isola

IS620i
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 properties, 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 or damage to the woven glass 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.

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. IS620i is sealed and shipped in a moisture barrier bag. Each bag should be inspected for breaches upon receipt. IS620i prepreg should be stored in the original, unopened packaging until used. If not handled properly, IS620i prepreg will absorb moisture, which will lead to depressed Tg's and cure and affect flow in the press. If extended storage is required, separate facilities should be reserved with appropriate environmental control. Prepreg should be stored at ≤ 23 °C and below 50% humidity.

Prepreg packages should be allowed to equilibrate to layup room conditions before opening to prevent moisture condensation on the prepreg.

Stabilization time will depend on storage temperature. In cases where storage temperature is significantly below room temperature, keep prepreg in the original sealed packaging during the stabilization period to prevent moisture condensation. Once the original packaging is opened, the prepreg should be used immediately. Remaining prepreg should be resealed in the original packaging with fresh desiccant. Storage should be in the absence of catalytic environments such as high radiation levels or intense ultraviolet light.

Part 2: Innerlayer Preparation

Isola Group's IS620i laminates are fully cured and ready for processing. It has been the experience of most fabricators that stress relief bake cycles are not effective in reducing any movement of high performance laminates such as IS620i. Therefore, it is suggested that the movement of unbaked laminate be characterized and the appropriate artwork compensation factors are used.

Dimensional Stability

The net dimensional movement of laminate after the etch, oxide and lamination processes is typically shrinkage. This shrinkage is due to the relaxation of stresses that were induced when the laminate was pressed as well as shrinkage contribution from the resin system. Most of the movement will be observed in the grain direction of the laminate.

There are situations that have been known to alter the proportion of shrinkage in grain versus fill direction in some board shops. These include autoclave pressing and cross-plying laminate grain direction to that of prepreg. While both of these practices have their advantages, material movement must be uniquely characterized.

Table 1 (for reference) illustrates the suggested approach to characterizing laminate movement and provides *approximate* artwork compensation factors for IS620i laminate when using a hydraulic press.

Table 1: Initial Artwork Compensation Factors

Base Thickness	Configuration	Direction	Comp (in/in)
≤ 0.005″	Signal/Signal	Warp (grain)	0.0009-0.0012
"	"	Fill	0.0001-0.0004
"	Signal/Ground	Warp (grain)	0.0006-0.0009
"	"	Fill	0.0001-0.0004
"	Ground/Ground	Warp (grain)	0.0003-0.0005
"	"	Fill	0.0000-0.0003
0.006-0.009″	Signal/Signal	Warp (grain)	0.0006-0.0009
"	"	Fill	0.0001-0.0004
"	Signal/Ground	Warp (grain)	0.0004-0.0006
"	"	Fill	0.0000-0.0003
"	Ground/Ground	Warp (grain)	0.0000-0.0003
"	"	Fill	0.0000-0.0003
0.010-0.014″	Signal/Signal	Warp (grain)	0.0003-0.0005
"	"	Fill	0.0000-0.0003
"	Signal/Ground	Warp (grain)	0.0001-0.0004
"	"	Fill	0.0000-0.0003
"	Ground/Ground	Warp (grain)	0.0000-0.0003
"	"	Fill	0.0000-0.0003

This table assumes that laminate and prepreg grain directions are oriented along the same dimension. Each shop must characterize material behavior given their particular lamination cycles, border designs and grain orientation of laminate to prepreg. It is also suggested that specific laminate constructions be specified and adhered to so that dimensional variations due to changes in construction are avoided.

Table 1 assumes that signal layers are either half or 1 ounce copper and ground layers are either 1 or 2 ounce copper.

Field fabrication testing indicates that the shrinkage of IS620i is approximately 30% greater than the shrinkage found with FR406 and FR408.

Imaging and Etching

IS620i laminates are imaged using standard aqueous dry films and are compatible with both cupric chloride and ammoniacal etchants.

Bond Enhancement

Oxide alternative chemistries have been used successfully in fabricating IS620i multilayer boards to date and are the only bond enhancement recommended for all applications. Reduced black oxide has been used successfully, but is more design and process sensitive, as well as being less thermally stable. Users should make sure the oxide or oxide replacement coating exhibits a consistent and uniformly dark color.

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 120 minutes minimum @ 110°C (230°F) or higher is required for boards to be subjected to high temperature assemploy processes. “lead-free” processes. Drying in racks is preferred.**

Wet cores interfere with the curing of prepreg, leading to low Tg values and degraded performance. Users need to verify the effectiveness of their process to achieve dry cores.

If reduced oxides are used, consult the chemical supplier for post oxide baking considerations as excessive baking may lead to lower pink ring resistance. It is generally suggested that post-oxide baking be performed vertically, in racks.

Peel strengths may be slightly lower as compared to FR406 due to the higher modulus properties of the resin system. The use of DSTFoil™ will typically increase the bond strength by approximately 1 to 1.5 lbs as compared to non-DSTFoil copper foil.

If immersion tin adhesion treatments are used, the fabricator should test the coating to verify adequate bond strength develops with IS620i prepregs.

Part 3: Lamination

Use of advanced bond or polytreat copper foil is strongly recommended. (Contact an Isola representative if additional help or process information is needed.)

Standard Lamination

The amount of time at cure temperature and the required pressure will be a function of board thickness and retained copper circuitry thickness and distribution. In general, thinner boards should be run at the lower end of the range, and thicker boards should be run at the higher end of the range.

Faster heat ramps lower the minimum achieved viscosity and improve resin fill and flow, but cause the material to spend less time in the flow window. This creates a tighter process window and is more likely to result in glass stop/glass lock conditions. A cycle with an isotherm hold is not recommended for faster heat ramps. Slower heat ramps do not achieve the same relative viscosity but enable the product to spend more time in the flow window, creating a wider process window. Slow heat ramps work well with isotherm lamination cycles.

Sequential Lamination

Sub-assemblies must be baked prior to performing the secondary lamination. Moisture will interfere with the curing of the IS620i resin system.

Sub-assemblies require much longer baking, particularly when stored in open environment. Baking times range from 3-24 hours at 110-180°C (230-356°F). Consult with an Isola Technical Expert for recommendations.

Lamination of Sub-Assemblies

Use both a 110 minute cure for sub-assemblies and a **110 minute cure for the final assembly.**

Removal of IS620i flash should be performed by routing rather than shearing to minimize crazing along the panel edges.

Table 2: IS620i General Lamination Parameters

Vacuum Time	30 minutes (no pressure, product on risers)
Curing Temperature	195-200°C (385-395°F) Do not let the package temperature exceed 205°C (400°F)
Curing Time	130-180 minutes (time at cure temperature or above 195°C (385°F), whichever applies.
Heat Ramp	3.5-5.0°C/min (6.2-9.0°F/min) from 80-140°C (176-284°F) Target > 4°C/min (7.2°F) Product temperature overshoot to 205°C (401°F) acceptable to meet heat ramp requirements with alternative oxides.
Pressure	See **Table 2.**
Pressure Application	50 PSI (3.5 Kg/cm^2) after vacuum dwell time, switch to high pressure $\leq$ 90°C (194°F) product temperature.
Pressure Drop	After 30 minutes above 190°C (375°F) reduce pressure to 100 PSI (7 Kg/cm^2).
Cool Down	Cool to 120°C (250°F) at 2.5°C/min (4.5°F/min) with 100 PSI (7 Kg/cm^2) pressure prior to removing or transferring the load.

Table 3 outlines general suggestions for lamination pressure based on press type used.

Table 3: IS620i Lamination Pressure

Lamination Method	Suggested Pressure Range
Hydraulic Pressing (without vacuum assist)	350 PSI 24 Kg/cm^2
Hydraulic Pressing (with vacuum assist via vacuum frames or bags)	200-350 PSI 21-24 Kg/cm^2
Hydraulic Pressing (vacuum enclosure)	250-350 PSI 17-24 Kg/cm^2

Part 4: Drill

General

The IS620i materials exhibit increased thermal stability and generate little or no smear. To assure effective removal of the resin debris during drilling, undercut drill geometries and high helix tools are ***strongly recommended*** on drills up to 1.0 mm in diameter. On high layer count technologies and thicker overall board thicknesses, peck drilling may be necessary. Suggested parameters are outlined below for typical multilayer designs.

Cutting Speed and Chipload

Relative to standard FR-4 parameters, use lower chiploads to drill IS620i printed circuit boards. The parameters in **Table 4** provide a *moderate initial starting point for typical multilayer board designs.*

Thick boards with heavy copper or special cladding such as invar will require more conservative drill parameters. Boards with numerous 2 oz. copper innerlayers or boards with coarse glass weave may require more conservative parameters.

High cutting speeds and high chiploads are associated with rough holes and fracturing around the glass yarn.

Stack Height and Hit Count

Stack heights and hit counts will vary with the construction and overall thickness of the boards being drilled. For thicker boards, above 2.5 mm (100 mils) overall, with high layer counts, drill one high. Use undercut bits for particularly demanding designs. Aluminum entry and lubricated backing help create good quality hole walls but are not essential in all applications.

Part 5: Hole Wall Preparation

General

When IS620i is properly cured and drilled, it it will generate very little smear. The main purpose of desmear processing on this material is to remove debris and provide an acceptable texture to the hole walls.

Good desmear and electroless copper deposition performance are more easily achieved when the drilled hole quality is good. The generation of smooth, debris free hole walls is influenced by the degree of resin cure, drilling conditions and board design considerations. The elimination of 7628 or similar heavy glasses (whenever possible), coupled with properly adjusted drill parameters on fully cured boards has been shown to improve overall drilled hole quality. This helps reduce smear generation, which improves desmear performance and can ultimately help to reduce copper wicking.

Factors which influence chemical desmear rates, and therefore the suggestions in this document, include: resin type, chemistry type, bath dwell times, bath temperatures, chemical concentrations in each bath and the *amount of solution transfer through the holes.*

Factors which influence the *amount of solution transfer through the holes* include: hole size, panel thickness, vertical or horizontal process equipment and equipment agitation parameters.

Chemical Desmear

Chemical desmear methods alone are not generally suggested for IS620i. However, some fabricators have been successful in utilizing chemical desmear processing. In these instances, the fabricator has conducted extensive hole wall testing to ensure adequate hole wall cleaning and surface preparation for electroless adhesion.

Table 4: Suggested Drilling Parameters For Initial IS620i Setup

Drill Size		Spindle Speed	Surface Speed Per Minute		Infeed		Chipload		Retract		Hits
Inch	mm	RPM	SFPM	SMPM	Inch min.	Meter min.	Mil Rev.	mm Rev.	Inch min.	Meter min.	Max
0.0098	0.25	110,000	282	94	50	1.27	0.45	0.012	800	20.3	400
0.0177	0.45	80,000	371	140	88	2.24	0.77	0.022	1000	25.4	600
0.0197	0.50	75,000	387	118	90	2.29	1.20	0.034	1000	25.4	600
0.0248	0.63	57,000	370	119	91	2.31	1.62	0.038	1000	25.4	600
0.0295	0.75	49,000	378	118	86	2.18	1.76	0.043	1000	25.4	800
0.0354	0.90	40,000	371	122	78	1.98	1.95	0.044	1000	25.4	800
0.0394	1.00	35,000	361	119	70	1.78	2.00	0.045	1000	25.4	800
0.0500	1.27	27,000	353	128	55	1.40	2.00	0.049	1000	25.4	800
0.0591	1.50	23,000	356	132	46	1.17	2.00	0.051	1000	25.4	800
0.0787	2.00	20,000	412	138	40	1.02	2.00	0.058	1000	25.4	800

Plasma Desmear

Plasma desmearing is the preferred method of desmear for IS620i. It can consistently etch the chemically resistant resin system, and can provide good hole wall texturing. It can be used with or without a single permanganate pass (to be determined by each fabricator). **Plasma processing tends to improve overall hole quality, particularly in thick and/or high aspect ratio boards. Standard plasma gas mixtures and cycles are generally satisfactory.**

Hole Wall Condition Verification

It is recommended that users take test samples for hole wall inspection after drill and deburring and after desmearing. The post drill condition indicates hole cleanliness and hole wall damage. Post desmear indicates desmear effectiveness and resin texturing. SEM pictures of holes cut vertically in half have been effective for executing this verification.

3-Point Etchback

True 3-point "etchback" exposes the innerlayer “post” on *all three sides* for subsequent plating processes. This will require a more robust approach compared to simple desmear which is designed only to remove resin smear from the vertical surface of the inner layer interconnect “posts”.

Permanganate chemistry alone should not be used for 3-point etchback with IS620i.

A combination of plasma and chemical processing is suggested. Testing indicates that the plasma provides nearly all of the resin removal. Chemical desmear should be used primarily for hole cleaning and conditioning.

If plasma is not available, chemical etch back for 3-point connections must be done with extreme care on IS620i to minimize copper wicking. This is not recommended. If chemical processing alone is used, it will be necessary to evaluate the dwell times in chemical baths. Consult the chemical supplier for suggested conditions. **The rapid dissolution rate of IS620i resin into chemical etching alone may result in excessive resin removal.**

Solder Mask Stripping

IS620i is an alkaline sensitive material. High temperature/concentration alkaline solutions will remove excessive resin from the board surface. **Therefore, solder mask stripping should be avoided.**

Secondary Drilling

As common with most high Tg materials with increased modulus properties, the use of entry and backer material may be necessary during the secondary drilling of larger hole sizes to avoid crazing/fracturing at the hole perimeter. Additionally, sharper plunge point angle geometries may be necessary to avoid crazing around secondary drilled hole perimeters.

Routing and Scoring

Due to the greater modulus properties of the IS620i materials, modifications of the final PWB rout fabrication process may be necessary. **Table 5** lists initial starting parameters using chip breaker or diamond cut tool designs. **Note that parameters listed may require further adjustment.**

Table 5: Suggested Routing Parameters for Initial IS620i Setup

Tool Diameter		Spindle Speed	Spindle Travel Speed	
Inch	mm	RPM	Inch min.	Meter min.
0.0620	1.5748	45,000	20	0.508
0.0930	2.3622	35,000	40	1.016
0.1250	3.1750	25,000	50	1.270

Chip breaker or diamond cut tool designs recommended.

For PWB designs requiring scored geometries, the testing of various Tg's and resin content materials has determined that adjustments to the process will be necessary. As the modulus strength of materials increases, the maximum resultant web thickness (dependent on the scored edge depth) must be decreased to avoid excessive fracturing upon breaking away the scored materials.

Individual board designs/stack ups may require adjustment of score depth geometries. **Thinner web thicknesses are typically required.** This is influenced by layer count, glass types and retained copper in the design.

The customer should contact the scoring equipment and/or bit supplier for application specific suggestions for use with IS620i materials. Your Isola Technical Account Manager may also be able to provide some initial suggestions, but these should be validated through testing by the individual PWB fabricator.

Part 6: Packaging and Storage

IS620i 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.

IS620i boards should be dry prior to packaging to ensure the most robust lead-free performance. The use of a Moisture Barrier Bag (MBB) with a Humidity Indicator Card (HIC) and adequate drying desiccant inside the MBB are recommended practices for improving shipping robustness 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 7: 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 IS620i Material Safety Data Sheet (MSDS)).

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 8: Ordering Information

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

Isola Group
3100 West Ray Road, Suite 301
Chandler, AZ 85226
Phone: 480-893-6527
Fax: 480-893-1409
info@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, Germany
Phone: 49-2421-8080
Fax: 49-2421-808164
info-dur@isola-group.com

The data contained in this document, while believed to be accurate and based on both field testing and analytical methods considered to be reliable, is for information purposes only. Any sales of these products will be governed by the terms and conditions of the agreement under which they are sold.

www.isola-group.com/products/IS620i

isola