








<b>Quality Management System</b>			<b>Procedure #</b>	<b>Rev</b>
			QC-2280-1	O
<b>Procedure Title</b>			<b>Pages</b>	<b>Date</b>
Copper Clad Laminate, Pre-Preg, and Metal Cladding			9	
<b>Division Manager</b>	<b>Director of Engineering</b>	<b>Process Engineer</b>	<b>Director of Quality</b>	<b>QMS</b>
				
<b>Initiated by</b>		<b>Rev</b>	<b>Researched by</b>	<b>Date</b>
Gary Robertson		M	Gary Robertson	04/10/12
		N	Gary Robertson	04/08/13
		O	Gary Robertson	04/11/14

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1 SCOPE

1.1 This specification establishes the basic requirements for clad and unclad laminate, prepreg and metal cladding used in the manufacture of printed circuit boards.

2 PRECEDENCE

2.1 Should a conflict arise between the purchase order and this specification, the purchase order will always take precedence.

3 SPECIFICATIONS

3.1 IPC-4101

3.2 IPC-4562

3.3 IPC-EG-140

4 LAMINATE

4.1 For the purpose of this specification and to differentiate thickness tolerance classes the following applies;

4.1.1 Multilayer core material is defined as laminate that is equal to or less than .039" thick.

4.1.2 Rigid material (double-side material) is defined as laminate thicker than .039" thick.

4.2 All materials shall meet the requirements of this specification and IPC-4101, or equivalent IPC standards.

4.3 All materials shall be flame retardant and meet requirements of UL 94-VO. The reinforcement fabric will be constructed according to IPC EG-140.

4.4 Approved suppliers and material systems are listed on the AVL.

4.5 The nominal base thickness will be specified on the purchase order.

4.5.1 Multilayer core material nominal thickness will not include the base copper.

4.5.2 Rigid material (laminate greater than .039" thick) nominal thickness will include the copper and construction will be adjusted by the manufacturer to meet specified thickness.

4.6 Grade of pits and dents: All laminates shall be manufactured to a minimum grade "B" surface quality.

4.7 No water marks are allowed in laminate.

4.8 Thickness tolerances:

4.8.1 Multilayer core materials shall meet class IPC-4101 "C" thickness tolerance requirements.

4.8.2 Rigid materials shall meet class IPC-4101 "B" thickness tolerance requirements.

4.9 Laminate construction shall be according to the following table unless otherwise specified on purchase order.

4.9.1 Purchase orders for material less than .0090 are single ply construction

unless specified on the Purchase Order as 2 Ply construction.

Laminate Thickness	S-PLY	M-PLY	Thickness Tolerance +/-
.002	1-106		.0005
.0025	1-1080		.0005
.003	1-2113	2-106	.0005
.0035	1-2113		.0005
.004	1-2116	1-106, 1-1080	.0005
.0045	1-2116	1-106, 1-1080	.0005
.005	1-1652	2-1080	.0007
.0055		1-1080, 1-2113	.0007
.006		2-2113	.0007
.007	1-7628	2-2113	.0007
.0075		1-2113, 1 -2116	.0007
.008	1-7628	2-2116	.001
.009		2-2116	.001
.010		2-1652	.001
.010		2-2116	.001
.011		2-2116, 1-1080	.001
.011		2-1080, 1-2116	.001
.012		2-1080, 1-7628	.001
.013		3-2116	.0015
.014		2-7628	.0015
.0145		2-2113, 1-7628	.0015
.015		2-7628	.0015
.016		2-7628, 1-1080	.0015
.017		2-7628, 1-1080	.0015
.018		2-7628, 1-2116	.0015
.018		2-7628, 1-2113	.0015
.020		3-7628	.0015
.021		3-7628	.002
.022		3-7628	.002
.024		3-7628, 1-2116	.002
.026		2-1080, 3-7628	.002
.028		4-7628	.002
.030		4-7628, 1-1080	.002
.031		4-7628, 1-1080	.002
.032		4-7628, 1-2116	.003

.034		5-7628	.003
.036		5-7628	.003
.037		5-7628	.003
.038		5-7628	.003
.039		5-7629	.003
.039		5-7628, 1-2116	.003
.043		6-7628	.005
.044		6-7628	.005
.047		7-7628	.005
.047		6-7628, 2-1080	.005
.059		8-7628	.005
.059		7-7628, 1-2116	.005
.062		8-7628	.005
.062		9-7628	.005

Grain Direction Requirements: (grain is underlined)

**LAMINATE**

- 24 x 18                      24.5 x 18.5
- 24 x 21                      24.5 x 21.5
- 21 x 27                      21.5 x 27.5
- 24 x 27
- 24 x 31
- 24 x 36

- 4.10 All laminate shall include a certificate of conformance as well as a Laminate Test Report for each lot of material received at TTM.
- 4.11 Rigid and multilayer core material must be cut to specified panel size with a diamond saw or edge beveled.
  - 4.11.1 Core material must not be sheared to size.

**5 METAL CLADDING**

- 5.1 Copper foil shall be according to IPC-4562.
  - 5.1.1 Standard treatment and HP or Poly-treated.
- 5.2 Rigid materials will be supplied with Type C, electrodeposited, standard elongation copper foil, Type C, SHINY side out.
- 5.3 Multilayer core materials will be supplied with Type S, reverse treated (RTF) electrodeposited, high temperature elongation (HTE) copper foil.
- 5.4 Outer Copper foils for multilayer panels will be type H, electrodeposited, HTE, grade 3, whether they are supplied as separate sheets or bonded to separator sheets.

5.5 Thickness tolerances, by weight, shall be Class 1, +/- 10% of nominal.

## 6 PRE-PREG

- 6.1 Pre-preg materials shall consist of a layer of impregnated glass fabric, advanced to the B-stage.
- 6.2 Unless otherwise specified the Pre-Preg material will be according to IPC-4101 specification slash sheet.
- 6.3 Parameters shall be according to standard manufacturing unless otherwise noted on purchase order or purchaser agreement.
- 6.4 Pre-preg for all panel sizes shall be punched according to PO requirements with a Multiline or Qualitek tooling pattern.
- 6.5 Pre-preg Quality: Pre-preg should be free from wrinkles, tears or fracturing, contamination or dry areas, which could lead to product defects.
- 6.6 Grain Direction: unless noted in purchase order, all cut panels and prepreg shall have grain direction (warp) as follows:
  - 6.6.1 18.5 x 24.5, 21.5 x 24.5: shortest dimension of the panel for FR4 140 and 170 deg Tg material only.
  - 6.6.2 All other materials and panel sizes will have the grain in the longest length unless otherwise specified.

## 7 CERTIFICATION OF CONFORMANCE

- 7.1 All Laminate suppliers will provide a monthly summary demonstrating that the manufactured lots for each core thickness have a minimum CPK of 1, for materials supplied to TTM.
- 7.2 All Pre-Preg supplies will provide a monthly summary demonstrating that the manufactured lots for each fabric style have a minimum CPK of 1, for materials supplied to TTM,.
- 7.3 Foil supplier shall provide certificates of conformance with each lot regarding the compliance to IPC-4562 for the particular grade of foil.
- 7.4 Certificates of conformance must accompany each order.
  - 7.4.1 Test reports must accompany each cert.
- 7.5 Laminate certificates must include at least the following:
  - 7.5.1 Material designation per IPC-4101
  - 7.5.2 Size
  - 7.5.3 Grain direction
  - 7.5.4 Quantity
  - 7.5.5 Purchase order number
  - 7.5.6 Date of manufacture
  - 7.5.7 Lot number
  - 7.5.8 Construction
  - 7.5.9 Foil manufactures
- 7.6 Pre-preg certifications must include at least the following:
  - 7.6.1 Material designation per IPC-4101.
  - 7.6.2 Size

- 7.6.3 Grain direction
- 7.6.4 Quantity
- 7.6.5 Purchase order number
- 7.6.6 Date of manufacture
- 7.6.7 Lot number
- 7.6.8 Resin content %
- 7.6.9 Scaled flow press thickness
- 7.6.10 Gel time
- 7.6.11 Melt Viscosity
- 7.7 Unless otherwise specified, testing will be done at vendor's normal frequency, using test methods per IPC-TM-650, or IPC-4101, as appropriate. All prepregs shall carry a warranty for 180 days from the manufacturing date provided the material is stored in the proper conditions of 68 deg. F. +/- 5 deg. F as stated in IPC-4101. Prepreg received by TTM will have a minimum of 90 days from the date of arrival at TTM.

8 SHIPPING QUANTITY, PACKAGING, AND LABELING

- 8.1 The acceptable deviation from order quantity for shipment is **-0% / +10%**
- 8.2 Only one lot of material may be included in each box or package.
- 8.3 LAMINATE:
  - 8.3.1 Pre-cut panels: Cut laminate panels shall be shrink wrapped without interleaving.
  - 8.3.2 Cut panels and sheets shall be according to the following table:

Core / Rigid Material Thickness Range	Maximum Quantity Per Box
.004 to .035	500 pcs.
.036 to .059	400 pcs.
.062 and greater	300 pcs.

- 8.3.3 All cores are to be shrink wrapped according to the following table:

Core / Rigid Material Thickness Range	Quantity Shrink wrapped
.002 to .014	30 pcs.
.015 to .089	15 pcs.
.090 and greater	10 pcs.

- 8.4 Package Labeling: Manufacturers standard labeling and bar-coding procedures shall be used as long as the following information is present:
  - 8.4.1 Supplier Name
  - 8.4.2 Date of Manufacture
  - 8.4.3 Quantity

- 8.4.4 Core thickness and tolerance
- 8.4.5 Copper weight - both sides
- 8.4.6 Copper supplier
- 8.4.7 Material description
- 8.4.8 Lot number
- 8.4.9 Purchase order
- 8.4.10 Material size
- 8.4.11 Grain direction
- 8.4.12 Construction
- 8.4.13 Material designation per IPC-4101 or equivalent IPC standards

8.5 PRE-PREG

- 8.5.1 Pre-cut pre-preg will be vacuum-sealed in plastic bags to prevent moisture absorption. Boxes shall be constructed to prevent folding, bending, or other damage during shipment and storage. Pre-preg shall be kited and boxed according to the following table.

Glass Style	Count per kit	Kits per box
106	100	4
1080	100	4
2113	100	4
2116	100	4
7628	50	4

8.6 MARKING

- 8.6.1 Laminate: The following information must be metal stamped or dot matrix engraved on all copper clad core material:
  - 8.6.1.1 As an option, Laminate can be marked with permanent ink.
  - 8.6.1.2 Core thickness
  - 8.6.1.3 Copper weight - both sides
    - 8.6.1.3.1 In the cases where the foil weight is different side to side. The stamp will occur on the heavy weight side.
  - 8.6.1.4 Lot Number
  - 8.6.1.5 Number of plies.
  - 8.6.1.6 Grain direction - metal stamping shall be located on grain direction dimension
- 8.6.2 Pre-preg: Manufacturers standard labeling and bar-coding procedures shall be used as long as the following information is present on the packaging.
  - 8.6.2.1 Supplier Name
  - 8.6.2.2 Date of Manufacture

- 8.6.2.3 Expiration date
  - 8.6.2.4 Quantity
  - 8.6.2.5 Material Description
  - 8.6.2.6 Lot Number
  - 8.6.2.7 Purchase Order
  - 8.6.2.8 Material size
  - 8.6.2.9 Grain direction
  - 8.6.2.10 Resin Content
  - 8.6.2.11 Scaled Flow Press Thickness
  - 8.6.2.12 Gel Time
  - 8.6.2.13 Melt Viscosity / Rheology control
  - 8.6.2.14 Material design per IPC-4101 or equivalent IPC standards.
- 8.6.3 Labels shall be constructed so that they shall be legible and remain undamaged when boxes are turned on their sides for vertical or horizontal storage.

## 8.7 FOIL PACKAGING

- 8.7.1 Foils must be packaged so that they are not bent or creased prior to or during shipping.
- 8.7.2 We require that each package come with a label on the outside of the package that has the following;
  - 8.7.2.1 Foil type (top, center or bottom)
  - 8.7.2.2 Foil weight
  - 8.7.2.3 Separator size
  - 8.7.2.4 Lot Number
  - 8.7.2.5 Quantity
  - 8.7.2.6 Separator thickness
- 8.7.3 Each individual piece will be labeled with the following;
  - 8.7.3.1 Lot number
  - 8.7.3.2 Separator size
  - 8.7.3.3 Foil weight
  - 8.7.3.4 Separator thickness
- 8.7.4 All foil will be tooled using standard multiline 4 slot tooling configuration, with a 5<sup>th</sup> slot on the offset side.
  - 8.7.4.1 The 5<sup>th</sup> slot is the offset in the opposite direction, which when the foil is flipped over allows it to be used as either a Top or Bottom piece.



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9 REVISION HISTORY

Rev M Yearly review. No updated required.

Rev N Yearly review. No changes.

Rev O Yearly review. No changes.



QCF-06-10  
1/9/14 App: JL

Supplier Notification of  
Purchase Requirements

(Supplier Name) (Date)  
(Contact Name)  
(Supplier Address) (FAX#)  
(Supplier Address)

As a supplier to TTM technologies, Logan Division (hereafter referred to as TTM), it is required that you sign and return this document. Failure to do so may jeopardize your status as a chosen supplier.

The following selected excerpts are taken from the Quality System Procedure, Purchasing Document:

- 1 EICC Code of Conduct, Version 4.0
  - 1.1 TTM expects all vendors to comply with the EICC Code of Conduct
    - 1.1.1 The electronic industry citizenship coalition® (EICC®) code of conduct establishes this standard to ensure that working conditions in the electronics industry supply chain are safe, that workers are treated with respect and dignity, and that business operations are environmentally responsible and conducted ethically.
- 2 RoHS and Reach Directives
  - 2.1 All purchased materials must be in compliance with the European Union RoHS and REACH Directives.
- 3 PURCHASE ORDER CONTROL
  - 3.1 All materials brought into the plant for evaluation or use must have a Purchase Order assigned to it, this includes sample and no charge items.
- 4 ITEMS SUPPLIED DIRECTLY TO CUSTOMER FROM OUTSIDE SUPPLIER
  - 4.1 The suppliers of these items assume total responsibility for the quality and liability of the services provided.
- 5 PURCHASED MATERIAL SPECIFICATIONS
  - 5.1 Suppliers are required to notify TTM Logan 90 days prior to any of the following conditions occurring in the manufacture of the materials or supply items sold to TTM Logan.
  - 5.2 A change in the raw materials, source or provider of the items.
  - 5.3 A significant change in the manufacturing process, which could include process reformulation or implementation of different manufacturing process equipment.
  - 5.4 A change in location of the facilities used to manufacture the items .



QCF-06-10  
1/9/14 App: JL

Supplier Notification of  
Purchase Requirements

5.5 Material is received and accepted with a supplier certification that the material meets the agreed upon standards or specifications.

#### 5.6 SHELF LIFE AND RECORD RETENTION

5.6.1 Products with a shelf life must have a minimum of 1 year or 50% remaining shelf life to be accepted for use at TTM. Products with less than 50% remaining shelf life must be approved on a case by case basis by Purchasing and Process Engineering before delivery.

5.6.2 All products must have one of the following printed on the label.

5.6.2.1 **Manufacture date with shelf life or**

5.6.2.2 **Expiration Date or**

5.6.2.3 **Shelf life = No expiration date**

5.6.3 Record Retention for supplied materials is a minimum of 10 years.

### 6 IMPLEMENTING A NEW MATERIAL OR SUPPLIER

6.1 All items brought into the plant for use must go through the New Material Specification (NMS) Process. MSDS and Technical Data Sheets must be submitted for review; once the NMS is approved a purchase order will be issued for the item.

### 7 SUBCONTRACTED SERVICES

7.1 Subcontracted services is defined as work that is normally performed inside, but due to capacity, equipment or tooling constraints, is performed by an outside supplier.

7.1.1 Qualification of suppliers for sub-components of the manufacturing process requires completion of the Supplier Quality System Evaluation (QCF-06-8).

### 8 SUPPLIER PERFORMANCE EVALUATIONS

8.1 Purchasing conducts quarterly performance evaluations of top suppliers.

8.2 Suppliers are evaluated based on:

8.2.1 Material Quality

8.2.2 Delivery

8.2.3 Service

8.2.4 Other Items as deemed necessary

8.3 Purchasing maintains records of the overall Quality of Materials supplied and Delivery History (See CAR / RMA Program).

8.3.1 Purchasing supplies a report of the Quality performance to each supplier of critical materials.

8.3.1.1 Preferred Candidate – 80% - 100%

8.3.1.2 Qualified Candidate – 60% - 79%

8.3.1.3 Provisional Candidate – Below 60%



QCF-06-10  
1/9/14 App: JL

Supplier Notification of  
Purchase Requirements

- 8.3.2 The Quality performance of the supplier is used to determine future status as an approved material supplier.
- 8.3.3 Process Engineering, Manufacturing, Purchasing and Quality Control determine the minimum acceptable level of Quality Performance required.
- 8.3.4 All suppliers whose overall quality performance exceeds the minimum level will be considered an approved supplier.
- 8.3.5 Other rated suppliers are reviewed at least once each calendar year, on a less formal basis, to determine their continuing status.
- 8.3.6 Suppliers shall grant right of access by TTM Technologies, their Customer, and Regulatory Authorities to the applicable areas of all facilities, at any level of the supply chain, involved in the order and to all applicable records.

9 DISCREPANT MATERIALS

9.1 If the incoming discrepant material or item causes a missed customer ship date or if a customer requirement is violated in processing the material or if the item causes a rejection of the order, it is submitted to the Steering Committee for possible corrective action.

Name (Print): \_\_\_\_\_

Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Please return to:  
TTM Technologies, Logan Division  
Purchasing Department  
710 North 600 West  
Logan, Utah 84321



**Subject: Process Change Notification**

Valued Supplier:

This letter is to inform you of our policy regarding Process Change Notification.

Policy:

Suppliers are required to notify TTM Logan 90 days prior to any of the following conditions occurring in the manufacture of the materials or supply items sold to TTM Logan.

- 1 – A change in the raw materials, source or provider of the items.
- 2 – A significant change in the manufacturing process, which could include process reformulation or implementation of different manufacturing process equipment.
- 3 – A change in location of the facilities used to manufacture the items.

Initially, we are requesting that you 1) provide a signed statement for our files that you have read and agree to the above policy, and 2) provide a list of any materials or supplies that have been affected by any of the above conditions during the past year.

Respectfully,

Purchasing, TTM Logan  
435-753-4700

<b>Our company has been read and agree upon the above policy</b>			
Supplier Company Name	Supplier Representative	Title	Date

<b>Materials affected during the past year</b>	
Material Name / description	Type of change involved









<b>Quality Management System</b>		<b>Procedure #</b>	<b>Rev</b>
		QC-2140	AF
<b>Procedure Title</b>		<b>Pages</b>	<b>Date</b>
PURCHASING		8	1/26/93
<b>General Manager</b>	<b>Purchasing Manager</b>	<b>QMS</b>	
			
<b>Director of Quality</b>	<b>Director of Engineering</b>	<b>EH &amp; S Manager</b>	
			
<b>Initiated by</b>	<b>Rev</b>	<b>Researched by</b>	<b>Date</b>
Les Nielsen	AD	J. Lenkersdorfer	12/03/12
	AE	J. Lenkersdorfer	05/08/13
	AF	P. Lindhardt	12/09/13

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1. SCOPE

- 1.1. This procedure describes the requirements for purchasing materials, assessing material suppliers, and documenting and accepting incoming materials.

2. PURCHASE ORDER CONTROL

- 2.1. All materials brought into the plant for evaluation or use should have a Purchase Order (P.O.) assigned to it, this includes sample and no charge items
  - 2.1.1. Orders placed on a credit card should have credit card and the name of the person ordering referenced in the P.O. field on the packing list.
- 2.2. Purchase requisitions must be completed and have the appropriate approval signature based off the delegation of authority matrix before a purchase order can be placed.
  - 2.2.1. Requisitions are not required when materials are ordered by the Purchasing Department to maintain stock levels for Min/Max inventory items or to fill Material Requirements Planning (MRP) requirements.
- 2.3. All subcontracted service suppliers must be on the AVL (QCF-06-06). A copy of QCF-9-16 completed for the intended process and a copy of the outside service shop traveler are required as the requisition and must be verified by purchasing before a purchase order can be created. Only Process Engineering can change the requirements on these documents.
- 2.4. Any airfreight is to be authorized by the Division General Manager, or designee.
- 2.5. The purchase order is placed with the supplier and signed by the Purchasing Manager or designee.
- 2.6. The original Purchase Order is filed in the Purchasing Department.
- 2.7. When the material arrives, Receiving enters the receipt into Great Plains and brings the packing list to Purchasing after checking the material in. Purchasing then posts the Receipt to the original P.O. and attaches the packing list to the P.O. Completed P.O's will be scanned then filed in the complete file.
- 2.8. When a partial shipment arrives, receiving enters the partial receipt into Great Plains, Purchasing posts the partial receipt to the P.O., the packing list is attached to the P.O and re-filed in the open P.O. file until complete.
- 2.9. Purchasing verifies that the data on the Purchase Order is adequate for the Supplier to supply the product specified.
  - 2.9.1. In the event that a Purchase Order is changed after it is issued the following procedure is to be used:
    - 2.9.1.1. Make changes to Purchase Order and reprint.
    - 2.9.1.2. Stamp revised P.O. with "Change Order" Stamp
    - 2.9.1.3. Note changes under "Revisions Made:"
    - 2.9.1.4. FAX or EMAIL revised P.O. to Supplier
    - 2.9.1.5. Attach Revised P.O. to original.

3. ITEMS SUPPLIED DIRECTLY TO CUSTOMER FROM OUTSIDE SUPPLIER

- 3.1. On occasion, subcontracted services are required to meet contractual obligations. These services might include testing, solder mask application, solder application or manufacturing of prototype boards.
- 3.2. The suppliers of these items assume total responsibility for the quality and liability of the services provided.

#### 4. PURCHASED MATERIAL SPECIFICATIONS

- 4.1. Process Engineering and Manufacturing define the End Item and Process items material requirements to Purchasing.
- 4.2. Purchasing is responsible to provide the supplier sufficient information, i.e. part numbers, specifications or other details so that the supplier can correctly supply the ordered material.
- 4.3. Suppliers are required to notify TTM Logan 90 days prior to any of the following conditions occurring in the manufacture of the materials or supply items sold to TTM Logan. (QCF-06-18)
  - 4.3.1. A change in the raw materials, source or provider of the items.
  - 4.3.2. A significant change in the manufacturing process, which could include process reformulation or implementation of different manufacturing process equipment.
  - 4.3.3. A change in location of the facilities used to manufacture the items.
- 4.4. Material is received and accepted with a supplier certification that the material meets the agreed upon standards or specifications.
  - 4.4.1. Process Engineering or Manufacturing may specify additional requirements relative to the particular material.
  - 4.4.2. The supplier is responsible to provide sufficient data to verify that these requirements are met.
- 4.5. Suppliers are required to Retain Records of materials supplied for a minimum of 10 years.

#### 5. SHELF LIFE

- 5.1. Products with a shelf life must have a minimum of 1 year or 50% remaining shelf life to be accepted for use at TTM. Products with less than 50% remaining shelf life must be approved on a case by case basis by Purchasing and Process Engineering before delivery.

#### 6. ITEM TYPES

- 6.1. Items purchased are categorized into the following:
  - 6.1.1. End Items; these are items that become part of the finished product.
  - 6.1.2. Process Items; these are items, supplies or equipment that are used in the processing of the product. The specification of these items is critical to the quality of the finished product.
  - 6.1.3. Support Items; these items are consumed or used in the process but are not critical to the quality of the finished product. Not all suppliers of Support Items will be listed on the AVL. This will be left up to the discretion of the Purchasing Department.
  - 6.1.4. Some raw materials may be specified by Corporate Purchasing to be used in specified plants.
  - 6.1.5. Maintenance repair parts or stock parts
    - 6.1.5.1. These items may be purchased without approval from Process Engineering if the item is an Original Equipment Manufacturer (OEM) part or meets the design specification of the OEM part.
    - 6.1.5.2. Maintenance is authorized to purchase items required for equipment repair



when Purchasing Department personnel are not available.

## 7. APPROVED SUPPLIER LIST & ITAR

- 7.1. Purchasing maintains an Approved Supplier List (AVL), QCF-06-6. This document lists approved suppliers, materials they supply, the status of the supplier, justification for being on the list and inspection requirements of the items.
- 7.2. Purchasing will renew supplier ITAR forms yearly.

## 8. IMPLEMENTING A NEW MATERIAL OR SUPPLIER

- 8.1. Process Engineering will specify End Items, Process Items and Subcontracted Service requirements with respective Suppliers to be added to the AVL. Information required to complete the AVL is included on the New Material Specification (NMS), QCF-09-3.
- 8.2. **Refer to QC2100 ( New Materials, Equipment, Processes and Suppliers.)**
  - 8.2.1. QCF-09-5, New material specification log is used to track issued and approved specifications. The Safety Director must review all New Material Specification sheets. Material Safety Data Sheets (MSDS) are to be provided prior to approval of order.
  - 8.2.2. The NMS Log will be maintained by Purchasing for all open and completed NMS.
- 8.3. Typically Support Items and the Suppliers are determined based on price and availability.
- 8.4. Purchasing adds the approved suppliers and items to the AVL within the guidelines of QC-2160-8.
  - 8.4.1. Materials that are brought in for evaluation purposes will not be added to the AVL until a final approval of the material is made.
- 8.5. Completed NMS forms are kept electronically by Purchasing.
  - 8.5.1. Final buy-off signatures are not required by departments not affected by the new material and may be designated as N/A, not applicable, by owner of the NMS.
- 8.6. New Suppliers of End and Process Items are to be provided with a copy of the Supplier Notification of Purchasing Requirements (QCF-06-10), which they are required to sign and return to the Purchasing Department.
  - 8.6.1. The signed letter is kept in the Supplier File.
- 8.7. If an End or Process item may be purchased from several different suppliers, i.e. distributors, those suppliers may be added to the AVL without going through the approval process.

## 9. SUBCONTRACTED SERVICES

- 9.1. Subcontracted service is defined as work that is normally performed inside, but due to capacity, equipment or tooling constraints, the work is performed by an subcontracted supplier.
- 9.2. These services could either be provided by another TTM Printed Circuit Group Division or by an approved service provider.
- 9.3. TTM Divisions are exempt from the following qualifications.
  - 9.3.1. Qualification of suppliers for sub-components of the manufacturing process, i.e. Mass Lamination of Multilayer panels, application of solder masks, or punching of boards out of the panel, requires completion of the Supplier Quality System

Evaluation (QCF-06-8).

9.3.2. Qualification of suppliers for the complete manufacture of customer orders requires completion of the Supplier Quality System Evaluation (QCF-06-8)

9.3.3. Reference QCF-06-16 **Subcontracted Service Provider List / Incoming Inspector** for list of approved subcontracted service providers and preference.

9.4. Forms are to be reviewed by Quality Control and to be kept by Purchasing in a Supplier File.

9.5. To ensure conformance and traceability to TTM specifications on Mass Lamination, the following criteria must be incorporated with each order:

9.5.1. Supplier must be supplied with TTM Material Lay-up Sheet for each part number ordered.

9.5.2. Supplier lay-up / construction of part must be the same as TTM's unless a deviation has been granted.

9.5.3. Supplier to supply X-Section Report, Construction Sheet and Certificate of Conformance with delivered parts.

9.5.4. Quality Control, or designee, must buy-off X-Section results prior to releasing parts to production.

9.5.5. Certificate of Conformance and X-Section Report to be kept in Purchasing with purchasing documents.

9.5.6. Purchase Order number used to procure Mass Lam must be listed on shop traveler.

## 10. CAPITAL EQUIPMENT PURCHASES

10.1. When new equipment is determined Process Engineering documents the requirements using a Process Improvement Team report. These details are listed in QC-2100.

10.2. Occasionally equipment may be purchased at Auctions and the details are not completed until after the actual purchase. However, nothing may be purchased, without communicating with and receiving verbal approval from those requesting the purchase.

10.3. To meet TTM safety requirements, all purchases of equipment that involves the use of electric heaters must meet the requirements of IPC 1331. This is to be included as part of the purchasing documents.

## 11. SUPPLIER JUSTIFICATION

11.1. The following are reasons for including a supplier on the AVL.

11.1.1. The material supplied is for an existing process. The process was evaluated and approved previously and there might not be documented evidence of the evaluation.

The history of using the process justifies continued purchase of the materials or items. These suppliers were "Grandfathered" into the system.

11.1.2. The items purchased have formal, documented approval for use.

## 12. SUPPLIER STATUS

12.1. All suppliers listed on the AVL are assigned a status. This is typically determined from past performance. Suppliers may also be limited to supplying only certain materials.

12.2. Suppliers that supply End Item materials and Process materials, or those deemed

necessary by Management (Purchasing, Process Engineering, Production and Quality Control) will be classified as follows:

12.2.1. Preferred: The supplier routinely meets requirements. When a choice exists between this supplier and another, the financial, quality and delivery aspects make this supplier preferred.

12.2.2. Approved: The supplier routinely meets agreed requirements.

12.2.3. Restricted: This status is for suppliers who are restricted to supply only certain types of a particular material or service. These suppliers may be new and the use of their services is being evaluated.

12.2.4. Probation: The supplier's ability to supply services is in question, and definite corrective action needs to be taken to resolve chronic problems.

12.2.5. Disqualified: The supplier is no longer approved to supply materials or services.

12.3. Suppliers of supply items that are listed on the AVL, unless otherwise determined by Purchasing, will be given an N/R (Not Rated) status.

### 13. SUPPLIER SURVEYS

13.1. Purchasing maintains completed Supplier Surveys for those suppliers that are in the top 10 suppliers by dollar volume, or are deemed necessary by Purchasing, Process Engineering, Production and Quality Control.

13.2. Supplier surveys are made using the Supplier Quality System Evaluation (QCF-06-8). If the supplier has an ISO Registration, a copy of their current registration certification may be supplied in lieu of the survey mentioned above.

13.3. Suppliers who do not respond to requested Supplier Surveys are to be listed as Restricted Suppliers.

### 14. SUPPLIER HISTORY

14.1. Purchasing maintains a file on all suppliers. Supplier's files include items such as, a copy of the supplier survey, discrepant material forms, applicable contract information, etc.

### 15. SUPPLIER PERFORMANCE EVALUATIONS

15.1. Purchasing (Logan, Santa Ana, Chippewa Falls) conducts Quarterly performance evaluations of the top suppliers by dollar volume.

15.1.1. Supplier rating is to be updated on Approved Supplier List upon completion of evaluations.

15.2. Suppliers are evaluated based on:

15.2.1. Material Quality

15.2.2. Delivery/Service

15.3. Purchasing maintains records of the overall quality of materials (see CAR/RMA) supplied and delivery history on computer.

15.4. Purchasing supplies a report of the quality performance to each supplier of critical materials.

15.5. The quality performance of the supplier is used to determine future status as an approved material supplier.

15.5.1. The supplier shall grant right of access by TTM Technologies, their Customer, and Regulatory Authorities to the applicable areas of all facilities, at any level of the

supply chain, involved in the order and to all applicable records.

- 15.6. Process Engineering, Manufacturing, Purchasing and Quality Control determine the minimum acceptable level of Quality Performance required.
- 15.7. All suppliers whose overall quality performance exceeds the minimum level will be considered an approved supplier.
- 15.8. Other rated suppliers are reviewed at least once each calendar year, on a less formal basis, to determine their continuing status.

## 16. INCOMING INSPECTIONS

- 16.1. See QC-2145, 805 for core and laminate, and 850 for prepreg and foils.

## 17. DISCREPANT MATERIALS

- 17.1. The department Supervisor, or Purchasing, documents the condition of the material on Discrepant Material Form (QCF-06-4 hereafter referred to as DMF). The originator adds the DMF number to the tag and ensures the material is placed in a hold area or provided to Purchasing.
  - 17.1.1. If a received material fails to meet incoming requirements, those inspecting the material will attach a Rejection Tag (QCF-06-3) to the material and follows the above procedure.
- 17.2. Purchasing will then reject the material and provide a copy to the Supplier.
  - 17.2.1. To issue a DMF there needs to be something physically wrong with the material.
  - 17.2.2. If receiving does not accept a shipment because the incoming product is not what was ordered, the shipment may be refused and a DMF does not need to be initiated.
- 17.3. If the materials are found to be out of specification and there is a need to use the discrepant materials, members of MRB must authorize their use.
- 17.4. Quality is to be notified each time that a DMF is issued. Quality then determines if a Corrective Action is needed.
- 17.5. Quality Engineering, in conjunction with Process Engineering may require a Supplier Corrective Action if:
  - 17.5.1. The incoming discrepant material or item causes a missed customer ship date
  - 17.5.2. A customer requirement is violated by using the material
  - 17.5.3. The item causes a rejection of the order. As needed Quality adds the NCMR number to the DMF form.
  - 17.5.4. The type of defect indicates a negative quality trend in the material.
- 17.6. If a corrective action is required
  - 17.6.1. Quality Eng. issues a SCAR and e-mails the notification to Purchasing.
    - 17.6.1.1. MRB reviews the DMF and if needed issues a Stop Delivery Notice (QCF-06-14) to the Supplier.
    - 17.6.1.2. Purchasing issues a Discrepant Materials List (QCF-06-13) to the department issuing the material, notifying the department not to use or receive affected material.
  - 17.6.2. Purchasing e-mails the notification and a copy of the Discrepant Material form, which contains the SCAR, to the customer.
  - 17.6.3. After the SCAR is completed, Purchasing has Quality approve and sign off the DMF, and forwards a copy of the DMF/SCAR to Quality.
- 17.7. Purchasing maintains a Log and file of issued DMF's to ensure:

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- 17.7.1. Supplier is informed of the problem.
- 17.7.2. That VCAR's are responded to on a timely basis.
- 17.7.3. Accounts Payable is informed of ensuing credit from Supplier.
- 17.7.4. Material has been properly reviewed and disposition made.
- 17.7.5. Applicable corrective actions are received.

17.8. If a material lot number needs to be restricted, Purchasing will add the DMF #, Date rejected, Manufacturer name, Lot Number and material description to QCF06-13 "Manufacturer / Lot Number Quarantine list" and email to the Supplier as a notification of lot # rejection. This list will also be provided to the Laminate Storage Department.

## 18. STORAGE AND HANDLING OF MATERIALS

- 18.1. Materials that are received and stored in the Chemical Storage area are stored, dispensed and disposed of as documented in QC-2120.
- 18.2. Periodic inspection of the condition of materials is also described in QC-2120.

## 19. RETURNING OR DISPOSING OF MATERIALS

- 19.1. Items that have been either shipped or ordered incorrectly, materials that exceed their shelf life or obsolete items may be returned to the supplier or disposed of.
- 19.2. Once the item is identified and a Discrepant Material Form has been created, Purchasing contacts the supplier and obtains approval for returning the item, completes a shipper for the material, and contacts the freight company for material pickup.
- 19.3. One copy of the shipper is returned with the item, one copy is retained in Purchasing, and one copy is sent to Accounting.

## 20. REVISION HISTORY

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|--------|---|
| Rev AD | Removed 6.2 Document control procedure reference.   |
| Rev AE | Updated all references of "Vendor" to "Supplier". Updated section 4 to match QCF-06-18. Changed "Outside Service" to Subcontracted Service"   |
| Rev AF | Added 4.5 – Suppliers are required to Retain Records for a minimum of 10 years for supplied materials. Added 15.5.1 – Suppliers shall grant right of access to TTM Technologies, their Customer and Regulatory Authorities. Deleted all references to QCF 6-5, we don't use this vendor evaluation form. 15.3 changed DMF reference to CAR/RMA. |