6/18/74

MATRIX

—Wash panel
use diluted ammonium biflouride (NH_4HF)

—Apply photo-resist

PVA (poly vinyl alcohol)
Rhoplex (AC-73 - acrylic emulsifier)
Water
Dichromate
Pluronic (L-72 surfactant-wetting agent)

Viscosity - 11-19 (Brookfield) viscometer
Machine dispensed

—Dry
(air)

—Exposure on lighthouses
makes exposed area insolvable in water

—PI (uses bare arc/less exposure/normally less than 1 minute exposure time)
—Delta (uses source, collimator/exposure time up to 8 minutes)
—Expose consecutive green, blue, red

—Develop
use DeI water
resist hardens where light hits (e.g. have water insolvable dots/lines)

—Apply graphite (lampblack ?)
5% solids mixture with DeI water and ammonia
PH, 10 to 10.5
Viscosity is important

—Graphite dried
(air ?)

—Hydrogen peroxide wash (10% solution)
dissolves insolvable dichromate
penetrates graphite over dots and etches out resist dots/stripes

—Rinse
washes out dots/stripes leaving matrix pattern

—Dry
(heat)

—Ready for screening

REFERENCE: Meeting with Marty Royce and Stan Harper on 6/17/74.

TYPICAL MATRIX SCHEDULE

TYPICAL MATRIX SCHEDULE - Sch. #4 (for 25V - 90° at Scranton)

I. Equipment:
   A. Model #L2799 - F9 -- 67 head in-line automatic matrix machine equipped with all supporting equipment.
   B. Model #L2801 - C4 lighthouse with lens wedge and set-up for green, blue, and red.
   C. Two water dispensers with automatic controls.
   D. Two 100-gallon (w 380 liters) stainless steel containers for graphite.
   E. Sponges
   F. Beakers, graduates, etc, necessary for controls.
   G. Two dispenser container filling funnels (160 ss mesh, 98 microns).

II. Materials:
   S 30 sodium hydroxide
   H7 hydrofluoris acid
      filtered high pressure air
   P903C Resist
   G917B Graphite
   H901A Hydrogen peroxide
   A609 Amonium bifluoride
   W60D De-ionized water
   S646A Caustic defoamer or
   S646B caustic defoamer
   A9 Aumonium Hydroxide

III. Procedure:
   A. Start-up
      1. Open valves to obtain resist and graphite slurries; fill dispensing containers; begin mixing.
      2. Open 6-foot valves.
         a. De-ionized water 40.5°
         b. Hot tap water
         c. Cold tap water
         d. High pressure air valves should always remain open in order to furnish cooling for exposure lighthouse mercury arc lamp.
      3. Push master control panel main power switch to "on" position.
      4. Turn all required spin position motors on and check spin speed.
      5. Turn on all required heaters and check to be sure they are on. Make sure all air dryers are on.
      6. Turn on developing cycle switches.
      7. Dispenser control panel. Push all switches to "on" position (dispensing solenoids shall be flushed prior to start-up and after four or more empty heads during the day's operation.)
      8. Master control panel setting:
         a. Turn index switch to "automatic".
         b. Turn index timer switch to "on" position.
         c. Check timer setting for proper time cycle.
         d. Machine should be indexing and the dispenser and salvage cycle should be operating at this point.
      9. Panel wash cycle
         a. Rinse thoroughly and change acid tanks on the

regularly scheduled basis.

b. Push washing cycle control panel main switches to "on".
c. Be sure all individual wash cycle switches are "on".
d. Check entire washing cycle at least once per hour to ensure proper operating conditions.

B. Operational Procedure by Positions

Position #66 Load Position

Notes: 1. Remove cap assembly from truck or conveyor and place on carrier.
2. Clamp firmly in position so that carrier clamp lever and twelve o'clock cap position are on the same side. The six o'clock side of the panel is identified by the two locating pads. Filmed and aluminized scrap cap assemblies which have been recovered are to be loaded on this machine.
3. Remove the mask from the cap assembly and place the mask in the mask carrier.

Position #67 Load position (see position #66)
Position #1 Water wash (optional caustic wash)
Position #2 Caustic wash

Notes: 1. Once per shift, check caustic concentration per sch. 1, 34-33-75.
2. If below 2% adjust by adding sodium hydroxide to make approx. 4% concentration.
3. Be sure caustic temperature is between 50° and 90°.

Position #3 Water rinse
Position #4&5 Hydrofluoric acid wash

Notes: 1. Once per shift check hydrofluoric acid concentration per sch. 2, 34-33-63.
2. If below 6% adjust by adding hydrofluoric acid to make a 12% maximum concentration.

Position #6 De-ionized water
Position #7 Spin dry
Position #8 Spin dry
Position #9&10 Spin dry with calrod heat applied from bottom.
Position #11 Spin dry
Position #12 Screen application, resist, automatic.

Notes: 1. Dispense about 160 ml. of resist into the center of the cap from charge dispenser, automatically operated.
2. Maintain inside center panel temperature at 31°C ± 2°C at time of dispense.

Position #13 Spin dry.
Position #14 Spin dry with heater.
Position #15 Spin dry with heater.
Position 16&17 Spin dry with heater.
Position 18&19 Spin dry with heater and wash excessive resist from sidewall.
Position 20-21 Spin dry with air blower.
Position #22 Automatic sidewall and seal load wiping with sponges.
Position 23-24 Resist application visual inspection and mask insertion.

Notes: 1. Inspect resist application for defects.
2. Position cap carrier so that lever of cap locking device will be at bottom.
3. Remove mask from carrier. Inspect for obvious mask defects. Recover mask defects per Sch. 4, 20-13T-600.

4. Insert springs in the bottom stud (twelve o'clock stud) and either the three o'clock or the nine o'clock stud simultaneously.
5. Insert the remaining two springs in the remaining two studs.
6. Be sure that all four springs are properly seated in the four studs.
7. Rejecgable applications are recorded in the appropriate columns on the scrap sheet. Flag rejected panels.

Position 25&26 Exposure Positions (see Sch. 14, 34-44-63)

Notes: 1. Remove mask-cap assembly from carrier and place on lighthouse conveyor to lighthouse area.
2. After exposure, cap is removed from conveyor and returned to an empty carrier and clamped into position so that carrier clamping lever and twelve o'clock cap position are on the same side. (at the bottom as viewed by operator).
3. Remove the mask assembly from the cap studs by disengaging the springs from the remaining two studs.
4. Place the mask assembly on the mask carrier with the six o'clock spring facing the operator.
5. Cap temperature as measured in the center of the top cap shall be maintained at 41°C±2°C at time of mask insertion. Mask shall be mounted in the panel at least four minutes prior to initiation of the first matrix dot exposure.
6. Mask assembly temperature at insertion shall be maintained at room temperature.
7. Temperature on the cylindrical portion of the water cooled lamp housing shall not exceed room temperature +3° at time of panel application or during exposure period.

Position 27-32 Resist Developing Positions

Notes: 1. Exposed resist applications are developed and all excess resist is removed.

Position #33 Limp stream rinse with pluronic mixture. Alter note method - Limp stream D.I. water developing with the addition of 1% pluronic L72, 49% methanol, 50% water D.I. - dripped into the limp stream.

Position #34 Spin dry

Position #35,36 Spin dry with heat.

Position #37-39 Spin dry with air blowers.

Position #40 Graphite application, automatic.

Notes: 1. Dispense about 40 to 50 ml./sec. of graphite into the center of the cap from the charge dispenser automatically operated.
Twice per shift QC shall measure the graphite PH and solids content. Limits are 4.0% and 9.0 to 10.5 for the PH. The process engineer or foreman are to be notified when limits are exceeded.

Position #41 Graphite Salvage

Notes: 1. Salvage graphite forced to the corners during the multi-speed spin-out, salvage the material through a 120 mesh (125 micron) stainless steel filter.

Position #42-44 Spin dry with heater.

Position #45-47 Spin dry with heater.

Position #48 Hydrogen peroxide dispense with spin.

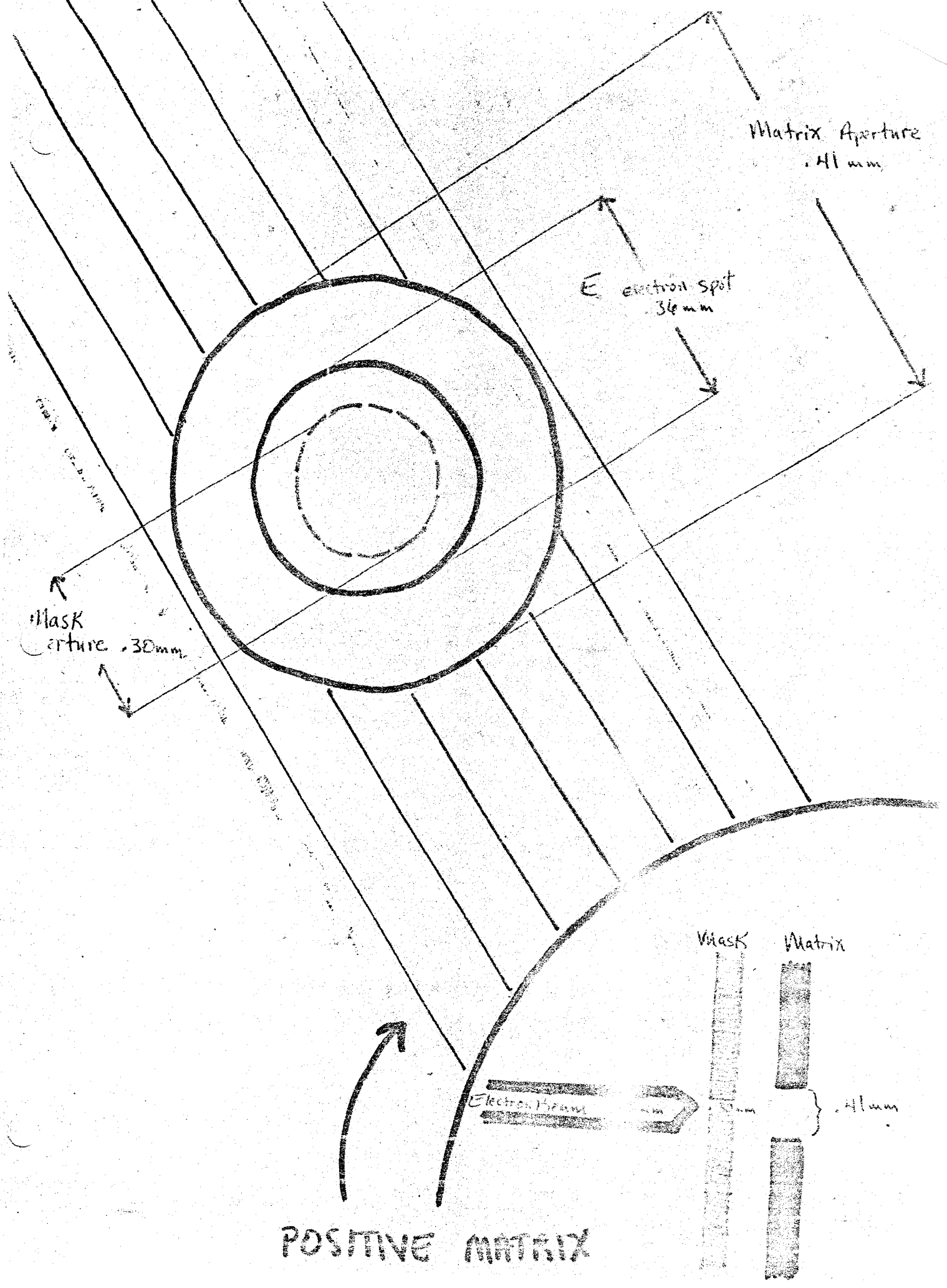
Position #49 Hydrogen peroxide spin.

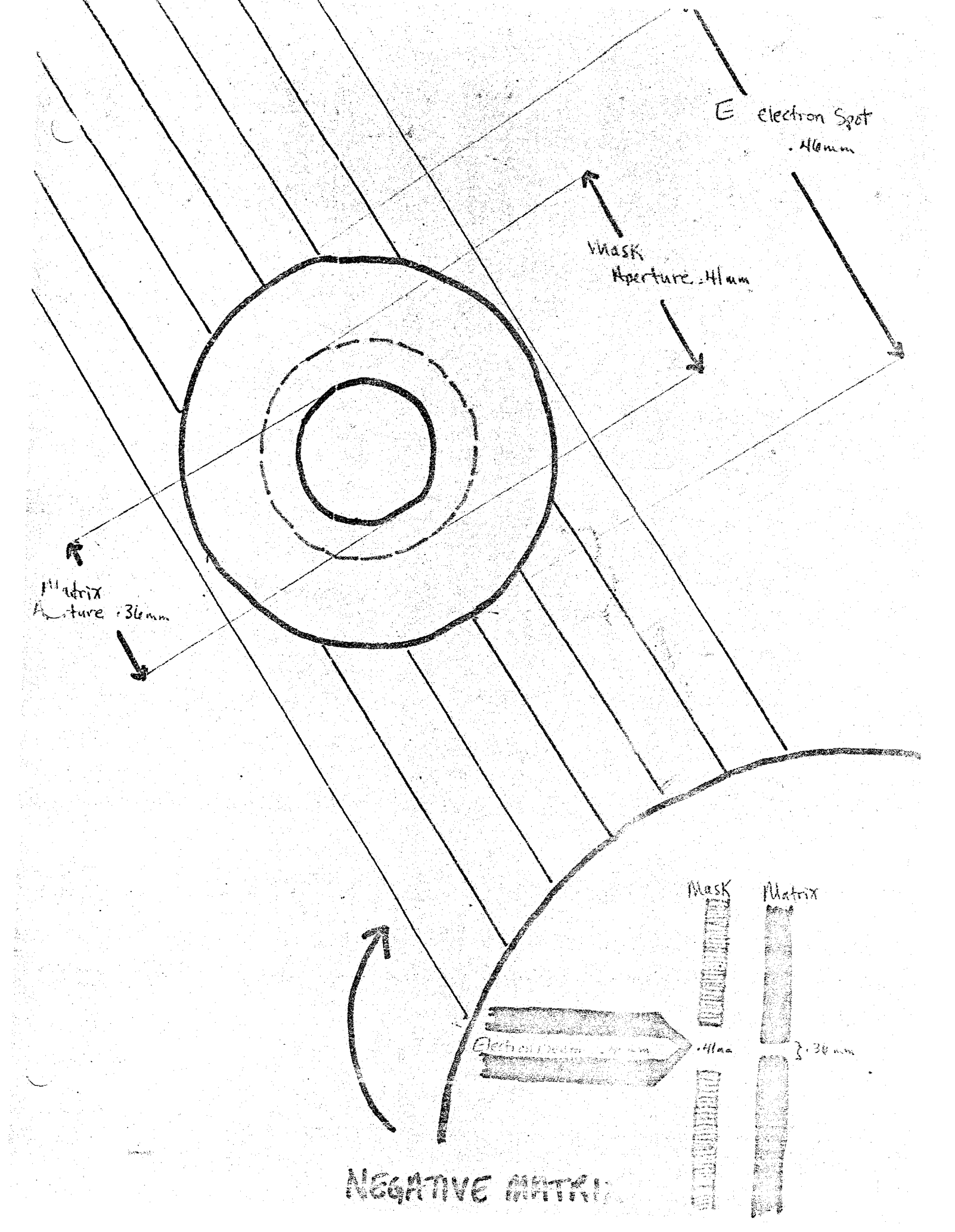
Notes: 1. Once per shift QC shall measure the H_2O_2 concentration PH, and temperature in the storage tank. Limits are 4% min. for concentration, 7.0-8.5 for the Ph and 80°-110°F (26.7°-43°C) for the temp.

Position #50 H_2O_2 dump and water develop.
Position #51 &52 Water Develop
Position #53 Limp stream water rinse.
Position #54-55 Aumonium bifluoride sidewall trimmers.
Position #56 Limp stream water rinse.
Position #57 Automatic seal land wiper with limp stream water rinse
Position #58&59 Spin dry with heater.
Position #60&61 Spin dry with air blowers.
Position #62 Spin dry
Position #63-65 Panel and mask unload positions. Remove the panel from the carrier and place on the inspection lighthouse. Remove the mask from the carrier and place on the carrier located at the inspection station. After inspection mark the passable matrices with production sequence # date code, inspector code, and lighthouse number on the sidewall. Insert the mask and load assembly on conveyor to screen rooms. For rejectable matrices, reload mask and carrier for reprocessing. If the panel/mask assembly is defective, set the assembly aside for analysis or salvage.
Note: For inspection of finished matrices, see Sch. [illegible], Std. #25-9-1C.

Area	Position	Operation	Setting	Head Rotation	Cap Angles
Washing	1	Water wash (optional caustic wash	Timer 5-13 sec.	10 rpm	0°
	2	Caustic wash	Temp. 50-90°		
	3	Water rinse	Index setting	10 rpm	0°
	4	HF wash	Timer 13 sec.	10 rpm	0°
	5	HF Wash	Timer 13 sec.	10 rpm	0°
	6	De-ionized water rinse	Index setting	10 rpm	0°
Drying	7	Spin		150 rpm	0°
	8	Spin drying		150 rpm	0°
	9	Calrod drying Spin dry and heat	Heater 50%	120 rpm	15°
	10	Spin dry with heat	OFF	120 rpm	15°
	11	Spin dry		10 rpm	75°
Dispense	12	Resist application	Timer ½ sec. delay, 7 sec. dispense ½ sec. uptilt		
			Rheostat setting high speed 28-32,	12-20 rpm	170°
			Rheostat setting low speed 20-25	6-12 rpm	155°
Drying	13	Spin dry		108 rpm	65°
	14	Spin dry with heat	heater 95%	80 rpm	65°
	15	Spin dry with heat	heater 50%	80 rpm	65°
	16	Spin dry with heat	heater OFF	55 rpm	65°
	m 17	Spin dry and heat	heater 90%	10 rpm	65°
	18-19	Rim wash and heat dry	heater 95%	10 rpm	65°
	20	Air blower		10 rpm	65°
	21	Air blower		10 rpm	65°
	22	Dry auto-wipe sidewall & seal land	Timer 8-10 sec.	10 rpm	65°
Visual Inspection	23	Visual inspect & insert mask			
	24			-0-	120°
	25-26	Load & unload lighthouse conveyor	L.H. set to proper time for its intensity	-0-	120°
Developing	27-32		Nozzle pressure 20-25 Thirty-three 0.5 nozzles on three manifolds on 3" centers.	30 rpm	75°
	33		.25" pipe nipple 2 psi Flooding cap	20 rpm	75°

Drying	34 35 36 37&38 39	Spin dry Spin dry with heat Spin dry with heat Spin dry with air Blowers	Heater OFF heater heater	60 rpm 60 rpm 60 rpm 80 rpm	75° 73° 75° 75°
Graphite Dispense	40	Graphite application	Timer One, $2\frac{1}{4}$ sec. delay, 18 sec. dispense. Rheostat setting high speed 40-60. Rheostat setting med. speed 25-30.	25-35 rpm 6-15 rpm	30°
Graphite Salvage	41		Variac setting low-42 Variac setting med.-80 Timer 12 sec. Variac setting high-100 Timer 11 sec. Variac setting 4th-42	60-80 rpm 80-85 rpm 145-150rpm 60-80 rpm	30°
Drying	42-44 45 46 47 48 49 50	Spin dry with heat Spin dry with heat Spin dry with heat Spin dry with heat H_2O_2 dispense H_2O_2 etch H_2O_2 develop, H_2O_2 dump	Heater 80% Heater 80-90% Heater 80-90% Heater 80-90% Timer 3-5 sec. 20 PSI - one #10 Nozzle, two #5 nozzles	10 rpm 60 rpm 60 rpm 60 rpm 40 rpm 40 rpm 30 rpm	55° 75° 75° 75° 157° 157° 75°
	51-52 53	Water Develop Limp stream water rinse	80psi - five #5 nozzles at pos. #52 & 53	30 rpm	75° 75°
	54-55 56-57 58 59 60	Edge wash-NH_4 HF_2 Limp stream rinse Spin dry and heat Spin dry and heat Spin dry and heat	Heater 50-65% Heater 50-65%	10 rpm 30 rpm 100 rpm 100 rpm 100 rpm	55° 55° 75° 75° 75°
	61 62 63-65 66-67	Spin dry with air Spin dry with air Unload Load		60 rpm 10 rpm -0- -0-	75° 75° 120° 120°


Matrix Aperture
.41 mm
E electron spot
.36 mm
Mask
erture .38mm
Mask
Matrix
Electron beam
.41mm
POSITIVE MATRIX


Electron Spot
.46mm
Mask
Aperture .41mm
Matrix
Aperture .36mm
Mask
Matrix
.41mm
.36mm
NEGATIVE MATRI

IV. Matrix Printing