A11 No-Flow Processing Guide

The processing guidelines contained in this document were developed through in-house testing and field experience. However, they *should be considered to be starting points that will require further adjustment.* Read the following review of processes for applicability to your particular Printed Wiring Board (PWB) fabrication environment. Remember that the suggestions contained herein can not account for all possible board designs or processing environments. Additional adjustments by the fabricator will be necessary. Isola can and will assist with this process, but the fabricator, not Isola, is ultimately responsible for their process and the end results. Fabricators should verify that PWBs made using these suggestions meet all applicable quality and performance requirements.

Part 1: Prepreg Storage and Handling

Isola Group's prepreg bonding sheets for use in multilayer printed circuit board applications are manufactured to specifications that include physical and electrical properties and processing characteristics relative to the laminating application. Handling and storage factors have an important influence on the desired performance of the prepreg. Some parameters are affected by the environment in which prepregs are stored. They can also deteriorate over extended periods of storage. The prepreg received by the customer is a glass fabric that has been impregnated with a stated quantity of low volatile, partially polymerized resin. The resin is tack-free but somewhat brittle. Many lamination problems arise from resin loss off the fabric due to improper handling. The fabric used is based on the order and supplies the required thickness. In most cases the amount of resin carried by the fabric increases as the fabric thickness decreases.

Isola Laminate Systems A11 is a proprietary general purpose difunctional epoxy (100°C Tg typical by DSC) no-flow prepreg. It has been specifically formulated for optimal performance in bonding applications that require minimal resin flow and consistency in lamination. The material brings the fabricator specific characteristics appropriate for use in heat sink bonding, die cavity board (direct chip attachment) and multilayer rigid-flex applications. It meets IPC-4101C specifications as well as UL 94 HB specifications.

Handling Suggestions

Handle all prepreg using clean gloves. Use sharp, precision equipment when cutting or paneling prepreg. Treat all prepreg as being very fragile. Use extreme care when handling very high resin content prepreg (glass fabrics 1080 and finer).

Storage Suggestions

Upon receipt, all prepreg should be immediately moved from the receiving area to a controlled environment. All prepreg should be used as soon as possible using a First-In-First-Out (FIFO) inventory management system.

No-flow prepregs should remain in their original bagging during storage and bags should be resealed if opened. If stored @ 5°C (41°F), the unopened bag should be equilibrated for 8 hours in the layup area prior to opening and use.

Attention must be given to environmental conditions in the storage/layup areas to insure that the prepreg is not allowed to absorb moisture. A11 prepregs are hygroscopic. Moisture absorption can lower minimum melt viscosity, resulting in a lengthening of the flow window. Further, excessive moisture absorption can also depress Tg and impact degree of cure. **If excessive moisture is absorbed, desiccation procedures may NOT return prepreg performance to original specifications.**

Prepreg should be stored at <= 23 ºC and below 50% humidity.

Part 2: Prepreg Selection

Isola Laminate Systems offers no-flow prepregs in various glass styles. The resin content and flow characteristics of these items are tightly controlled to optimize consistency of flow and filling capability, plus provide precise thickness contribution. Actual thickness will be dependent on the prepregs selected as well as on the specific lamination set-up, including temperature, pressure, area under lamination, and configuration of facing surfaces.

A11 no-flow prepreg is not suggested for exposed exterior surfaces, such as rigid/flex cover layers or face sheet under foil caps. Its unique chemistry provides somewhat limited chemical and thermal resistance. Where A11 prepreg is used for heat sink bonding, it should be cut back such that the edges are not exposed outside the metal part.

Generally, two plies of no-flow prepregs provide the best results. One ply of no-flow prepreg, style 1080 or thinner, is not generally suggested. This is due to the lack of sufficient cushioning during lamination and may result in an increased potential for lamination voids and other defects.

A11 no-flow prepregs are typically available in 104 and 108 glass styles in most regions (Asia, Europe and North America). Some regions may offer more than one combination of resin content and/or flow performance per glass style.

Prepreg selection should be based on the glass style and overall thickness requirement needed as well as the resin content and the flow characteristics of the specific prepreg product. The PWB fabrication process requirements as well as the end product's design and performance requirements should also be taken into account when choosing no-flow prepregs. **Consult your Technical Service representative for assistance with product selection as well as with general processing and press cycle adjustments.**

The processing suggestions contained in this document are general in nature. Each fabricator should characterize A11 no-flow prepregs in their specific applications.

Bond Enhancement

Bond strength and assembly reliability will be improved if the organic and metal surfaces to be bonded with no-flow prepregs are properly prepared using suitable procedures prior to lamination. Laminate surfaces (flex film or unclad laminate) should be clean and roughened (pumice scrubbed, plasma etched or similarly prepared). Metal or metallized surfaces should have the shininess broken and oxidation removed by pumice scrubbing, brushing, vapor honing, or similar means. Copper surfaces are best prepared with oxide or oxide replacements for maximum adhesion. Shiny nickel is a particularly challenging surface to be bonded. Surface(s) must be dry, as moisture will affect adhesion, prepreg flow characteristics and disrupt the curing mechanism. **Each each fabricator should conduct in-house testing to verify that their coating produces acceptable results with A11.**

Both reduced oxides and oxide alternative chemistries have been used successfully in fabricating A11 multilayer boards to date. Users should make sure the oxide or oxide replacement coating exhibits a consistent and uniformly dark color.

If reduced oxides are used, consult the chemical supplier for post oxide baking considerations as excessive baking may degrade the coating characteristics. It is generally suggested that post-oxide baking be performed vertically, in racks. Suggest mild bake of oxided innerlayers (15-30 minutes @ 80-100°C).

For conveyorized oxide replacements, an efficient dryer at the end of a conveyorized oxide replacement line should remove all moisture from the innerlayer surface. **However, drying of layers for 30 minutes minimum @ 100°C or higher is considered a "best practice". Drying in racks is preferred.**

If immersion tin adhesion treatments are used, the fabricator should test the coating to verify adequate bond strength develops with A11 prepregs.

Part 3: Lamination

Standard Lamination

The amount of time at cure temperature, and to some extent the actual cure temperature of A11 material, will be determined by the thickness of the multilayer package being produced. Very thick boards will require a longer cure time to assure optimum material performance.

Removal of A11 flash should be performed by routing rather than shearing to minimize crazing along the panel edges.

Table 1 outlines general suggestions for lamination pressure based on press type used. **Some designs and applications may require deviation from these guidelines. Consult with Isola Technical Service for assistance.**

Table 1: A11 Lamination Pressure

Lamination Method	Suggested Pressure Range
Hydraulic Pressing (without vacuum assist)	350-400 PSI 24-28 Kg/cm^2
Hydraulic Pressing (with vacuum assist via vacuum frames or bags)	325-375 PSI 23-26 Kg/cm^2
Hydraulic Pressing (vacuum enclosure)	325-375 PSI 23-26 Kg/cm^2
Autoclave Pressing	175-200 PSI 12-14 Kg/cm^2

Single-Stage Press Cycle Lamination

The following page outlines the suggested lamination parameters for a single-stage lamination cycle. Dual-stage cycles that utilize "kiss" pressure during the initial stage of the cycle are **not suggested** for use with A11 material.

The lamination cycle selected will be a function of board stackup, complexity and thickness as well as the lamination presses capability. Note that the following graph is for reference purposes only and may require adjustment depending on the board size, thickness and complexity. **Thicker boards may require additional dwell time at curing temperature to achieve full cure.** See "Standard Lamination" previously discussed.

The cycle includes a pressure reduction step, which facilitates stress relief of the package during the cure step. Further, the cycle assumes that vacuum is maintained throughout the heating cycle and that the book is cooled to a temperature well below the Tg of the material before the press is opened. All three conditions are considered to represent "best practice" conditions during lamination by Isola.

While use of both the pressure drop cycle and cooling well below Tg in the "hot" press are strongly suggested, these steps are considered to be "optional" and the PCB fabricator may have equipment or capacity limitations which prevent following these suggestions.

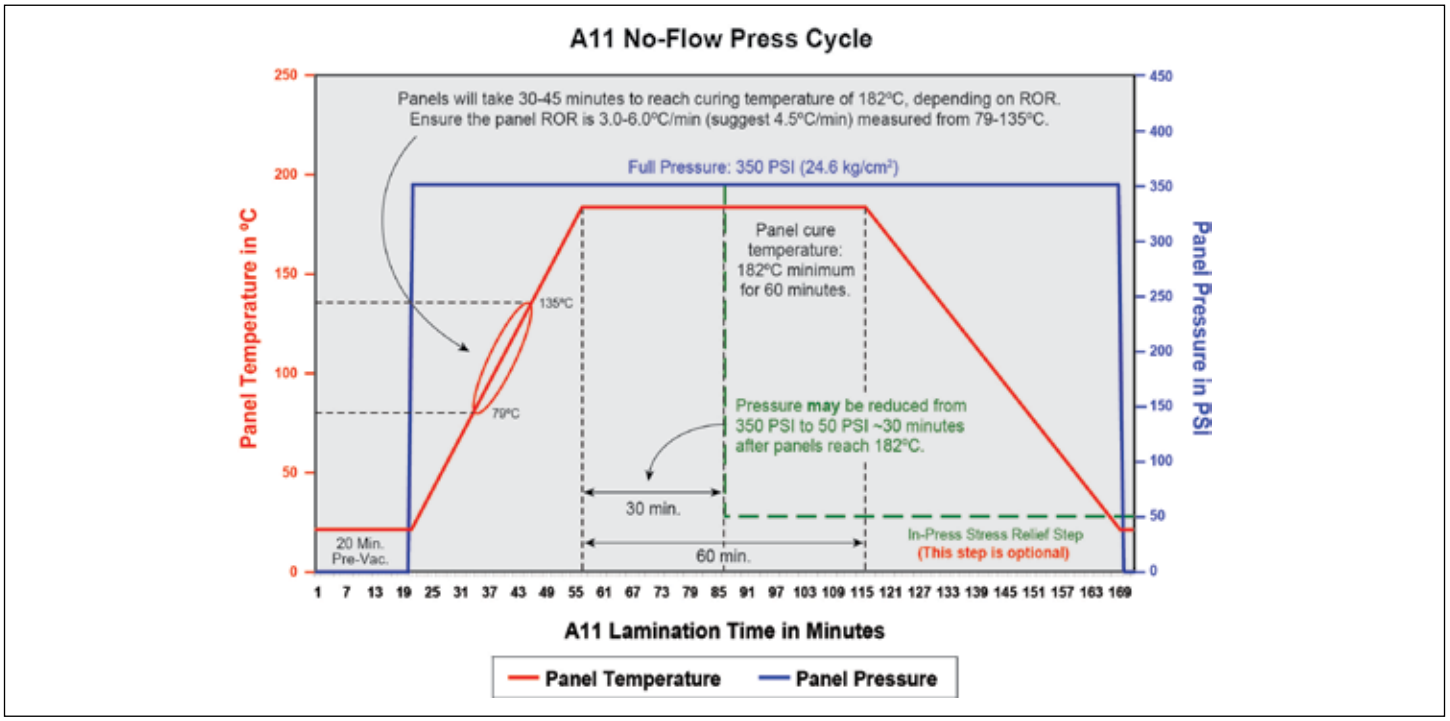
Also note that your Isola Technical Service representative may elect to utilize an "equilibrated" lamination cycle for some prepregs and some board designs. During this type of cycle the product temperature is held for 10-20 minutes in the product's melting temperature range under full pressure to facilitate better flow and wetout of structures. Although this type of cycle is not specifically illustrated on the following pages, it is considered to be an acceptable practice for some designs.

Single-Stage Lamination

1. Load/center the package as quickly as possible. **Pull vacuum for 20 minutes on lifters.**
2. Apply full pressure of 325-400 PSI (22.8-28.1 kg/cm^2) on the panels. Suggest 350 PSI (24.6 kg/cm^2) for initial pressure setting. See **Table 2.**
   NOTE: "Kiss" pressure cycles are not suggested with A11.
3. Adjust heat rise to ~3.0-6.0°C/min (5.5-11.0°F/min), as measured between 79-135°C (175-275°F) by controlling the platen ramp rate and/or by using the appropriate amount of pressure padding.
4. Cure for a minimum of 60 minutes @ 182°C (360°F) once the package *center* reaches the specified set point.
   NOTE: An 80 minute cure cycle @ 171°C (340°F) may be used in some applications, but the product may not develop full Tg. Further, if the presence of components dictates a lower cure temperature, note that cure duration should be increased by 60 minutes for every -12.2°C (10°F) reduction in cure temperature below 182°C (360°F) to develop maximum Tg. Unique press cycles should be validated by cure analysis.
   NOTE: Do not let the package temperature exceed 192°C (378°F).
5. Reduce the pressure to 50 PSI (3.5 kg/cm2) after package has been at cure temperature for 30 minutes.
6. Cool material as slowly as possible or at 2.8°C/min (5°F/min) down from 191°C (375°F) through 135°C (275°F) or below.

Suggested A11 Single-Stage Pressure-Temperature Profile

Please note: This is not a press control program! The graph represents the preferred pressure/temperature profile *panels* are subjected to during the lamination program cycle. **Note that the actual high pressure setting chosen may differ from the 350 PSI suggested in this graph. Press pressure and cure duration selected may depend upon board design as well as other factors.**



Part 4: Packaging and Storage

A11 finished boards have low moisture sensitivity and good shelf life. However, Isola recommends using best practices in storage and packaging, as noted below, to reduce risk during lead-free assembly.

A11 boards should be dry prior to packaging to ensure the most robust lead-free performance. For some complex, high reliability designs, baking prior to solder mask application can be implemented to ensure maximum floor life in assembly processing. Printed boards made for high temperature assembly from A11, which require a long shelf life, the best protection is provided using a Moisture Barrier Bag (MBB) with a Humidity Indicator Card (HIC) and adequate drying desiccant inside the MBB to prevent moisture absorption during shipment and long-term storage.

Upon opening the MBB, the boards should be processed within 168 hours when maximum shop floor conditions are at < 30°C (85°F)/60% RH. MBB bags that are opened for inspection should be resealed immediately to protect the boards from moisture uptake.

Part 5: Health and Safety

Always handle laminate with care. Laminate edges are typically sharp and can cause cuts and scratches if not handled properly. Handling and machining of prepreg and laminate can create dust (see A11 Material Safety Data Sheet).

Appropriate ventilation is necessary in machining/punching areas. The use of protective masks is suggested to avoid inhaling dust. Gloves, aprons and/or safety glasses are suggested if individuals have frequent or prolonged skin or eye contact with dust.

Isola Group does not use polybromidebiphenyls or polybromide-biphenyloxides as flame retardants in any product. Material Safety Data Sheets are available upon request.

Part 6: Ordering Information

Contact your local sales representative or visit:
www.isola-group.com for further information.

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