

SUM NOTES

Printed Circuit Board Micro-sectioning

Introduction

Micro-section a printed circuit board's copper-plated through-holes to reveal electrical interconnects as well as the laminate or substrate. When conducting routine process-control checks, meeting military (MIL) requirements, conducting life cycle, thermal analysis or researching the impact of the RoHS transition, a micro cross-section is invaluable.

Several challenges can impede attempts at accurately revealing details of interest. First of all, maintaining a flat specimen for measurement accuracy takes careful consideration with a wide range of materials present such as epoxy, solder (lead or lead free), acrylic adhesive, copper, and glass. Accurate pinning, selecting the right consumables, and automating the process will minimize preparation errors to help attain a centerline sectioning plane.

Another challenge of micro-sectioning is to create a surface in a plane, within 10 percent of the hole's center, if plated through-hole analysis is of interest. As through-holes decrease in size, so does the centerline deviation tolerance. This will decrease your margin for error, making it difficult to consistently cross section at the centerline. A key step to achieving success is by doing semi-automated sample preparation with a PWB Met™ Small Hole Accessory for holes that are 0.004" (4 mil) in diameter or greater. The system is designed to increase accuracy primarily by pinning each coupon individually.

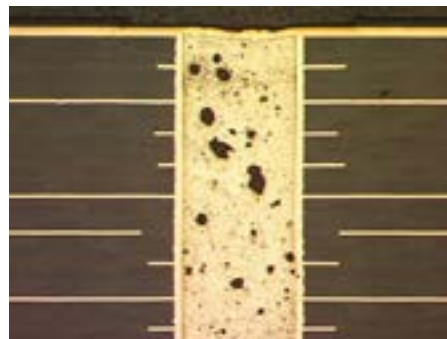
Preparation Procedure

Coupon Generation

Start the preparation process by punching or routing coupons from a designated area on the board or test panel. While making a punch is relatively quick, routing is necessary for extracting a coupon from multi-layer boards that will be damage free. Next, reference holes are drilled 150 thousandths of an inch from the center of the circuit holes on the target (center) plane. Accurately drilling the reference holes is essential when targeting small holes. The Small Hole Cross Sectioning System can accommodate pin-to-feature dimensions up to 450 thousandths of an inch.

Coupon Pinning

In order to expose multiple through-holes at the same time, index pins are used to align reference holes within a mount. The coupons are pinned prior to mounting to establish a fixed distance between a through-hole and the pins. Individual pinning eliminates error caused by the pins flexing in numerous coupon systems. A PWB Met™ Pin Loader provides a simple and efficient means of inserting index pins a predetermined distance into the coupons without



Through-Hole cross section at 50X.

damage occurring. Follow this step-by-step process for pinning:

- Insert index pin in Pin Loader and lock in place
- Align the coupon reference holes over the pins
- Gently push coupon onto pins
- Press the handle down to fully insert pins
- Remove coupon
- Repeat for all coupons

Mounting

Prepare a batch of SamplKwick®, which is a fast-cure acrylic resin. A 1-to-1, hardener-to-resin, ratio is recommended to provide optimum penetration and a quick cure rate (approximately 10 minutes). Before loading the pinned coupons into a PWB Met™ Small Hole Accessory sample holder, dip each coupon in SamplKwick® hardener to improve the surface coverage of epoxy material inside the hole. This step is especially useful with small holes.

Load each sample holder in a balanced manner to achieve the most efficient and exact polishing. Place an equal number of coupons in each cavity and equally space the mounts. For example, when preparing nine coupons, place three coupons in each mounting cavity and use three locations – 120 degrees apart. Fill the remainder of the cavities with epoxy to balance a load on the sample holder.

Pour enough SamplKwick acrylic into each cavity to just cover the top edges of the coupons. Excess mounting media will simply prolong the grinding operation while not enough may expose the coupons to damage. Labeling each mold could also be done at this time. Once the resin has cured, release the mold clamps and remove the upper mold plate and base plate.

Grinding Polishing

Controlled material removal is of primary importance when cross sectioning through-holes to the center. Use the supplied height gauge and gauge pin to verify the diamond-stop calibrations. Set the grinding stops in their correct positions based on the pin locations within the mounts. For Buehler's NelsonZimmer® Cross Sectioning Systems, set the diamond short stops (final polish) to 0.005 inch (127 um) and 0.008 inch (203 um) for the diamond long stops (planar grinding).

Grinding

1. Silicon carbide cuts quickly through polymer-based materials. Therefore, start with 240 (P280) grit SiC Carbimet® 2 paper to remove any excess mounting media. Using water as a lubricant,

Table 1. NelsonZimmer Small Hole Accessory Preparation Method

Surface/Abrasive	Base/Head (RPM)	Direction Head	Time (mins)
CarbiMet® 2 240grit [P280] SiC paper	250/60	Contra	Until diamond long stops are reached
CarbiMet® 2 240grit [P280] SiC paper	120/60	Contra	≈2:00* Until short stops are reached
TexMet® Cloth 3m MetaDi® paste & MetaDi® Fluid	120/60	Contra	1:30
MicroCloth® MasterPrep® Alumina Polishing Suspension	120/60	Contra	1:30

*Grinding SiC paper only lasts 1-2 minutes, especially on finer grit sizes

set the grinder / polisher to a force of 5 lbs (22N)/mount, base speed of 250 RPM and a contra head speed of 60 RPM. This step will take up to two minutes. Time may have to be increased if excess mounting media was used or if all three diamond long stops have not been reached.

2. Rinse specimens with water, along with the holder, thoroughly between each step.
3. Back out the diamond long stops (planar grinding) 1 to 2 turns.

Polishing

At this point in the preparation process, the exposed surface is about 8 mils or lower, depending on the undercut from grinding with SiC paper, from the center of the holes. Use a force of 5 lbs (22N)/mount, base speed of 120 RPM, and a contra head speed of 60 RPM for each remaining preparation step.

4. Next use a 600 (P1200) grit SiC Carbimet 2 paper for approximately two minutes or until all three diamond short stops have been reached. The height of each mount can be checked with a dial gauge ensuring each is the same.
5. At this point, the exposed surface is about 5 mils* or lower. Back out the diamond short stops one quarter of a turn.
6. Place TexMet® (or TexMet® MB) cloth on the platen. Apply 3 um MetaDi® of paste and use MetaDi® Fluid as a lubricant. Always use paste when working with soft materials, such as solder, to reduce the risk of the abrasive being embedded in the sample. Any SiC scratches from the previous step should be removed in two minutes or less.
7. The final step is to polish with MasterPrep® Alumina Polishing Suspension on MicroCloth® for 40-60 seconds. Running water

for the last 15 seconds of polishing will simplify cleaning of the machine.

*1 mil = 25.4 micron

Variations to the cross-section preparation procedure may be needed, depending on the number of coupons per mount, the coupon (board) thickness, and the amount of material to be removed

Inspection

Inspect the quality of the coupon specimens with an inverted microscope before removing them from the holder. Once a coupon is removed, it cannot be returned.

Sample Removal

Using a PWB Met™ Extractor, apply pressure to the back of each mount. The completed cross section will safely drop into a drawer.

Quickly capture images for your records and conduct measurements as needed by placing your sample on a microscope equipped with an OmniMet® Image Analysis system. Combine the powerful capabilities of a database with a custom template to create the ideal report.

From coupon to report, Buehler offers a complete solution that can be accomplished in less than one hour.

Equipment

PWB Met™ Router
PWB Met™ Drill with Monitor
PWB Met™ Pin Loader
PWB Met™ Small Hole Accessory
EcoMet®/AutoMet® 300 Grinder Polisher
PWB Met™ Extractor
ViewMet® Microscope
OmniMet® Image Analysis system

Consumables

SamplKwick® Resin
Carbimet® 2 Abrasive Paper
MetaDi® Diamond Paste
MetaDi® Diamond Fluid
TexMet® Polishing Cloth
MasterPrep® Colloidal Silica
MicroCloth® Polishing Cloth

Sectioning AbrasiMet • AbrasiMatic • IsoMet	Mounting SimpliMet	Grinding & Polishing EcoMet • AutoMet • MetaServ	Imaging & Analysis OmniMet	Hardness Testing Wilson® Hardness
--	-----------------------	---	-------------------------------	--------------------------------------



BUEHLER Worldwide Headquarters
41 Waukegan Road
Lake Bluff, Illinois 60044-1699 USA
P: (847) 295-6500
www.buehler.com | info@buehler.com

BUEHLER Germany
info.eu@buehler.com

BUEHLER France
info.fr@buehler.com

BUEHLER United Kingdom
info.uk@buehler.com

BUEHLER Canada
info@buehler.ca

BUEHLER Japan
info.japan@buehler.com

BUEHLER China
info.cn@buehler.com

BUEHLER Asia-Pacific
info.asia@buehler.com