MATRIX

—Wash panel
  use diluted ammonium biflouride (NB4HF)

—Apply photo-resist
  PVA (poly vinyl alcohol)
  Rheoplex (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 Harger on 6/17/74.
TYPICAL MATRIX SCHEDULE
I. Equipment:
A. Model #12759 - F9 -- 67 head in-line automatic matrix machine equipped with all supporting equipment.
B. Model #128C1 - 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
P902C Resist
G917B Graphite
H901A Hydrogen peroxide
A609 Ammonium bifluoride
W800 De-ionized water
S646A Caustic defoamer or
S6453 caustic defoamer
A0 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
regulary 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 #425 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.

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. Rejectable 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°C 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 multispeed 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 $\text{H}_2\text{O}_2$ concentration
    pH, and temperature in the storage tank. Limits are 44
    min. for concentration, 7.0-8.5 for the pH and 80°-
    110°F (26.7°-43°C) for the temp.

Position #50 H$_2$O$_2$ dump and water develop.
Position #51 & 52 Water Develop.
Position #53 Limp stream water rinse.
Position #54-55 Ammonium 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. 9
    Std. #35-9-1C.
<table>
<thead>
<tr>
<th>Area</th>
<th>Position</th>
<th>Operation</th>
<th>Setting</th>
<th>Head Rotation</th>
<th>Cap Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washing</td>
<td>1</td>
<td>Water wash (optional caustic wash)</td>
<td>Timer 5-13 sec.</td>
<td>10 rpm</td>
<td>0°</td>
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<tr>
<td></td>
<td>2</td>
<td>Caustic wash</td>
<td>Temp. 50-90°</td>
<td>10 rpm</td>
<td>0°</td>
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<tr>
<td></td>
<td>3</td>
<td>Water rinse</td>
<td>Index setting</td>
<td>10 rpm</td>
<td>0°</td>
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<td></td>
<td>4</td>
<td>HF wash</td>
<td>Timer 13 sec.</td>
<td>10 rpm</td>
<td>0°</td>
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<td>5</td>
<td>HF Wash</td>
<td>Timer 13 sec.</td>
<td>10 rpm</td>
<td>0°</td>
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<tr>
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<td>6</td>
<td>De-ionized water rinse</td>
<td>Index setting</td>
<td>10 rpm</td>
<td>0°</td>
</tr>
<tr>
<td>Drying</td>
<td>7</td>
<td>Spin</td>
<td>150 rpm</td>
<td>0°</td>
<td></td>
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<tr>
<td></td>
<td>8</td>
<td>Spin drying</td>
<td>150 rpm</td>
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<td></td>
<td>9</td>
<td>Calrod drying</td>
<td>Heater 50%</td>
<td>120 rpm</td>
<td>15°</td>
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<tr>
<td></td>
<td>10</td>
<td>Spin dry and heat</td>
<td>OFF</td>
<td>120 rpm</td>
<td>15°</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Spin dry</td>
<td>10 rpm</td>
<td>75°</td>
<td></td>
</tr>
<tr>
<td>Dispense</td>
<td>12</td>
<td>Resist application</td>
<td>Timer ½ sec., delay, dispense, timer delay</td>
<td>12-20 rpm</td>
<td>170°</td>
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<td></td>
<td></td>
<td></td>
<td>Rheostat setting high speed 28-32, low speed 20-25</td>
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<tr>
<td>Drying</td>
<td>13</td>
<td>Spin dry</td>
<td>108 rpm</td>
<td>65°</td>
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<tr>
<td></td>
<td>14</td>
<td>Spin dry with heat</td>
<td>heater 95%</td>
<td>80 rpm</td>
<td>65°</td>
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<tr>
<td></td>
<td>15</td>
<td>Spin dry with heat</td>
<td>heater 50%</td>
<td>80 rpm</td>
<td>65°</td>
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<td></td>
<td>16</td>
<td>Spin dry with heat</td>
<td>heater OFF</td>
<td>55 rpm</td>
<td>65°</td>
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<td></td>
<td>17</td>
<td>Spin dry and heat</td>
<td>heater 90%</td>
<td>10 rpm</td>
<td>65°</td>
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<td></td>
<td>18-19</td>
<td>Rim wash and heat dry</td>
<td>heater 95%</td>
<td>10 rpm</td>
<td>65°</td>
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<tr>
<td></td>
<td>20</td>
<td>Air blower</td>
<td>10 rpm</td>
<td>65°</td>
<td></td>
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<tr>
<td></td>
<td>21</td>
<td>Air blower</td>
<td>10 rpm</td>
<td>65°</td>
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<tr>
<td></td>
<td>22</td>
<td>Dry auto-wipe sidewall &amp; seal land</td>
<td>Timer 8-10 sec.</td>
<td>10 rpm</td>
<td>65°</td>
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<tr>
<td>Visual Inspection</td>
<td>23</td>
<td>Visual inspect &amp; insert mask</td>
<td>-0-</td>
<td>120°</td>
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<td></td>
<td>24</td>
<td>Load &amp; unload lighthouse conveyor</td>
<td>-0-</td>
<td>120°</td>
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<tr>
<td>Developing</td>
<td>27-32</td>
<td>Nozzle pressure 20-25</td>
<td>30 rpm</td>
<td>75°</td>
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<tr>
<td></td>
<td></td>
<td>Thirty-three 0.5 in. nozzles on three manifolds</td>
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<td></td>
<td>3 in. centers</td>
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<tr>
<td></td>
<td></td>
<td>25&quot; pipe nipple</td>
<td>20 rpm</td>
<td>75°</td>
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<td></td>
<td></td>
<td>2 psi</td>
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<td></td>
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<td>Flooding cap</td>
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</tr>
<tr>
<td>Step</td>
<td>Action</td>
<td>Timer/Heater Settings</td>
<td>RPM</td>
<td>Temp</td>
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</tr>
<tr>
<td>34</td>
<td>Spin dry</td>
<td>Heater OFF</td>
<td>60</td>
<td>750</td>
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</tr>
<tr>
<td>35</td>
<td>Spin dry with heat</td>
<td>heater</td>
<td>60</td>
<td>750</td>
<td></td>
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<td>36</td>
<td>Spin dry with heat</td>
<td>heater</td>
<td>60</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>37 &amp; 38</td>
<td>Spin dry with air</td>
<td></td>
<td>80</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Blowers</td>
<td></td>
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<tr>
<td>40</td>
<td>Graphite dispense</td>
<td>Timer One, 2.5 sec. delay, 18 sec. dispense, Rheostat setting high speed 40-60, low speed 25-30.</td>
<td>25-35</td>
<td>30</td>
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<tr>
<td>41</td>
<td>Graphite salvage</td>
<td>Variac setting low-42</td>
<td>60-80</td>
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<td></td>
<td>Variac setting med-80</td>
<td>80-85</td>
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<td></td>
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<td>Timer 12 sec.</td>
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<td>Variac setting high-100</td>
<td>145-150</td>
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<td>Timer 11 sec.</td>
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<td>Variac setting 4th-42</td>
<td>60-80</td>
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<tr>
<td>42-44</td>
<td>Spin dry with heat</td>
<td>Heater 80%</td>
<td>10</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Spin dry with heat</td>
<td>Heater 80-90%</td>
<td>60</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>Spin dry with heat</td>
<td>Heater 80-90%</td>
<td>60</td>
<td>75</td>
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</tr>
<tr>
<td>47</td>
<td>Spin dry with heat</td>
<td>Heater 80-90%</td>
<td>60</td>
<td>75</td>
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</tr>
<tr>
<td>48</td>
<td>H₂O₂ dispense</td>
<td>Timer 3-5 sec.</td>
<td>40</td>
<td>157</td>
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</tr>
<tr>
<td>49</td>
<td>H₂O₂ etch</td>
<td></td>
<td>40</td>
<td>157</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>H₂O₂ develop, H₂O₂ dump</td>
<td>20 PSI - one #10 nozzle, two #5 nozzles</td>
<td>30</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>51-52</td>
<td>Water develop</td>
<td>80 psi - five #5 nozzles at pos. #52 &amp; 53</td>
<td>30</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Limp stream water rinse</td>
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<tr>
<td>54-55</td>
<td>Edge wash-NH₄HF₂</td>
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<tr>
<td>56-57</td>
<td>Limp stream rinse</td>
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</tr>
<tr>
<td>58</td>
<td>Spin dry and heat</td>
<td>Heater 50-65%</td>
<td>100</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Spin dry and heat</td>
<td>Heater 50-65%</td>
<td>100</td>
<td>75</td>
<td></td>
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<td>60</td>
<td>Spin dry and heat</td>
<td>Heater 50-65%</td>
<td>100</td>
<td>75</td>
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</tr>
<tr>
<td>61</td>
<td>Spin dry with air</td>
<td></td>
<td>60</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Spin dry with air</td>
<td></td>
<td>10</td>
<td>75</td>
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</tr>
<tr>
<td>63-65</td>
<td>Unload</td>
<td></td>
<td>-0-</td>
<td>120</td>
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</tr>
<tr>
<td>66-67</td>
<td>Load</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Matrix Aperture
41 mm

Electron Spot
34 mm

Mask Aperture
30 mm

Positive Matrix

Electron Flow

Mask

Matrix

41 mm
IV. Matrix Printing

- Wash Panel
  - Dry
  - Apply PVA
    - Dry
    - Insert Mask
      - Expose L.H. G-B-R
        - Remove Mask
          - Develop Image
            - Dry
            - Apply Graphite
              - Dry
              - Dissolve PVA Image Peroxide
                - Develop Matrix
                  - Dry
                    - Phosphor Application