



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 fabrication environment. Remember that the suggestions contained herein can't 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 PWB's made using these suggestions meet all applicable quality and performance requirements.**

Part 1: Prepreg Storage and Handling

Isola Laminate Systems FR406N is a proprietary High-Tg (165°C Tg typical by DSC) multifunctional epoxy 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-4101B/24, /26 and /28 specifications as well as UL94 V-0 specifications.

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 careless 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.

Handling Suggestions:

Handle all prepreg using clean gloves. Use sharp, precision equipment when cutting or paneling prepreg. Treat all prepreg as being very fragile.

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. A FIFO (first-in-first-out) inventory management system should be used.

No-Flow prepregs should remain in their original bagging during storage and bags should be resealed if opened. If stored in a cooler @ 41°F (5°C), 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. FR406N 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 properties will be maintained at least 3 months when stored at 68°F and below 50% relative humidity.

Prepregs are sold to IPC-4101B specifications, **except that storage at or below 41°F (5°C) does not extend the product's shelf life to 6 months.** After customer delivery, retesting services are available, but passing retest results do not constitute a re-certification. Prepregs will be retested at the original manufacturing site or at another appropriate site to be determined by Technical Service.

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.

Where UL94 V-0 flammability rating, high temperature and chemical resistance are required, FR406N should be considered for use.

Generally, 2 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.

FR406N No-Flow prepregs are typically available in 106 and 1080 glass styles in most regions (Asia, Europe & North America). Some regions may offer more than one combination of resin content and/or flow performance per glass style. Consult your local Sales representative, Customer Service representative or Technical Service representative for currently available products.

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 generic or general in nature. Each fabricator should characterize FR406N No-Flow prepregs in their specific applications.

Bond Enhancements

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. **However, each fabricator should conduct in-house testing to verify that their coating produces acceptable results with FR406N.** Shiny Nickel is a particularly challenging surface to be bonded. Surface(s) must be dry. Moisture will affect adhesion, prepreg flow characteristics and disrupt the curing mechanism.

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 oxidized surfaces (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 surface. **However, see the drying suggestion at bottom of this page.**

If tin immersion type adhesion treatments are to be used, the fabricator should test the coating to verify adequate bond strength is developed with FR406N prepregs.

Drying of layers for 30 minutes minimum @ 100°C or higher is considered a “best practice”, for most applications. Drying in racks is preferred.



Standard Lamination

The amount of time at cure temperature, and to some extent the actual cure temperature of FR406N, 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 the FR406/FR406N flash should be performed by routing rather than shearing to minimize crazing along the panel edges.

Table 2 outlines general suggestions for lamination pressure based on press type used. **However, some designs and applications may require deviation from these pressure guidelines.** On **rare** occasions a customer will encounter a board design with highly unusual fill characteristics. In those cases, it is sometimes necessary to use very high pressures (**400-500PSI**) to achieve complete resin fill with the prepreg in question. It is important to understand when higher pressure is the

appropriate solution to the problem and when a different prepreg (thicker glass style, higher resin content or higher Circle Flow performance) is a more appropriate solution. **Consult with Isola Technical Service for assistance.**

Table 2 – FR406N Lamination Pressure

| LAMINATION METHOD | SUGGESTED PRESSURE RANGE |
|---|---|
| Hydraulic Pressing: (without vacuum assist) | 350 - 400 PSI (24.6 – 28.1 Kg/cm ²) (24.1 – 27.6 Bar) |
| Hydraulic Pressing: (with vacuum assist via vacuum frames or bags) | 325 - 375 PSI (22.9 – 26.4 Kg/cm ²) (22.4 – 25.9 Bar) |
| Hydraulic Pressing: (vacuum enclosure) | 325 - 375 PSI (22.9 – 26.4 Kg/cm ²) (22.4 – 25.9 Bar) |
| Autoclave Pressing: | 175 - 200 PSI (12.3 – 14.1 Kg/cm ²) (12.1 – 13.8 Bar) |

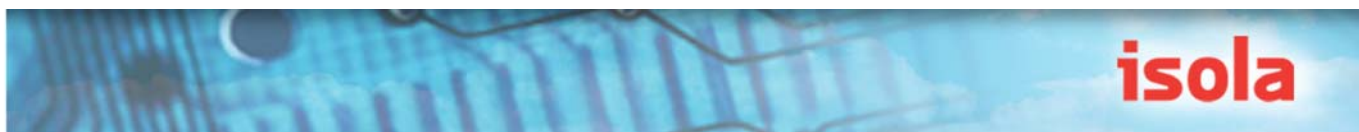
Single-Stage Press Cycle Lamination

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 FR406N. The lamination cycle selected will be a function of board stackup, complexity and thickness as well as the lamination press’s capability. Note that the attached 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” above.

The cycle includes a pressure reduction step, which facilitates stress relief of the package during the cure step. Further, the cycles assumes vacuum is maintained throughout the heating cycle and presumes 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.

However, while use of both the pressure drop cycle and cooling well below Tg in the “hot” press are strongly suggested, they 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.



Part 3: Lamination

Standard 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 (21.1 – 28.1 kg/cm²) on the panels. Suggest **350 PSI (24.6 kg/cm² or 24.1 Bar)** for initial setup.

NOTE: Kiss pressure cycles are NOT Suggested with FR406N.

3. Adjust heat rise to approximately 5.5-11.0°F/min (3-6°C/min), as measured between 175°F (79°C) to 275°F (135°C) by controlling the platen ramp rate and/or by using the right amount of pressure padding.
4. Cure for a minimum of 80 minutes @ 365°F (185°C) once the center of package reaches 365°F.

NOTE: A 60 minute cure cycle @ 365°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 10°F reduction in cure temperature below 365°F to develop maximum Tg. **The use of unique press cycles should be validated by cure analysis.**

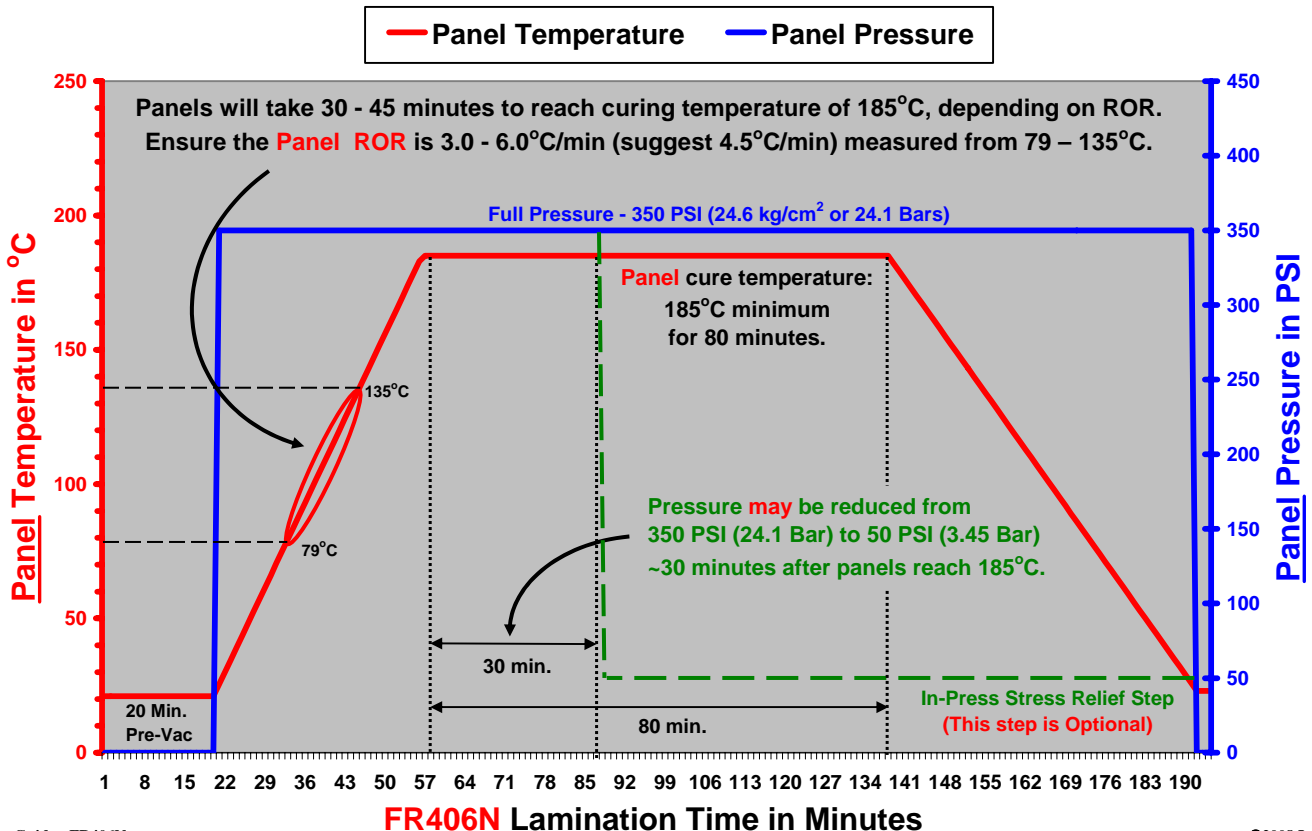
NOTE: Do NOT permit lamination package temperature to exceed 378°F (192°C).

5. If possible, 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 5°F/minute (2.8°C/minute) down from 365°F (185°C) through 275°F (135°C) or below.

SUGGESTED FR406N 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 setting shown in this graph. Press pressure selected may depend upon board design as well as other factors.

FR406N PRESS CYCLE



FR406N Lamination Time in Minutes

Part 6: Health & 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 FR406N 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 7: Ordering Information

Contact your local sales representative or:

Isola Group
3100 West Ray Road, Suite 301
Chandler, AZ 85226
Phone: 480-893-6527
Fax: 480-893-1409
For further information visit:
www.isola-group.com

Isola Asia Pacific (Hong Kong) Ltd.
Unit 3512 - 3522, 35/F
No. 1 Hung To Road, Kwun Tong,
Kowloon, Hong Kong
Phone: (852) 2418 1318
Fax: (852) 2418 1533
Info.hkg@isola-group.com

Isola GmbH
Isola Strasse 2
D-52348 Düren
Phone: +49(0)2421-8080
Fax: +49(0)2421-808164
E-Mail:info-dur@isola-group.com

MAS Italia s.r.l.
Via S. Sebastiano 21
I-51032 Bottegone (PT)
Phone: +39-05 739221
Fax: +39-0573-922265

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