

HEM TIM Application Note - SP Type

Honeywell Electrical Material

Honeywell

- **Product introduction** 产品介绍
- **Handling method & storage condition** 操作方法和存储条件
- **Equipment** 设备
- **Printing methodology** 印刷方法
- **Thickness measurement** 厚度测量
- **Rework method** 返工方法
- **Special application notice** 特殊应用注意事项
- **Basic troubleshooting** 基础问题疑难解决

- **SP type is a screen printable paste that can be applied by hand or automated methods, allowing for quick applications with the same characteristics, once dried, of same continuous roll format**

SP形式是可印刷的热界面材料，它可以通过手动或者自动的方式快速应用到各种界面，它在变干之后和同类型的片状卷轴有相同的特性

- **SP type allows for flexibility in application size, shape and thickness¹**

SP形式 可以支持不同的尺寸/形状/厚度的印刷

- **Reliability tests are recommended if deviating from 10 mil thickness**

如果印刷厚度和10mil差别很大的话，建议需要做一下可靠性测试

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Handling Method & Storage Condition

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- **Store container in a cool and dry ambient environment in an up right position. Keep away from incompatible materials as outlined in the MSDS**

开口向上，将罐装材料存放在干冷及干燥的环境里，并依照MSDS标示，远离与它不匹配的材料

- **Do not handle, store or open the container near open flame and/or source of heat or sources of ignition**

接近火源或引火源时，请勿开启，储存或者处理材料

- **The pot life of the paste material is 12 hours once the jar is opened @ 35 °C. This can be extended to 48 hours if the lid is closed when the material is not being used**

在35 °C开启包装时，使用寿命为12小时；如果材料开封过，但未使用又密封可以延长到48小时

- **The shelf life of the paste material is 12 months when stored at 10~30 °C and 65% RH in a sealed container**

当储存条件为10~30 °C，65% RH并且没有拆封时，材料寿命为12个月

- **If it will be kept for a long time, suggest to store in lower temperature condition like 5~7 °C while 4hrs/RT thawing is needed before using**

如果材料将长时间不使用，建议在低温条件下储存：5~7 °C并在使用前在室温下进行4小时解冻；

- **Read MSDS before using this product. Use with adequate ventilation, good industrial hygiene and housekeeping practices and wash hands after use**

使用前请详细阅读MSDS，使用时有适当通风并符合安全要求,使用后请洗手

- **Keep container tightly closed and upright except when mixing and actively printing paste**

如不使用时，请保持包装开口向上并紧闭封口

- **The entire contents of the container needs to be thoroughly mixed before application for approximately 2- 4 minutes**
使用前必须充分搅拌2-4分钟
- **The stirring rod or spatula length to be long enough to ensure bottom portion can be reached comfortably. Honeywell recommends PVC, Polypro or rubber stirring rods or spatulas**
搅拌棒或者抹刀长度要足够使底部材料得到充分搅拌，Honeywell建议使用PVC，Polypro, rubber材质的搅拌棒或者抹刀
- **During the mixing, the container can be tilted (without the paste spilling out) and the stirring action should include upwards movement to make sure that the bottom part of the container be well mixed with the top part**
搅拌过程中，罐子可以倾斜但不能有材料溢出，搅拌动作要包含从下往上的过程确保底部材料可以和上部材料混合
- **For large containers (i.e. 1kg package), a jar-rolling device can be used to help good mixing**
对于大尺寸包装（例如1kg），滚动设备可以帮助充分搅拌；
- **When thoroughly mixed, the material appears homogeneous with no carrier fluid separation**
充分搅拌之后，材料呈现均匀性，不会有流体分离的现象
- **Repeat mixing every 4 hours during use or a light mixing in-between applications**
使用过程中每过4小时需要搅拌一次或者使用过程中经常轻微搅拌

- **Squeegee** 刮刀

Recommended supplier: Transition Automation 推荐供应商

- PRINTPERFECT SQUEEGEE™
 - ◆ PLX-HAN-A-XX (blade width customized)



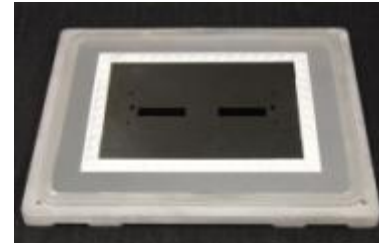
• Stencil 网板

1. Recommended stencil format: metal stencil (i.e. stainless steel, brass, nickel etc.) with tensioning frame 推荐网板式样: 金属网板 (不锈钢/铜/镍)

- Rigid frame 刚架
- Consistent flatness of stencil 连续平整
- Stainless steel mesh recommended for the tension screen 张力网板推荐使用不锈钢钢网



Top side of framed stencil



Bottom side of framed stencil

2. Recommended stencil fabrication technique: laser cutting with polishing

推荐网板: 抛光激光制板

- To achieve smooth aperture wall for good stencil separation and sharp printing edge definition
光滑开口边缘有助于网板分离和边缘印刷
- Other advanced technology for stencil fabrication also applicable (i.e. electroforming, chemical etching)
其他网板制造工艺 (电镀 / 蚀刻) 也适用

3. Recommended stencil suppliers

推荐网板供应商

- Integrated Ideas & Technologies, Inc.
3896 N. Schreiber Way, Coeur d'Alene, ID 83815-8362,
Phone: (208)665-2166 Fax: (208)665-5906
<http://www.integratedideas.com/index.htm>

- Sefar Printing Solutions, Inc.
Scott Lay 3796 Dunlap Street North, Arden Hills, MN 55112
Tel: 651-294 3624 Fax: 651-486 0476
Scott.Lay@sefar.us

- **Printing Station (Printer)** 印刷设备

1. Customer may use commercialized stencil printer from SMT technology suppliers or customized printing setup 客户可使用SMT商用印刷机或者自有印刷工艺

- Stencil must be maintained parallel to the print surface
确保在印刷时网板平面与应用表面平行放置
- Stencil opening must be aligned with part to: 网板开口应与产品一致
 - ◆ position the aperture correctly with respect to the to-be-printed area
开口位置与需要印刷位置对应
 - ◆ avoid any movement between the stencil and printing part during printing
防止在印刷工程中网板和印刷产品的任何移动
 - ◆ ensure clear separation of stencil after the printing 保证印刷完成之后网板分离



Honeywell customized printing station for memory modules

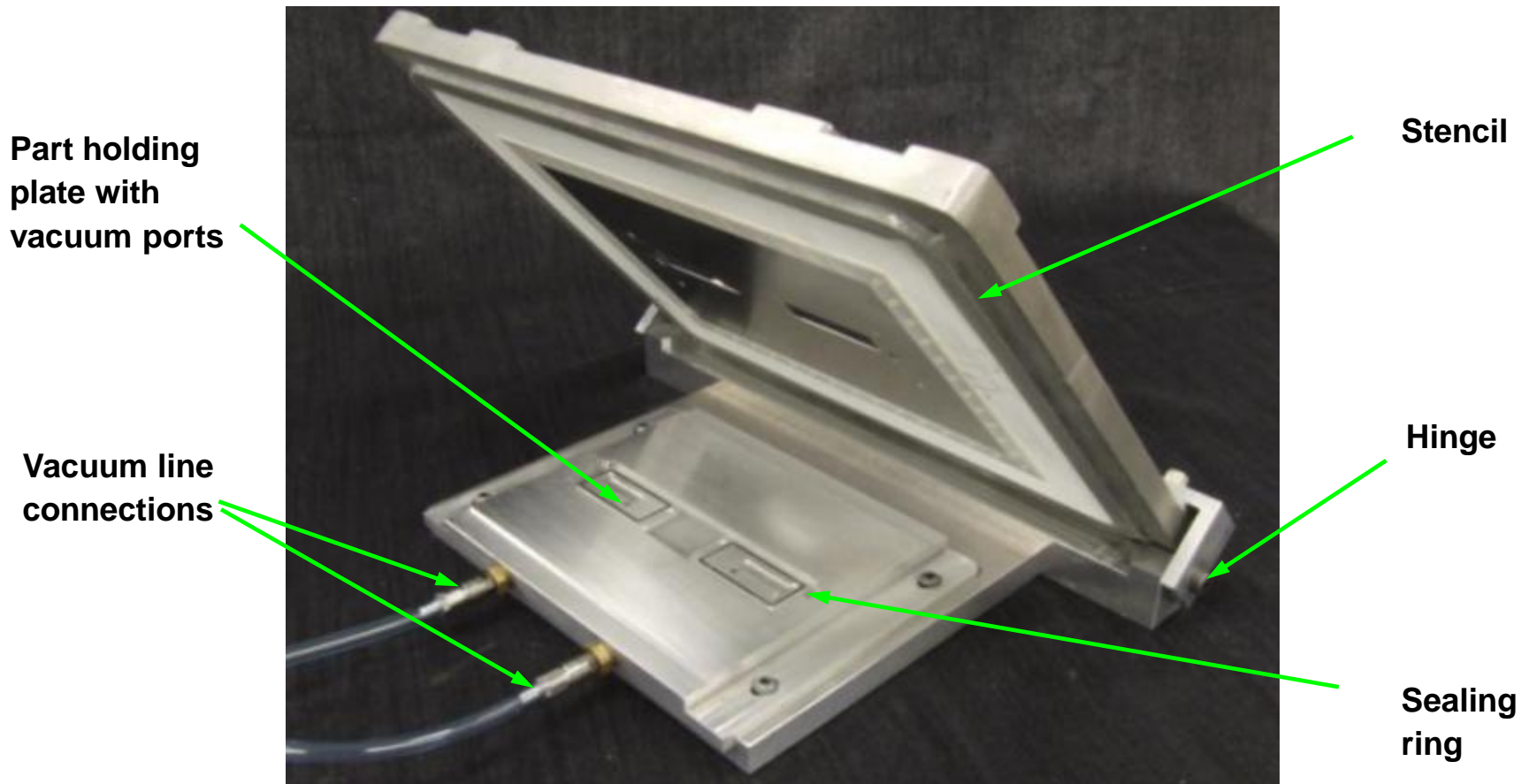
- **Printing Station (Printer)** 印刷设备

- 2. Vacuum application to secure part in printing stations

真空设备可以保证产品处于印刷位置

- Good seal of vacuum is necessary, otherwise may cause smearing of the printing edges

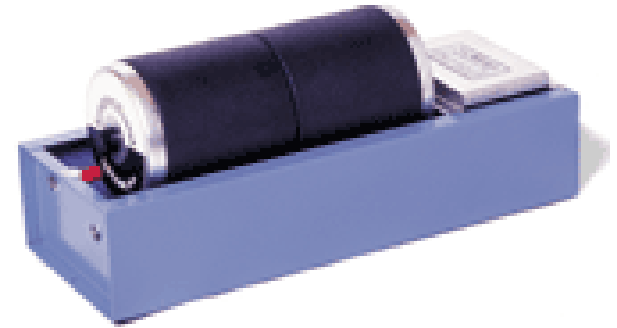
真空密封度非常重要以免造成印刷拖尾现象



- **Miscellaneous Tools** 其他工具

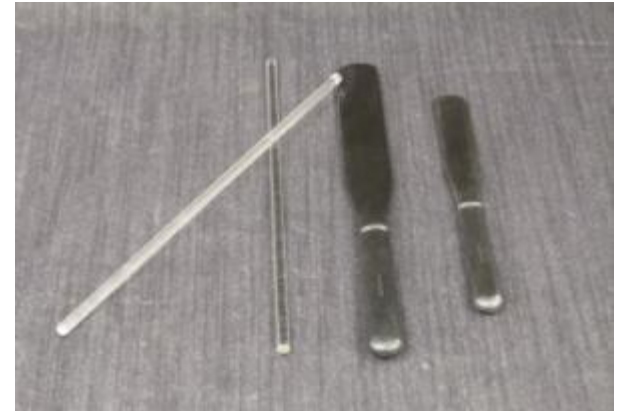
1. Jar roller 滚动装置

- To ensure proper mixing of SP type material
用于确保SP形式材料充分混合



2. Glass rods and plastic spatulas 玻璃棒和塑料抹刀

- For SP hand mixing and dispensing 用于SP混合和添加



3. Cleaning towels and wipes 清洁布

4. Honeywell accepted cleaning solvents

可使用清洁溶剂

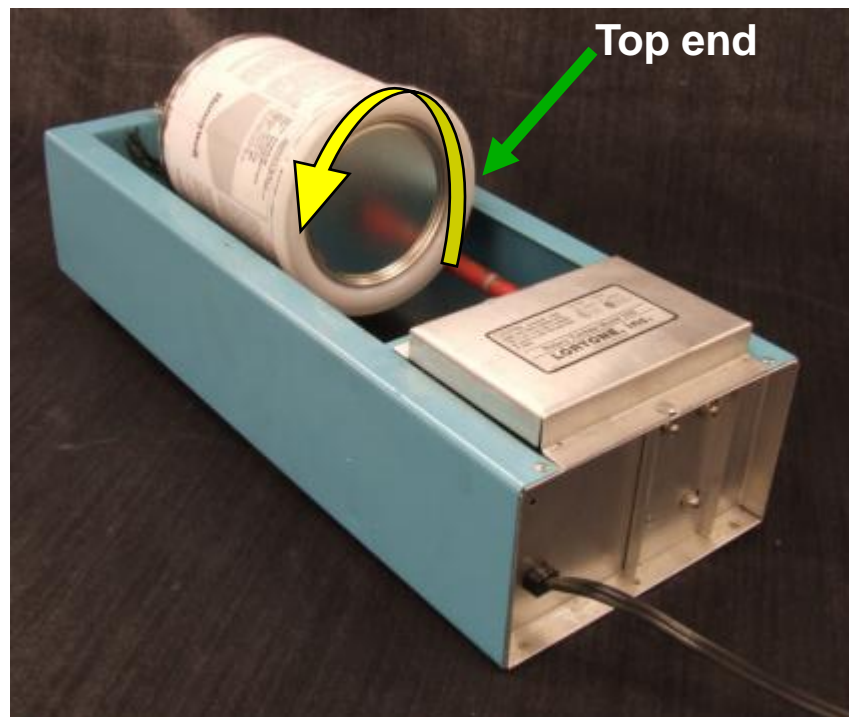
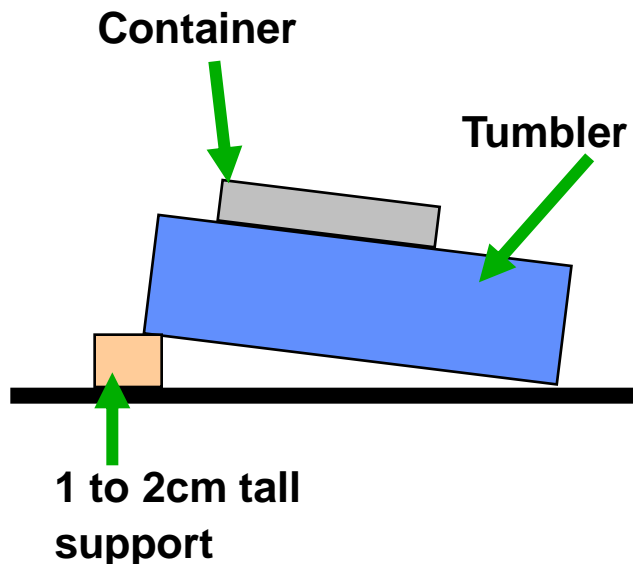
5. Acetone 丙酮

6. Toluene 甲苯

7. Alcohol (ethanol, Isopropanol) 酒精



- **Use a jar roller** 使用滚动设备
 - Jar speed of 40RPM, 30 minutes rolling 滚动速度40RPM, 时间30分钟
 - With the container's bottom lifted 1 to 2cm higher than the top 使罐装底部放置高于顶部1-2cm
 - Enlonged rolling has no adverse effect 加长时间没有反作用



Jar rolling on the tumbler with the bottom end higher than the top end for axial flow

- The stencil should be slightly thicker than the targeted TIM application (dry) thickness

钢网厚度应比需要干后的TIM材料厚度稍厚

- The stencil and the squeegee should be clean, flat, and free of deformation

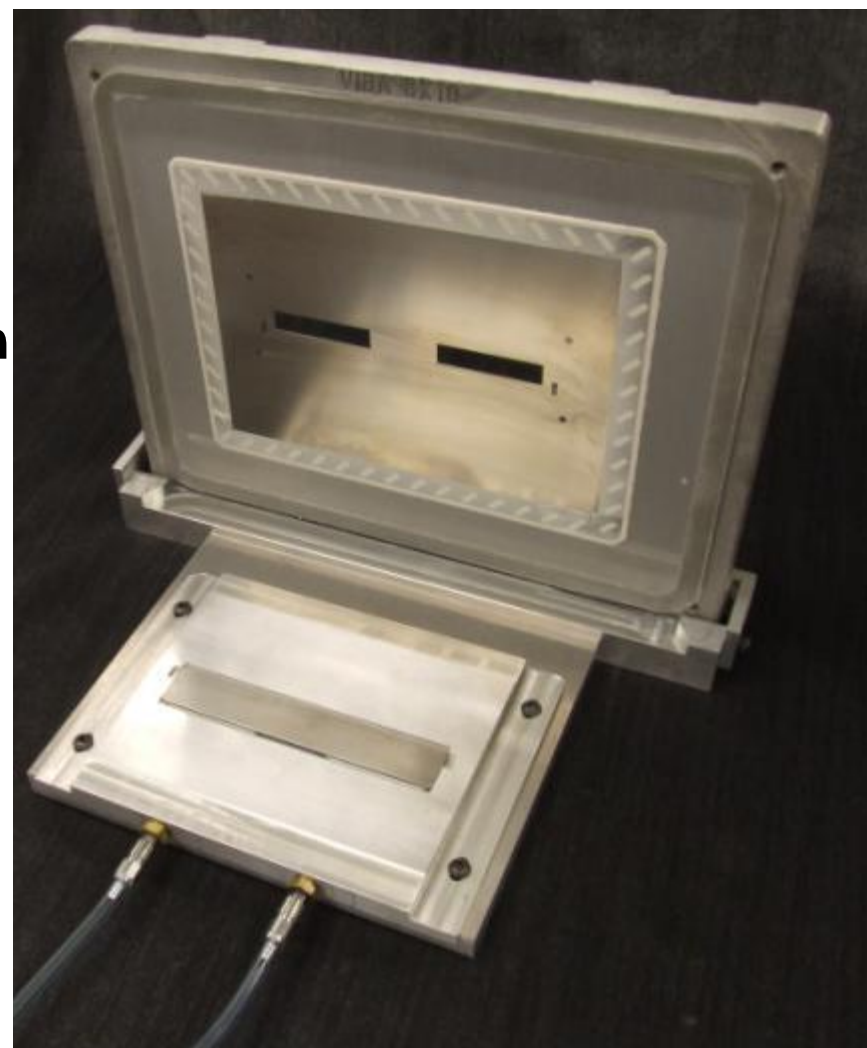
钢网和刮刀应平整无变形

- Ensure the edges of the stencil opening and squeegee blade should be smooth, straight, and burr free

网板开口和刮刀边缘应平滑无毛刺

- Fixtures should be utilized to avoid relative movement between application surface and stencil during the printing and to lift the stencil in upright direction after printing

应使用夹具来防止在印刷过程中和取出印刷产品时，印刷表面和网板之间产生错位



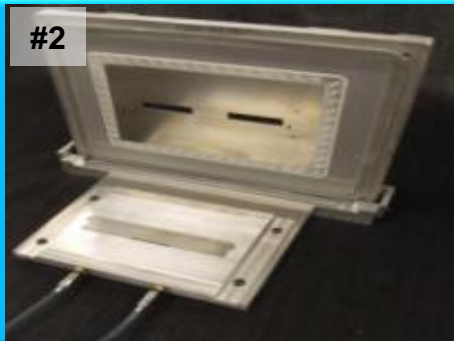
A sample device to fixture part and stencil

Printing Methodology – Suggested Printing Procedure **Honeywell**



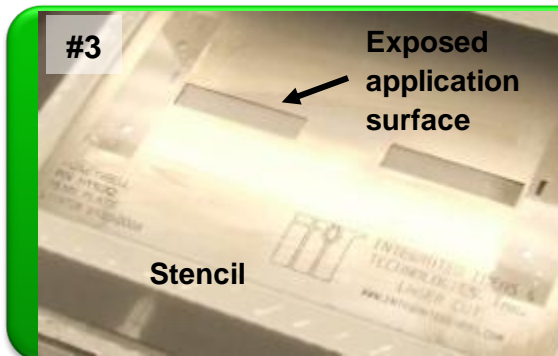
After jar-rolling and just before printing, maintain thorough mixing of the SP material utilizing a glass rod

在滚动装置混合之后印刷之前，用玻璃棒持续搅拌



Place the part to be printed in the fixture

把印刷产品放置于治具中



Rotate the stencil onto the application surface

把网板放置于印刷产品表面

Printing Methodology – Suggested Printing Procedure **Honeywell**

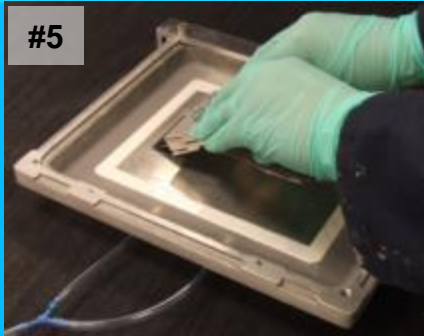
#4



“Prime” the stencil with SP material as shown above

如图把SP材料涂放于网板上

#5



Use both hands to hold squeegee and spread the SP material evenly over the stencil aperture

双手紧握刮刀涂刷SP材料使其均匀分布于网板开口位置

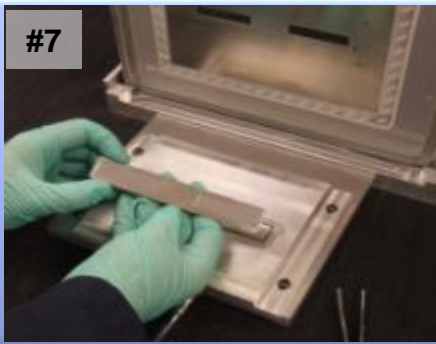
#6



Squeegee flood stroke at approximately 20°

刮刀倾斜（大约20°）印刷

Printing Methodology – Suggested Printing Procedure **Honeywell**



#7

Carefully raise stencil and
remove part

小心提起刮刀并取出印刷产品



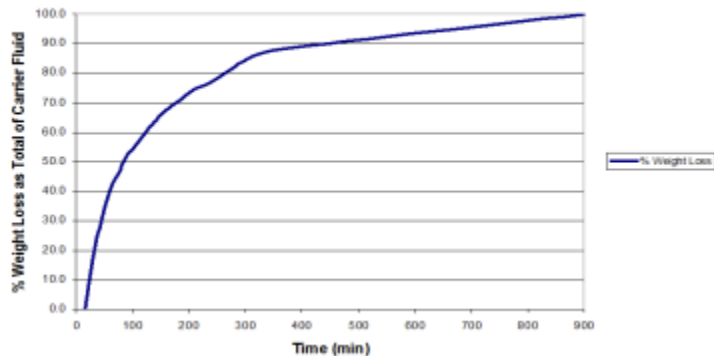
#8

Thoroughly clean underside of Stencil
and edge of squeegee to prepare for
next printing cycle (return to step 1.)

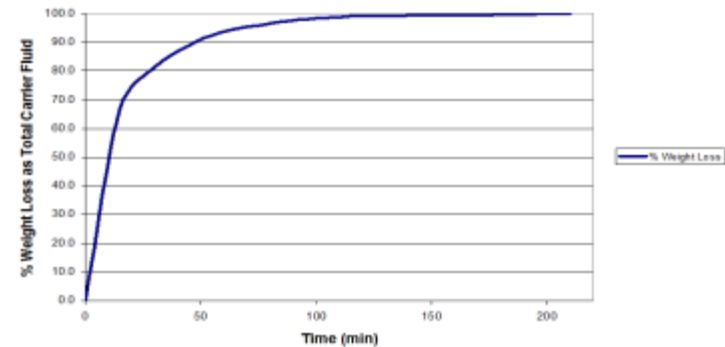
彻底清除网板背面和刮刀边缘的残留材料并准
备下一次印刷

- **SP type will dry after approximately 15 hours at ambient temperatures with a thickness of 10 to 12 mils***
当厚度处于10~12mil 时，SP形式材料在室温条件下要经过大约15小时才会变干
- **SP material dry time can also be accelerated in a forced exhaust oven or similar equipment at 50 °C for 3.5 hours**
也可以通过50 °C /3.5小时的烘烤来加速干化

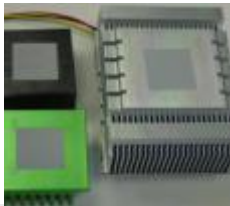
Carrier fluid evaporation v time in open air @
25 °C for a 20mmX20mm, 10 mil sample
% Weight Loss of Carrier Fluid @ RT



Carrier fluid evaporation v time in open air @ 50
°C for a 20mmX20mm, 10 mil sample
% Weight Loss of Carrier Fluid @ 50 C



- **The application of SP material is not limited to heat sink design**
SP形式材料的应用不受散热块设计所局限



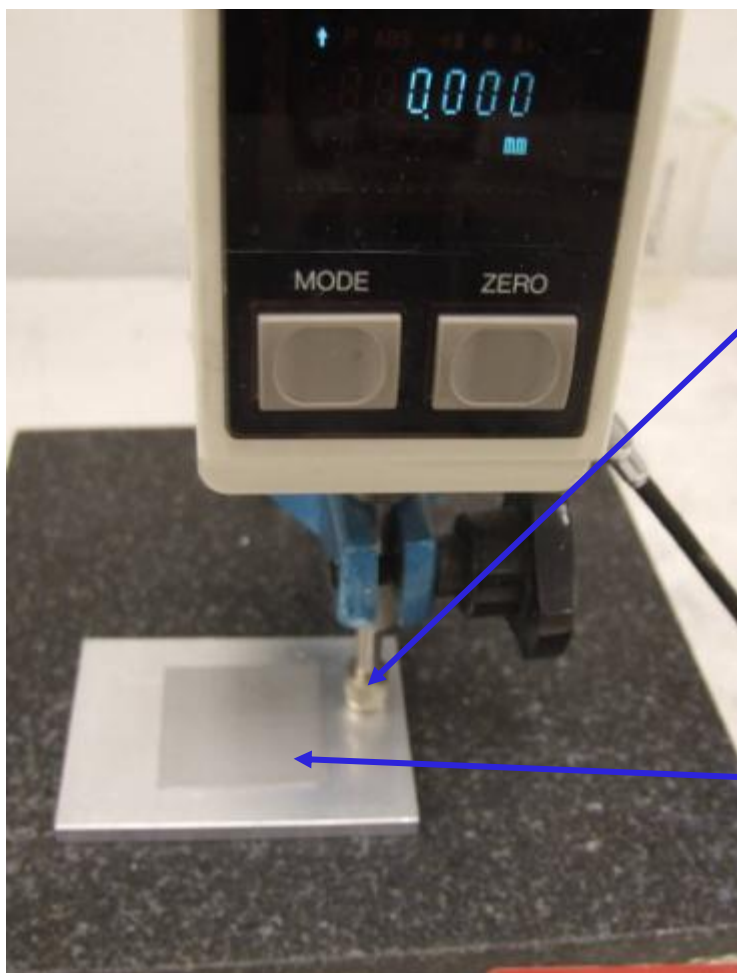
Different shapes of SP material are possible depending on the screen print design.

SP材料可以通过不同网板设计达到不同的形状

*Dry time may vary depending environment temperature and ventilation conditions
干化时间取决于环境温度和通风状况

Thickness Measurement

Honeywell



Flat tip



Dry
PCM

1) Zero the drop gauge reading on application surface (e.g. heat sink) 先在应用表面读数清零

2) Measure the PCM layer thickness
测量PCM层表面厚度

One suggested measurement of dried SP material application thickness

- **If rework is required simply remove SP material from the heat sink surface and use an appropriate cleaning solvent such as acetone, IPA or toluene to remove any residue**

如果需要做返工，只需要简单去除散热块表面的**SP**材料，然后用适当的溶剂进行清洗（例如丙酮，**IPA**或者甲苯可以去除残留）

- **Solvent can be applied to soften and remove the dried applications. A hard plastic edge may be applied to assist the removal of dried application as well**

一些干化材料的去除可以使用溶剂，与此同时，塑料铲工具也可以用来去除干化的材料

- **Reapply SP material on the newly cleaned surface**

重新在清洁过的表面上印刷**SP**材料

* Refer to the supplier's MSDS for safety instruction for handle special solvent like acetone, IPA or toluene
根据溶剂供应商的安全指示进行操作，比如丙酮，**IPA**或者甲苯

- **Large Area Printing** 大尺寸网板印刷

- **Basing on customer's large area print application, HEM provide the follow solution with good verification result :**

针对客户的大尺寸印刷，霍尼韦尔在经过验证试验之后有以下推荐方案：

- 1. For continuous printing, there is no additional step since there is no dry off concern;**

如果进行连续性印刷，因为没有变干顾虑而不需要做任何额外动作（大批量不间断生产）；

- 2. If there is idle time during two printing time, retain sample on stencil is suggested to be shaved together by squeegee to prevent dry off; (It is confirmed at least 1.5hrs staging time w/o print issue)**

如果两次印刷之间会有长时间间隔，建议把网板上的残留材料刮到一起防止变干（已经确认过在1.5小时之内不会有变干或者印刷问题）；

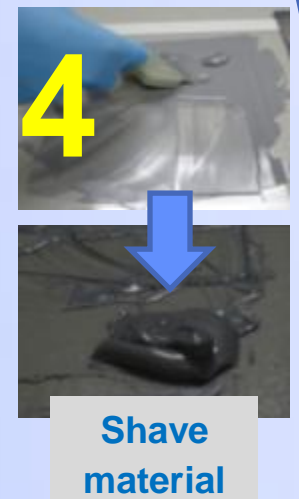
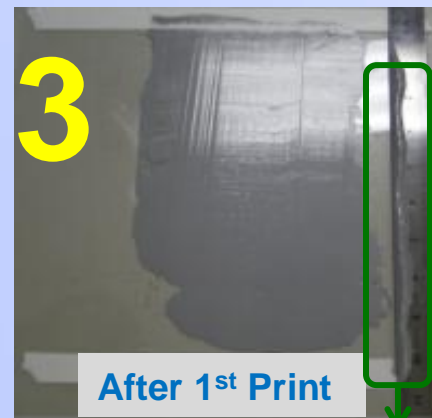
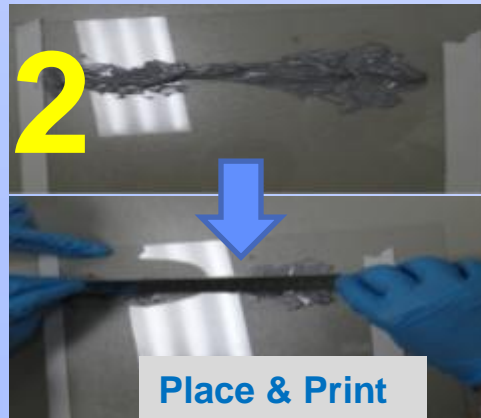
- 3. There is no dry off concern for the retain material on squeegee for at least 1.5hrs;** 对于刮刀上的残留材料，如果有一定量的话，没有变干或者印刷问题；如果残留量不多的话，建议和网板上的材料相同操作（刮到一起）；

- 4. Some volume of dried material on stencil can be mixed with high volume fresh material for next step printing;** 刮刀和网板上残留的小部分变干的材料可以与剩余大量材料混合进行下一步印刷（这种混合不会影响材料的热性能）；

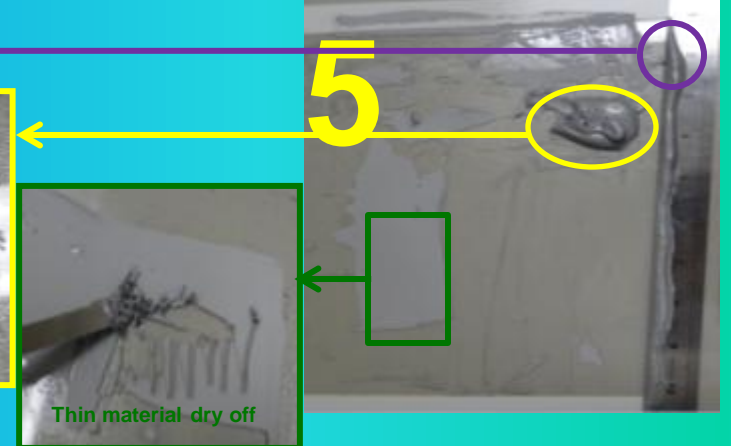
- 5. If there is a long process window, retain material is suggested to be reclaimed back to packing tin right after print;** 如果在作业时有相当长的滞留之间，建议把残留材料（包括网板和刮刀）在一次作业完成之后回收到包装罐密封保存；

Special Application Notice – Large Area Printing Honeywell

Zero Time



After 1.5hrs



Special Application Notice — High Temperature Fail Honeywell

- **High temperature test failure** 高温测试失效
 - **Some special application need to use high temperature and may fail due to improper material application method;**

有些特殊应用需要进行高温测试，而因为不适当的使用方法可能造成失效

HEM provide the follow solution with good verification result :

霍尼韦尔在经过验证试验之后有以下推荐方案:

1. Good printing thickness and flatness 合适的印刷厚度和平整度

Recommended printing thickness around 0.25~0.30mm & good flatness which provides good connection between HEM SP material and thermal parts;

推荐印刷厚度在0.25到0.30mm以及保证界面材料和散热部件完全接触的平整度

2. Enough queue time for HEM SP material to finish phase change with temperature & pressure, recommended options as following

在一定的压力和温度条件下，有充分时间可以使材料完成相变化，推荐条件如下

Pressure	Temperature	Time
40psi	50°C	180s
40psi	80°C	30s

Defect

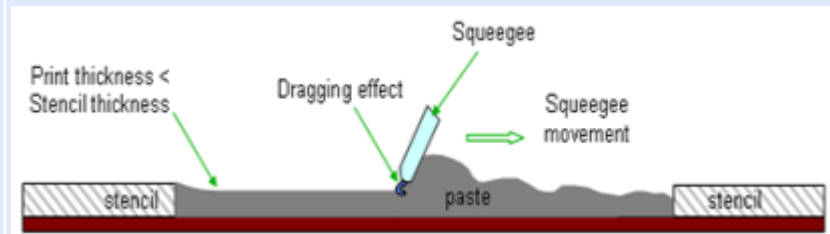
Thin printing thickness
 (Thickness after dries is thinner than printing thickness or stencil thickness)
 印刷厚度太薄
 (材料变干之后厚度低于印刷厚度或网板厚度)



Location	Thickness (µm)
L1	67
L2	60
L3	64
L4	58
L5	14
L6	12
L7	11

Failure Mechanism


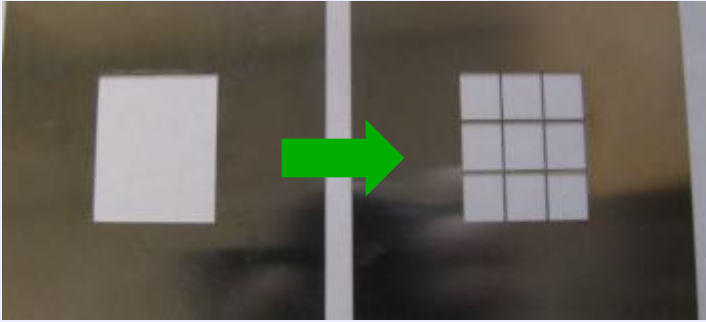
- Solvent evaporation leaves smaller dry printing thickness compared to wet;
 溶剂挥发导致变干厚度降低
- Actual wet printing thickness much smaller than the stencil thickness;
 Deformation of squeegee worsens the situation
 实际印刷厚度比网板薄，刮刀变形会加剧这种情况




Solution

Refer to next page
 参照下一页解决方案

Basic Troubleshooting – Printing Defects

Defect	Poor printing flatness (different thickness through visual inspection or tilt) 表面平整度差 (目视不平整或倾斜)	
Failure Mechanism	<ul style="list-style-type: none">- SP exposed for too long time, evaporation of solvent cause increased viscosity; 材料暴露在空气中太长时间，溶剂挥发使粘度增加;-The stencil or squeegee application surfaces was not clean; 网板或者刮刀表面不清洁或粘污	
Solution	<ul style="list-style-type: none">- Customized stencil design and thickness selection; 客户定制网板设计和厚度选择- Operator training to achieve desired thickness (variation of application force on squeegee significantly affects the printing thickness even with the same stencil, larger downwards push on squeegee results thinner printing); 培训操作工因为不同压力会影响印刷厚度和平整度- Add ribs for larger size printing (>10x10mm) 大面积印刷建议加加强筋 (如图)	

Defect	<p>Material Separation /Delamination</p> <p>(A layer of clear solvent may appear on top of the content; Printings with the bottom material of a settled container has more chance of failure;)</p> <p>材料分层 (罐体上层出现透明溶剂, 使用出现沉降罐体底部材料会增加不良机会)</p>	 <p>Bad separated material</p>
Failure Mechanism	<p>-Long time storage without rolling or other special case; (长时间储存或者其他特殊情况)</p>	
Solution	<p>- Follow the recommendation per HEM application notes to well & thoroughly mixed before use; Hand mixing or jar rolling Detail see Application Note 按照HEM的应用指导在使用前混合材料 手动搅拌或者罐体滚动搅拌, 详情请参考应用指导</p>	 <p>Fresh, well mixed material</p>

Defect

Mechanical Problem

(Some incidents happened due to customers applications' mechanical problems : air gap between the SP and heat sources)

机械问题

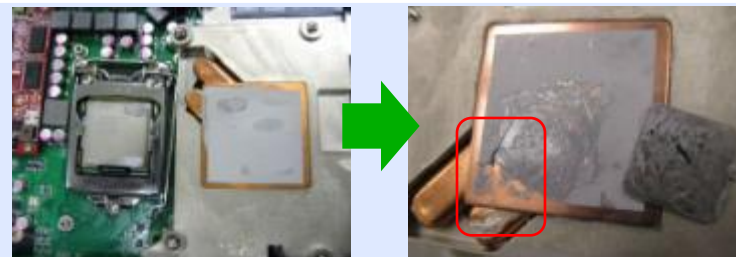
(有些问题是由客户应用时的机械问题造成 : 材料和热源之间有空气间隙)



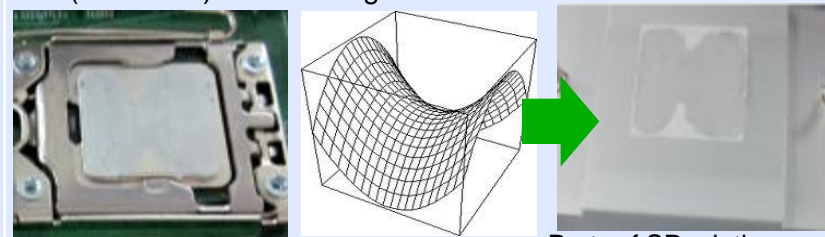
Failure Mechanism

-Thin SP printing and large non-flatness of heating surface;
材料印刷厚度太薄以及热源表面不平整

- Severe heat spreader deformation under localized mounting load
散热片在安装压力下严重变形



Test showed the printing with very good reflow. But thickness (11~70um) is not enough to overcome the non-flatness



Saddle shaped heat spreader surface

Parts of SP printings not contacting the deformed spreader surface

Solution

- Make sure the proper printing thickness & flatness to fill the air gap
确保合适的印刷厚度和平整度

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