Evaluation Report of
Medium Temperature Dry Cabinet

-Evaluation by actual testing
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Purpose of the evaluation--MSD

MSD (Moisture Sensitive Device) is mainly referred to non-hermetic SMD components, including plastic IC and other moisture permeable polymeric encapsulation (epoxy resin, organic silicon resin, etc.) The common ICs, Chips, Electro, Leds, etc. all belong to non-hermetic SMD components.

When MSD is exposed in the air, moisture in the air would diffuse and penetrate into the encapsulant material. Then during the SMT soldering process, the moisture inside components would expand fast to cause delamination or even cracking, thus causing damage to the components.
Purpose of the evaluation-- To choose baking method

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Medium temperature baking</th>
<th>High temperature baking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mild baking, little damage cause to components</td>
<td>2. Low energy consumption \3. Can used for long term storage and monitor all the time</td>
<td>1. Fast dehumidification \2. Low cost of the equipment</td>
</tr>
</tbody>
</table>

| Disadvantage                                  | 1. Dehumidification slower \2. High cost of the equipment | 1. High energy consumption, operating security poor \2. Negative effect in solderability and deformation \3. The storage time must be controlled strictly \4. Special requirement of components’ packing material |

| Conclusion                  | Is it possible to replace high temperature baking (90°C, 125 °C) by medium temperature/low humidity dry cabinet (40°C, 50 °C, 60°C)? |
2. Comparison of the equipment-- Dehumidifying result (Components)

Fig.: 1. Different drying methods using QFP100 as an example
2. Comparison of the equipment-- Dehumidifying result (PCBs)

Comparison drying at 45°C/ <1% RH

- Rigid-flex
- Flexible
- Rigid
- QFP
- FR4

Weight change vs. Time (000 h to 500 h)
2. Comparison of the equipment – Baking time

<table>
<thead>
<tr>
<th>Package Body</th>
<th>Thickness ≤1.4 mm</th>
<th>Baking reference of IPC-STD-033C</th>
<th>Medium temperature baking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>Bake @ 125°C +10%−0°C ≤5% RH</td>
<td>Bake @ 60°C +30%−0°C ≤5% RH</td>
<td>Bake @ 40°C +30%−0°C ≤5% RH</td>
</tr>
<tr>
<td>2</td>
<td>Exceeding Floor Life by &gt;72 h</td>
<td>Exceeding Floor Life by &lt;72 h</td>
<td>Exceeding Floor Life by &lt;72 h</td>
</tr>
<tr>
<td>2a</td>
<td>7 hours</td>
<td>5 hours</td>
<td>23 hours</td>
</tr>
<tr>
<td>3</td>
<td>9 hours</td>
<td>7 hours</td>
<td>23 hours</td>
</tr>
<tr>
<td>4</td>
<td>11 hours</td>
<td>7 hours</td>
<td>25 hours</td>
</tr>
<tr>
<td>5</td>
<td>12 hours</td>
<td>10 hours</td>
<td>25 hours</td>
</tr>
<tr>
<td>5a</td>
<td>16 hours</td>
<td>10 hours</td>
<td>25 hours</td>
</tr>
<tr>
<td>Thickness &gt;1.4 mm ≤2.0 mm</td>
<td>2</td>
<td>18 hours</td>
<td>12 hours</td>
</tr>
<tr>
<td>2a</td>
<td>21 hours</td>
<td>18 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td>3</td>
<td>17 hours</td>
<td>12 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td>4</td>
<td>20 hours</td>
<td>18 hours</td>
<td>2 days</td>
</tr>
<tr>
<td>5</td>
<td>25 hours</td>
<td>20 hours</td>
<td>20 days</td>
</tr>
<tr>
<td>5a</td>
<td>40 hours</td>
<td>20 hours</td>
<td>20 days</td>
</tr>
<tr>
<td>Thickness &gt;2.0 mm ≤4.5 mm</td>
<td>2</td>
<td>48 hours</td>
<td>48 hours</td>
</tr>
<tr>
<td>2a</td>
<td>48 hours</td>
<td>48 hours</td>
<td>7 days</td>
</tr>
<tr>
<td>3</td>
<td>48 hours</td>
<td>48 hours</td>
<td>7 days</td>
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<tr>
<td>4</td>
<td>48 hours</td>
<td>48 hours</td>
<td>7 days</td>
</tr>
<tr>
<td>5</td>
<td>48 hours</td>
<td>48 hours</td>
<td>7 days</td>
</tr>
<tr>
<td>5a</td>
<td>48 hours</td>
<td>48 hours</td>
<td>7 days</td>
</tr>
<tr>
<td>BGA package &gt;17 mm × 17 mm or any stacked dice package</td>
<td>2.5a</td>
<td>68 hours (See Note 2)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

- **Body Thickness Level**
  - 25°C
  - 40°C
  - 50°C
  - 60°C
  - 25°C
  - 40°C
  - 50°C

- **1%RH HSD/KSD Series**
  - 2a 5 days 2 days 1 days 12 hours 7 days 5 days 23 hours
  - 3 8 days 3 days 1.5 days 18 hours 12 days 5 days 8 days 33 hours
  - 4 9 days 4 days 2 days 24 hours 13 days 6 days 9 days 37 hours
  - 5 10 days 5 days 2.5 days 30 hours 14 days 7 days 10 days 41 days
  - 5a 10 days 6 days 3.5 days 36 hours 15 days 9 days 10 days 54 hours

- **2%RH MSD/SBD/SDA Series**
  - 2a 11 days 5.5 days 7 days 35 days 16 days 23 days 4 days
  - 3 11 days 5.5 days 7 days 35 days 16 days 23 days 4 days
  - 4 14 days 7 days 3 days 40 days 17 days 28 days 5 days
  - 5 16 days 8 days 4 days 50 days 24 days 35 days 6 days
  - 5a 18 days 9 days 4 days 67 days 27 days 56 days 8 days

- **5%RH N Cabinet**
  - 2a 22 days 10 days 5 days 30 days 15 days 22 days 3 days
  - 3 22 days 11 days 5.5 days 7 days 35 days 16 days 23 days 4 days
  - 4 26 days 14 days 7 days 3 days 40 days 17 days 28 days 5 days
  - 5 28 days 16 days 8 days 4 days 50 days 24 days 35 days 6 days
  - 5a 30 days 18 days 9 days 4 days 67 days 27 days 56 days 8 days

- **Thickness >2.0 mm ≤4.5 mm**
  - 2a 67 days 20 days 10 days 5 days 80 days 30 days 67 days 10 days
  - 3 67 days 22 days 11 days 5 days 80 days 31 days 67 days 10 days
  - 4 67 days 22 days 11 days 5 days 80 days 31 days 67 days 10 days
  - 5 67 days 22 days 11 days 5 days 80 days 31 days 67 days 10 days
  - 5a 67 days 22 days 11 days 5 days 80 days 31 days 67 days 10 days
3. Experiment Comparison-- Experiment method

- **Samples**: Two types of BGA; PCBs with two lengths; common tape materials;
- **Testing standard**: IPC-STD-033C; Medium temperature baking reference provided by supplier; Test method of QSMC SMTLAB.
- **Checking method**:
  1. **Dehumidification effect of medium temperature cabinet**:
     ① Put samples inside baking oven under 125°C to bake till the weight no change;
     ② Put samples inside temperature humidity chamber till moisture absorption saturated.
     ③ Then put samples inside medium temperature cabinet, to record storage time and ratio of moisture lose, and test the change of outside appearance.

  2. **To heat**: Put samples inside SK-5000, to examine and record effect caused during heating.

  3. **To measure the warpage of PCBs**: To put the saturated PCBs into baking oven and bake under 60°C and 125°C for 48 hrs, take them out and measure the warpage.

  4. **To check the outside appearance**: To examine with microscope.

Testing Items: Weight, appearance, warpage testing, heating examination.
Experiment Comparison-- Dehumidifying result

Baking result of common BGA form production line:
1. The time to reach 0.1Wt% under 125 °C is 18H
2. The time to reach 0.1Wt% under 50 °C, 2%RH is 96H
Clear distortion comes out of common tape material under 85°C.
## Experiment Comparison--Summary

<table>
<thead>
<tr>
<th></th>
<th>Medium temperature dry cabinet</th>
<th>High temperature baking oven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehumidifying effect</td>
<td>Common</td>
<td>Good</td>
</tr>
<tr>
<td>Effect on tape packing material</td>
<td>no significant change</td>
<td>Distortion</td>
</tr>
<tr>
<td>Color change of the components</td>
<td>no significant change</td>
<td>no significant change</td>
</tr>
<tr>
<td>Effect on PCB OSP Pad</td>
<td>no significant change</td>
<td>Become dark</td>
</tr>
<tr>
<td>Warpage of PCB</td>
<td>no significant change</td>
<td>no significant change</td>
</tr>
<tr>
<td>Spalling of PCB</td>
<td>no significant change</td>
<td>no significant change</td>
</tr>
</tbody>
</table>
Conclusion

Conclusion can be drawn from the above evaluation:

• The high temperature baking oven with high dehumidifying efficiency is still irreplaceable, esp. suits for baking of BGA requesting urgent production;

• The mild environment of medium temperature dry cabinet is well suited for dehumidification and storage of PCBs and components with plastic encapsulation.

So there would be potential need of medium temperature dry cabinets in both production lines and labs.