MASK TECHNOLOGY, INC.
QUALITY PLAN

Hot Air Solder Leveling
Teledyne Halco (HASL)

Operating Instructions

1. Adjust **air knife** gap to accommodate specific board thickness.
2. Set **solder pot** temperature. (See recommended temperature ± 5º F)
3. Set **air knife** at 800º F.
4. Adjust **pre-heat** temperature for panel thickness. (See Parameters)
5. Set **air knife pressure** to recommended PSI. (See Parameters)
6. Clean **air knives**.
7. Run **dummy panel** (laminate) to verify gap.
8. Re-adjust **air knife** gap if necessary and verify.
9. Run F/A and make adjustments as necessary.

Recommended Set-Up Parameters

Brd Thk./Type	Solder Temp.	Air Knife Temp./PSI		Pre-heatTemp./Conv. Speed/Board Temp.		
.010 to .028/flex	480º F ± 5	800º F	16/14	OFF	3.5-5.0 fpm	Ambient
.015 to .060 rigid/flex	490º F ± 5	800º F	20/18	OFF	3.5-5.0 fpm	N/A
.061 to .090 rigid/flex	500º F ± 5	800º F	22/20	175º F	3.5-5.0 fpm	95-110ºF
.091 to .150 rigid/flex	505º F ± 5	800º F	22/20	230º F	3.5-5.0 fpm	160-175ºF
.151 to .250 rigid	505º F ± 5	800º F	26/24	Spec. Proj.	3.5-5.0 fpm	Spec. Proj.
.015 to .060 rigid	490º F ± 5	800º F	20/18	175º F	3.5-5.0 fpm	95-110º F
.061 to .090 rigid	500º F ± 5	800º F	22/20	350º F	3.5-5.0 fpm	250-300º F
.091 to .125 rigid	505º F ± 5	800º F	22/20	425º F	3.5-5.0 fpm	300-325º F
.126 to .200 rigid	505º F ± 5	800º F	24/20	475º F	3.5-5.0 fpm	325-550º F
.201 to .250 rigid	505º F ± 5	800º F	26/24	Spec. Proj.	3.5-5.0 fpm	Spec. Proj.

NOTE: MORE THAN (2) PASSES **MUST** HAVE QUALITY APPROVAL.

CONTROL INSTRUCTION

Hot Air Solder Leveling (HASL)

1.0 Scope

1.1. Purpose

This document describes how the chemistry and solder alloy in the Hot Air Solder Leveling (HASL) process is controlled. These instructions ensure that proper procedures are followed to insure that make-up and control of the pre-clean, post-clean, flux, and solder process is best practice and to the manufacturers recommended specification.

2.0 Applicable Document

2.1 Hot Air Solder Leveling (HASL) process specification

2.1.1. Enthone PC-7077 …. Microetch Data Sheet

2.1.2. Enthone AF1863 …. HSL Flux Data Sheet

2.1.3. Enthone HAL Solder …. Data Sheet

2.1.4. Enthone …. Tin Data Sheet

3.0 Process Audits

3.1. The control process and related instructions shall be audited periodically by the Quality Department. A review of the instructions will also be required if it has been determined that a deviation from the instructions is the cause of rejection.

4.0 Chemical Control Instructions

4.1. Solution make-up (Line Operator)

4.1.1. Microetch Pre-Clean Enthone PC-7077 (55 gallons)

4.1.1.1 Fill clean tank 10% full with tap water

4.1.1.2 Add 20 gallons PC-7077.

4.1.1.3 Add tap water to bring tank to full

4.1.1.4 Verify temperature setting at 100º F $\pm$ 5

4.1.2. Flux- Enthone AF-1863 (10 gallons)

4.1.2.1. Fill clean tank with 5 gallons AF-1863

4.1.2.2. Temperature should be ambient

4.1.3. Post Clean- Cemco Horizontal Washer

4.1.3.1. Fill clean tank with tap water

4.1.3.2. Verify that all spray nozzles are clean and working properly

5.0 Tin/Lead Alloy Maintenance and Control

5.1 Alloy adjustment

5.1.1. Solder pot (750 lbs. Enthone HAL Solder)

5.1.1.1 Add small amounts of tin to maintain alloy at 63-37% ratio tin to lead as indicated by lab analysis

5.1.1.2 Maintain solder level of pot

5.1.1.3 Maintain oil level Enthone AF1864 (3-5 gallons per shift)

5.1.2. Copper contamination test and control

5.1.2.1 Remove copper from tin/lead twice a day by boiling down the solder pot and skimming the surface contaminants (drossing), then add 16 lbs of pure solder.

5.1.2.2 Pull solder sample weekly for analysis of the solder pot by an outside lab (Enthone) to determine metallic contamination (impurity) with a copper limit of .25% (note: copper limit prior to this revision was .30%).

5.1.2.3 Monthly Maintenance.

5.1.2.4 Dump solder pot (750 lbs) bimonthly or as indicated by laboratory analysis.

6.0 Line Start-Up

6.1 The following procedures shall apply when activating the line to process product

6.1.1 Insure that all process tanks to be used are at operating level

6.1.2 Activate power to the conveyorized line

6.1.3 Verify temperature controls are working and indicator lights are on

6.1.4 Set conveyor at 3 ft./min.

6.1.5 Turn on pumps and verify that they are pumping

6.1.6 Process etch rate panel and record etch rate at ft. per. Min.

6.1.7 Adjust conveyor to obtain etch rate of 20-40 micro inches per min.

6.1.8 Check condition of rollers and solution dams for flood level

6.1.9 Verify temperatures on all process tanks

7.0 Line Shut-Down

7.1 The following procedures shall be followed for line shut down:

7.1.1 Turn off water

7.1.2 Turn off pumps and filters

7.1.3 Turn off power to line

8.0 Spent Chemistry Removal for Waste Management or Metal Reclaim

8.1 Spent chemistry shall be handled in the following way:

8.1.1 Pump chemistry from process tank to a designated drum

8.1.2 Fill in required information on Waste Treatment Label and transport to burmed area.

WORK INSTRUCTION

Hot Air Solder Leveling (Teledyne Halco)

1.0 Scope

1.1. Purpose

This document describes how hot air solder leveling (HASL) is applied on printed wire boards using the Teledyne Halco line. Theses procedures ensure good coverage, thickness and the required solderability.

2.0 Applicable Documentation

2.1. Traveler
2.2. Process Specification
2.3. Customer Drawings and/or Purchase Order
2.4. Inspection Report
2.5. XRF Measurement (Thickness of plated metals)

3.0 Process Audits

3.1. The process and related work instructions shall be audited periodically by the Quality Department or as indicated. A review of the work instructions will also be required if it has been determined that deviation from the instructions is the cause of rejection.

4.0 Work Instructions

4.1. First Article (Set-Up)

4.1.1. The process steps shall be followed in the order listed.
4.1.2. Review Quality Traveler to identify the process, thickness requirements and special instructions.
4.1.3. **Tape** required areas per Quality Traveler.
4.1.4. Check **board thickness** with caliper.
4.1.5. Adjust **air knife gap** on solder level machine to accommodate board thickness.
4.1.6. Verify **solder pot temperature**. (See recommended set-up parameters $\pm$ 5ºF)
4.1.7. Set **air knife temperature** at 800º F.
4.1.8. Adjust **pre-heat temperature** for panel thickness. (See set-up parameters)
4.1.9. Set **air knife pressure** to recommended PSI. (See set-up parameters)
4.1.10. Clean air knives.
4.1.11. Run dummy panel (laminate) to verify gap.
4.1.12. Re-adjust gap if necessary and verify.
4.1.13. Process First Article printed circuit board and make adjustments as necessary.
4.1.14. Load board on pre-clean conveyor.
4.1.15. Process through the conveyorized **copper etch**, **rinse** and **dry**.
4.1.16. Conveyorized **pre-heater**
4.1.17. Roller solder **fluxer.**
4.1.18. **Solder pot** at 2-second dwell.
4.1.19. Hold on **air table** for 10-20 seconds depending on the thickness of the panel.
4.1.20. Process through conveyorized **post-clean** washer, **rinse** and **dry**.
4.1.21. **Visually inspect** for solder appearance and coverage per Quality Requirements.
4.1.22. Check solder **thickness and alloy** on x-ray machine per customer requirement for conformance to traveler and specification.
4.1.23. If necessary, adjust HALCO and run second F/A for verification.

4.2. Production

4.2.1. Process production boards using parameters identified when running F/A.

4.2.2. Boards shall be visually inspected for coverage and defects. (See Inspector Work Instructions)

4.2.3. Check solder thickness per customer requirements.

4.2.4. Verify panel count and sign off traveler.

4.2.5. Transfer order to shipping department.

5.0 Quality Requirements

5.1 The following test and visual checks shall be performed as required by the Quality Line Inspector.

5.1.1 The solder deposit shall have a uniform lustrous appearance with no evidence of pitting, roughness, out gassing, de-wetting, or cold spots.

5.1.2 Solder shall be deposited on the copper traces or features and no bridges of the laminate substrate shall be allowed.

5.1.3 All of the exposed copper areas will be coated to the required thickness.

5.1.4 Each lot of boards processed will be X-RAY tested for solder alloy and thickness when required by the customer.

6.0 Process Control

6.1 The hot air solder leveling process shall be monitored and controlled as follows:

6.1.1 Solder will be drossed daily to remove copper contamination and insure that the alloy is within specification.

6.1.2 Flux will be replaced after (8) hours of production.

6.1.3 A first article board (F/A) shall be processed through the (HASL) line and checked for conformity prior to running production.

TROUBLESHOOTING

Hot Air Solder Leveling Process (HASL)

9.0 Scope

1.1. Purpose

This specification identifies probable cause and corrective action for various problems associated with the application of Hot Air Solder Leveling (HASL) to printed wire boards. This specification covers the equipment, chemicals and procedures required.

10.0 Applicable Document

10.1 Hot Air Solder Leveling (HASL) process specification

2.1.5. Enthone PC-7077 …. Microetch Data Sheet
2.1.6. Enthone AF1863 …. HSL Flux Data Sheet
2.1.7. Enthone HAL Solder …. Data Sheet
2.1.8. Enthone …. Tin Data Sheet

11.0 Troubleshooting

3.1. See problem, probable cause and appropriate corrective action to resolve process issues.

3.1.1. Alloy not within specification guidelines
3.1.1.1. Insufficient tin in solder pot……Check and adjust
3.1.1.2. Insufficient lead in solder pot ……Check and adjust
3.1.2. High copper contamination of solder
3.1.2.1. Copper removal insufficient……Lower temp. to 280-350º F and remove copper
3.1.2.2. Removal cycle not often enough……Check and adjust cycle
3.1.3. Exposed copper (selective)
3.1.3.1. Insufficient etch rate……Check etch rate
3.1.3.2. Solder mask residue……Process second time (product permitting)
3.1.3.3. Inactive fluxing……..Change flux and re-process
3.1.4. Black solder mask- blind vias
3.1.4.1. Trapped micro etch in via……Improve rinsing
3.1.4.2. Solder mask blocking via……Strip and recoat mask-improving registration
3.1.5. Solder plugged holes
3.1.5.1. Copper nodules in holes……..Identify for customer rework
3.1.5.2. Low air knife pressure……Increase air pressure
3.1.6. Low solder thickness
3.1.6.1. Excess air knife pressure……Reduce air pressure
3.1.6.2. Directional (BGA & Quad Paks)…….Increase board angle to 33-45° if possible
3.1.7. High solder thickness
3.1.7.1. Low air knife pressure……Verify and correct
3.1.8. Solder dewetting
3.1.8.1. Insufficient cleaning……Verify etch rate
3.1.8.2. Flux activity low……Change flux
3.1.8.3. Flux dwell insufficient……Increase dwell time
3.1.8.4. Excess reflow oil on board……..Reduce oil flow

3.1.9. Solder reduced hole sizes
- 3.1.9.1. Low air knife pressure……..Increase pressure
- 3.1.9.2. Over plated copper in holes……..Verify (see customer)
- 3.1.9.3. Copper nodules in hole…….Verify (see customer)

3.1.10. Solder balls
- 3.1.10.1Air turbulence……..Adjust air knife pressure
- 3.1.10.2Board process angle not optimum……Adjust for best results

3.1.11. Solder cold spots (flat white)
- 3.1.11.1Low solder temperature……Increase solder temperature