



ASSOCIATION CONNECTING
ELECTRONICS INDUSTRIES®

IPC-1710A

OEM Standard for Printed Board Manufacturers' Qualification Profile

Developed by the OEM council of the IPC, the MQP sets the standard for assessing PWB manufacturers capabilities and allows PWB manufacturers to more easily satisfy customer requirements.

IPC-1710A
May 2004

A standard developed by IPC

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The material in this standard was developed by the OEM Council of the Institute for Interconnecting and Packaging Electronic Circuits.

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FOREWORD

It is not intended that this Manufacturers' Qualification Profile (MQP) satisfies all the requirements of the customer, however, conscientious maintenance of this document and or registration to ISO 9000 requirements should satisfy the major concerns. Thus, audits should be simpler, required less frequently, and facilitate less paper work as customers and suppliers work closer to meeting each others needs.

ACKNOWLEDGMENTS

The IPC is indebted to the members of the OEM council who participated in the development of this document. A note of thanks is also expressed to the members of the IPC Presidents Council for their review and critique and construction recommendations in finalizing the principles developed for the MQP.

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SECTION 1.1

COMPANY DESCRIPTION

| |
|-----------------------------------|
| DATE COMPLETED August 20, 2009 |
|-----------------------------------|

GENERAL INFORMATION

| | | | |
|--|---|--|--|
| LEGAL NAME Calumet Electronics Corporation | | | |
| PHYSICAL ADDRESS 25830 Depot Street | | | |
| CITY Calumet | STATE MI | ZIP 49913 | |
| PROVINCE N/A | COUNTRY USA | | |
| TELEPHONE NUMBER 906-337-1305 | FAX NUMBER 906-337-5359 | TELEX NUMBER N/A | |
| E-MAIL ADDRESS smarshall@calumetelectronics.com | MODEM NUMBER N/A | DATE FOUNDED 1968 <input type="checkbox"/> PUBLIC <input checked="" type="checkbox"/> PRIVATE | |
| INTERNET URL www.calumetelectronics.com | FTP SITE ftp.calumetelectronics.com | | |

MANAGEMENT

| |
|---|
| PRESIDENT / CEO Stephen Vairo, svairo@calumetelectronics.com , 906-337-1305 x125 |
| VICE PRESIDENT OF OPERATIONS (Quality, Safety) Ed Kraai, ekraai@calumetelectronics.com , 906-337-1305 x120 |
| NATIONAL SALES MANAGER (Marketing, Customer Service) Stephen J. Marshall, smarshall@calumetelectronics.com , 906-337-1305 x113 |
| GENERAL MANAGER (Human Resources, Procurement, Waste Management, Material Control, Production Control, Engineering Management) Elden Hendrickson Jr., ehendrickson@calumetelectronics.com , 906-337-1305 x139 |
| CONTROLLER (Finance, Accounting) Brian Taivalkoski, btaivalkoski@calumetelectronics.com , 906-337-1305 x123 |

| CORPORATE DESCRIPTION | NUMBER OF EMPLOYEES | | COMMENTS |
|------------------------|---------------------|-------------|---|
| | CORPORATE | SITE | |
| DESIGN AND DEVELOPMENT | - | - | NOTE: Calumet builds PCBs to customer specifications using applicable standards. |
| ENGINEERING | 14 | Calumet, MI | (8) Process Engineering Personnel (6) CAM Engineering Personnel |
| MANUFACTURING CONTROL | 18 | Calumet, MI | (17) Quality Control Personnel (1) Production Manager |
| MANUFACTURING | DIRECT | 48 | (48) Production Operators |
| | INDIRECT | 5 | (4) Maintenance Personnel (1) Housekeeping Personnel |
| QUALITY CONTROL | QUALITY ENGINEERS | 2 | (1) Quality Engineer (1) Quality Representative |
| | INTERNAL AUDITORS | - | (4) Quality Engineers and Quality General Management perform internal audits. |
| | GENERAL MANAGEMENT | 2 | (1) Quality Assurance (1) Quality Systems |
| ADMINISTRATION | 14 | Calumet, MI | (6) General Management (5) General Administrative Support (3) Sales, Marketing, Customer Service Support |
| TOTAL | 103 | Calumet, MI | All employees are full time; total count is down due to business climate. |

SECTION 1.2

SITE DESCRIPTION

DATE COMPLETED
August 20, 2009

| MANUFACTURING FACILITY | | | |
|---|--|-------------------|---|
| COMPANY NAME | Calumet Electronics Corporation | | |
| PHYSICAL ADDRESS | 25830 Depot Street | | |
| CITY | Calumet | STATE | MI |
| PROVINCE | N/A | COUNTRY | USA |
| TELEPHONE NUMBER | 906-337-1305 | FAX NUMBER | 906-337-5359 |
| E-MAIL ADDRESS | MODEM NUMBER | YEARS IN BUSINESS | |
| smarshall@calumetelectronics.com | N/A | 41 | |
| INTERNET URL | www.calumetelectronics.com | FTP | ftp.calumetelectronics.com |
| PRINCIPLE PRODUCTS/SERVICES/SPECIALTIES | BUSINESS CHARACTERIZATION | | |
| Type 1, 2 and 3 rigid bare printed circuit board manufacturing in compliance with IPC-A-600 rev. G class 2 and 3, Military MIL-PRF-31032, MIL-PRF-55110, ITAR registered, HUBZone small business | Low – medium volume, prototypes, quick-turns, High mix part catalogs | | |
| <p>Calumet Electronics has been manufacturing mission-critical printed circuit boards since 1968. Every board is built in the security of its ITAR registered facility located in Calumet, MI, USA. The company is a registered Small Business and a certified HUBZone Enterprise specializing in manufacturing to IPC Class 2 and Class 3 performance and Department of Defense QPL and QML listing requirements. Calumet delivers standard tin/lead and lead-free solutions to OEM and EMS companies from prototype to end-of-life cycles with dock-to-stock dependability and innovative supply-chain solutions. Product realization is achieved with a quality system registered to ISO9001:2000 and Military specifications MIL-PRF-31032 and MIL-PRF-55110.</p> | | | |

| FACILITY MANAGEMENT | TITLE | REPORTS TO (Function/Job Title) |
|---|------------------------------|---------------------------------|
| OVERALL OPERATION RESPONSIBILITY FOR THIS SITE Stephen Vairo | President / CEO | Board of Directors |
| MANUFACTURING Elden Hendrickson Jr. | General Manager | President / CEO |
| TECHNICAL/ENGINEERING Elden Hendrickson Jr. | General Manager | President / CEO |
| MATERIALS/PRODUCTION CONTROL Elden Hendrickson Jr. | General Manager | President / CEO |
| PURCHASING Elden Hendrickson Jr. | General Manager | President / CEO |
| QUALITY Ed Kraai | Vice President of Operations | President / CEO |
| SALES REPRESENTATIVE Stephen J. Marshall | National Sales Manager | President / CEO |
| WASTE MANAGEMENT Ed Kraai | Vice President of Operations | President / CEO |

| BUILDINGS | | | | SYSTEMS (INDICATE % COVERAGE) | | | | | | |
|-------------------|-----|----------------|---------------------------|-------------------------------|---------|-------------|------------------|------------|-----------------|-------|
| | AGE | AREA (Sq. Ft.) | Construction (Wood/Brick) | Power Conditioning | Heating | Ventilation | Air Conditioning | Sprinklers | Waste Treatment | Other |
| Office | 13 | 8380 | Block | 100 | 100 | 100 | 100 | 0 | 0 | 0 |
| Manufacturing | 80 | 83014 | Masonry | 20 | 100 | 100 | 30 | 13 | 100 | 0 |
| Storage | 80 | 5000 | Masonry | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Planned additions | | | | | | | | | | |

| SAFETY AND REGULATORY AGENCY REQUIREMENTS | | | |
|--|---|--|--|
| Are fire extinguishers functional and accessible to employees? | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | What is the distance to the nearest fire station? (in minutes) |
| Do you conform to local/federal environment protection agency requirements? | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | Date of last OSHA visit Date of last EPA visit |
| Are you currently operating under a waiver or in violation of local government requirements? | <input type="checkbox"/> YES | <input checked="" type="checkbox"/> NO | Other Agency Audits, UL, ISO 9000, NECQ, CSA Approval and Number |
| | | | <input checked="" type="checkbox"/> UL #ZPMV8-E49465 <input checked="" type="checkbox"/> CSA # ZPMV2- |
| | | | <input checked="" type="checkbox"/> ISO 9000# 14351-5 <input checked="" type="checkbox"/> Other MIL-PRF-31032 and |

| | | | | | |
|--|---|-----------------------------|--|----------------------------|----------------------------------|
| | | | | E49465 ITAR reg# M19545 | MIL-PRF-55110 (VQE-03-003430) |
| Do you have a safety program? Describe below. | <input checked="" type="checkbox"/> YES | <input type="checkbox"/> NO | Hazardous Waste Number Trade Waste Account Number | | |

PLANT PERSONNEL (TOTAL EMPLOYEES)

| Regular | Contract | Office | Technical/ Engineering | Production | Full-Time QA | Part-Time QA | Union | Non- Union | Union Name | Contract Expires (Date) |
|---------|----------|--------|---------------------------|------------|-----------------|-----------------|-------|---------------|---------------|----------------------------|
| 103 | - | 15 | 18 | 49 | 21 | - | - | 103 | - | - |

COMMENTS

53 employees IPC-A-600 certified specialist (see attached certificates). 50% of employees have over 15 years experience on the job. All commercial product compliant to IPC-A-600 and IPC-7711

Safety program, safety committee and HAZMAT response team, meet all OSHA requirements, weekly departmental inspections, various training to specific safety issues, right-to-know, MSDS's available in centralized location.

Uncontrolled

SECTION 2.1

PROCESS

DATE COMPLETED
August 20, 2009

This section is intended to provide overview information on the processes used to fabricate printed board products.

Site Capability Snapshot (Please Check all that apply)

| Designators | | Remarks |
|-------------|---|--|
| A | Conductor Forming Processes <input type="checkbox"/> Subtractive <input type="checkbox"/> Thin Foil Subtractive less than .5 oz. <input checked="" type="checkbox"/> Semi-Additive <input type="checkbox"/> Additive (Electro-less) <input type="checkbox"/> Black Hole <input type="checkbox"/> Thick Film Paste and Fire <input type="checkbox"/> Thin Film Semi-conductor Sputtering <input type="checkbox"/> Other: | Tin is used as etch resist, |
| B | PTH Materials and Processes <input checked="" type="checkbox"/> Acid Copper <input type="checkbox"/> Pyro-Phosphate Copper <input type="checkbox"/> Full Built Electro-Less <input type="checkbox"/> Gold Paste <input type="checkbox"/> Copper Paste <input type="checkbox"/> Gold Conductor Sputtering <input type="checkbox"/> Nickel Conductor Sputtering <input type="checkbox"/> Other: | 2 PAL automatic plating lines, see FMEA, section G (supporting docs) |
| C | Permanent Over-plating <input type="checkbox"/> Tin <input checked="" type="checkbox"/> Tin-Lead <input checked="" type="checkbox"/> Tin-Nickel Alloy <input type="checkbox"/> Nickel <input type="checkbox"/> Nickel Gold (Hard) <input checked="" type="checkbox"/> Nickel Gold (Soft) <input type="checkbox"/> Nickel Rhodium <input type="checkbox"/> Conductive Polymer <input checked="" type="checkbox"/> Other: Immersion Silver | Cemco Alchemy D Horizontal HASL Lead-free HASL Uyemura ENIG KAT-450, see process parameters section G (supporting docs.) Uyemura RGA-14 |

| | | | |
|---|-----------------------------|--|--|
| D | Permanent Selective Plating | <input type="checkbox"/> Tin <input checked="" type="checkbox"/> Tin-Lead <input checked="" type="checkbox"/> Tin-Nickel Alloy <input type="checkbox"/> Nickel <input checked="" type="checkbox"/> Nickel Gold (Hard) <input checked="" type="checkbox"/> Nickel Gold (Soft) <input type="checkbox"/> Nickel Rhodium <input type="checkbox"/> Conductive Polymer <input checked="" type="checkbox"/> Other: Immersion Silver | Cemco Alchemy D Horizontal HASL Lead-free HASL Technic gold tab line Uyemura ENIG KAT-450, see process parameters in section G (supporting documents) Uyemura RGA-14 |
| E | Permanent Mask or Coating | <input type="checkbox"/> Photo Dry Film <input checked="" type="checkbox"/> Photo Liquid <input type="checkbox"/> Image Transfer Screen Mask <input type="checkbox"/> Conformal Coating Solder Mask <input type="checkbox"/> Cover Coat <input type="checkbox"/> Other: | Circuit Automation DP1500 coater, Taiyo soldermask PSR-4000MP and HFX |
| F | Other Surface Finishes | <input type="checkbox"/> Tin-Lead Fused <input type="checkbox"/> Immersion Tin <input checked="" type="checkbox"/> Solder Leveled <input type="checkbox"/> Roll Soldered <input type="checkbox"/> Electro-less Solder Fused <input type="checkbox"/> Solder Bumped Lands <input type="checkbox"/> Solder Paste Fused <input type="checkbox"/> Azole Organic Protective Covering <input type="checkbox"/> Flux Protective Covering <input type="checkbox"/> Other: | Cemco Alchemy D horizontal HASL |
| G | Supporting Documents | Process parameters directory ENIG process parameters.xls Process flow directory 64INN Inner Layer Flow.pdf 72PRM Primary Imaging Flow.pdf 74PLT Electro Plating Flow.pdf 78LPI Soldermask Flow.pdf FMEA directory Calumet plating CE - FMEA CE FMEA(8-21- SPC Chart directory ENIG charts.doc ionic charts.doc | |

| |
|---|
| <p>Reject Library directory</p> <p style="text-align: center;">Reject-defect library.xls</p> <p>IST directory</p> <p style="text-align: center;">J09_2485_report_01 .pdf</p> <p>Equipment List</p> <p style="text-align: center;">Master Equipment List.xls</p> <p>Plant Layout</p> <p style="text-align: center;">Plant layout.pdf</p> |
|---|

Uncontrolled

SECTION 2.2

ELECTRICAL TEST EQUIPMENT

DATE COMPLETED
August 20, 2009

This section is intended to provide overview information on the test equipment and testing capability of the manufacturer.

Site Capability Snapshot (Please Check the column that applies furthest to the right.)

| Designators | | | Remarks |
|-------------|-------------------|--|--|
| A | Number of Nets | <input type="checkbox"/> <200 <input type="checkbox"/> 200 <input type="checkbox"/> 500 <input type="checkbox"/> 1000 <input type="checkbox"/> 2000 <input type="checkbox"/> 3000 <input type="checkbox"/> 4000 <input type="checkbox"/> 5000 <input checked="" type="checkbox"/> >5000 <input type="checkbox"/> Other: | Maximum board size on fixtureless tester is 19.5" x 22.5"; on fixture tester it is 16.7" x 15.9" 400 per sq. in. using fixtureless testers. |
| B | Number of Nodes | <input type="checkbox"/> <500 <input type="checkbox"/> 500 <input type="checkbox"/> 1000 <input type="checkbox"/> 2000 <input type="checkbox"/> 3000 <input type="checkbox"/> 4000 <input type="checkbox"/> 5000 <input type="checkbox"/> 6000 <input checked="" type="checkbox"/> >6000 <input type="checkbox"/> Other: | 2500 per sq. in. using fixtureless tester |
| C | Probe Point Pitch | <input type="checkbox"/> >1.0 [.040] <input type="checkbox"/> 1.0 [.040] <input type="checkbox"/> 0.8 [.032] <input type="checkbox"/> 0.65 [.025] <input checked="" type="checkbox"/> 0.50 [.020] <input type="checkbox"/> 0.40 [.016] <input type="checkbox"/> 0.30 [.012] <input type="checkbox"/> 0.20 [.008] <input checked="" type="checkbox"/> <0.20 [.008] <input type="checkbox"/> Other: | Fixture style tester Fixtureless tester |

| | | | |
|---|----------------------|---|--|
| D | Test % Single Pass | <input type="checkbox"/> None <input type="checkbox"/> <60% <input type="checkbox"/> 60% <input type="checkbox"/> 70% <input type="checkbox"/> 80% <input type="checkbox"/> 90% <input type="checkbox"/> 95% <input checked="" type="checkbox"/> 99% <input type="checkbox"/> 100% <input type="checkbox"/> Other: | |
| E | Probe Accuracy (DTP) | <input type="checkbox"/> >0.2 [.008] <input type="checkbox"/> 0.2 [.008] <input type="checkbox"/> 0.15 [.006] <input type="checkbox"/> 0.125 [.005] <input type="checkbox"/> 0.1 [.004] <input type="checkbox"/> 0.075 [.003] <input checked="" type="checkbox"/> <0.075 [.003] <input type="checkbox"/> Other: | |
| F | Grid Density | <input checked="" type="checkbox"/> Single Side Grid <input checked="" type="checkbox"/> Double Sided Grid <input type="checkbox"/> Double Density Grid <input type="checkbox"/> Double Density Double Sided <input type="checkbox"/> Quad Density <input type="checkbox"/> Double Sided Quad Density <input checked="" type="checkbox"/> Flying Probe <input type="checkbox"/> Other: | 100mil X 100mil 100mil X 100mil 4mil pitch |
| G | Netlist Capability | <input type="checkbox"/> Golden Board <input checked="" type="checkbox"/> IPC-D-356 <input checked="" type="checkbox"/> Net List Extraction <input checked="" type="checkbox"/> CAD/CAM Net List Compare <input type="checkbox"/> Other: | IPC-D 356A Orbotech Frontline Genesis 2000 Performed at various stages of the CAM process. |

| | | | |
|---|---------------------|--|--|
| H | Test Voltage | <input type="checkbox"/> <20 VDC <input type="checkbox"/> 20 VDC <input type="checkbox"/> 40 VDC <input type="checkbox"/> 60 VDC <input type="checkbox"/> 80 VDC <input type="checkbox"/> 100 VDC <input type="checkbox"/> 500 VDC <input type="checkbox"/> 1000 VDC <input type="checkbox"/> >1000 VDC <input checked="" type="checkbox"/> Other: 150VDC | Per IPC-9252A unless otherwise specified. Continuity threshold = 10ohms, Isolation threshold = 10Mohms |
| J | Impedance Meas | <input type="checkbox"/> Micro Section <input type="checkbox"/> Inboard Circuit <input checked="" type="checkbox"/> Coupon <input type="checkbox"/> Manual TDR <input type="checkbox"/> Automated TDR <input type="checkbox"/> Other: | Polar Instruments, see attached equipment list, coupon is generated with in-house tools (Polar Si8000, CITS500S4) to a targeted value. |
| K | Impedance Tolerance | <input type="checkbox"/> None <input type="checkbox"/> >20% <input type="checkbox"/> 20% <input type="checkbox"/> 15% <input checked="" type="checkbox"/> 10% <input type="checkbox"/> 7% <input type="checkbox"/> 5% <input type="checkbox"/> 2% <input type="checkbox"/> <2% <input type="checkbox"/> Other: | +/- 10% of targeted ohm requirement. |

SECTION 2.3

PRODUCT TYPE

| |
|-----------------------------------|
| DATE COMPLETED August 20, 2009 |
|-----------------------------------|

This section is intended to provide overview information on the printed board product types being fabricated by the manufacturer.

Site Capability Snapshot (Please Check all that apply.)

| Designators | | | Remarks |
|-------------|-----------------------|--|---|
| A | Product Type | <input checked="" type="checkbox"/> Rigid Printed Board <input type="checkbox"/> Flex Printed Board <input type="checkbox"/> Rigid/Flex Board <input checked="" type="checkbox"/> Rigid Back Plane <input type="checkbox"/> Molded Product <input type="checkbox"/> Ceramic Printed Board <input type="checkbox"/> Multichip Module <input type="checkbox"/> Laminated Multichip Module <input type="checkbox"/> Deposited Dielectric Multichip Modules <input type="checkbox"/> Other: | FR4, Polyimide, per IPC-4101B Isola 370HR – FR4, high TG Nelco N4105-6FC – FR4 Kingboard 6164 – FR4 Shenyi 1170 – FR4 Nelco N4000-11 – FR4, high Tg Isola FR406 - FR4, high Tg Isola FR408 - FR4, high Tg Ventec VT-47 – FR4 Nelco N7000-2VO – Polyimide Nelco N4000-13 – G-Tech equivalent |
| B | Circuit Mounting Type | <input checked="" type="checkbox"/> Single Sided <input checked="" type="checkbox"/> Double Sided <input checked="" type="checkbox"/> Multilayer <input type="checkbox"/> Single-sided Bonded to Substrate <input type="checkbox"/> Double-sided Bonded to Substrate <input type="checkbox"/> Multilayer Bonded to Substrate <input type="checkbox"/> Constrained Multilayer <input type="checkbox"/> Distributed Plane Multilayer <input type="checkbox"/> Other: | |
| C | Via Technology | <input checked="" type="checkbox"/> No-Vias <input checked="" type="checkbox"/> Thru Hole Vias <input type="checkbox"/> Buried Vias <input type="checkbox"/> Blind Vias <input type="checkbox"/> Thru Hole & Blind Vias <input type="checkbox"/> Thru Hole & Buried Vias <input type="checkbox"/> Thru Hole Buried & Blind Vias <input type="checkbox"/> Buried & Blind Vias <input type="checkbox"/> Other: | Smallest drill size is 10mil. |

| | | | |
|---|------------------------|--|--|
| D | Laminate Material | <input type="checkbox"/> Phenolic <input type="checkbox"/> Epoxy Paper <input checked="" type="checkbox"/> Epoxy Glass <input type="checkbox"/> Modified Epoxy Composite <input type="checkbox"/> Polyimide Film & Reinforce <input type="checkbox"/> Cyanate Ester <input type="checkbox"/> Teflon <input type="checkbox"/> Ceramic Glass Types <input type="checkbox"/> Various Combinations <input checked="" type="checkbox"/> Other: Polyimide | <p>Per IPC-4101B appropriate slash sheet, or as specified by customer.</p> <p>Polyimide per IPC-4101b, or as specified by customer</p> |
| E | Core Material | <input type="checkbox"/> No Core <input type="checkbox"/> Polymer <input checked="" type="checkbox"/> Copper <input type="checkbox"/> Aluminum <input type="checkbox"/> Graphite <input type="checkbox"/> Copper Invar/Copper <input type="checkbox"/> Copper Moly/Copper <input type="checkbox"/> Other: | |
| F | Copper Thickness (Oz.) | <input type="checkbox"/> 1/8 Minimum <input type="checkbox"/> 1/4 Minimum <input type="checkbox"/> 3/8 Minimum <input checked="" type="checkbox"/> 1/2 Nominal <input checked="" type="checkbox"/> 1 Nominal <input checked="" type="checkbox"/> 2 Nominal <input checked="" type="checkbox"/> 3-5 Max <input type="checkbox"/> 6-9 Max <input type="checkbox"/> >10 <input type="checkbox"/> Other: | <p>3 oz inners max, 5 oz outers max</p> |
| G | Construction | <input checked="" type="checkbox"/> ≤4 Planes <input checked="" type="checkbox"/> >4 Planes <input checked="" type="checkbox"/> THK to TOL ≤0.2 mm <input checked="" type="checkbox"/> THK to TOL >0.2 mm <input checked="" type="checkbox"/> Bow/Twist ≤1% <input checked="" type="checkbox"/> Bow/Twist >1% <input checked="" type="checkbox"/> ≤0.3 mm Profile Tolerance <input checked="" type="checkbox"/> 0.3 mm Profile Tolerance <input type="checkbox"/> Other: | <p>Per IPC-TM-650: 2.4.22, acceptance for class 1, 2, 3 where bow and twist shall be .75% for SMT technology and 1.5% for all other designs.</p> |

| | | | |
|---|-----------------------|---|---|
| H | Coatings and Markings | <input checked="" type="checkbox"/> ≤ 0.1 mm Mask Clearance <input checked="" type="checkbox"/> > 0.1 mm Mask Clearance <input checked="" type="checkbox"/> One Side (Legend) <input checked="" type="checkbox"/> Two Side (Legend) <input checked="" type="checkbox"/> None (Legend) <input checked="" type="checkbox"/> UL Material Logo <input checked="" type="checkbox"/> U.L. V ₀ Logo <input type="checkbox"/> U.L. V ₁ Logo <input type="checkbox"/> U.L. V ₂ Logo <input type="checkbox"/> Other: | UL Direct Support on FR4 where applicable CEC3-0, CEC5-0, CEC3L-0, CEC5L-0 |
|---|-----------------------|---|---|

SECTION 2.4

PRODUCT COMPLEXITY

DATE COMPLETED
August 20, 2009

This section is intended to provide overview information on product complexity being fabricated by the manufacturer.

(Please check the column that applies farthest to the right)

| Designators | | | Remarks | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------------|--------------------------|---|--|-----------------------------|--|--|--|--|----------------|--|--------------------|--|------------------|------|--------|------|--------|-------|------|--------|------|--------|-------|------|--------|------|--------|-------|------|--------|------|--------|-------|
| A | Board Size Diagonal | <input type="checkbox"/> <250 [10.00] <input type="checkbox"/> 250 [10.00] <input type="checkbox"/> 350 [14.00] <input type="checkbox"/> 450 [17.50] <input type="checkbox"/> 550 [21.50] <input type="checkbox"/> 650 [25.50] <input checked="" type="checkbox"/> >750 [29.50] <input type="checkbox"/> 850 [33.50] <input type="checkbox"/> >850 [33.50] <input type="checkbox"/> Other: | <table border="1"> <thead> <tr> <th colspan="5">Measurements are in inches.</th> </tr> <tr> <th colspan="2">raw panel size</th> <th colspan="2">useable panel size</th> <th>useable diagonal</th> </tr> </thead> <tbody> <tr> <td>14.0</td> <td>x 24.0</td> <td>12.5</td> <td>x 22.5</td> <td>25.74</td> </tr> <tr> <td>16.0</td> <td>x 24.0</td> <td>14.5</td> <td>x 22.5</td> <td>26.77</td> </tr> <tr> <td>18.0</td> <td>x 24.0</td> <td>16.5</td> <td>x 22.5</td> <td>27.90</td> </tr> <tr> <td>21.0</td> <td>x 24.0</td> <td>19.5</td> <td>x 22.5</td> <td>29.77</td> </tr> </tbody> </table> | Measurements are in inches. | | | | | raw panel size | | useable panel size | | useable diagonal | 14.0 | x 24.0 | 12.5 | x 22.5 | 25.74 | 16.0 | x 24.0 | 14.5 | x 22.5 | 26.77 | 18.0 | x 24.0 | 16.5 | x 22.5 | 27.90 | 21.0 | x 24.0 | 19.5 | x 22.5 | 29.77 |
| Measurements are in inches. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| raw panel size | | useable panel size | | useable diagonal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14.0 | x 24.0 | 12.5 | x 22.5 | 25.74 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16.0 | x 24.0 | 14.5 | x 22.5 | 26.77 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18.0 | x 24.0 | 16.5 | x 22.5 | 27.90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 21.0 | x 24.0 | 19.5 | x 22.5 | 29.77 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | Total Board Thickness | <input type="checkbox"/> <1,0 [.040] <input type="checkbox"/> 1,0 [.040] <input type="checkbox"/> 1,6 [.060] <input type="checkbox"/> 2,0 [.080] <input checked="" type="checkbox"/> 2,5 [.100] <input type="checkbox"/> 3,5 [.135] <input type="checkbox"/> 5,0 [.200] <input type="checkbox"/> 6,5 [.250] <input type="checkbox"/> >6,5 [.250] <input type="checkbox"/> Other: | <p>UL certified down to .020" on multilayer and .025" on double sided</p> <p>.125" limited by soldermask coater</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | Number Conductive Layers | <input type="checkbox"/> 1-4 <input type="checkbox"/> 5-6 <input type="checkbox"/> 7-8 <input checked="" type="checkbox"/> 9-12 <input type="checkbox"/> 13-16 <input type="checkbox"/> 17-20 <input type="checkbox"/> 21-24 <input type="checkbox"/> 25-28 <input type="checkbox"/> >28 <input type="checkbox"/> Other: | <p>Results of PCQR2 per IPC-9151 and IST per IPC-650 2.6.26 available upon request.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| | | | |
|---|--------------------------------|---|--|
| D | Dia Drilled Holes | <input type="checkbox"/> >0,5 [.020] <input type="checkbox"/> 0,5 [.020] <input type="checkbox"/> 0,4 [.016] <input type="checkbox"/> 0,35 [.014] <input type="checkbox"/> 0,30 [.012] <input checked="" type="checkbox"/> 0,25 [.010] <input type="checkbox"/> 0,20 [.008] <input type="checkbox"/> 0,15 [.006] <input type="checkbox"/> <0,15 [.006] <input type="checkbox"/> Other: | Mechanical drilled |
| E | Total PTH TOL (Max-Min) | <input type="checkbox"/> >0,250 [.010] <input type="checkbox"/> 0,250 [.010] <input type="checkbox"/> 0,200 [.008] <input checked="" type="checkbox"/> 0,150 [.006] <input type="checkbox"/> 0,125 [.005] <input type="checkbox"/> 0,100 [.004] <input type="checkbox"/> 0,075 [.003] <input type="checkbox"/> 0,050 [.002] <input type="checkbox"/> <0,050 [.002] <input type="checkbox"/> Other: | +/- .003" [.006"] is Calumet's minimum standard PTH TOL. [.005] and [.004] design-specific DFM Results of PCQR2 per IPC-9151 and IST per IPC-650 2.6.26 available upon request. |
| F | Hole Location TOL DTP | <input type="checkbox"/> >0,50 [.020] <input type="checkbox"/> 0,50 [.020] <input type="checkbox"/> 0,40 [.016] <input type="checkbox"/> 0,30 [.012] <input type="checkbox"/> 0,25 [.010] <input type="checkbox"/> 0,20 [.008] <input type="checkbox"/> 0,15 [.006] <input checked="" type="checkbox"/> 0,10 [.004] <input type="checkbox"/> <0,10 [.004] <input type="checkbox"/> Other: | |
| G | Internal Layer Clearance (Min) | <input type="checkbox"/> >0,350 [.014] <input type="checkbox"/> 0,350 [.014] <input type="checkbox"/> 0,250 [.010] <input type="checkbox"/> 0,200 [.008] <input type="checkbox"/> 0,150 [.005] <input type="checkbox"/> 0,125 [.005] <input checked="" type="checkbox"/> 0,100 [.004] <input type="checkbox"/> 0,075 [.003] <input type="checkbox"/> <0,075 [.003] | Hole to copper feature |

| | | | |
|---|--------------------------------------|--|---|
| | | <input type="checkbox"/> Other: | |
| H | Internal Layer Conductor Width (Min) | <input type="checkbox"/> >0,250 [.010] <input type="checkbox"/> 0,250 [.010] <input type="checkbox"/> 0,200 [.008] <input type="checkbox"/> 0,150 [.006] <input checked="" type="checkbox"/> 0,125 [.005] <input checked="" type="checkbox"/> 0,100 [.004] <input type="checkbox"/> 0,075 [.003] <input type="checkbox"/> 0,050 [.002] <input type="checkbox"/> <0,050 [.002] <input type="checkbox"/> Other: | Standard Special |
| J | Internal Layer Process Allowance | <input type="checkbox"/> >0,100 [.004] <input type="checkbox"/> 0,100 [.004] <input checked="" type="checkbox"/> 0,075 [.003] <input type="checkbox"/> 0,050 [.002] <input type="checkbox"/> 0,040 [.0015] <input type="checkbox"/> 0,030 [.0012] <input type="checkbox"/> 0,025 [.001] <input type="checkbox"/> 0,020 [.0008] <input type="checkbox"/> <0,020 [.0008] <input type="checkbox"/> Other: | Layer to layer registration, verified and registration using X-Ray Drill. |
| K | External Layer Clearance (Min) | <input type="checkbox"/> >0,350 [.014] <input type="checkbox"/> 0,350 [.014] <input type="checkbox"/> 0,250 [.010] <input type="checkbox"/> 0,200 [.008] <input type="checkbox"/> 0,150 [.006] <input checked="" type="checkbox"/> 0,125 [.005] <input type="checkbox"/> 0,100 [.004] <input type="checkbox"/> 0,075 [.003] <input type="checkbox"/> <0,075 [.003] <input type="checkbox"/> Other: | |

| | | | |
|---|--------------------------------------|---|--|
| L | External Layer Conductor Width (Min) | <input type="checkbox"/> >0,250 [.010] <input type="checkbox"/> 0,250 [.010] <input type="checkbox"/> 0,200 [.008] <input type="checkbox"/> 0,150 [.006] <input checked="" type="checkbox"/> 0,125 [.005] <input type="checkbox"/> 0,100 [.004] <input type="checkbox"/> 0,075 [.003] <input type="checkbox"/> 0,050 [.002] <input type="checkbox"/> <0,050 [.002] <input type="checkbox"/> Other: | |
| M | External Layer Process Allowance | <input type="checkbox"/> >0,100 [.004] <input type="checkbox"/> 0,100 [.004] <input checked="" type="checkbox"/> 0,075 [.003] <input type="checkbox"/> 0,050 [.002] <input type="checkbox"/> 0,040 [.0015] <input type="checkbox"/> 0,030 [.0012] <input type="checkbox"/> 0,025 [.001] <input type="checkbox"/> 0,020 [.0008] <input type="checkbox"/> <0,020 [.0008] <input type="checkbox"/> Other: | <p>Evaluated and controlled using the OLEC Accutray.</p> |
| N | Feature Location DTP | <input type="checkbox"/> >0,50 [.020] <input type="checkbox"/> 0,50 [.020] <input type="checkbox"/> 0,40 [.016] <input type="checkbox"/> 0,30 [.012] <input type="checkbox"/> 0,25 [.010] <input type="checkbox"/> 0,20 [.008] <input type="checkbox"/> 0,15 [.006] <input type="checkbox"/> 0,10 [.004] <input checked="" type="checkbox"/> <0,10 [.004] <input type="checkbox"/> Other: | |

All Dimensions are in millimeters [inches shown in brackets]

SECTION 2.5

QUALITY DEVELOPMENT

DATE COMPLETED
August 20, 2009

This section is intended to provide overview information on the quality systems in place in the manufacturing facility.
Calumet Electronic's Quality Management System ISO-9001:2000 certified; NSF registration number 14351-5.

Site Capability Snapshot (Please Check all that apply.)

| Designators | | | Remarks |
|-------------|----------------------|--|--|
| A | Strategic Plan | <input checked="" type="checkbox"/> Functional Steering Committee Formed <input checked="" type="checkbox"/> TQM Plan & Philosophy Established & Published <input checked="" type="checkbox"/> Documented Quality Progress Review <input checked="" type="checkbox"/> Implementation & review of Project Team Recommendations <input checked="" type="checkbox"/> TQM Communicated throughout organization <input checked="" type="checkbox"/> Controlled New process Start-up <input checked="" type="checkbox"/> Management Participates in TQM Audits <input checked="" type="checkbox"/> Employee Recognition Program <input type="checkbox"/> Total TQM Plan/Involvement Customer Training <input type="checkbox"/> Other: | Calumet Electronic's Quality Management System ISO-9001:2000 certified; NSF registration number 14351-5. |
| B | Employee Involvement | <input checked="" type="checkbox"/> Certified Training Available <input checked="" type="checkbox"/> Training of Employee Base <input checked="" type="checkbox"/> TQM Team Trained <input type="checkbox"/> Design of Experiment Training and Use <input checked="" type="checkbox"/> New Process Implementation Training <input checked="" type="checkbox"/> Support Personnel Training <input type="checkbox"/> Advanced Statistical Training <input type="checkbox"/> Quality Functional Deployment <input type="checkbox"/> Ongoing Improvement Program for Employees <input type="checkbox"/> Other: | |

| | | | |
|---|--------------------------------|---|---|
| C | Quality Manual | <input checked="" type="checkbox"/> Quality Manual Started <input checked="" type="checkbox"/> Generic Quality Manual for Facility <input type="checkbox"/> 10% of manufacturing depts. have process specifications <input type="checkbox"/> 25% of manufacturing depts. have process specifications <input checked="" type="checkbox"/> 50% of manufacturing depts. have process specifications <input type="checkbox"/> Non-manufacturing Manuals Developed <input type="checkbox"/> 25% of all departments have quality manuals <input type="checkbox"/> 50% of all departments have quality manuals <input checked="" type="checkbox"/> All Manufacturing and support depts. have controlled quality manual <input type="checkbox"/> Other: | |
| D | Instructions | <input checked="" type="checkbox"/> Work Instructions Started <input checked="" type="checkbox"/> Quality Instructions Started <input type="checkbox"/> 10% Work Instructions Completed <input type="checkbox"/> 10% Quality Instructions Completed <input type="checkbox"/> 25% Work Instructions Completed, Controlled <input type="checkbox"/> 25% Quality Instructions Completed, Controlled <input type="checkbox"/> 50% Work Instructions Completed, Controlled <input type="checkbox"/> 50% Quality Instructions Completed, Controlled <input checked="" type="checkbox"/> Quality and work Instruct. Completed, Controlled <input checked="" type="checkbox"/> Other: 95% AS9100 Quality instructions complete. Undergoing upgrade to AS9100. Some documentes need completing. | Complete set of quality and work instructions to ISO and MIL specs. |
| E | SPC Implementation IPC-PC-9191 | <input checked="" type="checkbox"/> Plan Exists <input checked="" type="checkbox"/> Training Started <input checked="" type="checkbox"/> Process Data Collected & Analyzed <input type="checkbox"/> All Employees Trained <input type="checkbox"/> First Process Stable & Capable <input checked="" type="checkbox"/> Several Major Processes Stable & Capable <input checked="" type="checkbox"/> Continued Improvement of Stable Processes <input checked="" type="checkbox"/> Additional Mfg Processes under Control <input type="checkbox"/> All Processes Under Control <input type="checkbox"/> Other: | Lotus Notes used in conjunction with Excel and MiniTab. Paradigm charting utilized. |
| F | Supplier Programs/Controls | <input checked="" type="checkbox"/> Supplier Rating Program <input type="checkbox"/> Monthly Analysis Program <input checked="" type="checkbox"/> Key Problems Identified <input checked="" type="checkbox"/> Supplier Reviews Performance Data provided <input type="checkbox"/> TQM Acceptance by suppliers <input type="checkbox"/> 10% of Suppliers Using SPC <input checked="" type="checkbox"/> 25% of Suppliers Using SPC <input type="checkbox"/> 50% of Suppliers Using SPC | Quarterly analysis and feedback to most critical suppliers. |

| | | | |
|---|-----------------------|---|---------------------|
| | | <input checked="" type="checkbox"/> All Key Suppliers using Certified parts program <input type="checkbox"/> Other: | |
| G | Third Party IPC-QS-95 | <input type="checkbox"/> Instrument Controls in Place <input type="checkbox"/> Measurement System in Control IPC-PC-90 <input type="checkbox"/> Document Controls in Place <input type="checkbox"/> Reduced Lot Sampling <input type="checkbox"/> 10% of Processes Under Audit Control <input type="checkbox"/> 50% or Greater of Processes Under Audit Control <input type="checkbox"/> ISO-9003 Certified <input type="checkbox"/> ISO-9002 Certified <input checked="" type="checkbox"/> ISO-9001 <input type="checkbox"/> Other: | ISO# <u>14351-5</u> |

SECTION 3

EQUIPMENT PROFILE (Pre-Site Audit)

DATE COMPLETED
August 20, 2009

* Examples of equipment limitations include:
min/max board size & min/max working area

| 3.1 PHOTOTOOL CAPABILITY | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|---|-------------------------------------|-------------------------------------|---------------------------------------|-----|------------------|
| A) AOI of phototool | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) AOI CAD reference (CAM) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Frontline Genesis, Orbotech Discovery | 3 | |
| C) Photoplotting | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Orbotech LP9008IUS | 1 | |
| D) Photo reductions | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| E) Film scan and conversion | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| F) Film processing <input type="checkbox"/> air-dried <input type="checkbox"/> force-dried <input checked="" type="checkbox"/> processed in automatic processor | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Glunz & Jensen MP72 | 1 | |
| G) Media types <input checked="" type="checkbox"/> silver halide film <input type="checkbox"/> glass <input type="checkbox"/> diazo | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |

| 3.2 DRILLING EQUIPMENT | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|-----------------------------|-------------------------------------|-------------------------------------|----------------------------------|-----|-----------------------------|
| A) Manual | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Optical (single spindle) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | X-Ray Drill, Pluritec Inspecta L | 1 | |
| C) N.C. drill | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Hitachi Drill machines | 7 | See attached equipment list |

| 3.3 ROUTING EQUIPMENT | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|-----------------------------|-------------------------------------|-------------------------------------|-----------------------------|-----|-----------------------------|
| A) Edge beveler | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Radoll Designs Edgemate 045 | 1 | |
| B) Hand router (pin router) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) N.C. router | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Hitachi routers | 3 | See attached equipment list |

| | | | | | |
|----------------------------|-------------------------------------|-------------------------------------|------------------|---|-----------------------------|
| | | | Excellon routers | 4 | |
| D) N.C. driller/router | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| E) Scoring (profile) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| F) Scoring (straight line) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Accusystems | 2 | See attached equipment list |

| 3.4 MECHANICAL EQUIPMENT | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--------------------------|-------------------------------------|-------------------------------------|---------------------------|-----|------------------|
| A) Punch press | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Shear | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Famco Electric Sheer 1452 | | |
| C) Milling machine | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |

| 3.5 HOLE PREPARATION (DESMEAR) | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--------------------------------|-------------------------------------|-------------------------------------|-------------------------------|-----|------------------|
| A) Permagnate | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Circuit Chemistry Equipment | | |
| B) Plasma | <input checked="" type="checkbox"/> | <input type="checkbox"/> | March Plasma Systems, PCB-800 | | |
| C) Mechanical | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| D) Etchback | <input checked="" type="checkbox"/> | <input type="checkbox"/> | March Plasma Systems, PCB-800 | | |

| 3.6 PRIMARY IMAGE APPLICATION | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|-------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|--------|------------------|
| A) Dry film | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Morton CSL 1500b Morton CSL 1500d | 1 1 | |
| B) Hand screening | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Machine screening | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| D) Wet film | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| E) Liquid photoimageable | <input type="checkbox"/> | <input type="checkbox"/> | | | |

| 3.7 TYPE OF TREATMENT FOR MULTILAYER INNERLAYERS | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--|-------------------------------------|-------------------------------------|-----------------------|-----|------------------|
| A) Black oxide | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Red oxide | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Copper scrub | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| D) Durabond | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| E) Other | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Double treat material | | |

| 3.8 LAMINATION | YES | NO | MATERIAL | QTY | APPLICATION TECHNIQUE |
|-----------------------|-------------------------------------|-------------------------------------|-----------|-----|-----------------------|
| A) High pressure | <input checked="" type="checkbox"/> | <input type="checkbox"/> | TMP Press | 2 | |
| B) High temperature | <input checked="" type="checkbox"/> | <input type="checkbox"/> | TMP Press | 2 | |
| C) Vacuum | <input checked="" type="checkbox"/> | <input type="checkbox"/> | TMP Press | 2 | |
| D) Vacuum assist | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| E) Foil heat assist | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| F) Separate cool-down | <input checked="" type="checkbox"/> | <input type="checkbox"/> | TMP Press | 2 | |

| 3.9 ELECTROLESS COPPER PLATING | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--|-------------------------------------|-------------------------------------|---|-----|------------------|
| A) Fully additive application | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Electroless deposition (semiadditive) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Circuit Chemistry Equipment PolaMassa Deburr, high pressure rinse | 1 | |
| C) Through-hole and via | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Circuit Chemistry Equipment PolaMassa Deburr, high pressure rinse | 1 | |

| 3.10 COPPER ELECTROPLATING | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|----------------------------|-------------------------------------|-------------------------------------|---|-----|------------------|
| A) Copper sulfate | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Process Automation International (PAL) | 2 | |
| B) Pyrophosphate | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Copper fluoborate | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| D) Other | <input type="checkbox"/> | <input type="checkbox"/> | | | |

| 3.11 TIN/LEAD SURFACE PLATINGS/COATINGS | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--|-------------------------------------|-------------------------------------|---------------------------------------|-----|------------------|
| A) Tin/lead electroplated | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Immersion tin or tin/lead (electroless) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Other | <input checked="" type="checkbox"/> | <input type="checkbox"/> | CEMCO Quicksilver lead-free solder | 1 | |

| 3.12 FUSING PROCESSES | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|-------------------------------|--------------------------|-------------------------------------|-----------|-----|------------------|
| A) I.R. reflow | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Hot oil reflow | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Horizontal (hot air level) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |

| | | | | | |
|-----------------------------|--------------------------|-------------------------------------|--|--|--|
| | | | | | |
| D) Vertical (hot air level) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |

| 3.13 NICKEL SURFACE PLATING | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|-----------------------------|-------------------------------------|--------------------------|-----------------------------|-----|------------------|
| A) Electroless nickel | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Intergrated Process Systems | 1 | |
| B) Electroplated nickel | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Technic gold tab line | 1 | |

| 3.14 GOLD SURFACE PLATING | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|---------------------------|-------------------------------------|--------------------------|---|-----|------------------|
| A) Electroless gold | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Immersion gold, Intergrated Process System, Uyemura | 1 | |
| B) Electroplated gold | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Technic gold tab line | 1 | |

| 3.15 PALLADIUM SURFACE PLATING | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--------------------------------------|--------------------------|-------------------------------------|-----------|-----|------------------|
| A) Electroless palladium (immersion) | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Electroplated palladium | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |

| 3.16 SOLDERMASK | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--------------------------------|-------------------------------------|-------------------------------------|---------------------------|-----|--------------------|
| A) Screened deposited image | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Dry film photoimageable | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Liquid photoimageable | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Circuit Automation DP1500 | 3 | See equipment list |
| D) Dry film/liquid combination | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |

| 3.17 ORGANIC SURFACE PROTECTION | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|---------------------------------|--------------------------|-------------------------------------|-----------|-----|------------------|
| A) Benzotriazole | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| B) Imidazole | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |
| C) Benzimidazole | <input type="checkbox"/> | <input checked="" type="checkbox"/> | | | |

| 3.18 MICROSECTION CAPABILITY | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|-------------------------------|-------------------------------------|--------------------------|-------------------|-----|------------------|
| A) Manual | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |
| B) Single cavity automated | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Buehler Ecomet IV | | |
| C) Multiple cavity automated | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |
| D) Plating thickness analysis | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |

| | | | | | |
|--|--|--|--|--|--|
| | | | | | |
|--|--|--|--|--|--|

| 3.19 CHEMICAL ANALYSIS | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|----------------------------|-------------------------------------|--------------------------|--|-----|------------------|
| A) Etching chemistry | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |
| B) Plating chemistry | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |
| C) Effluent (PPM) analysis | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Perkinelmer Atomic Absorption Spectrometer | | |

| 3.20 ELECTRICAL TEST EQUIPMENT | YES | NO | EQUIPMENT | QTY | EQUIPMENT LIMITS |
|--------------------------------|-------------------------------------|--------------------------|----------------------------------|-----|------------------|
| A) Continuity and shorts | <input checked="" type="checkbox"/> | <input type="checkbox"/> | TTI Fixture Tester | 4 | |
| B) Fixture development | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | | |
| C) Flying probe test | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Microcraft Flying Probe Machines | 5 | |
| D) Impedance control | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Polar Instruments CITS500S4 | | |