Making the Most of UL PCB Recognition

Presented by Emma Hudson BEng (Hons)

ICT Arundel Evening Seminar – 1st March 2011
What we will cover this evening

PCB Recognition Categories

Material additions to existing boards
- CCIL Programme
- Permanent Coatings Programme
- How to tell if materials can be added to your boards through these programmes

Making the most of your UL Recognized boards
- Initial Recognition
- Materials Purchasing
- PCB Sales
PCB Recognition

Categories PCBs are Recognized in –

• Single-Layer* Rigid
• Multi-Layer Rigid
• Mass-Laminate Multi-Layer
• Metal-Based
• High Density Interconnect (HDI)

Section in UL796 dedicated to Embedding Components

• Flex / Flex-Rigid
  • Single or Multi-Layer
  • Flex, Flex-to-install, or Rigid
  • Construction and Application categorisation

* Single-layer boards = single-sided and PTH = no internal conductor layers, single layer of dielectric material
PCB Recognition

Two types of Recognition –

• Full-Recognition
  • 6 – 12 weeks to complete Certification from receiving samples

• Flame-Only Recognition
  • 6 weeks to complete Certification from receiving samples

End-product Standard will define which Recognition is required for PCB

Also, End-Product Specific Program
• Test production board
• Limited to that board design only
Reduced / No-Test Programmes Available for Adding Materials to Recognized Boards –

- **MCIL / CCIL* Programme**
  - For addition of laminate and laminate/prepreg packages to existing boards
  - Metal-clad laminate parameters need to be equal or more severe than PCB being added to
  - Can add single-layer materials without testing
  - Can add multi-layer materials through delamination-only testing
  - Can add multi-layer core materials to HDI boards through delamination-only testing

* MCIL – metal clad industrial laminate, CCIL – copper clad industrial laminate
## CCIL Program – How to do a Comparison

### Single-layer PCB

<table>
<thead>
<tr>
<th>PCB Type</th>
<th>UL/ANSI</th>
<th>Min. Thk. (mm)</th>
<th>Dir Sup</th>
<th>Cu Thk. (μm)</th>
<th>SS/DS/ML</th>
<th>Mfrg. Proc.</th>
<th>Min. Width (mm)</th>
<th>Max. Diam. (mm)</th>
<th>Min Edge Width (mm)</th>
<th>Solder Limits (°C/sec)</th>
<th>MOT (°C)</th>
<th>UL 94 Flame</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCB A</td>
<td>FR-4</td>
<td>0.38</td>
<td>Y</td>
<td>E: 9 – 102</td>
<td>DS</td>
<td>1</td>
<td>0.075</td>
<td>127.0</td>
<td>0.075</td>
<td>288/20</td>
<td>130</td>
<td>V-0</td>
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</tbody>
</table>

### Requested Laminate

| Laminate A | FR-4 | 0.38 | Y | E: 5 – 102 | DS | — | — | 50.8 | — | 150/300, 200/60, 290/30 | 130 | V-0 |
| Laminate B | FR-4 | 0.63 | Y | E: 9 – 102 | DS | — | — | 50.8 | — | 150/300, 200/60, 290/10 | 130 | V-0 |

**Recognized copper clad thickness of this laminate is thicker than that required (may still be able to add this material if unclad thickness is suitable)**

**Solder Limits do not have a maximum time AND maximum temperature equal to the solder limits of the PCB. Can still be added to PCB but full testing would be required**

The largest maximum area diameter Recognized for a laminate is 50.8mm (2”) – this is considered representative for larger maximum area diameters on the PCB.
CCIL Program – How to do a Comparison

<table>
<thead>
<tr>
<th>PCB Type</th>
<th>Min. Build-Up Thk. (mm)</th>
<th>Dir Sup</th>
<th>Cu Thk. (μm)</th>
<th>SS/DS/ML</th>
<th>Mfrg. Proc.</th>
<th>Min. Width (mm)</th>
<th>Max. Diam. (mm)</th>
<th>Min Edge Width (mm)</th>
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<th>MOT (°C)</th>
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<td>PCB C</td>
<td>GPY 0.38 E: 12 - 135 I: 102 ML 2 0.050 127.0 0.150</td>
<td>150/300, 200/60, 290/20</td>
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<tr>
<td>Laminate X / Prepreg X1</td>
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<tr>
<td>Laminate Y / Prepreg Y1</td>
<td>FR-4 0.38 Y E: 9 - 210 I: 210 ML — — 50.8 —</td>
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</table>

Can only use abbreviated test programs when ANSI grades are the same

MOT of metal clad Multi-layer material is less than PCB. Cannot use CCIL for addition. If unclad material has min electrical / mechanical RTIs of 130 / 130 then may conduct full testing to add – recommend against mixing different UL/ANSI materials under the same board type.
How to Find the Data to do a CCIL Comparison

Use the UL iQ Database, a searchable version of the Listing Cards –
How to Find the Data to do a CCIL Comparison

![UL IQ for Printed Wiring Boards](image)

**Laminate category:** Metal clad ratings

**Type:** Industrial Laminates

**ANSI Type:** n/a

**Minimum Build up (mm):**

**Electrical RTI (C):** n/a

**Mechanical RTI (C):** n/a

**Flame Class:** equal to n/a

**Hot Wire Ignition (HWI):** n/a

**High Arc Ignition (HAI):** n/a

**High Voltage Tracking (HVT):** n/a

**Comparative Tracking Index (CTI):** n/a

**Additional Information:**
- n/a
- additionally certified in accordance with Canadian National requirements

Click **Search** to proceed.
How to Find the Data to do a CCIL Comparison

ULiQ for Printed Wiring Boards

181 products met the selected criteria (click on a product to see the complete listing)

181 products met the selected criteria (click on a product to see the complete listing)
# How to Find the Data to do a CCIL Comparison

<table>
<thead>
<tr>
<th>Mill Bag</th>
<th>ASMI Type</th>
<th>AllSI Min</th>
<th>Buildup (microns)</th>
<th>Cond Min</th>
<th>Cond Ext (microns)</th>
<th>Cond Max</th>
<th>Cond Int (microns)</th>
<th>Cond Max</th>
<th>Flame Class</th>
<th>Max Op Temp (°C)</th>
<th>Sealer Temp (°C)</th>
<th>Sealer Time (sec)</th>
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How to Find the Data to do a CCIL Comparison

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<tr>
<th>GRACE ELECTRON CORP</th>
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<tbody>
<tr>
<td>12TH FL 69 SEC 3 MINSHENG E RD, ZHONGSHAN DISTRICT, TAIPEI 104 TW</td>
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<tr>
<td>GA-150-LL</td>
</tr>
<tr>
<td>Metal clad industrial laminates for use in multilayer printed wiring boards with copper on one or both sides furnished as sheets</td>
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<th>Unclad Dsg</th>
<th>Propreg Dsg</th>
<th>ANSI Type</th>
<th>Build Up Min Thk (mm)</th>
<th>Cond Min Ext (mic)</th>
<th>Cond Max Ext (mic)</th>
<th>Cond Max Int (mic)</th>
<th>Max Area Diam (mm)</th>
<th>Max Oper Temp (C)</th>
<th>Flame Temp (C)</th>
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Report Date: 1997-07-24
Last Revised: 2010-07-07

Underwriters Laboratories Inc®

IEC and ISO Test Methods

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<tr>
<th>Test Name</th>
<th>Test Method</th>
<th>Units</th>
<th>Thickness Tested (mm)</th>
<th>Value</th>
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<td>Class (color)</td>
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Underwriters Laboratories Inc®

UL, the standard in safety
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p/12
How to Make the Most of the Material Recognitions

Reduced / No-Test Programmes Available for Recognized Boards –

• **Permanent Coatings Program**
  • Solder resist additions to existing boards
  • Recognized solder resist to have equal or more severe parameters than PCB being added to
  • No testing to add to single or multi-layer boards
Permanent Coatings Program – How to do a Comparison

<table>
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<tr>
<th>PCB Type</th>
<th>FR/ANSI</th>
<th>Min. Thk. (mm)</th>
<th>Dir Sup</th>
<th>Cu Thk. (μm)</th>
<th>SS/DS/ML</th>
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<td>288/20</td>
<td>130</td>
<td>V-0</td>
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<tr>
<td>Requested Solder Resist:</td>
<td>FR/ANSI</td>
<td>Min. Thk. (mm)</td>
<td>Coating Thk</td>
<td>Colours</td>
<td>Solder Limits (°C/sec)</td>
<td>UL 94 Flame</td>
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<tr>
<td>Resist X</td>
<td>FR-4</td>
<td>0.63</td>
<td>15 - 50μm</td>
<td>GN</td>
<td>277/30</td>
<td>V-0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resist Y</td>
<td>FR-4</td>
<td>0.38</td>
<td>10 - 60μm</td>
<td>ALL</td>
<td>290/20</td>
<td>V-0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Solder resist X has only been tested on a minimum dielectric thickness of 0.63mm when the PCB we are adding it to has a minimum thickness of 0.38mm. Cannot add through Permanent Coatings Program – Flame testing required.

Solder resist X has only been tested using solder limits of 277°C for 30 seconds. Although time meets requirements maximum temperature does not, targeting 288 °C. Cannot add through Permanent Coatings Program – Flame testing required.
How to Find the Data to do a Permanent Coatings Comparison

UL iQ for Printed Wiring Boards

Search for: Coatings for Printed Wiring Boards

<table>
<thead>
<tr>
<th>Coating Type: Resist</th>
<th>Company Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame Class: V-0</td>
<td>Country: CN</td>
</tr>
<tr>
<td>Min. Laminant Thick (mm): 0.38</td>
<td>Max. solder Temp (C): 288</td>
</tr>
<tr>
<td>ANSI Type: FR-4</td>
<td>Solder Time (sec): 20</td>
</tr>
</tbody>
</table>

*Coatings recognized for use with FR-4 and FR-4 materials are considered suitable for use with CEM-1 and CEM-3 materials.

S79 products met the selected criteria (click on a product to see the complete listing)

<table>
<thead>
<tr>
<th>Coating Type</th>
<th>Min. Thickness (mm)</th>
<th>Max. Thickness (mm)</th>
<th>Flame Class</th>
<th>ANSI Type</th>
<th>Laminant Min. (mm)</th>
<th>Solder Temp (C)</th>
<th>Solder Time (sec)</th>
<th>IQ Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCE MATERIALS CORP (E218000) Taiwan</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>288</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>LSY-755/5-700</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>288</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>P85-200L-1.6-50B</td>
<td>15</td>
<td>35</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>288</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>P85-100L-1.6-50B</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>288</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>SR 4900/CA-10</td>
<td>8</td>
<td>50</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>288</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>AJINOMOTO FIRE-TECHNOL CO INC (E166114)</td>
<td>8</td>
<td>50</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>KIKK-200H-714</td>
<td>8</td>
<td>50</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>KT-3800K-2C</td>
<td>5</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>KT-3800K-3</td>
<td>5</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.38</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>AIRAN SHENG ELECTRONIC MATERIAL CO LTD (E254155) China</td>
<td>10</td>
<td>35</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.33</td>
<td>288</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>APS-A065/APS-A050</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>BAI-CHEN RESEARCH LABORATORY (E68000) Japan</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>DB-206/BU-20 Additive</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>CCR-239/4 No. 6/CCR-232 Additive</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>DPR-805B/945-8050 Additive</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>DPR-800K C</td>
<td>8</td>
<td>60</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>DPR-8100</td>
<td>25</td>
<td>70</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.29</td>
<td>250</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

The UL, the standard in safety.
How to Find the Data to do a Permanent Coatings Comparison

Coatings for Use on Recognized Printed Wiring Boards - Component

SUN CHEMICAL CIRCUITS
NORTON HILL, MIDSORER NORTON, BATH SOMERSET BA3 4RT GB

XV501T-4 Series A
Resist coatings for use on Recognized printed wiring boards, furnished as: two component liquid

<table>
<thead>
<tr>
<th>Color</th>
<th>Min Thk</th>
<th>Max Thk</th>
<th>Coating Flame</th>
<th>Coating ANSI Type</th>
<th>Laminate Min Thk</th>
<th>Laminate Temp</th>
<th>Solder Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>GN</td>
<td>15</td>
<td>50</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.30</td>
<td>288</td>
<td>30</td>
</tr>
<tr>
<td>ALL</td>
<td>15</td>
<td>55</td>
<td>V-0</td>
<td>FR-4</td>
<td>0.63</td>
<td>288</td>
<td>30</td>
</tr>
</tbody>
</table>

Report Date: 1988-08-11
Last Revised: 2007-11-28
Underwriters Laboratories Inc®

IEC and ISO Test Methods

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Test Method</th>
<th>Units</th>
<th>Laminate/Coating Thickness (mm/mic)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammability</td>
<td>IEC 60695-11-10</td>
<td>Class (color)</td>
<td>0.30/15</td>
<td>V-0 (GN)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.63/15</td>
<td>V-0 (ALL)</td>
</tr>
</tbody>
</table>

Underwriters Laboratories Inc®
How to Make the Most of the Material Recognitions

Reduced / No-Test Programmes Available for Recognized Flex Boards –

• Polyimide ANSI-Like Program
  • PI films used with same adhesive already evaluated for construction in combination with a PI film and used within PI Recognition limits
    • For addition to flame-only Recognized boards = no testing
    • For addition to full Recognition boards = reduced testing
Additional Ways to Minimise Testing

Multi-layer boards can be considered representative for Single-Layer boards providing –

- Multi-layer board has more severe or equal parameters than the single-layer board (inc. UL/ANSI grade)
- Multi-layer board manufacturing process is equal or more severe than single-layer board manufacturing process (post lamination)

Can reduce sample numbers / test programme
How to make the most of UL Recognition

From the Perspective of –

• PCB Manufacturer
  • Initial Recognition
  • Materials purchasing
  • PCB Sales
How to make the most of UL Recognition

PCB Manufacturer – Initial Recognition Process

• Create boards that cover your customer needs and are competitive with the competition

• Consider creating boards where testing can be minimised in the future
  • Can single and multi-layer boards employ same key parameters and process?
  • Do the parameters of the board permit the reduced / no-test programmes to be used?
How to Check the Competition’s Recognition
How to make the most of UL Recognition

PCB Manufacturer – Materials Purchasing

• Find materials that can be added with reduced or no-testing
  • Less / no samples to make, so less line-time taken-up
  • Project costs reduced for CCIL / Permanent Coating Programme additions
  • Quicker to add when no testing is involved

• If the material you want to use does not have parameters that permit addition through these programmes let your supplier know
  • By highlighting the benefits of these programmes to your material suppliers they know the value they bring to you
How to make the most of UL Recognition

PCB Manufacturer – PCB Sales Team

• UL Recognition is a selling point – not all PCB manufacturers have this and many end-product manufacturers need it

• Understand what the UL Recognition is, so you can highlight the safety aspect and the benefits this Certification brings

• Add a link to your UL Listing Card on your company website to highlight your Safety Certification

• Use the UL Listing Cards to find potential customers.
  • The majority of UL Listed products will need Recognized PCBs
How to Find UL Listed Products

[Image of UL Online Certifications Directory search interface]

- Begin a basic search by entering one or more search criteria in the parameters below:
  - Company Name (options)
  - City
  - US State
  - US Zip Code
  - Country
  - Region
  - Postal Code (non-US)
  - UL Category Code (options)
  - UL File Number (help)
  - Keyword

- Search tips:
  - Select a search method

- Specific searches:
  - Select a specific search:

- Featured links:
  - UL Alarm Services Search
  - UL Code Correlation Database

- Links of interest:
  - UL Family of Databases
  - ULC Online Directories
  - Code Correlation Database
  - UL Search Tools

- Online Certifications Directory:
  - Quick Guide
  - Contact Us
  - UL.com

- About the Online Certifications Directory:
  - Verify a UL Listing, Classification, or Recognition
  - Verify a UL Listed product use
  - Verify a UL Recognized component use
  - Verify a product safety standard

Learn more with the Quick Guide to the Online Certifications Directory.
How to make the most of UL Recognition

PCB Purchaser / User –

• **Understand what the end-product requirements are for the PCB**
  • This information allows you to find which companies have the appropriate Recognition

• **Use UL Recognized boards for non-US products**
  • You know the UL mark means independent Safety evaluation and continuous monitoring of your supplier

• **If concerned about “airmiles” of components, can identify Recognized PCB manufacturers local to you**
  • UL files can contain multiple manufacturing locations, all will be treated the same under our Safety evaluation and continuous monitoring programmes, but if location is important then ask the supplier
How to Find the Recognized PCB you Need

UL iQ for Printed Wiring Boards

- Construction Type: n/a
- Flame Class: n/a
- Max Operating Temperature (C): n/a
- Comparative Tracking Index (CTI): n/a
- Meets UL 796 DSR: n/a
- Company Name: n/a
- Country: n/a
- Conductor Attributes:
  - Min Width
  - Min Edge
  - Max Area

- Max Solder Temp (C): n/a
- Solder Time (sec): n/a
- show multiple solder limits only

* additionally certified in accordance with Canadian National requirements

* A triangle symbol is marked on those products within a given type designation that comply with direct support of current-carrying parts performance level requirements of UL 796. "M" is used to indicate that all base materials under that type designation comply with direct support of current-carrying parts performance level requirements of UL 796.
Summary

• Make the most of the CCIL & Permanent Coatings programmes for making material additions = less work, lower cost!

• Make the most of the UL iQ database for –
  • Finding materials that can be added through the reduced / no-test programmes
  • Checking your competitors Recognition
  • Sourcing PCBs with the parameters you need

• Make the most of the UL Listing Cards for finding companies who need UL Recognized PCBs
Useful Web Addresses

UL iQ Database
http://www.ul.com/iq

UL Listing Cards
http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm

UL Pre-Certification Projects
Thank-you!