the metal cone to the reference line is sprayed with an insulation paint. They plan to eventually run the 16" tubes through the present 10" bulb cleaning machine.

They are making a concentrated effort to match the 16AP4 processing schedules to the 10BP4.

The equipment used for making the 16" is planned to meet schedule with a net loss of 25%.

G. L. Case
W. L. Jones, Jr.

WLJ:haw

TO Moffit
RT Pennoyer
WL Peters
AN Reagan
PE Sullivan
Engineers
GF Callahan - Bldg. 269
KC DeWalt - Bldg. 267
GF Murphy,- CAP Racetrack - Bldg. 5