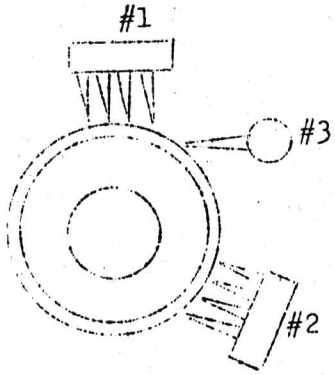
SCHEDULE NO. 1

Sealing Face Plate to Metal Cone
(Initially for C7408C)

1. EQUIPMENT

a. Sealing Machine

(1) Preheat burners (3-1/2" ribbon type) using gas and air and positioned as indicated in following diagram.



MAY 1955

(2) Preheat fires:

No. 1	- Length of flame	15"
	Inner cone	7"
No. 2 & 3	- Length of flame	12"
	Inner cone	1-1/2"

(3) Sealing manifolds using hydrogen and oxygen with 1" inner flame and 5" total flame.

Main manifold - 44 small Litton burners directed up on both sides of sealing surface.

Secondary manifold - 10 small Litton burners played onto metal under sealing lip.

b. Annealing oven - E. H. Allen.

2. PROCEDURE

The following is the schedule that has been worked out for the 3/16" thick 27" radius of curvature Fourco glass face plate.

a. Preheating.

** Note: At Lancaster prior to placing face plate on sealing surface of the bulb, wipe inside of face plate in a sweeping motion with a clean, lint-free cloth.

Method A - The face plate is placed on the sealing surface of the cone and the assembly is placed in an oven held between 450 and 550°C. for 2 minutes and then removed to the sealing machine. Glass temperature should be above 250°C.

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2. PROCEDURE (Cont.)

MAY 1955

a. Preheating.

Method B - The face plate is placed on the sealing surface of the bulb and the assembly placed on to the sealing machine. The assembly is made to rotate at 44 rpm. with the preheating fires turned on. The assembly is preheated for about 2 minutes or until the glass is above 250° C. at which time the seal is started.

b. Sealing.

The face plate seal is made by heating the under side of the surface marked "A" on drawing #MJ ( ) Dev. ( ) to a temperature between 1000 to 1100° C. The glass is allowed to flow out covering this surface, from the start of the radius of the lip edge to just below the radius of the sealing lip. The plate is then blown slightly upward to remove any sharp angle between the glass and the metal. It is held in this position for approximately 20 sec. to form a tight bond between the metal and glass. The sealing fires are then removed and the face plate is allowed to "set" in the above position for 15 seconds. At the end of this period the assembly is removed to the annealing oven.

c. Annealing.

The annealing of the face plate is started at the same time that the sealing is started. A series of large gas and air burners are located so that they heat both the face plate and the upper part of the cone. They are adjusted so that they remove all stresses from the face plate during the sealing operation.

When the sealed bulb is removed from the sealing machine or sealing position, the face plate should be entirely free of all strain.

The bulb is removed from the sealing position to an oven held at 550° ±10° C. and held there for five minutes. At the end of five minutes, the bulb is removed from the oven and allowed to cool to room temperature.

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SCHEDULE NO. 2

Sealing Glass Neck-Cone Assly. to Metal Cone. MAY 1955
(Initially for C7408C)

1. EQUIPMENT

a. Litton Glass Blowing Lathe, Model K, No. 10.
(1) 14 small burners with 3" flame having 1/2" inner cone.

2. PROCEDURE

a. Preheating Metal Cone and Face Plate Sub-Assembly.

Method A - Remove the sub-assembly from the annealing oven (as outlined under face plate sealing) and place it directly on to the neck sealing lathe before it has had a chance to cool below 250° C seal immediately.

Method B - Place the sub-assembly (metal cone and face plate) into an oven held between 300° and 400° C. Leave the assembly there long enough to attain a temperature of 250° C. or hotter (usually about 3 minutes). Remove it from the oven and place it on the neck sealing machine and seal immediately.

b. Preheating Glass Cone and Neck Sub-Assembly.

Preheat glass cone for 30 seconds with a cannon fire, directing the flame so that it plays on both the inside and outside of the assembly. (Fire to be about 10" long with just enough air to prevent any yellow in the flame).

c. Sealing and Annealing.

Heat the end of the cone to red heat (1000° C.), but hold the glass cone about 2" from the cone. As soon as the sealing surface is at a red heat bring the glass cone into contact with the sealing surface and make the seal continuing to keep the seal at red heat.

Make sure that the reference line to face plate distance is correct by adjusting the amount of glass in the seal. Blow the glass cone to size and remove the sealing fires. Allow the glass to "set" and then anneal using a cannon fire until all strain is removed (as viewed through a portable polariscope). Reduce the cannon to an 8" flame with no air and keep hot for 30 seconds.

* Data Rearranged

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SCHEDULE NO. 2

Sealing Glass Neck-Cone Assly. to Metal Cone.
(Initially for C7408C)

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Preheat glass cone for 30 seconds with a cannon fire, directing the flame so that it plays on both the inside and outside of the assembly. (Fire to be about 10" long with just enough air to prevent any yellow in the flame).

c. Sealing and Annealing.

Heat the end of the cone to red heat (1000° C.), but hold the glass cone about 2" from the cone. As soon as the sealing surface is at a red heat bring the glass cone into contact with the sealing surface and make the seal continuing to keep the seal at red heat.

Make sure that the reference line to face plate distance is correct by adjusting the amount of glass in the seal. Blow the glass cone to size and remove the sealing fires. Allow the glass to "set" and then anneal using a cannon fire until all strain is removed (as viewed through a portable polariscope). Reduce the cannon to an 8" flame with no air and keep hot for 30 seconds.

SCHEDULE NO. 5

Sealing face plate to metal shell
(Initially for 21AP4)
(1185 enamel - E259A)

1. EQUIPMENT a. 16 Head Face Plate Sealing Machine
   1. Drive Mechanism
      a. Head Rotation - A 3/4 HP - 1800 RPM motor through a gear reduction unit drives a chain which in turn causes head to rotate at 24 RPM by engaging a sprocket located at end of head spindle.
         1. Reasons for failure of head rotation.
            a. Check switch for "on" position.
            b. Head shear pin may be broken. Motor will run but will not actuate driving sprocket. Pin should be replaced and observations made to determine cause of failure - usually observations in path of rotation (broken glass, etc.).
            c. Electrical overload. Push reset button on magnetic switch to resume operation.
            d. Pulley off one of the heads.
            e. Chain may have slipped off sprocket. Usually caused by discrepancies in heights of sprockets.
            f. Idler gear shaft broken.
            g. Key on drive reduction unit worn out (rare).
      b. Turret Index - A continuously operating 1 HP at 1800 RPM drive motor connected by a shaft through a gear reduction unit, and through a second shaft to a one revolution pressure clutch actuated by a solenoid switch through a timer. Clutch drives drive shaft which is geared to turret. One revolution of the clutch will index machine one position.
         1. Reasons for failure of turret index
            a. Fires down - safety switch prevents machine from indexing.
               1. Check and be sure high pressure air valve is open.
               2. May need diaphragm in bellows. Check for leakage of air.
            b. Electrical overload.
               1. Press emergency start button, and index reset button on main panel. However, be positive fires are up before pressing index reset button.
            c. The index solenoid does not cause the clutch to engage. The clutch can be engaged by manually pulling the chain.
            d. The manual lock on index "stop" button prevents machine from indexing.
            e. If the machine is stopped at half index, emergency "start" button must be pressed to index machine.
            f. Index motor is not running and will not start when reset button is pushed.

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1. EQUIPMENT a. 16 Head Face Plate Sealing Machine (Cont'd)

g. Index motor kicking out and causing machine to stop at half index.
1. Possible causes.
a. Seal fires not rising soon enough. This may be due to:
1. Lack of sufficient air or air pressure in high pressure line to raise seal fires.
2. Defective timer. Seal fires not rising before index.
3. Defective solenoid on seal fire circuit.
b. Defective safety switch on seal fires.
c. Arm on seal fires not hitting safety switch.
d. Arm on oven doors (front and back) not hitting safety switch.
e. Arms on cams on driving shaft under machine turret not set correctly.
f. Spring on clutch latch breaks on index clutch.

h. Cooling ovens: The ovens are constructed of three banks of resistance heating elements contained in a stainless steel lined brick insulated unit. The cooling oven occupies 8 of the 16 positions, the oven is wired so that it is controlled by two Brown Pyrometric Controllers. Each controller controls 4 positions. The first section is controlled at #3 thermocouple (11th machine position) and the last section at #8 thermocouple (16th machine position).

i. Control thermocouples: Made of 18 gage chromel-alumel alloys positioned 1/2" to 1" above center of face plate.

j. The thermocouple leads from the 3rd oven position are connected to a Brown Indicating Controller, Model No. 105 CIPS - 10 - 55, Range 0 - 800°C, Serial No. 551477. The thermocouple leads from the 8th oven position are connected to a Brown Electronic Potentiometer Pyrometer with a circular recording chart, Model No. 152R13PS-141-11, Range 0 - 600°C., Serial No. 699740.

k. Number one machine head wired for temperature readings.

2. MATERIAL ---- Face plate
---- Metal shell with sealed on glass cone.

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3. PROCEDURE

a. Starting

1. Be certain all valves are closed.
2. Open high pressure air valve (located near sealing manifolds). The machine cannot be operated unless manifold is raised to upper position by high pressure air.
3. Turn on main switch located on oven panel.
4. Push panel switch to "on" position.
5. Turn timer switch to "automatic" position.
6. At load position - start heads rotating by pushing start button.
7. Also at load position start machine index by pushing "index" start button.
8. Turn oven switch to "on".
9. Check oven controllers for proper setting. If oven indicator light is not on, depress knob on side of controller until it comes on. Entrance oven (Couple in #3 oven position) should be set at 535°C. Exit oven (Couple in #8 oven position at 525°C for high expansion glass (50 to 100 muu/cm) and 530° for low expansion glass (0 to 50 muu/cm). (Couples in oven should be located 1/2" to 1" above center of face plate).
10. Machine cycle should be checked with a stop watch and set as follows:

	On	Off
Index	0	75 seconds
Warning light	60	75 seconds
Ring manifold	8	63 seconds

11. Turn on gas and low pressure air and light oven neck fires and also radiant burners and neck fires in cooling position immediately on front of oven. These fires controlled by set of valves located on 3rd oven position.
12. Lighting preheat and sealing fires. (Positions 2 through 7).
    a. Check six foot oxygen valve, located at preheat positions, for fully closed position.
    b. Open gas valve at preheat positions and light preheat fires. Adjust valve until a flame approximately 4" long is obtained.
    c. Open gas valve at seal positions and light seal fires. Adjust valve until a flame approximately 5" long is obtained.
    d. Check to be sure manifolds are in the raised position.
    e. Open oxygen valve (This valve supplies both the preheat and seal fires) partially and adjust gas valve in preheat and seal positions to obtain proper fire settings. Coordinate opening of six foot six valves until they are fully open. Main oxygen regulator pressure should be approximately 13 pounds.
    f. Open low pressure air valves.
    g. Check O_2 pressure regulator in each individual preheat position. O_2 pressure should be approximately 2 to 5 pounds.
    h. Check O_2 pressure regulator in 5th preheat and seal fire positions. O_2 pressure should be approximately 4 pounds.
    i. Turn sealing manifold fire switch to the "on" position.
    j. Adjust economizers for proper action speed. Also adjust high pressure air for proper up and down manifold speed.

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3. PROCEDURE (Cont'd)

b. Shutting down.
   1. Short period.
      a. After last head containing an assembly has indexed out of the last seal position, the oxygen valve should be turned off, the low pressure air valve turned off and the gas valve adjusted until a flame about 3" long remains.
      b. Heads should be kept rotating and turret indexing.
      c. High pressure air should be left on.
      d. Oven and oven neck fires should be left on.
   2. Long period.
      a. After the last head containing an assembly has indexed out of the last seal positions the O_2 valve should be turned completely off, the gas valves (preheat and seal) turned fully off and the low pressure air valve turned off.
      b. After the last assembly has been removed from the machine the neck fires should be turned off and the oven control switch turned to the "off" position.
      c. Index switch and head rotation switch should be left on until the oven temperature reaches 300°C, then turn index switch to the "off" position.
      d. Head rotation switch should be turned off.
      e. Push panel switch to the "off" position.
      f. Turn main switch to the "off" position.
      g. Turn high pressure air off. (Manifolds will slowly drift to the down position after HP air is turned off).

c. Machine positions.
   1. Load and unload.
      Head to be free to rotate manually in this position to facilitate loading and unloading of bulb from machine. A warning light above position warns operator when machine will index. Light comes on 15 seconds before turret will index.
   2. First preheat.
      Two stationary manifolds (Buck horn same circulator type). Outside manifolds contain eighteen 1301A or 1142 AGF burners, in ball sockets. Outside manifold has facilities for 25 burners but seven of the holes are plugged. Inside manifold contains fifteen 1301A or 1142 AGF burners in ball sockets. The inside manifold has facilities for 19 burners but 4 of the holes are plugged. Burners are directed upward at a 12° angle, 1-1/2" from corner of rectangular metal shell at nearest point. Both outside and inside manifold are connected to separate AGF mixers. Mixer size is AGF #13-28-Q, and is drilled 85-15. (Draw tube area is equal to 85% of the burner pot area, while oxygen orifice is equal to 15% of burner pot area). Each mixer is supplied with oxygen and city gas. Pressure of the gas is standard plant pressure while pressure of the oxygen is adjusted with a pressure regulator.

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3. PROCEDURE (Cont'd)

c. Machine positions (Cont'd)

2. First preheat (Cont'd)
The position of the front and back manifold should be perfectly level. Allow 1/2" clearance at both ends of manifold when bulb is indexing with diagonal perpendicular to the direction of the index. The fires are directed at the sealing land of the metal shell. To obtain proper flame length, it is necessary to burn an excess of gas giving a blue inner cone from 1/2" to 3/4" long. By varying the O_2 pressure with the gas pressure constant, the length of this cone can be altered to achieve even heat distribution; a short inner cone will heat excessively the corners and short side of the shell while a longer O_2 cone will more effectively heat the long side of the shell. Face plate fire is furnished by a ribbon burner using city gas and low pressure air. This fire is directed at a 25° angle impinging on the face plate at a point 6" from the center of rotation and sweeping across the center. This flame should be bushy. A glass cone fire is not used for 21A bulbs.

3. Second preheat.
Equipment the same as 1st preheat except manifold buck horn type manifold.

4. Third preheat.
Equipment the same as in 1st and 2nd preheat positions.

5. Fourth preheat.
Equipment and set up is the same as in the third preheat position. The seal should be about 1/4" wide in this position. Temperature at the end of the cycle should be 1030°C.

6. Fifth preheat position.
Equipment and set up is the same as the fourth preheat position.

7. Seal position.
A circular manifold mounted on a pivoted movable support. The manifold can be raised to the vertical position by a high pressure air cylinder which is activated by a solenoid valve through a timer. The manifold contains fifty-four 1301A AGF burners in ball socket. (The manifold has facilities for 36 burners but 18 of the holes are plugged). The burners are directed upward at 12° angle 1-1/2" from corner of the rectangular metal shell at nearest point. The manifold is supplied with oxygen and city gas through a 85-15 mixer. Manifold dwell in the "up" position may be regulated by "on" and "off" settings on main panel. Speed of travel of manifold may be regulated by air valve at entrance to pressure cylinder. The height of the manifold in the down position may be regulated by two set screw located in base bracket of the manifold support structure. There are two sets of oxygen and gas valves and two mixers for the manifold. Face plate fire furnished by a ribbon burner located on the moveable structure and supplied with city gas and low pressure air. This fire is directed at a 25° angle from the horizontal impinging at a point 8" from the center of rotation. The flame of this fire should be kept bushy.

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3. PROCEDURE: (Cont'd)

c. Machine positions (Cont'd)

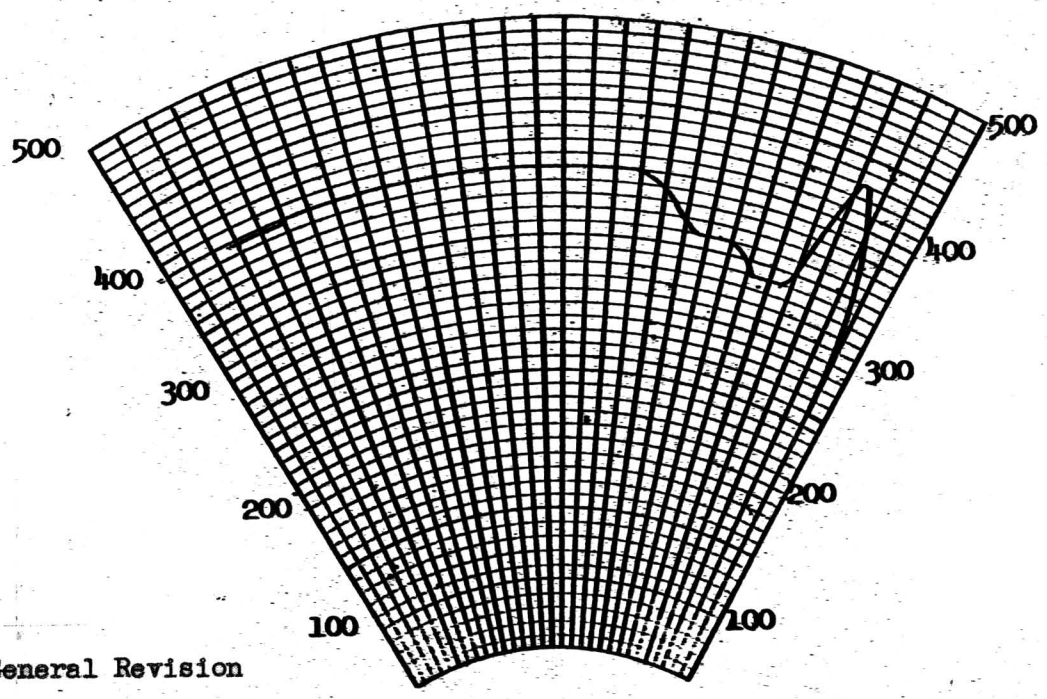
8. Cooling position.
Face plate fire is furnished by a ribbon burner and two Selas radiant burners mounted on 5" centers such that the center of the outside burner is 9" from center of the face plate. A glass cone neck fire from a cannon burner is also used in this position. The temperature of the seal at the end of the cycle should be 630°C ± 20°C.

9-16. Oven positions.
Oven temperature at the end of the cycle in each position should be as follows:

	A
1st oven -	600° ± 10°C
2nd oven -	590° ± 10°C
3rd oven -	575° ± 10°C
4th oven -	560° ± 10°C
5th oven -	550° ± 10°C
6th oven -	540° ± 10°C
7th oven -	540° ± 10°C
8th oven -	525° ± 5°C

A - As measured by thermocouples spotwelded on the cone sealing land and record on a recording pyrometer. The curve is the same as shown on page 5f, S.N. 34-18-71 except for the lower limits of 525°C ± 50°C for high expansion glass. The same limits as shown on curve will be used for low expansion glass.

Glass cone fires are used in all oven positions.
A cannon burner with a bushy flame, using city gas and low pressure air is used.
The oven fires should be adjusted to keep temperature of glass cone between 425°C to 435°C for annealing purposes.
This reading is checked by using a recording pyrometer (circular chart) for ideal curve with limits. See limits below.



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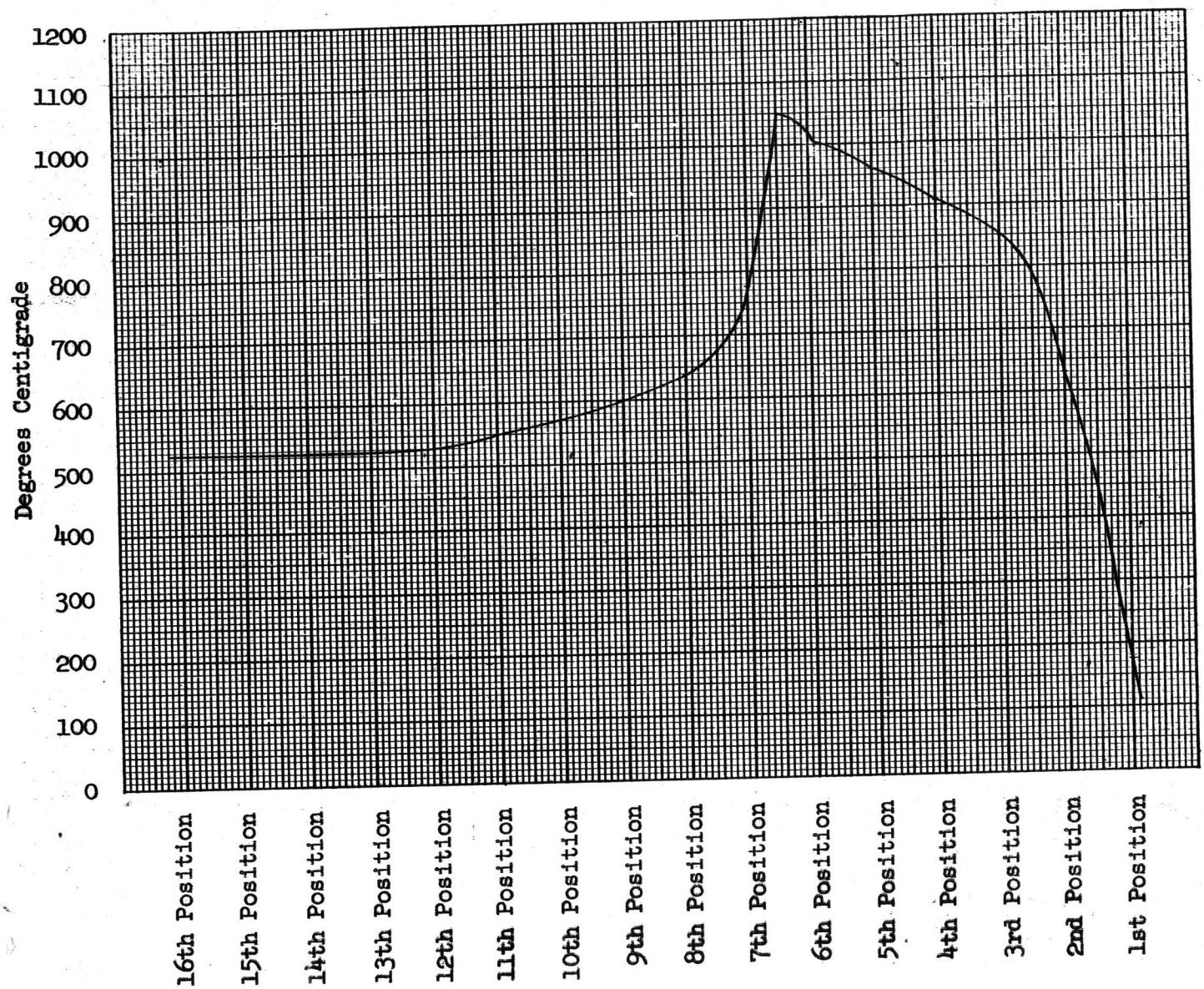

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SCALE—

DIMENSIONS IN UNLESS OTHERWISE SHOWN. DIMENSIONS SHOWN WITHOUT TOLERANCES ARE DESIGN CENTERS

21-5310-19-60 PCL22098-133LG

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3. PROCEDURE (Cont'd)

c. Machine positions (Cont'd)

9-16. Oven positions (Cont'd)

Error in the thermocouple system in use measured approximately 30° lower than actual temperature of bottom cone. This error resulted in readings as shown above. The actual reading is 30° added to above reading. This reading is within the limits specified. Limits 425° and 435°C. The thermocouple wire was placed inside the cone approximately 1-1/2" from the glass cone-metal cone seal. The curve shown was taken on a one pen circular chart Brown recording pyrometer.

d. Operator procedure: Two operators are used in the face plate sealing operation.

1. Load and unload operator.

a. Operator places metal cone - glass cone assembly with face plate, into head in load position, making sure rim of metal cone contacts all fingers and that flared neck depresses rubber bulb seal stopper a minimum of 1/4". Using a rubber stamp, the operator on the glass cone-metal cone machine (#1 - 406) stamps the metal-cone with the face plate sealing code. Operator should be sure face plate fits snugly into the cone.

b. When the sealing cycle is complete, operator unloads bulb assembly making sure asbestos gloves do not contact face plate and that no direct air blast impinges on assembly.

2. Hand blow operator.

a. The hand blow operator is responsible for the shape of the seal. Seal shape controlled by manipulation of a red paddle which opens a valve allowing low pressure air to flow in to the assembly. This air comes in from below the track, up through the spindle, through the glass neck, and up to the face plate. There is another hole in the track which is used as a "bleeder", so that any excess air will bleed out. This makes the blowing less sensitive. The amount of air going into the assembly is regulated by the number of times the paddle is pushed down or the length of time it is held down. Extra pressure may be obtained by putting a finger over the air escape valve near the red paddle.

b. Blowing should begin when there is approximately a 1/16" sag of the edge of the face plate below the inside edge of the sealing land of the metal cone. See Figure 1. When the paddle is first pushed down, it should be held for a few seconds (3 to 4) and then released with short jerky strokes to follow. The amount of air should be increased gradually until a ridge approximately 1/16" to 1/8" high is visible in the glass about 1/2" in from the inner edge of the rim. See Figure 2. The glass should be blown so that this ridge appears while the seal fires are still down around the bulb. If it is blown up after the fires rise, it tends to stretch the glass (shapr blow). See Figure 4. Blowing must continue until the bulb indexes out of the blow position and this ridge must be maintained. Blowing is very critical. Blowing too late or too low causes rim cracks. While blowing too soon, too rapidly or too high a blow weakens the bulb's pressure strength. It is best not to use extra pressure obtained by putting a finger over the air escape valve unless it is necessary, for this makes any movement of the paddle mush more critical. Every blowing operator should keep in mind the following points at all times:

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3. PROCEDURE (Cont'd)

d. Operator procedure (Cont'd)

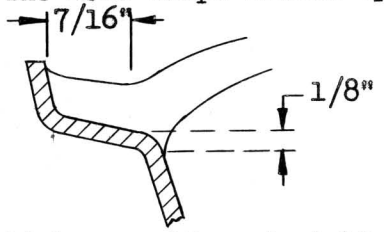
b. (Cont'd)

1. Be sure glass sags down over sealing land.
2. Be sure to blow ridge.
3. Be sure to blow ridge while fires are still on.
4. Be sure to continue blowing until machine indexes, and be sure to maintain ridge until machine indexes.

c. The blowing is automatic in the fifth preheat position and the cooling position. However, in the event it is necessary, the operator can control the blow by the manipulation of air paddles as directed on (a) above.

4. CONTROLS

a. Seal Shape - The seal shape should appear as illustrated.



Ridge bogie 7/16" from rim interface. Glass 1/8" down over radius of seal land. Good smooth fillet.

The seal should be a uniform dark blue color and be composed of clear glass. The following are undesirable seal shapes and should not be permitted.

1. High blow, See Figure 1. Caused by improper blowing.
2. Sharp blow, See Figure 6. Caused by improper blowing. Usually caused by blowing the glass when it is too cold, i.e., after the sealing fires are up or by allowing the face plate to sag too far and then blowing it up too quickly.
3. Low blow, See Figure 2. Caused by improper blowing. Results from the failure of the blowing operator to blow the ridge. Can also be caused by leakage of air from the bulb during the blowing operation.
4. Cold seal, See Figure 5. Caused by underheating and/or misdirection of burners. May be remedied by resetting burners and/or increasing flame temperature. May also result from too small a face plate and/or excessive expansion of the metal cone.
5. Narrow seal, See Figure 3. Usually caused by the blowing operator failing to allow the face plate to sag. The ridge is formed too soon. Can also be caused by poor face plate fits and/or bulb not properly positioned on machine head.
6. Wide seals, See Figure 4. Usually caused by overheating and may be corrected by cooling down the fires. Can also be caused by improper face plate fit, cone not centered on machine head or leakage of air from the bulb during the blowing operation.
7. Reentrant or resagged seal, See Figure 8. Usually caused by improper blowing. (Face plate sagged, was blown up and allowed to resag). Can also be caused by too hot a fire in 5th preheat position or too hot face plate fires.

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4. CONTROLS (Cont'd)

a. Seal shape (Cont'd)

8. Bubbles or gas in seals, See Figure 9. Can be caused by trapped air overheating, contamination of seal area and improper blowing.

9. Uneven seals. Caused by improper face plate fit or poor centering of cone on machine head. Also may be caused by leakage of air from bulb during blowing or excessive cone expansion.

5. STRAIN CHECK

a. There should be at least a 1" wide band of compression completely around periphary of seal. A sample should be taken every two hours and compared to control bulb on display.

b. An undersirable strain pattern is one which has any tension within this 1" wide band.

6. BOTTOM CONE SCRATCH TEST

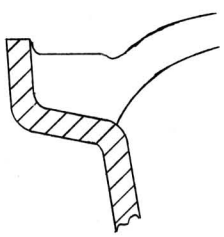
This test will be made on botton glass cones after face plate sealing to check annealing quality of oven fires. Cones will be scratched on the inside and outside at the seal and on the ball of the cone with #180 grit paper. Two cones per shift will be scratched. To obtain samples for this test, an assembly without a face plate should be run immediately after a good annealing curve on bottom cone is obtained. In event of failure, supervisor and engineer must be notified.

7. LINE INSPECTION

All bulb assemblies are to be 100% inspected for blow and seal defects as listed below. Any assembly exhibiting a defect should be recorded on the form provided and action taken in accordance with instructions given below for a particular defect. Those assemblies requiring pressure testing are to be tested in the pressure tank available for ten (10) minutes at thirty (30) pounds gage pressure. The inspector upon noticing excessive numbers of any defect should notify the foreman or engineer immediately and the condition causing the defect should be corrected.

HIGH BLOW — See limit sample.

Figure 1



Remove from the line all asemblies that are as bad or worse than the limit sample and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and return the assembly to the line.

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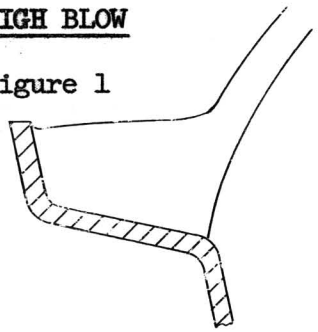
7. LINE INSPECTION (Cont'd)

HIGH BLOW

Figure 1

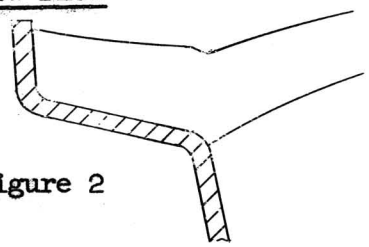


See limit sample.

Remove from the line all assemblies that are as bad or worse than the limit sample and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and return the assembly to the line.

LOW BLOW

Figure 2

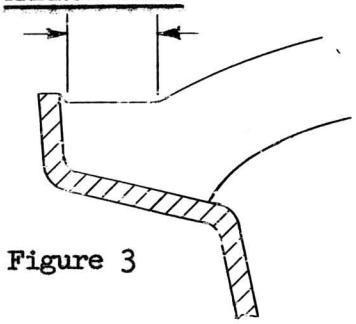


A seal with no blow ridge in glass.

Record and let assembly stay on conveyor.

NARROW SEAL

Figure 3



S.N. 25-7-2,
A seal whose width, measured from the lip interface to the ridge in the glass, is less than 3/8" on long or short sides and 1/4" in the corners.

Remove from the line and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and hold for disposition by the glass engineers.

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7. LINE INSPECTION (Cont'd)

WIDE SEAL

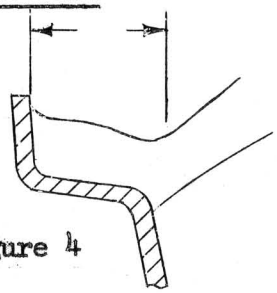

Figure 4

S.N. 25-7-2.
A seal whose width, measured from the lip interface to the ridge in the glass, is more than 5/8" anywhere on the seal.

Remove from the line and hold for disposition by the glass engineers.

COLD SEAL

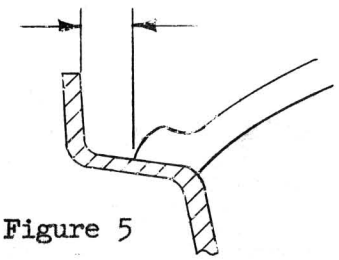

Figure 5

S.N. 25-7-2.
A seal where there is a gap of more than 3/16" between the lip interface and the face plate glass.

Remove from the line and scrap the assembly.

SHARP BLOW

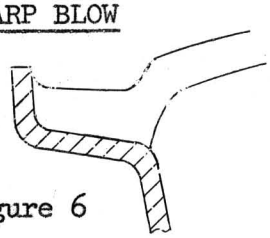

Figure 6

Sharp one way

See limit samples.

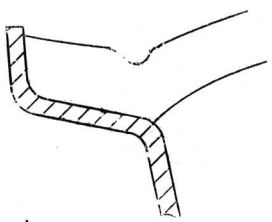

Figure 7

Sharp two ways

Remove from the line all assemblies that are as bad or worse than the limit samples and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and return the assembly to the line.

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7. LINE INSPECTION (Cont'd)

RESAGGED FACE PLATE

A seal that has a reentrant angle in the glass at the blow ridge.

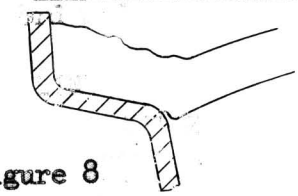

Figure 8

Record and let assembly stay on the conveyor.

UNEVEN SEAL

Record as uneven, if the seal is both narrow and wide. Remove from the line and pressure test. If the assembly survives pressure testing, paint a red letter "T" on the face plate and hold for disposition by the glass engineers.

GASSY SEAL

S.N. 25-7-2

Remove from the line and scrap the assembly, if the following limits are exceeded:

No blister in seal at glass to metal interface is allowed.

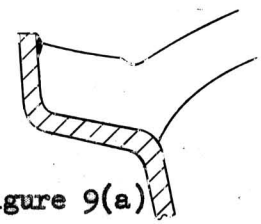

Figure 9(a)

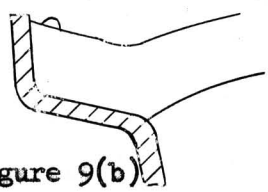

Figure 9(b)

Blisters on outer surface of seal shall not exceed 1/8" (.125).

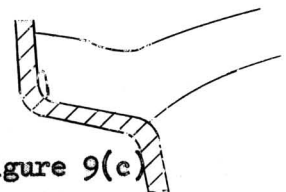

Figure 9(c)

Blisters at the lip are not to exceed a width of .050" and a maximum length of 2.000" on the sealing land.

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7. LINE INSPECTION (Cont'd)

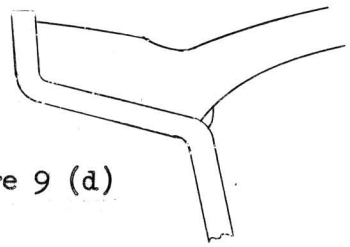

Figure 9 (d)

Blisters at the fillet are rejectable, if they exceed .100" diameter.

NOTE I Blisters in a cluster are not to exceed a width of .10" and a maximum length 1.500".

NOTE II Bubbles are to be considered as the same type of defect as blisters and they are to be rejected according to the same criteria set up for blisters. This does not apply to minute bubbles known as gassy seals.

GLASS OVER EDGE S.N. 25-7-2

Glass over the lip of the cone is cause for rejection regardless of area or quantity. Does not include fired enamel on top of the lip. Remove from the line and hold for possible salvage and final disposition.

DENTED CONE See limit sample.

Remove from line and scrap assembly, if dent is worse than limit sample.

INK ON FACE PLATE None allowed.

Remove from line and hold for possible salvage and final disposition.

SCRATCHED FACE PLATE

Remove from line and hold for final disposition.

BROKEN CONE None Allowed.

Remove from the line for salvage. All breakage above the neck splice is to be called a broken cone.

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7. LINE INSPECTION (Cont'd)

BROKEN NECK — None Allowed.

Remove from the line for salvage. All breakage below the neck splice is to be called a broken neck.

STAINED FACE PLATE

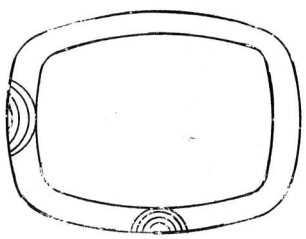
Record all face plate stains but do not remove assembly from the conveyor.

FACE PLATE BREAKAGE — None allowed.

Regardless of the type, remove from the line and scrap the assembly.

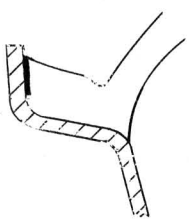
Identify and record the various type breaks as follows:

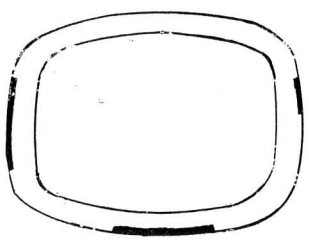
KNOCKED BULB
Figure 10
Parting of the glass and metal at the lip and on sealing land as the result of a knock.



Usually occur on long and short sides. Break lines are circular and have a colored appearance (as in an oily film).

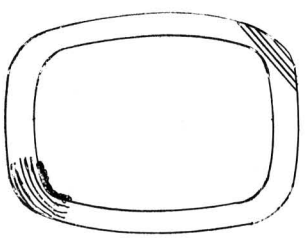
LIP STRIP
Figure 11
Parting of the glass and metal at the lip interface.





Usually occur on long or short sides. Break is parallel with cone. May or may not run out into seal.

CORNER STRIP
Figure 12
Parting of the glass and metal on the sealing land at the corners of the bulb.



Always occur in the corners. Break lines follow contour of corner or run diagonally across the corner. Usually have a colored appearance.

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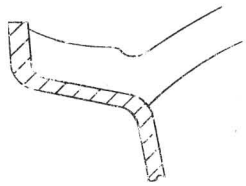
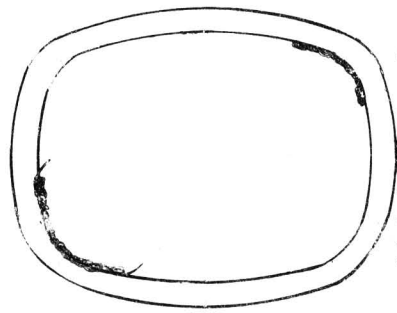
7. LINE INSPECTION (Cont'd)

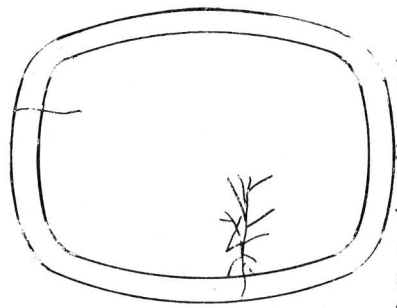
RIM CRACK
Figure 13
Parting of the glass and metal in the fillet area.





Can occur anywhere in the fillet area. Usually start in the corners. Break may or may not run out into the face plate.

RADIAL CRACK
Figure 14
Start a glass to metal interface and are perpendicular to lip.



Always run out into face plate. May be a single crack or many cracks. May run only a short way into face plate or all the way across the face plate.

8. MECHANICAL INSPECTION (S.N. 17-1-1, page FBM166-601C (a))

Four assemblies per hour are to be mechanically inspected and the information recorded on the forms provided. Items to be checked are as follows:
a. Reference line to rim at place cc'.
b. Reference line to bottom of neck at plane cc'.
c. Dimensions D-aa', D-bb' and D-cc'.
d. Seal shape and quality.
All assemblies that are found to be out of specified dimensions are to be held and the foreman or factory engineer notified. The engineer should analyze the assembly to determine cause, make disposition and take remedial action.

9. BREAKAGE ANALYSIS AND PRODUCT CONTROL

a. The various types of breaks are as follow:
   1. Lip strip. See Figure 11.
      a. Lip strip is a fracture of the glass at the glass-metal interface. Usually runs parallel to the metal rim at the rim interface and/or in the seal area. This type crack does not usually run out into the face plate on bulb assemblies.

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9. BREAKAGE ANALYSIS AND PRODUCT CONTROL (Cont'd)

a. The various types of breaks are as follows: (Cont'd)

1. Lip strip (Cont'd)

b. Causes:

1. Improper cooling in the oven resulting in the formation of excessive tensile stresses.
2. Mismatch between metal and glass.
3. An aggregation of frit due to excess heat at the top of the glass metal face causing poor adherence.
4. Cold seals - rolled with reentrant angle between glass and metal at seal area.
5. Narrow seals - ridge too close to metal lip and/or fillet not down over cone radius.

2. Rim crack. See Figure 13.

a. Fillet strips are circumferential cracks in the glass where glass dips over seal land (at fillet). These cracks may or may not transverse entire circumference of seal and may appear in the corners, sides or ends.

b. Causes:

1. Low blow, heavy fillet. See Figure 18.
2. Resagged face plate.
3. Gas or bubbles in fillet.
4. Too high exit temperature.

3. Corner strips. See Figure 12.

a. Type of break where the glass strips away from the metal. The origin of strip may be either (a) between the inside of the lip and face plate or (b) in the fillet.

b. Causes:

1. Too high annealing temperature in ovens.
2. Corners not properly filled out. May be due to contaminated frit or poor frit application.

4. Knocked bulbs. See Figure 10.

a. Type of break where the glass strips away from the metal in the lip area of the seal. The break is usually less than 2" long. A knock can usually be distinguished from a strip seal in that the strip is smaller in length and seems to radiate from a point. Also, in the break, rings of color are noticeable.

b. Causes:

1. A knock on the inside of the lip. This tends to push the metal of the lip away from the glass seal and so causes a fracture or strip.

5. Radial cracks. See Figure 14.

a. Type of break which runs from the lip at seal area in towards the center of the face plate. May occur all the way around seal or in one spot. This type of break usually does not occur in bulb assemblies.

b. Caused by high tangential tension in the seal.

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SCHEDULE NO. 7

Sealing face plate to metal shell
(Initially for 21AP4)
(3720 Frit - F-251)

1. EQUIPMENT a. 16 Head Face Plate Sealing Machine
   1. Drive Mechanism
      a. Head Rotation - A 3/4 HP - 1800 RPM motor through a gear reduction unit drives a chain which in turn causes head to rotate at 24 RPM by engaging a sprocket located at end of head spindle.
         1. Reasons for failure of head rotation.
            a. Check switch for "on" position.
            b. Head shear pin may be broken. Motor will run but will not actuate driving sprocket. Pin should be replaced and observations made to determine cause of failure - usually observations in path of rotation (broken glass, etc.).
            c. Electrical overload. Push reset button on magnetic switch to resume operation.
            d. Pulley off one of the heads.
            e. Chain may have slipped off sprocket. Usually caused by discrepancies in heights of sprockets.
            f. Idler gear shaft broken.
            g. Key on drive reduction unit worn out (rare).
      b. Turret Index - A continuously operating 1 HP at 1800 RPM drive motor connected by a shaft through a gear reduction unit, and through a second shaft to a one revolution pressure clutch actuated by a solenoid switch through a timer. Clutch drives drive shaft which is geared to turret. One revolution of the clutch will index machine one position.
         1. Reasons for failure of turret index
            a. Fires down - safety switch prevents machine from indexing.
               1. Check and be sure high pressure air valve is open.
               2. May need diaphragm in bellows. Check for leakage of air.
            b. Electrical overload.
               1. Press emergency start button, and index reset button on main panel. However, be positive fires are up before pressing index reset button.
            c. The index solenoid does not cause the clutch to engage. The clutch can be engaged by manually pulling the chain.
            d. The manual lock on index "stop" button prevents machine from indexing.
            e. If the machine is stopped at half index, emergency "start" button must be pressed to index machine.
            f. Index motor is not running and will not start when reset button is pushed.

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1. EQUIPMENT a. 16 Head Face Plate Sealing Machine (Cont'd)

g. Index motor kicking out and causing machine to stop at half index.
1. Possible causes.
a. Seal fires not rising soon enough. This may be due to:
1. Lack of sufficient air or air pressure in high pressure line to raise seal fires.
2. Defective timer. Seal fires not rising before index.
3. Defective solenoid on seal fire circuit
b. Defective safety switch on seal fires.
c. Arm on seal fires not hitting safety switch
d. Arm on oven doors (front and back) not hitting safety switch.
e. Arms on cams on driving shaft under machine turret not set correctly.
f. Spring on clutch latch breaks on index clutch.

h. Cooling ovens: The ovens are constructed of three banks of resistance heating elements contained in a stainless steel lined brick insulated unit. The cooling oven occupies 8 of the 16 positions, the oven is wired so that it is controlled by two Brown Pyrometric Controllers. Each controller controls 4 positions. The first section is controlled at #3 thermocouple (11th machine position) and the last section at #8 thermocouple (16th machine position).

i. Control thermocouples: Made of 18 gage chromel-alumel alloys positioned 1/2" to 1" above center of face plate.

j. The thermocouple leads from the 3rd oven position are connected to a Brown Indicating Controller, Model No. 105 CIPS - 10 - 55, Range 0 - 800°C, Serial No. 551477. The thermocouple leads from the 8th oven position are connected to a Brown Electronic Potentiometer Pyrometer with a circular recording chart, Model No. 152R13PS-141-11, Range 0 - 600°C., Serial No. 699740.

k. Number one machine head wired for temperature readings.

2. MATERIAL ---- Face plate
---- Metal shell with sealed on glass cone.

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3. PROCEDURE

a. Starting

1. Be certain all valves are closed.
2. Open high pressure air valve (located near sealing manifolds). The machine cannot be operated unless manifold is raised to upper position by high pressure air.
3. Turn on main switch located on oven panel.
4. Push panel switch to "on" position.
5. Turn timer switch to "automatic" position.
6. At load position - start heads rotating by pushing start button.
7. Also at load position start machine index by pushing "index" start button.
8. Turn oven switch to "on".
9. Check oven controllers for proper setting. If oven indicator light is not on, depress knob on side of controller until it comes on. Entrance oven (Couple in #3 oven position) should be set at 610°C. Exit oven (Couple #8 oven position) should be set at 545°C.

10. Machine cycle should be checked with a stop watch and set as follows:

	On	Off
Index	0	75 seconds
Warning light	60	75 seconds
Ring manifold	8	63 seconds

11. Turn on gas and low pressure air and light oven neck fires and also radiant burners and neck fires in cooling position immediately on front of oven. These fires controlled by set of valves located on 3rd oven position.
12. Lighting preheat and sealing fires. (Positions 2 through 7).
    a. Check six foot oxygen valve, located at preheat positions, for fully closed position.
    b. Open gas valve at preheat positions and light preheat fires. Adjust valve until a flame approximately 4" long is obtained.
    c. Open gas valve at seal positions and light seal fires. Adjust valve until a flame approximately 5" long is obtained.
    d. Check to be sure manifolds are in the raised position.
    e. Open oxygen valve (This valve supplies both the preheat and seal fires) partially and adjust gas valve in preheat and seal positions to obtain proper fire settings. Coordinate opening of six foot six valves until they are fully open. Main oxygen regulator pressure should be approximately 13 pounds.
    f. Open low pressure air valves.
    g. Check O_2 pressure regulator in each individual preheat position. O_2 pressure should be approximately 2 to 5 pounds.
    h. Check O_2 pressure regulator in 5th preheat and seal fire positions. O_2 pressure should be approximately 4 pounds.
    i. Turn sealing manifold fire switch to the "on" position.
    j. Adjust economizers for proper action speed. Also adjust high pressure air for proper up and down manifold speed.

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3. PROCEDURE (Cont'd)

b. Shutting down.
1. Short period.
a. After last head containing an assembly has indexed out of the last seal position, the oxygen valve should be turned off, the low pressure air valve turned off and the gas valve adjusted until a flame about 3" long remains.
b. Heads should be kept rotating and turret indexing.
c. High pressure air should be left on.
d. Oven and oven neck fires should be left on.
2. Long period.
a. After the last head containing an assembly has indexed out of the last seal positions the O_2 valve should be turned completely off, the gas valves (preheat and seal) turned fully off and the low pressure air valve turned off.
b. After the last assembly has been removed from the machine the neck fires should be turned off and the oven control switch turned to the "off" position.
c. Index switch and head rotation switch should be left on until the oven temperature reaches 300°C, then turn index switch to the "off" position.
d. Head rotation switch should be turned off.
e. Push panel switch to the "off" position.
f. Turn main switch to the "off" position.
g. Turn high pressure air off. (Manifolds will slowly drift to the down position after HP air is turned off).

c. Machine positions.
1. Load and unload.
Head to be free to rotate manually in this position to facilitate loading and unloading of bulb from machine. A warning light above position warns operator when machine will index. Light comes on 15 seconds before turret will index.
2. First preheat.
Two stationary manifolds (Buck horn same circulator type). Outside manifolds contain eighteen 1301A or 1142 AGF burners, in ball sockets. Outside manifold has facilities for 25 burners but seven of the holes are plugged. Inside manifold contains fifteen 1301A or 1142 AGF burners in ball sockets. The inside manifold has facilities for 19 burners but 4 of the holes are plugged. Burners are directed upward at a 12° angle, 1-1/2" from corner of rectangular metal shell at nearest point. Both outside and inside manifold are connected to separate AGF mixers. Mixer size is AGF #13-28-Q, and is drilled 85-15. (Draw tube area is equal to 85% of the burner pot area, while oxygen orifice is equal to 15% of burner pot area). Each mixer is supplied with oxygen and city gas. Pressure of the gas is standard plant pressure while pressure of the oxygen is adjusted with a pressure regulator.

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3. PROCEDURE (Cont'd)

c. Machine positions (Cont'd)

2. First preheat (Cont'd)

The position of the front and back manifold should be perfectly level. Allow 1/2" clearance at both ends of manifold when bulb is indexing with diagonal perpendicular to the direction of the index. The fires are directed at the sealing land of the metal shell. To obtain proper flame length, it is necessary to burn an excess of gas giving a blue inner cone from 1/2" to 3/4" long. By varying the O_2 pressure with the gas pressure constant, the length of this cone can be altered to achieve even heat distribution; a short inner cone will heat excessively the corners and short side of the shell while a longer O_2 cone will more effectively heat the long side of the shell. Face plate fire is furnished by a ribbon burner using city gas and low pressure air. This fire is directed at a 25° angle impinging on the face plate at a point 6" from the center of rotation and sweeping across the center. This flame should be bushy. A glass cone fire is not used for 21A bulbs.

3. Second preheat.

Equipment the same as 1st preheat except manifold buck horn type manifold.

4. Third preheat.

Equipment the same as in 1st and 2nd preheat positions.

5. Fourth preheat.

Equipment and set up is the same as in the third preheat position. The seal should be about 1/4" wide in this position. Temperature at the end of the cycle should be 1030°C.

6. Fifth preheat position.

Equipment and set up is the same as the fourth preheat position.

7. Seal position.

A circular manifold mounted on a pivoted movable support. The manifold can be raised to the vertical position by a high pressure air cylinder which is activated by a solenoid valve through a timer. The manifold contains fifty-four 1301A AGF burners in ball socket. (The manifold has facilities for 72 burners but 18 of the holes are plugged). The burners are directed upward at a 12° angle 1-1/2" from corner of the rectangular metal shell at nearest point. The manifold is supplied with oxygen and city gas through a 85-15 mixer. Manifold dwell in the "up" position be regulated by "on" and "off" settings on main panel. Speed of travel of manifold may be regulated by air valve at entrance to pressure cylinder. The height of the manifold in the down position may be regulated by two set screws located in base bracket of the manifold support structure. There are two sets of oxygen and gas valves and two mixers for the manifold. Face plate fire furnished by a ribbon burner located on the moveable structure and supplied with city gas and low pressure air. This fire is directed at a 25° angle from the horizontal impinging at a point 8" from the center of rotation. The flame of this fire should be kept bushy.

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3. PROCEDURE: (Cont'd)

c. Machine positions (Cont'd)

8. Cooling Position.

Face plate fire is furnished by a ribbon burner and two Selas radiant burners mounted on 5" centers such that the center of the outside burner is 9" from center of the face plate. A glass cone neck fire from a cannon burner is also used in this position. The temperature of the seal at the end of the cycle should be 630°C ± 20°C.

9-16. Oven positions.

Oven temperatures at the end of the cycle in each position should be as follows:

	A	B
1st oven -	600° ± 10°C	575° ± 10°C
2nd oven -	590° ± 10°C	585° ± 10°C
3rd oven -	585° ± 10°C	610° ± 10°C
4th oven -	575° ± 10°C	575° ± 10°C
5th oven -	560° ± 10°C	550° ± 10°C
6th oven -	550° ± 10°C	545° ± 10°C
7th oven -	540° ± 10°C	540° ± 10°C
8th oven -	530° ± 5°C	545° ± 5°C

A. As measured by thermocouples spotwelded on the cone sealing land and recorded on a recording pyrometer. See page 7f.

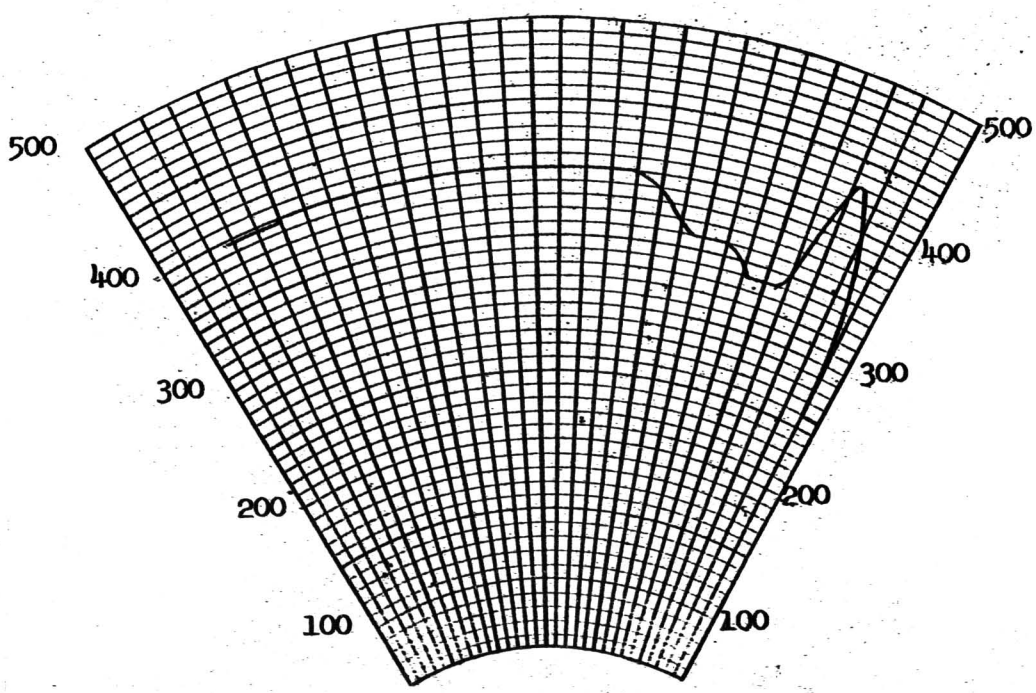
B. As measured by oven thermocouples and read on the meter located on the main panel.

Glass cone fires are used in all oven positions.

A cannon burner with a bushy flame, using city gas and low pressure air is used.

The oven fires should be adjusted to keep temperature of glass cone between 420°C to 440°C for annealing purposes.

This reading is checked by using a recording pyrometer (circular chart) for ideal curve with limits. See limits below.



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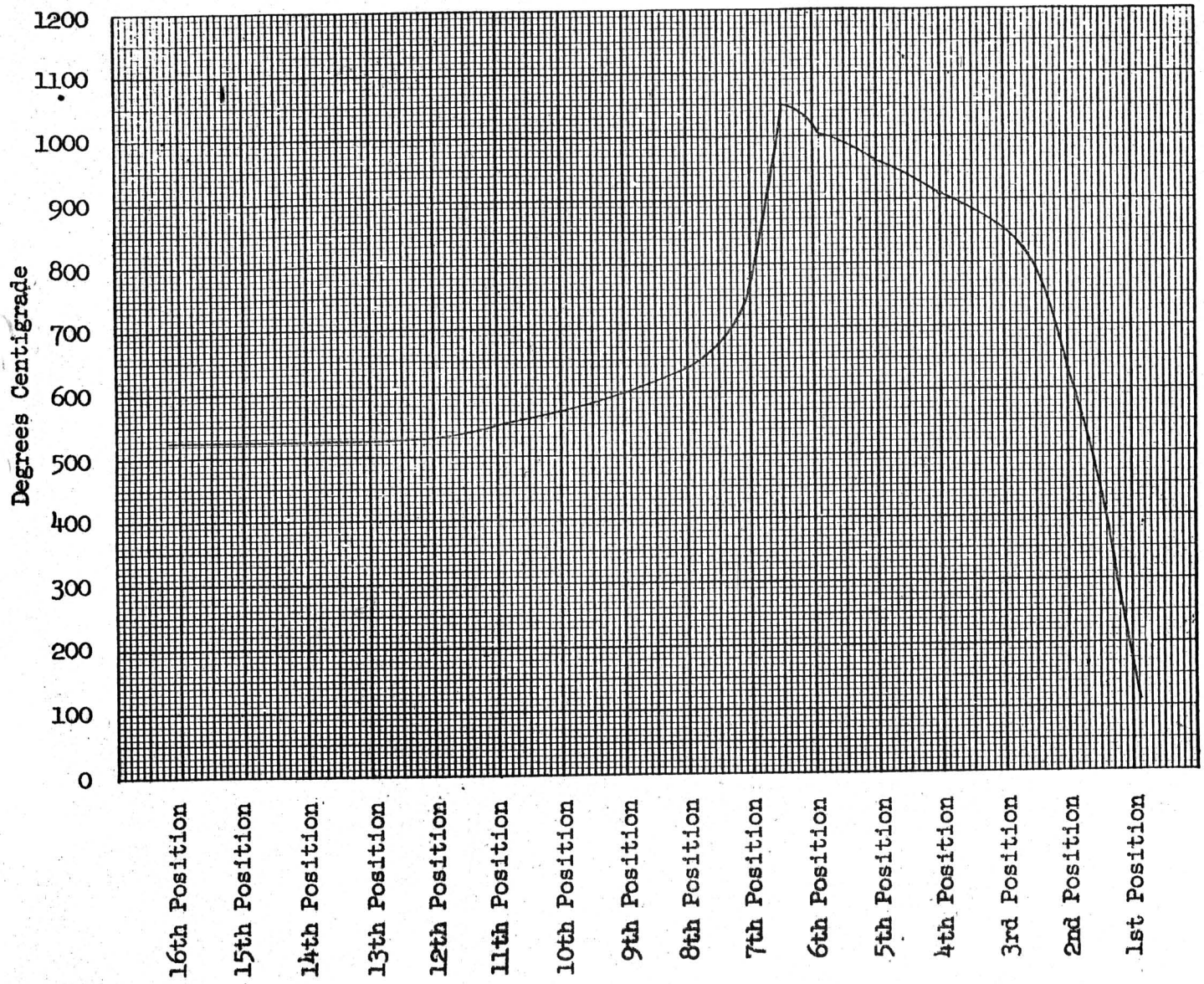

SCALE—

DIMENSIONS IN UNLESS OTHERWISE SHOWN. DIMENSIONS SHOWN WITHOUT TOLERANCES ARE DESIGN CENTERS

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3. PROCEDURE (Cont'd)

c. Machine positions (Cont'd)

9-16. Oven positions (Cont'd)

Error in the thermocouple system in use measured approximately 30° lower than actual temperature of bottom cone. This error resulted in readings as shown above. The actual reading is 30° added to above reading. This reading is within the limits specified. Limits 425° and 435°C. The thermocouple wire was placed inside the cone approximately 1-1/2" from the glass cone-metal cone seal. The curve shown was taken on a one pen circular chart Brown recording pyrometer.

d. Operator procedure: Two operators are used in the face plate sealing operation.

1. Load and unload operator.

a. Operator places metal cone - glass cone assembly with face plate, into head in load position, making sure rim of metal cone contacts all fingers and that flared neck depresses rubber bulb seal stopper a minimum of 1/4". Using a rubber stamp, the operator on the glass cone-metal cone machine (#1 - 406) stamps the metal-cone with the face plate sealing code. Operator should be sure face plate fits snugly into the cone.

b. When the sealing cycle is complete, operator unloads bulb assembly making sure asbestos gloves do not contact face plate and that no direct air blast impinges on assembly.

2. Hand blow operator.

a. The hand blow operator is responsible for the shape of the seal. Seal shape controlled by manipulation of a red paddle which opens a valve allowing low pressure air to flow in to the assembly. This air comes in from below the track, up through the spindle, through the glass neck, and up to the face plate. There is another hole in the track which is used as a "bleeder", so that any excess air will bleed out. This makes the blowing less sensitive. The amount of air going into the assembly is regulated by the number of times the paddle is pushed down or the length of time it is held down. Extra pressure may be obtained by putting a finger over the air escape valve near the red paddle.

b. Blowing should begin when there is approximately a 1/16" sag of the edge of the face plate below the inside edge of the sealing land of the metal cone. See Figure 1. When the paddle is first pushed down, it should be held for a few seconds (3 to 4) and then released with short jerky strokes to follow. The amount of air should be increased gradually until a ridge approximately 1/16" to 1/8" high is visible in the glass about 1/2" in from the inner edge of the rim. See Figure 2. The glass should be blown so that this ridge appears while the seal fires are still down around the bulb. If it is blown up after the fires rise, it tends to stretch the glass (sharp blow). See Figure 4. Blowing must continue until the bulb indexes out of the blow position and this ridge must be maintained. Blowing is very critical. Blowing too late or too low causes rim cracks. While blowing too soon, too rapidly or too high a blow weakens the bulb's pressure strength. It is best not to use extra pressure obtained by putting a finger over the air escape valve unless it is necessary, for this makes any movement of the paddle mush more critical. Every blowing operator should keep in mind the following points at all times:

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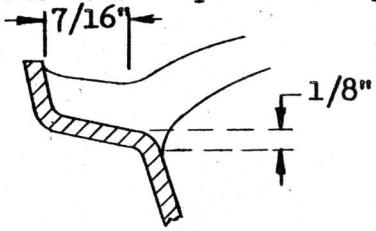
3. PROCEDURE (Cont'd)

d. Operator procedure (Cont'd)
b. (Cont'd)
1. Be sure glass sags down over sealing land.
2. Be sure to blow ridge.
3. Be sure to blow ridge while fires are still on.
4. Be sure to continue blowing until machine indexes, and be sure to maintain ridge until machine indexes.

c. The blowing is automatic in the fifth preheat position and the cooling position. However, in the event it is necessary, the operator can control the blow by the manipulation of air paddles as directed on (a) above.

4. CONTROLS

a. Seal Shape - The seal shape should appear as illustrated.



Ridge bogie 7/16" from rim interface. Glass 1/8" down over radius of seal land. Good smooth fillet.

The seal should be a uniform dark blue color and be composed of clear glass. The following are undesirable seal shapes and should not be permitted.

1. High blow, See Figure 1. Caused by improper blowing.
2. Sharp blow, See Figure 6. Caused by improper blowing. Usually caused by blowing the glass when it is too cold, i.e., after the sealing fires are up or by allowing the face plate to sag too far and then blowing it up too quickly.
3. Low blow, See Figure 2. Caused by improper blowing. Results from the failure of the blowing operator to blow the ridge. Can also be caused by leakage of air from the bulb during the blowing operation.
4. Cold seal, See Figure 5. Caused by underheating and/or misdirection of burners. May be remedied by resetting burners and/or increasing flame temperature. May also result from too small a face plate and/or excessive expansion of the metal cone.
5. Narrow seal, See Figure 3. Usually caused by the blowing operator failing to allow the face plate to sag. The ridge is formed too soon. Can also be caused by poor face plate fits and/or bulb not properly positioned on machine head.
6. Wide seals, See Figure 4. Usually caused by overheating and may be corrected by cooling down the fires. Can also be caused by improper face plate fit, cone not centered on machine head or leakage of air from the bulb during the blowing operation.
7. Reentrant or resagged seal, See Figure 8. Usually caused by improper blowing. (Face plate sagged, was blown up and allowed to resag). Can also be caused by too hot a fire in 5th preheat position or too hot face plate fires.

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4. CONTROLS (Cont'd)

a. Seal shape (Cont'd)

8. Bubbles or gas in seals, See Figure 9. Can be caused by trapped air overheating, contamination of seal area and improper blowing.

9. Uneven seals. Caused by improper face plate fit or poor centering of cone on machine head. Also may be caused by leakage of air from bulb during blowing or excessive cone expansion.

5. STRAIN CHECK

a. There should be at least a 1" wide band of compression completely around periphary of seal. A sample should be taken every two hours and compared to control bulb on display.

b. An undersirable strain pattern is one which has any tension within this 1" wide band.

6. BOTTOM CONE SCRATCH TEST

This test will be made on botton glass cones after face plate sealing to check annealing quality of oven fires. Cones will be scratched on the inside and outside at the seal and on the bell of the cone with #180 grit paper. Two cones per shift will be scratched. To obtain samples for this test, an assembly without a face plate should be run immediately after a good annealing curve on bottom cone is obtained. In event of failure, supervisor and engineer must be notified.

7. LINE INSPECTION

All bulb assemblies are to be 100% inspected for blow and seal defects as listed below. Any assembly exhibiting a defect should be recorded on the form provided and action taken in accordance with instructions given below for a particular defect. Those assemblies requiring pressure testing are to be tested in the pressure tank available for ten (10) minutes at thirty (30) pounds gage pressure. The inspector upon noticing excessive numbers of any defect should notify the foreman or engineer immediately and the condition causing the defect should be corrected.

HIGH BLOW

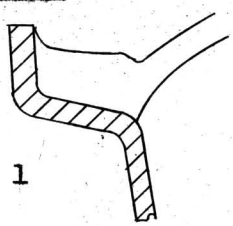

Figure 1 See limit sample

Remove from the line all assemblies that are as bad or worse than the limit sample and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and return the assembly to the line.

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7. LINE INSPECTION (Cont'd)

LOW BLOW

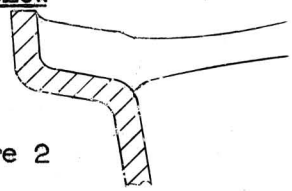
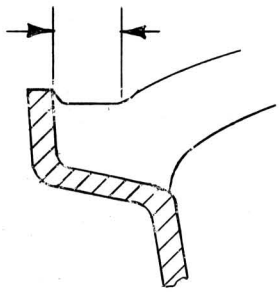


Figure 2

A seal with no blow ridge in glass

Record and let assembly stay on conveyor.

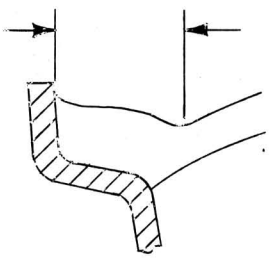
NARROW SEAL
Figure 3



S.N. 25-7-2.
A seal whose width, measured from the lip interface to the ridge in the glass, is less than 3/8" on long or short sides and 1/4" in the corners.

Remove from the line and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and hold for disposition by the glass engineers.

WIDE SEAL
Figure 4



S.N. 25-7-2.
A seal whose width, measured from the lip interface to the ridge in the glass, is more than 5/8" anywhere on the seal.

Remove from the line and hold for disposition by the glass engineers.

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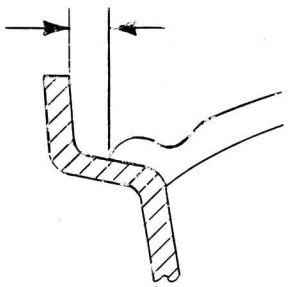
7. LINE INSPECTION

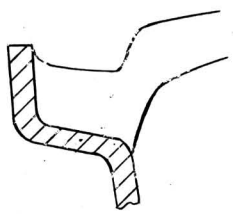
COLD SEAL
Figure 5



S.N. 25-7-2
A seal where there is a gap of 3/16" or more between the lip interface and the face plate glass.

Remove from the line and scrap the assembly.

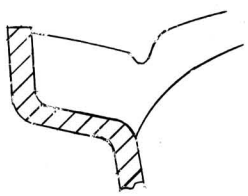
SHARP BLOW
Figure 6



Sharp one way

See limit samples.

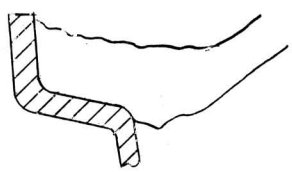
Figure 7



Sharp two ways

Remove from the line all asemblies that are as bad or worse than the limit samples and pressure test. If the bulb survives pressure testing, paint a red letter "T" on the face plate and return the assembly to the line.

RESAGGED FACE PLATE
Figure 8



A seal that has a reentrant angle in the glass at the blow ridge.

Record and let assembly stay on the conveyor.

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7. LINE INSPECTION (Cont'd)

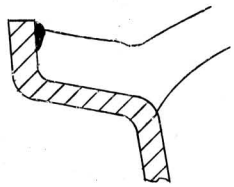
UNEVEN SEAL

Record as uneven, if the seal is both narrow and wide. Remove from the line and pressure test. If the assembly survises pressure testing, paint a red letter "T" on the face plate and hold for dispostion by the glass engineers.

GASSY SEAL S.N. 25-7-2.

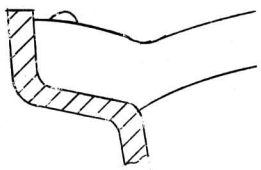
Remove from the line and scrap the assembly, if the following limits are exceeded:

Figure 9 (a)



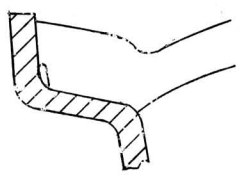
No blister in seal at glass to metal interface is allowed.

Figure 9 (b)



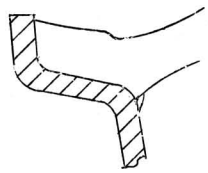
Blisters on outer surface of seal shall not exceed 1/8" (.125).

Figure 9 (c)



Blisters at the lip are not to exceed a width of .050" and a maximum length of 2.000" on the sealing land.

Figure 9 (d)



Blisters at the fillet are rejectable, if they exceed .100" diameter.

NOTE I: Blisters in a cluster are not to exceed a width of .10" and a maximum length 1.500".

NOTE II: Bubbles are to be considered as the same type of defect as blisters and they are to be rejected according to the same criteria set up for blisters. This does not apply to minute bubbles known as gassy seals.

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7. LINE INSPECTION (Cont'd)

GLASS OVER EDGE — S.N. 25-7-2
Glass over the lip of the cone is cause for rejection regardless of area quantity. Does not include fired enamel on top of the lip. Remove from the line and hold for possible salvage and final disposition.

DENTED CONE — See Limit sample.
Remove fron line and scrap assembly, if dent is worse than limit sample.

INK ON FACE PLATE — None allowed.
Remove from line and hold for possible salvage and final disposition.

SCRATCHED FACE PLATE
Remove from line and hold for final disposition.

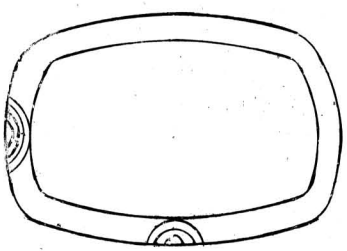
BROKEN CONE — None allowed.
Remove from the line for salvage. All breakage above the neck splice is to be called a broken cone.

BROKEN NECK — None allowed.
Remove from the line for salvage. All breakage below the neck splice is to be called a broken neck.

STAINED FACE PLATE
Record all face plate stains but do not remove assembly from the conveyor.

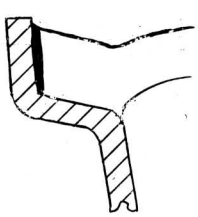
FACE PLATE BREAKAGE — None allowed.
Regardless of the type, remove from the line and scrap the assembly. Identify and record the various type breaks as follows:

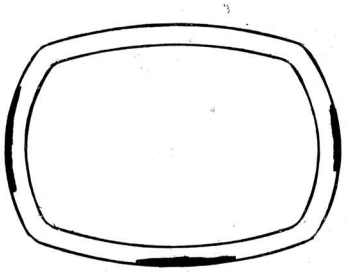
KNOCKED BULB
Figure 10
Parting of the glass and metal at the lip and on sealing land as the result of a knock.



Usually occur on long and short sides. Break lines are circular and have a colored appearance (as in an oily film).

LIP STRIP
Figure 11
Parting of the glass and metal at the lip interface.





Usually occur on long or short sides. Break is parallel with cone. May or may not run out into seal.

SCALE—
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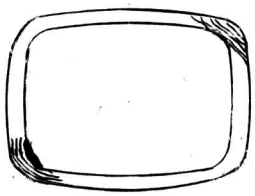
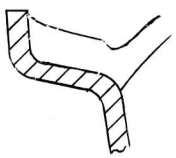
7. LINE INSPECTION (Cont'd)

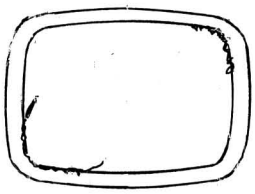
CORNER STRIP
Figure 12
Parting of the glass and metal on the sealing land at the corners of the bulb.



Always occur in the corners. Break lines follow contour of corner or run diagonally across the corner. Usually have a colored appearance.

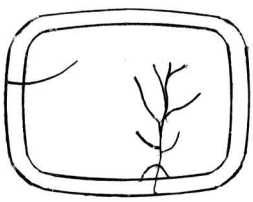
RIM CRACK
Figure 13
Parting of the glass and metal in the fillet area.





Can occur anywhere in the fillet area. Usually start in the corners. Break may or may not run out into the face plate.

RADIAL CRACK
Figure 14
Start a glass to metal interface and are perpendicular to lip.



Always run out into face plate. May be a single crack or many cracks. May run only a short way into face plate or all the way across the face plate.

8. MECHANICAL INSPECTION (S.N. 17-1-1, page FBM166-601C (a))

Four assemblies per hour are to be mechanically inspected and the information recorded on the forms provided. Items to be checked are as follows:
a. Reference line to rim at plane cc'.
b. Reference line to bottom of neck at plane cc'.
c. Dimensions D-aa', D-bb', and D-cc'.
d. Seal shape and quality.
All assemblies that are found to be out of specified dimensions are to be held and the foreman or factory engineer notified. The engineer should analyse the assembly to determine cause, make disposition and take remedial action.

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9. BREAKAGE ANALYSIS AND PRODUCT CONTROL

a. The various types of breaks are as follows:
   1. Lip strip. See Figure 11.
      a. Lip strip is a fracture of the glass at the glass-metal interface. Usually runs parallel to the metal rim at the rim interface and/or in the seal area. This type crack does not usually run out into the face plate on bulb assemblies.
      b. Causes:
         1. Improper cooling in the oven resulting in the formation of excessive tensile stresses.
         2. Mismatch between metal and glass.
         3. An aggregation of frit due to excess heat at the top of the glass metal face causing poor adherence.
         4. Cold seals - rolled with reentrant angle between glass and metal at seal area.
         5. Narrow seals - ridge too close to metal lip and/or fillet not down over cone radius.
   2. Rim crack. See Figure 13.
      a. Fillet strips are circumferential cracks in the glass where glass dips over seal land (at fillet). These cracks may or may not transverse entire circumference of seal and may appear in the corners, sides, or ends.
      b. Causes:
         1. Low blow, heavy fillet. See Figure 18.
         2. Resagged face plate.
         3. Gas or bubbles in fillet.
         4. Too high exit temperature.
   3. Corner strips. See Figure 12.
      a. Type of break where the glass strips away from the metal. The origin of strip may be either (a) between the inside of the lip and face plate or (b) in the fillet.
      b. Causes:
         1. Too high annealing temperature in ovens.
         2. Corners not properly filled out. May be due to contaminated frit or poor frit application.
   4. Knocked bulbs. See Figure 10.
      a. Type of break where the glass strips away from the metal in the lip area of the seal. The break is usually less than 2" long. A knock can usually be distinguished from a strip seal in that the strip is smaller in length and seems to radiate from a point. Also, in the break, rings of color are noticeable.
      b. Causes:
         1. A knock on the inside of the lip. This tends to push the metal of the lip away from the glass seal and so causes a fracture or strip.
   5. Radial cracks. See Figure 14.
      a. Type of break which runs from the lip at seal area in towards the center of the face plate. May occur all the way around seal or in one spot. This type of break usually does not occur in bulb assemblies.
      b. Caused by high tangential tension in the seal.

End of Schedule #7

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