SUBJECT MAIN SEALING
Process Specification

1. EQUIPMENT Initially for 16AP4 at Marion.

a. Stem Preheater Model L721RR.
b. Etch Machine.
c. Sealing Machine Model L701MM.
d. Quality control length gage for measuring sealing length.
e. Vertical polariscope manufactured by Polarizing Instrument Company.
f. Hot Wire Glass Cutoff.

2. PURPOSE

The purpose of the main sealing process is to create a physical bond between the glass of a stem and the glass neck of a bulb assembly. This bond must be structurally sound and have a high resistance to gas leakage.

3. PROCEDURE

Assuming that the parts used are not defective in any way, the general process is one of raising the temperature of both neck glass and stem glass to the same or nearly same point and allowing the glass parts to fuse together. After the parts have been fused together certain desired strains may be induced in the glass of the stem and other undesired strains may be annealed out of the neck.

This work is done in 16 steps which are tabulated below:

	STEM	NECK OF BULB ASSEMBLY
(1)	Temperature slowly raised from room temperature to 250° C.	None.
(2)	Loaded on mount pin whose temperature is 250° C.	None.
(3)	Raised to temperature of approx. 300° C.	Raised to temperature of approx. 300° C.
(4)	Raised to temperature of approx. 350° C.	Raised to temperature of approx. 300° C.
(5)	Raised to temperature of approx. 400° C.	Raised to temperature of approx. 400° C.
(6)	Raised to temperature of approx. 450° C.	Raised to temperature of approx. 500° C.

(7) Glass of neck and glass of stem fused together by high velocity gas/oxygen burners which simultaneously shape the seal.

(8) Excess glass of neck cut off by high velocity gas/oxygen burners.

(9) Some of the heat of sealing is allowed to dissipate from the sealed assembly. The temperature of the glass of the stem and seal is allowed to drop faster than that of the tubulation.

(Cont. on page 2)

3. PROCEDURE (Cont.)

(10) Same as (9) only a lower temperature is reached.

(11) Same as (9) only a still lower temperature is reached.

(12) Here the emphasis is shifted to the seal area where the stem glass and neck glass were joined. The seal area is allowed to cool slightly.

(13) Same as (12).

(14) Same as (12).

(15) Same as (12).

(16) Same as (12) except that the end temperature is now approximately 200° C. At this point the sealed tube is unloaded from the machine.

A more detailed explanation of the steps listed above follows:

The stem is placed in the preheater where it is heated to a temperature such that, when the stem is placed on the mount pin, no heat will flow from the mount pin to the stem or from the stem to the mount pin. If there is a temperature differential between these two, heat will flow from the hot to the cold. If the differential is such that the stem is the cold object, the lower part of it will be heated, while the inside and the top are still cool. This will create temperature stresses which will tend to crack the stem.

The stem is now raised to a high temperature in four uniform steps. Plotted on a graph this would be represented by a nearly straight line curve. At the same time heat is applied to the neck so as to raise its temperature from room temperature to just below that required for sealing.

In the sealing position the stem and neck glass are fused together. Here a physical bond is created between two pieces of glass. This requires the addition of considerable heat with several jets of high velocity gas to form the required shape. After sealing several other high velocity burners melt off any excess glass and form the bottom of the seal. This is known as "cutoff".

Following cutoff the stem and seal contain a considerable amount of heat, which, if allowed to dissipate properly can be made to do several useful things. First, it is desired to create a band of tension in the glass surrounding the tubulation. Second, it is desired to create an area of compression in the fillets and third, it is desired to anneal the glass of the neck so that no strains are set up in it. To accomplish this, only enough heat is added to control the rate of cooling so that the amount of heat lost to the atmosphere just exceeds that added by the ceramic fires. By properly controlling the rate and manner of cooling, the desired strains can be set up in the stem and the undesired strains can be eliminated from the neck.

(Cont. on page 3.)

3. PROCEDURE (Cont.)

The following positions are used for fires as described:

Fire Position 1.
a. Single horizontal ceramic fire with center line directed at the top rim of the G3 inside neck.
b. A sharp fire directed through holes in shoulder of mount pin.

Fire Position 2.
a. Single horizontal ceramic directed as in fire #1.
b. Single sharp fire directed through holes in shoulder of mount pin.

Fire Position 3.
a. Two horizontal ceramics directed at the getter area.
b. Single sharp horizontal fire directed through holes in shoulder of mount pin.

Fire Position 4.
a. Two horizontal ceramics directed at the getter.
b. Two sharp horizontal fires directed at holes in shoulder of mount pin.

Fire Position 5.
a. Six sharp horizontal fires positioned with 3" distance from burner to tube neck. The two inside burners are located approximately 1/4" apart and play directly on the flare of the mount. The next two are spaced another 1/2" and directed 1/8" higher. The extreme fires just touch the outside of the neck. These are located an additional 1/8" higher making the shoulder 3/8" high.

Fire Position 6.
a. Four sharp horizontal fires are used. The two center ones play just under the flare of the mount. The outer two just skip the flare on either side, rounding the seal slightly.

Fire Position 7.
a. Single ceramic. For direction of burner, sight along top of ceramic and observe mount pin holes in shoulder. Angle is approximately 15° from horizontal.

Fire Position 8.
a. Single ceramic exactly as in position #7.

Fire Position 9.
a. Single horizontal ceramic positioned so that top of ceramic sights 3/8" below the top edge of the mount pin.

Fire Position 10.
a. Single horizontal ceramic with the center line aimed 1/2" above the seal area.

Fire Position 11.
a. Same as 10.

(Cont. on page 4)

3. PROCEDURE (Cont.)

Fire Position 12.
a. Same as 10.

Fire Position 13.
a. Same as 10.

Fire Position 14.
a. Same as 10.
b. A sharp horizontal fire directed through holes in shoulder of mount pin.

See Pages 7 and 8 for drawings showing burner positions.

4. BURNERS

Burners are used as follows:

Fire Position	Burner	Gases
1	1300A	Natural Gas/Oxygen
1	1-626N	Natural Gas/Air
2	1-1300A	Natural Gas/Oxygen
2	1-626N	Natural Gas/Air
3	2-626N	Natural Gas/Air
4	2-1300A	Natural Gas/Oxygen
4	2-626N	Natural Gas/Air
5	6-1142A	Natural Gas/Air/Oxygen
6	4-1142A	Natural Gas/Air/Oxygen
7	1-626N	Natural Gas/Air
8	1-626N	Natural Gas/Air
9	1-626N	Natural Gas/Air
10	1-626N	Natural Gas/Air
11	1-626N	Natural Gas/Air
12	1-626N	Natural Gas/Air
13	1-626N	Natural Gas/Air
14	1-626N	Natural Gas/Air
14	1-525D	Natural Gas/Oxygen

5. FIRE TEMPERATURES

The following fire temperatures can be used as a guide to operation. It will be noticed that only limits are specified. Temperatures should be adjusted so that adjacent temperatures are not at extremes of the range. For example: mount pin fire #3 should not be on the low side and mount pin fire #4 on the high side.

6. MOUNT PIN TEMPERATURES

These temperatures are very critical and are measured with a hand pyrometer touched to the tip of a mount pin which has a loaded tube on it. The pyrometer tip should be preheated to about the correct temperature beforehand by touching the tip to the side of a ceramic burner.

(Cont. on page 5)

6. MOUNT PIN TEMPERATURES (Cont.)

Temperature Ranges:

Mount pin load	245 to 255° C.
Mount pin fire #1	300 to 310° C.
Mount pin fire #2	345 to 355° C.
Mount pin fire #3	390 to 410° C.
Mount pin fire #4	440 to 460° C.

7. PREHEATER TEMPERATURE

The temperature of a mount as removed from the preheater should be 250° ± 15°C.

8. TEMPERATURES INDICATED BY PYROMETER

A pyrometer using a chromel-alumel thermocouple which has a alumel wire target 5/8" in diameter is read in one of two positions. In Fire positions 7, 8 and 9, the temperature is read with the couple in the low position. In all other positions except #5 and #6 where no readings are taken, the temperature is measured in the high position. The target area in the high position is adjusted to be half way between the elevation of the axes of the ceramics in positions 2 and 3. The target area in the low position is adjusted to such a position that the axis of the ceramic burner in fire position #7 intersects the center of the target.

Successful temperature ranges are:

Ceramic fire #1	200 to 300° C.
Ceramic fire #2	250 to 325° C.
Ceramic fire #3	350 to 450° C.
Ceramic fire #4	450 to 550° C.
Ceramic fire #7	250 to 350° C.
Ceramic fire #8	250 to 350° C.
Ceramic fire #9	200 to 300° C.
Ceramic fire #10	200 to 300° C.
Ceramic fire #11	200 to 300° C.
Ceramic fire #12	200 to 250° C.
Ceramic fire #13	200 to 250° C.
Ceramic fire #14	150 to 200° C.

9. OPERATION

The stem preheater contains 20 separate heating compartments, each heated by its own electric heating coil. This machine should be allowed to come up to operating temperature before it is loaded.

The fires on the sealing machine should be lighted 15 to 20 minutes before it is loaded. The sealing machine burners are lighted by first turning on the gas (air has been left on) and lighting all burners. Then the oxygen is turned on.

(Cont. on page 6)

9. OPERATION (Cont.)

Loading and unloading of the machine is accomplished as follows:

a. Grasp wrench and release jaws holding sealed tube.
b. Grasp sealed tube and transport to conveyor.
c. Grasp unsealed bulb on conveyor, transport to etch machine.
d. Etch bulb.
e. Grasp mount in preheater.
f. Transport to sealing pin (mount pin).
g. Load on pin.
h. Grasp etched bulb.
i. Transport to bulb holder on machine.
j. Load in bulb holder.
k. Grasp wrench.
l. Position bulb.
m. Tighten jaws.
n. Remove wrench.

10. ADDENDUM

The Quality Control sealing length gage listed under EQUIPMENT is used in conjunction with a tube base which has the key and pins removed. The base is placed on the tube and the overall length of the tube with base attached is measured.

Refer to S.N. 34-18-74A for information concerning the use of the hot wire cutoff and the polariscope. The acceptable limits of strain are also covered in 34-18-74A.

(Cont. on page 7.)

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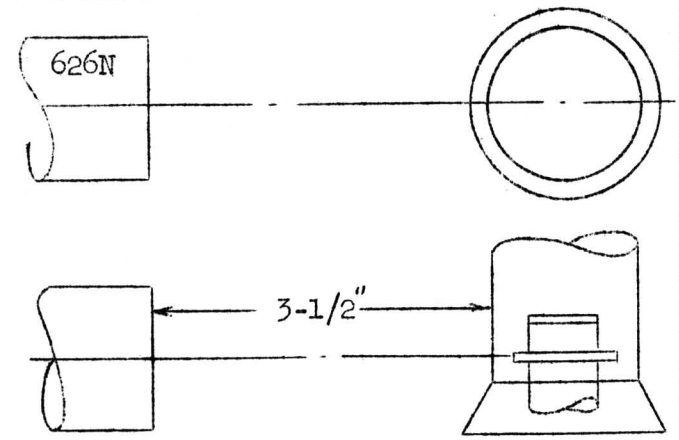
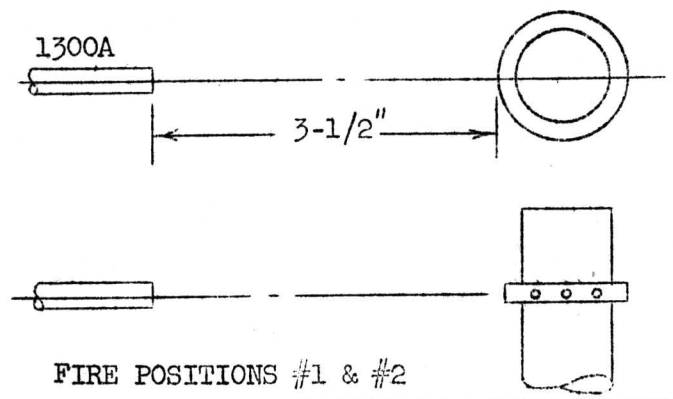
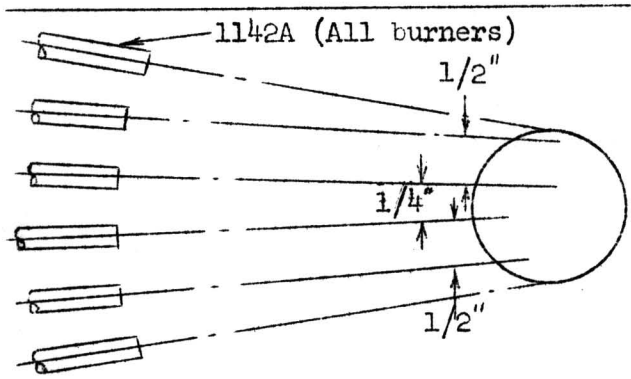
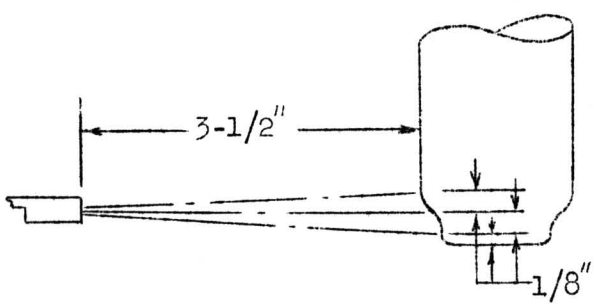
Process Specification



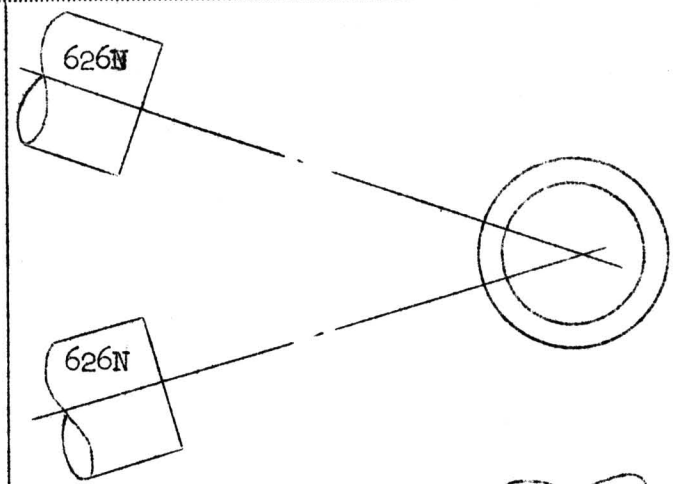


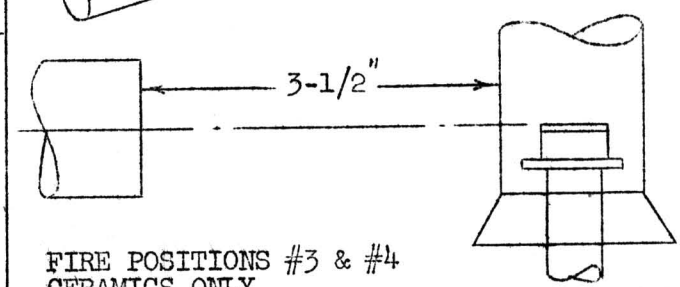
FIRE POSITIONS #1 & #2



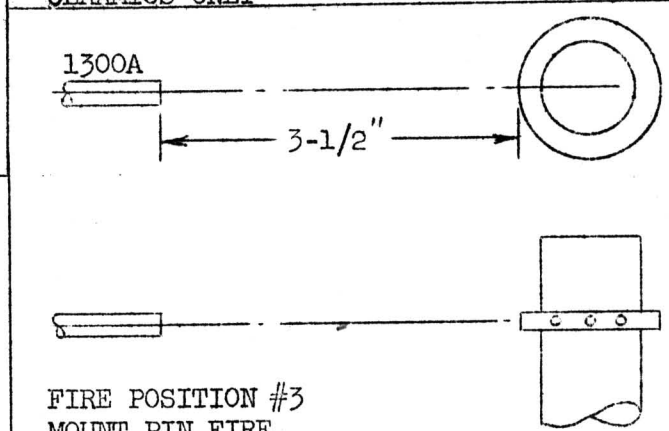


FIRE POSITION #5

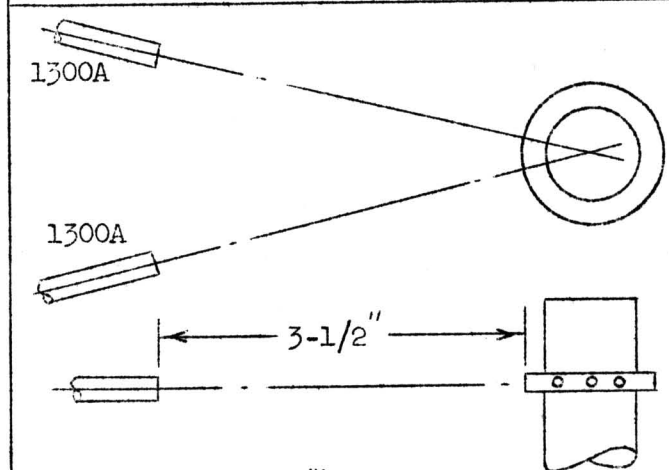




FIRE POSITIONS #3 & #4
CERAMICS ONLY



FIRE POSITION #3
MOUNT PIN FIRE



FIRE POSITION #4
MOUNT PIN FIRES

SUBJECT MAIN SEALING
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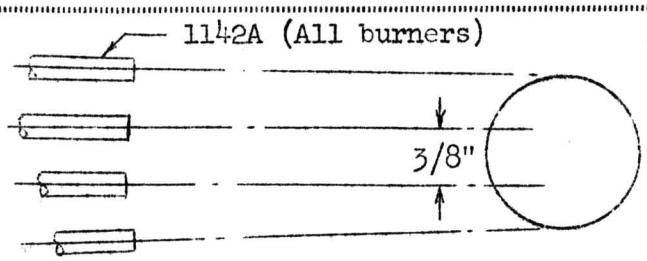
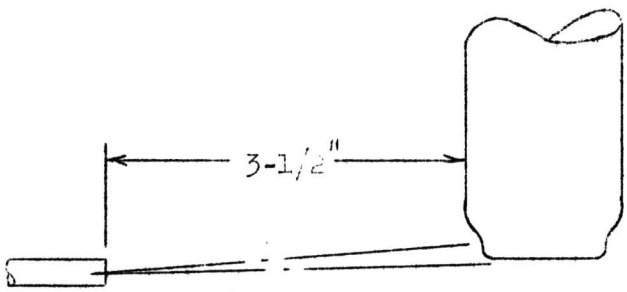
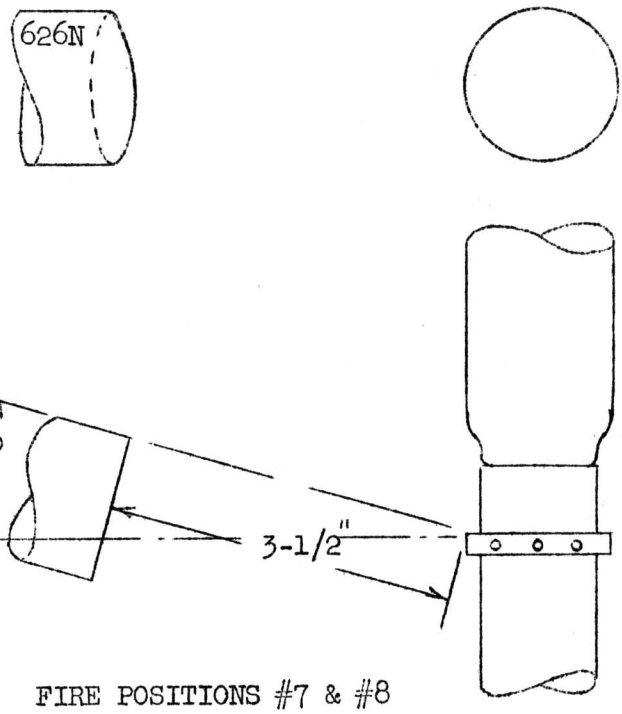


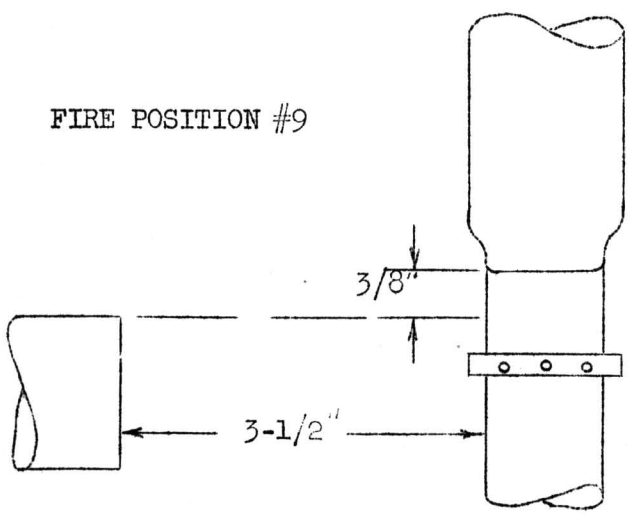


FIRE POSITION #6

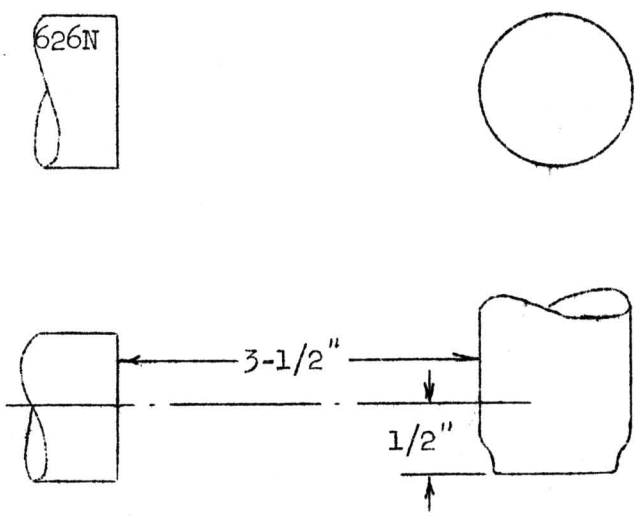


FIRE POSITIONS #7 & #8

FIRE POSITION #9



CERAMIC FIRES #10 - #14



MOUNT PIN FIRE IN POSITION #14 IS SAME AS POS #3 EXCEPT BURNER IS 525D

ENGINEERING SECTION
STANDARDIZING

10-4912-27-63 LMM,RLC-121/bw 105