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REVISION HISTORY LOG

REVISION	PAGES/ FIGURES	CO NUMBER	ISSUE DATE	DESCRIPTION OF REVISION
10	Pgs. 1-12	19,016-3	04-18-2008	Revised entire document. Revised form AB2011A.DOC (Dated 04-17-2008) Added form AB2011D.DOC (Dated 04-17-2008)
11	Pgs. 1-12	24,645-3	06-10-2009	Revised: 2.1.9.2, 10.7.1, 10.7.1.2, 10.8.2, Section 4 header. Section 10.2.4, Added: 2.1.9.1, 2.2.7, Renumbered where applicable. Added Form AB2011E.DOC (Dated 06-09-2009)
12	Pgs. 1-12	27,136-3A	04-19-2010	Revised Work Instruction title Revised: 2.1.3, 3.1.9 – 3.1.11, Table under 10.3.1.2, Table under 10.4.3.1, Table under 10.4.5.2 Added: 2.1.9, 4.1, 10.3.1.2.3, 10.5, 10.5.1, Table under 10.5.1, 10.9.3 – 10.9.4 Removed: Section 2.2.1 – 2.2.4 Renumbered where applicable Removed Form AB2011A.DOC Revised Forms AB2011C, D, & E.DOC (Dated 04-19-2010)
13	Pgs. 1-12	31,808-3A	12-06-2011	Removed Form extensions throughout entire document Added: 4.2, 4.3, 10.1.10.6, 11.1, 11.2, 11.2.1 Revised: 10.2.4.1, 10.2.4.4, Table under 10.3.1.2 Revised Forms AB2011C, D, & E (Dated 12-05-2011)
14	Pgs. 1-14	35,365-3A	02-19-2013	Added: 10.1.10.1.1 – 10.1.10.1.4, 10.4.2.2, Note under 10.4.3.1, 10.4.4.2, 10.5.1 Revised: 2.1.3, 2.2.1, 3.9, 3.10, 3.11, 10.2.4.1, 10.2.4.4, Table under 10.3.1.2, 10.4.2.1, Table under 10.4.3.1 Renumbered where applicable
15	Pgs. 1-15	41,209-3A	11-13-2014	Revised: 10.1.10.1.2, Section 10.2.4, 10.7.1, 10.8.1.5 Added: 2 nd Note under 10.4.3.1, 10.4.6.2 Renumbered where applicable
16	Pgs. 1-15	41,420-3A	12-10-2014	Removed “Confidential” from document header
17	Pgs. 1-14	44,847-3A	03-28-2016	Revised: Table under 10.3.1.2 Revised Form AB2011C (Dated 03-28-2016)
NA	Pgs. 1-14	47,371-3A	05-26-2017	Revised Form AB2011C (Dated 05-25-2017)
18	Pgs. 1-15	48,466-3A	11-21-2017	Revised entire document Removed Form AB2011E Added Forms AB0743CF, CG, CH, CI, CJ (Dated 05-01-2012) & AB0743KA (Dated 12-05-2016)
19	Pgs. 1-14	51,134-3A	12-04-2018	Changed title; previously titled “Laminates, Metal Clad (C-Stage), Pre-preg (B-Stage), Copper Foil, and Resin Coated Foil Specification” Revised entire document Revised Forms AB2011C, D (Dated 11-30-2018)
20	Pgs. 1-14	53,902-3A	11-15-2019	Revised: 1.1, 10.2.1, 10.3.1.1, 10.3.2.1.4, 10.3.3.1, 10.3.5.1, 10.3.10.1.1, 10.3.10.1.2, 10.3.10.1.4, 10.4.5.9, 10.10.1 Added: 10.11 Renumbered where applicable
21	Pgs. 1-14	54,224-3A	01-10-2020	Added: 2.2.3 Added Form AB2011F (Dated 01-10-2020) Renumbered where applicable

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1 SCOPE

- 1.1 This specification meets and may exceed various requirements of the ISO, AS, and IPC Standards. This specification provides the requirements for all external providers, which include suppliers, subcontractors, TTM internal service providers, calibration vendors, etc.

2 APPLICABLE DOCUMENTS

2.1 Reference Documents

- 2.1.1 Purchase Order
- 2.1.2 Part Record
- 2.1.3 IPC-4101, Specification for Base Materials for Rigid and Multilayer Printed Boards
- 2.1.4 IPC-4103, Specification for Base Materials for High Speed/High Frequency Applications
- 2.1.5 IPC-TM-650, Test Methods Manual
- 2.1.6 IPC-4562, Metal Foil for Printed Wiring Applications
- 2.1.7 IPC-4563, Resin Coated Copper Foil for Printed Wiring Boards
- 2.1.8 [AB-20.04](#), Supplier/Subcontractor Corrective Action System
- 2.1.9 [AB-07.43](#), Lamination Tooling Drawings
- 2.1.10 Order of Precedence
 - 2.1.10.1 Part record
 - 2.1.10.2 Purchase order
 - 2.1.10.3 This specification
 - 2.1.10.4 IPC specifications

2.2 Forms

- 2.2.1 Packaging Requirements for Laminate and B-Stage, [AB2011C](#)
- 2.2.2 Curl Requirement Specification, [AB2011D](#)
- 2.2.3 Supplier Potential Obsolescence, [AB2011F](#)
- 2.2.4 C-Stage Laminate Stamping Requirements, [AB0743KA](#) (online only)
- 2.2.5 B-stage (Slot) 16.5 x 18.5, [AB0743CF](#) (online only)
- 2.2.6 B-stage (Slot) 18.5 x 24.5, [AB0743CG](#) (online only)
- 2.2.7 B-stage (Slot) 18.5 x 27.5, [AB0743CH](#) (online only)
- 2.2.8 B-stage (Slot) 21.5 x 24.5, [AB0743CI](#) (online only)
- 2.2.9 B-stage (Slot) 21.5 x 27.5, [AB0743CJ](#) (online only)

3 TERMS AND DEFINITIONS

- 3.1 SCAR – Supplier Corrective Action response.
- 3.2 Dimensional Stability – A measure of the dimensional change of material that is caused by factors such as temperature changes, humidity changes, chemical treatment (aging), and stress exposure.
- 3.3 Peel Strength after Thermal Stress – The force per unit, in lbs/inch, width that is required to peel a conductor foil from a laminate perpendicular to the surface of the substrate.
- 3.4 Thermal Stress Etched – This test is designed to determine the thermal integrity of unclad laminates using short-term solder exposure.
- 3.5 Thermal Stress Unetched – This test is designed to determine the thermal integrity of metallic clad laminates using short-term solder exposure.
- 3.6 Basis Weight – Weight per unit area (typically oz/yd²) of glass fabric prior to the laminator applying resin.
- 3.7 Resin Content – Difference between the basis weight of the glass fabric and the weight of the coated glass fabric. Resin content is the percentage of weight due to the resin.
- 3.8 Core Thickness – The thickness of the core of the laminate after the copper has been etched off, also known as “Thickness” in the TTM part record.
- 3.9 Visual – Visual inspection of the laminate and prepreg shall be done in accordance with IPC-4101, section 3.8.3.1 for laminate and section 3.8.3.2 for prepreg and this specification.
- 3.10 Surface/subsurface Imperfections – Inspection of the surface/subsurface shall be done in accordance with IPC-4101, section 3.8.3.1.6 and this specification.
- 3.11 Curl – Also referred to as Bow in IPC-4101, which is an out of plane measurement of corners of a copper clad laminate when placed unrestrained on a hard, flat surface such that the middle of the panel is contacting the surface and corners are raised (concave side down). Expressed in inches.
- 3.12 Material Size – The length and the width of the material. Also known as “Dimensions” in the TTM part record (i.e. 18.5 X 24.5).
- 3.13 Foil Weight – The weight of the copper per unit area, typically oz/ft².
- 3.14 Glass Construction – Describes the combination of glass fabric types used to make a core (i.e. 2116/2113, 106, etc). This is also known as “Glass Laminations” in the TTM part record.
- 3.15 Material Type – The type of resin used to manufacture the Prepreg.
- 3.16 Copper Cladding – Describe the foil weights to construct the laminate (i.e. 1/1, H/H, 1/H, etc). This is also known as “side 1” and “side 2” of “Copper” in the TTM part record.

4 SAFETY AND ENVIRONMENTAL

- 4.1 TTM encourages suppliers to implement an Environmental Management System.
- 4.2 TTM requires suppliers to implement the Responsible Business Alliance (RBA) formerly known as EICC.
- 4.3 TTM requires suppliers to install a Business Continuity Plan, including Pandemic Preparedness, and test the plan at least yearly.
- 4.4 Metrology data, including Gauge R & Rs are required and available to TTM Technologies upon request.
- 4.5 Process control data must be kept and made available to TTM Technologies upon request.

5 HANDLING

6 EQUIPMENT

7 TOOLING

8 MATERIALS

9 START - UP

10 OPERATION

10.1 General Requirements

10.1.1 Advance Deviation Request (ADR)

10.1.1.1 An ADR must be requested if material violates a TTM specification requirement, including the TTM part record. The following procedure must be used:

10.1.1.1.1 Contact Supplier Quality with the following information:

- 10.1.1.1.1 Reason for request
- 10.1.1.1.2 Purchase order number
- 10.1.1.1.3 TTM part number
- 10.1.1.1.4 Lot number
- 10.1.1.1.5 Quantity
- 10.1.1.1.6 Material type

- 10.1.1.1.2 If an Advance Deviation Request (ADR) is granted, an ADR number will be issued. This number must be recorded on the peel labels as well as the vendors Certificate of Conformance and/or packing slip. In addition, a colored sticker (other than green), or other visible method, must be included on each package indicating the ADR number and the expiration date.
- 10.1.1.1.3 If the above procedure is not followed, the material may be returned to the supplier at their expense.
- 10.1.1.1.4 A corrective action may be issued when the ADR is requested.
- 10.1.1.1.5 All elements of this specification apply for materials that are samples, developmental, etc. If an element cannot be met, an ADR must be requested. The reason for this is all materials are manufactured using normal production processes.

10.1.2 Change Notification

- 10.1.2.1 TTM Chippewa Falls Division requires a written notification 60 days prior to a requested change.
- 10.1.2.2 The supplier shall furnish TTM Supplier Quality with written notification of changes that may affect the form, fit, function, reliability, serviceability, inventory performance, regulatory compliance, safety, or processing at TTM.
- 10.1.2.3 TTM will provide a written response of receipt of the change notification.
 - 10.1.2.3.1 Once the supplier receives the written response that the change notification was received by TTM, the supplier is free to implement the change after 60 days unless the change is rejected in writing by TTM. The date also may be extended beyond the 60 days if qualification is required.
- 10.1.2.4 TTM will write a formal response to the change notification and it will be submitted to the supplier within 30 days of receipt of the change notification.

EXAMPLES OF CHANGE NOTIFICATION

NEW RAW MATERIAL

NEW SUPPLIER

PROFILE CHANGE

FORMULATION CHANGE

INTERNAL PRODUCT SPECIFICATION CHANGE

TEST METHOD

NEW EQUIPMENT INSTALLATION

PACKING CHANGE

CHEMISTRY CHANGE

MANUFACTURING FACILITY CHANGE

NEW MATERIAL CURRENTLY NOT IN USE

ETC.

10.1.3 This notification shall take place prior to implementation and will be subject to approval.

10.2 Rejected Material

10.2.1 Rejected lots of material may be put on hold and may require containment, root cause, and corrective action analysis. **A response within 24 hours is required for containment analysis**, where applicable. A maximum 10-business day response time is required for root cause and corrective action analysis of SCARs and complaints and a maximum 30-day response time is required for payment of credits. Root cause and corrective action analysis of credits is not required. **NOTE:** Any root cause and corrective action that cannot be met within 10 business days may receive an extension which must be requested through a phone call or e-mail to the TTM Supplier Quality Manager or delegate. Credit requests will not receive an extension and will be late if received after the due date.

10.3 Material Requirements (C-Stage)

10.3.1 Thermal Stress – Per applicable IPC specifications

10.3.1.1 The sample shall be examined under 5-x magnification. There shall be no evidence of measling, weave exposure, or material degradation. The copper shall show no blistering or delamination.

10.3.2 Surface Imperfections (Laminate)

10.3.2.1 Foil indentations shall be located and measured per IPC specifications. The copper surface condition shall meet the requirements of the IPC specifications with the following exceptions:

10.3.2.1.1 Pits, dents, or fiber dents between .0025” and .025” in length shall not exceed 3 in any 12” by 12” area.

10.3.2.1.2 Pits or dents less than .0025” in the longest dimension shall not be counted in the three (3) feature per square foot requirement.

10.3.2.1.3 Imperfections of any size that contains deposits of foreign materials such as resin, dirt, grit, etc., are unacceptable.

10.3.2.1.4 Any single surface defect, no matter the size, which causes a conductor defect such as an open, dent, line depth reduction, line width reduction or raised conductor is cause for rejection.

10.3.3 Subsurface Imperfections (Laminate)

10.3.3.1 Panels shall be inspected and verified so that no imperfection shall exceed IPC specifications at incoming material inspection and/or at in-process AOI inspection with the following exception: subsurface imperfections will be rejected if the defect falls beneath conductors or between closely spaced in-plane conductors, no matter the size.

10.3.4 Dimensional Stability, per applicable IPC specifications

10.3.5 Dielectric Thickness

10.3.5.1 Core thickness shall be measured per IPC specifications, with copper removed.

10.3.5.2 Tolerances per the Part Record.

10.3.6 Cure requirements.

10.3.6.1 As agreed upon between TTM and supplier.

10.3.7 Curl

10.3.7.1 Maximum displacement for curl (copper clad & un-clad) unrestrained on a flat surface is 0.50” for even copper weights and symmetric constructions for all core thickness.

10.3.7.2 Maximum displacement for curl (copper clad) unrestrained on a flat surface is 0.75” for uneven copper weights and asymmetric constructions for all core thickness.

10.3.8 Grain Direction

10.3.8.1 All C-Stage laminate shall meet the grain direction requirement as stated per the Part Record.

10.3.9 Square/Edge condition for panels with 0.50” oversize.

10.3.9.1 Minimum length and width dimensions shall be -.000” + .060”.

10.3.9.2 Perpendicularity shall be .050” maximum.

10.3.9.3 Rippled edges cannot extend more than .125” into panel, and no loose copper.

10.3.9.4 Rippled edged height cannot exceed 0.0025 above/below base copper.

10.3.9.5 Edges shall not exhibit burrs > 0.0025”.

10.3.10 Panel Identification

10.3.10.1 All individual panels of material must be identified for lot traceability. Exceptions as agreed upon between user and supplier. Reference Form AB0743KA (C-Stage Laminate Stamping Requirements), section 2.2.3 of this document, for location. **NOTE:** Markings must be located on the long side of panel. The core must be stamped in inches, with no cladding (i.e. 0.003 inches or 030).

10.3.10.1.1 If laser stamping is the chosen method for identification. If laser stamping is chosen as the means of identifying the panel, the stamp must be engraved into the b-stage so that if the copper is etched away, it is still legible. The laser stamp also must be legible after adding resist.

10.3.10.1.2 If Ink stamping is the chosen method of identification, the ink must act as a resist and be legible after the preclean, microetch, and develop/etch/strip (DES) processes.

10.3.10.1.3 “Pin” or “Impression” stamping is the least desirable method of identification. If this is the only method available, the stamp depth must be minimal so that it does not increase the panel thickness in this area, yet remains legible.

- 10.3.10.1.4 Non-identified panels may be returned to vendor, at vendor's expense. An ADR is required if shipping without a stamp. Reference Section 10.1.1 of this specification for ADR instructions.
- 10.3.10.2 For Differential Copper Weights (i.e. .5/1) panels must be stamped on the side with the heaviest copper. For any panel that has a combination of Differential Copper Weights and Standard Cu/Reverse Treat Cu, the requirements for Differential Copper Weight takes precedence.
- 10.3.10.3 Standard Cu/Reverse Treat Cu with even copper weight panels must be stamped on the standard copper side.
- 10.3.10.4 On asymmetric constructions and even copper weights, stamp on heavy glass side.
- 10.3.10.5 The order of precedence for marking is:
 - 10.3.10.5.1 Differential copper weights - heaviest copper
 - 10.3.10.5.2 Standard Cu/Reverse Treat Cu - standard copper
 - 10.3.10.5.3 Asymmetric Glass construction - heaviest glass
- 10.3.10.6 Each C-Stage construction within an individual press load must be tested and recorded on a test report or as agreed upon between user and supplier.
- 10.3.10.7 Laminate hi-pot pretesting only allowed with written approval by TTM.
- 10.3.10.8 C of C should be sent to CF_Certs@ttmtech.com at, or before the time of shipment and should include the following:
 - 10.3.10.8.1 Designation codes (See IPC for codes)
 - 10.3.10.8.2 TTM part number (must be barcoded)
 - 10.3.10.8.3 TTM PO number (must be barcoded)
 - 10.3.10.8.4 Core thickness (inches, with no cladding)
 - 10.3.10.8.5 Copper cladding
 - 10.3.10.8.6 This specification (AB-20.11)
 - 10.3.10.8.7 Manufacturer lot number (must be barcoded)
 - 10.3.10.8.8 Quantity
 - 10.3.10.8.9 Manufacture date
 - 10.3.10.8.10 Material size
 - 10.3.10.8.11 Material type
 - 10.3.10.8.12 Glass construction
 - 10.3.10.8.13 Foil vendor
 - 10.3.10.8.14 Grain direction
 - 10.3.10.8.15 Statement of RoHS compliance
 - 10.3.10.8.16 Approval signature

10.3.10.8.17 ADR, if applicable

10.4 Material Requirements (Pre-preg)

10.4.1 Pre-preg Visual Properties

10.4.1.1 Inclusions and Imperfections per IPC specifications. Testing in accordance with IPC specifications.

10.4.2 Cleanliness

10.4.2.1 Must be free of loose fibers and dust.

10.4.3 Dimensions

10.4.3.1 All dimensions must meet the drawings found in Sections 2.2.4 - 2.2.7 of this specification.

10.4.4 Tooling

10.4.4.1 All pre-preg must be cut and tooled per the Part Record. Reference corporate tooling drawings, in Sections 2.2.4 - 2.2.7 of this specification, for pre-preg size, tolerances, and tooling hole locations.

10.4.5 Preservation

10.4.5.1 Pre-preg must be shipped with:

10.4.5.1.1 60 days of shelf life remaining for pre-preg with a 90-day shelf life

10.4.5.1.2 120 days of shelf life remaining for pre-preg with 180-day shelf life

10.4.5.1.3 90 days of shelf life remaining for pre-preg stored in condition 1

10.4.5.2 Supplier shall request an Advanced Deviation Request Number (ADR #) prior to shipping product that will exceed this requirement. Reference Section 10.1.1 of this specification for ADR instructions.

10.4.5.3 Before the ADR # is granted, pre-preg must be retested if:

10.4.5.3.1 Over 45 days old for pre-preg with a 90-day shelf life

10.4.5.3.2 Over 90 days old for pre-preg with 180-day shelf life

10.4.5.4 The requirements for the retested data must include:

10.4.5.4.1 The retested values recorded on the test report

10.4.5.4.2 The date retested

10.4.5.4.3 The original test results

10.4.5.5 The retest must be done within 7 days of shipping and prepreg must be desiccated per the IPC standard.

10.4.5.6 Pre-preg must be vacuum packed, where appropriate, and sealed to eliminate the possibility of moisture absorption, the introduction of debris, and to reduce the risk of handling damage.

10.4.5.7 Pre-preg packages are to be in quantities specified by TTM and not to exceed 25 pounds per package and a maximum of 100 sheets.

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- 10.4.5.8 Any minimum order quantity (MOQ) will be waived at TTM’s discretion for any ADR request.
- 10.4.5.9 All prepreg that was issued an ADR number must have a label or other designation that lists the ADR number as well as the expiration date of the prepreg. This notification must be visual and if a label is used, it should be placed next to the package label.
- 10.4.5.10 C of C should be sent to CF_Certs@ttmtech.com at, or before the time of shipment and should include the following:
 - 10.4.5.10.1 Designation codes (See IPC for codes)
 - 10.4.5.10.2 TTM part number (must be barcoded)
 - 10.4.5.10.3 TTM PO number (must be barcoded)
 - 10.4.5.10.4 This specification (AB-20.11)
 - 10.4.5.10.5 Manufacturer lot number (must be barcoded)
 - 10.4.5.10.6 Quantity
 - 10.4.5.10.7 Manufacture date
 - 10.4.5.10.8 Cut date (if applicable)
 - 10.4.5.10.9 Expiration date
 - 10.4.5.10.10 Material size
 - 10.4.5.10.11 Material type
 - 10.4.5.10.12 Glass construction
 - 10.4.5.10.13 ADR number, if applicable
 - 10.4.5.10.14 Grain direction
 - 10.4.5.10.15 Statement of RoHS compliance
 - 10.4.5.10.16 Approval signature
 - 10.4.5.10.17 Resin content, limits and actual value
 - 10.4.5.10.18 Rheology data as specified in the part record, limits and actual value

10.5 Chemical Requirements

- 10.5.1 All chemicals shall be shipped in a manner where the top of the drum is clean and dry and there shall be no liquids on the top of the drum.
- 10.5.2 Drums should not be leaking.

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10.5.3 Chemical container should have the appropriate hazardous labeling. See below.



10.5.4 C of A should be sent to CF_Certs@ttmtech.com at, or before, the time of shipment.

10.5.5 Pallets should be in good condition at receipt at TTM. If there are multiple barrels on the pallet, the barrels must be wrapped with plastic strapping.

10.6 Miscellaneous Materials

10.6.1 C of A or C of C should be sent to CF_Certs@ttmtech.com at, or before, the time of shipment and should include the following:

- 10.6.1.1 TTM part number
- 10.6.1.2 TTM purchase order number
- 10.6.1.3 Manufacturer lot number
- 10.6.1.4 Manufacture date
- 10.6.1.5 Expiration date
- 10.6.1.6 ADR number, if applicable

10.7 Supplier Quality Assurance Provisions

10.7.1 All individual shipments shall be accompanied by the following documentation.

- 10.7.1.1 Certification of Compliance shall be to this specification, IPC Specification sheet, as well as the purchase order. The Certification of Compliance must be accompanied by test analysis data and retained for a minimum of seven (7) years or as stated in the Purchase Order.
- 10.7.1.2 All measurements shall be performed per IPC specifications unless otherwise specified.
 - 10.7.1.2.1 Thickness values shall be performed per this specification, Section 10.3.5.
 - 10.7.1.2.2 Supplier shall provide certification and test data from the copper suppliers upon request.
 - 10.7.1.2.3 Visual inspections shall be performed per this specification, Section 10.3.3.

10.8 Packaging and Shipping Requirements

10.8.1 Packages

- 10.8.1.1 Packages to be constructed such that product will not be damaged during normal shipping.

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10.8.2 Weight of laminate and pre-preg must include package and contents

10.8.2.1 Total weight of package with material must not exceed 25 pounds.

10.8.2.2 Packages shall not have any paper inside.

10.8.3 Chemicals

10.8.3.1 Default packages are acceptable (i.e. container, barrel, tanker, box, etc.).

10.8.4 Labeling of Packages/Containers

10.8.4.1 The label on the packages must include the same information as required on the C of C or C of A.

NOTE: For bar coding, the 1D (1 Dimensional) standard should be used.

NOTE: It is recommended that the TTM part number and Quantity are displayed in a 48, bold font. This is for ease of viewing while on the shelf.

10.8.5 Labeling of Containers

10.8.5.1 The labels on the container shall be identical to the label on the package.

10.8.5.2 The containers must be labeled to quickly indicate if it is prepreg or laminate. Recommendation is to use a different color label for prepreg, but a big sticker indicating prepreg or laminate placed near the package label is acceptable.

10.8.6 Peel Label Requirements

10.8.6.1 Peel labels are required for all laminate and prepreg shipments.

10.8.6.2 The peel labels must contain the following, at a minimum:

10.8.6.2.1 TTM part number

10.8.6.2.2 TTM purchase order number

10.8.6.2.3 Manufacturer lot number

10.8.6.2.4 Expiration date, for prepreg

10.8.6.2.5 Copper cladding, for laminate

10.8.6.2.6 Core thickness, for laminate (inches, with no cladding)

10.8.6.2.7 ADR number, if applicable

10.8.6.3 The peel labels on the package must include the following information. Each individual peel label must not exceed .5” in height and 3.5” in width. The print on the peel labels must be legible and the label color must be white for prepreg.

10.8.6.4 Each package is required to have a minimum of six (6) peel labels.

10.8.7 Shipping method

10.8.7.1 It is the responsibility of the supplier to use a shipping method that enables the material to meet the end user requirements, even if TTM is paying the shipping expense.

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10.8.7.2 All shipments of pre-preg are required to have a temperature indicator in each box to ensure that if the temperature is elevated for an extended period, the indicator would be tripped. It is at TTM's discretion whether prepreg would be returned or samples sent for retest.

10.8.7.3 The shipping requirements of AB2011C are required.

10.8.7.3.1 Some of the requirements of this specification may be out of the control of the vendor, but it will be their responsibility to work with the freight carriers to meet this specification.

10.9 **Packing Slip**

10.9.1 **Prepreg and Laminate must be on separate packing slips.**

10.9.2 The information on the packing slip must include the following information, at a minimum:

10.9.2.1 TTM part number

10.9.2.2 TTM purchase order number

10.9.2.3 Packing slip number

10.9.2.4 Batch/lot number

10.9.2.5 Material type

10.9.2.6 Grain direction

10.9.2.7 Core thickness, for laminate

10.9.2.8 Copper cladding, for laminate

10.10 **Traceability Requirements**

10.10.1 Lot traceability is required from the finished product back to the raw materials, which shall include process equipment, date stamps, and operator and is made available to TTM upon request.

10.11 **Calibration Providers**

10.11.1 Must be accredited.

10.11.2 Proof that standards used are traceable to international or national measurement standard.

10.11.2.1 Where no standard exists, the basis used for calibration or verification shall be submitted.

10.11.3 Before and after data must be recorded on the certifications.

10.11.4 A list of equipment used for calibration and the calibration dates of this equipment.

10.11.5 Safeguarded from adjustments.

10.11.6 Procedure used for calibration.

10.11.7 Calibrations must be carried out under suitable environmental conditions.

11 QUALITY REQUIREMENTS

11.1 Laminate fallout rate

11.1.1 The required fallout rate due to supplier defects is 0.4% or less. The supplier scorecard will reflect the actual monthly rate and points will be awarded based on the actual fallout rate.

11.2 Continuous Improvement

11.2.1 All suppliers should be working to continually improve their quality to TTM. Upon request, the supplier should be able to provide their top three (3) issues they are working on to improve quality to TTM as well as their status. This shall be made available to TTM upon request.

11.2.2 All suppliers shall establish and maintain an effective Foreign Object Debris (FOD) Prevention Program to reduce the potential of FOD.

11.3 Supplier Maintenance

11.3.1 Supplier will retain quality records for products, equipment, or services provided to TTM for a minimum of seven (7) years after the requirements of the procurement action have been fulfilled, or as stated on the purchase order.

11.3.2 Copies of quality records or documents may be saved in electronic or paper format, but shall be available to TTM, TTM customers, or Regulatory Authorities within 48 hours of request.

11.3.3 Suppliers may periodically be asked to complete a self-evaluation form (i.e. Supplier Self-Assessment Survey) as well as submit to an audit of the external provider's quality management system at periodic intervals, upon written advance notification.

11.3.4 Right of Access: After providing advanced and reasonable notice, TTM reserves the right of access to all applicable external provider facilities, at any level of the external provider chain, to allow their customers and/or regulatory authority's access to review any applicable records pertaining to an order of purchased goods or services.

11.3.5 Counterfeit Part Prevention: For those who provide materials, the external provider shall not deliver products that contain counterfeit electrical and/or mechanical material/elements. External provider must notify TTM and disclose the source of materials if the material becomes the subject of a legal or counterfeit issue. External provider shall have a program in place to be able to authenticate the materials being delivered to TTM. The link to TTM Technologies position and requirements for counterfeit parts is located at the following link:

[HTTPS://WWW.TTMTECH.COM/SUPPORT/SUPPLIER_REQ.ASPX](https://www.ttmtech.com/support/supplier_req.aspx)

Click on: Supplier Counterfeit Parts Requirement.pdf.

11.3.6 TTM Technologies may submit a material to an outside lab for testing to confirm validity of materials used in the product at any time without the external provider's consent.

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12 SHUTDOWN

13 MAINTENANCE

13.1 Routine Operator Maintenance

13.2 Miscellaneous Maintenance

14 TRAINING

15 TROUBLESHOOTING GUIDE/RESPONSE FLOW CHECKLIST

16 CONTROL PLANS