DELIVERING THE FUTURE OF COMPOSITE SOLUTIONS

FORMULATED PRODUCTS

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INTRODUCTION

Introduction to Gurit

Gurit pioneered the use of epoxy resin in the manufacture of large light weight, high stress composite structures, by formulating low viscosity systems with long working times before gelation. These systems allow the use of vacuum bagging techniques to be used, which improve the mechanical properties of the finished item by obtaining highly favourable fibre to resin ratios. This reduced void numbers and sizes and improved the interface between resin matrix and the fibres by ensuring they are in intimate contact before and during curing.

These epoxy systems also used lower temperature post cures to more fully polymerise the epoxy matrix than had been experienced in the composites industry before this time.

This legacy of creating formulations which generate the highest possible properties from the simplest and most robust production processes have allowed the use of Gurit Laminating and Infusion products for both new build and repair on small items and huge structures the world over.

All of the “formulated products” manufactured by Gurit are classified as thermosetting materials or ‘thermosets’. These materials are supplied in a liquid or semi-liquid form, usually as a “2-part system”. Under the correct conditions, the system undergoes a chemical reaction (known as “curing”) to form a solid material. While the resultant cured material will soften above a certain temperature (its glass transition temperature, or Tg), it will not become liquid and flow again, unlike ‘thermoplastics’ which can be heated up and will reflow in a reversible and repeatable process.

GURIT FORMULATED PRODUCTS

Gurit manufactures a wide range of epoxy chemistry based formulated resin products. These formulations are unique combinations of chemicals that have been blended together to yield products with characteristics optimised for their intended application. The products have been extensively tested both for their handling and usage characteristics, and for the properties that result from their curing, and this information is presented here.

The characteristics of thermosts mean that they can be formulated into a wide variety of forms, with many different liquid-state properties and cured properties. The products manufactured by Gurit have therefore been grouped under the following headings, broadly relating to their intended application:

- Ampreg™ Laminating Systems - epoxy based liquids, low viscosity for good wet-out, high strength and stiffness.
- AMPRO™ Multi-purpose Systems - epoxy based. Capable of performing as adhesives, coatings, filling compounds and laminating systems.
- PRIME™ Resin Infusion Systems – low viscosity, high performance epoxy based liquids ideal for vacuum bag infusion and resin transfer moulding process.
- Spabond™ Adhesives - epoxy based semi-liquids and pastes, high strength and durability.
- Filling and Fairing Compounds - epoxy based pastes, high adhesive ability and durability.
- Coatings - epoxy process coats for in-mould application to achieve a defect free surface ready for sanding and painting.
- Tooling Products - a complete range of epoxy composite tooling products that can be used up to an operating temperature of 160°C.
LAMINATING SYSTEMS

The Ampreg™ 3X Series replaces Gurit’s legacy range of wet laminating systems for the manufacture of large composite structures in the marine, wind and construction industries.

The comprehensive 3X Series portfolio comprises of a single range of low toxicity, blendable Ampreg™ 3X hardeners that can be used in conjunction with the following resins:

- **Ampreg™ 30 Low viscosity Resin**: replaces Ampreg™ 21
- **Ampreg™ 31 Drainage resistance Resin**: replaces Ampreg™ 22
- **Ampreg™ 36 Premium performance Resin**: replaces Ampreg™ 26

Additional ancillary products including Thixotropic Pregel Resin and High Tg hardeners are also available.

Health and Safety Focus

The award winning Ampreg™ 3X Series laminating system has been reformulated to prioritise user health and safety through careful selection of base chemicals. The new low toxicity resin matrix is CMR, SVHC free* and the hardeners are classified as environmentally non-hazardous.

Light Reflective Technology As Standard

The Ampreg™ 3X series is now available with LRT (Light Reflective Technology) as standard, which serves as a risk monitoring feature for the user and enables inspection of contamination by means of UV light. To learn more about Gurit® LRT technology, please refer to the respective data sheet.

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* CMR = Substances classified as Carcinogenic, Mutagenic or toxic for Reproduction
SVHC = Substances of Very High Concern

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<table>
<thead>
<tr>
<th>System Properties At 25°C</th>
<th>Mixed Viscosity*</th>
<th>150g Pot-Life*</th>
<th>Earliest Time To Apply Vacuum*</th>
<th>Latest Time To Apply Vacuum*</th>
<th>Earliest Demould Time*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ampreg™ 3X Low viscosity Resin</td>
<td>900 cP</td>
<td>½ hour</td>
<td>1 ½ hours</td>
<td>2 hours</td>
<td>3 hours</td>
</tr>
<tr>
<td>Ampreg™ 3X Standard Hardener</td>
<td>550 cP</td>
<td>1 hour</td>
<td>2 ½ hours</td>
<td>3 hours</td>
<td>6 ½ hours</td>
</tr>
<tr>
<td>Ampreg™ 3X Slow Hardener</td>
<td>250 cP</td>
<td>4 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>16 hours</td>
</tr>
<tr>
<td>Ampreg™ 3X Extra-slow Hardener</td>
<td>150 cP</td>
<td>7 hours</td>
<td>6 hours</td>
<td>7 ½ hours</td>
<td>40 hours</td>
</tr>
<tr>
<td>Ampreg™ 3X High Tg Hardener</td>
<td>420 cP</td>
<td>8 ½ hour</td>
<td>7 ½ hours</td>
<td>9 ½ hours</td>
<td>60 hours</td>
</tr>
<tr>
<td>Ampreg™ 3X Thixotropic Pregel</td>
<td>600 cP</td>
<td>5 hours</td>
<td>4 hours</td>
<td>6 hours</td>
<td>30 hours</td>
</tr>
</tbody>
</table>

(Ampreg™ 3X Fast Hardener)

Viscosity optimised for good fabric wet-out and drainage resistance, DNV-GL & Lloyd’s Register Certified, Replaces Ampreg™ 22

(Ampreg™ 3X Standard Hardener)

Viscosity optimised for good fabric wet-out and drainage resistance, DNV-GL & Lloyd’s Register Certified, Replaces Ampreg™ 22

(Ampreg™ 3X Slow Hardener)

Improved fabric impregnation, Faster mechanical property generation, High flexural properties, Replaces Ampreg™ 26

(Ampreg™ 3X Thixotropic Pregel)

Viscosity optimised for good fabric wet-out and drainage resistance, DNV-GL & Lloyd’s Register Certified, Replaces Ampreg™ 22

Working time properties are highly subjective to ambient conditions and should be used as an approximate guideline for all Ampreg™ systems at 25°C.

Please refer to the corresponding page of this document for specific testing methods used.
AMPREG™ 30
Low Toxicity Epoxy Wet Laminating System

- Low Toxicity Hardener Formulations
- Low initial mixed viscosity & good cure progression from ambient only cures
- With Gurit LRT (Light Reflective Technology) as standard
- Same 100:26 resin to hardener mix ratio by weight across range of hardener speeds
- DNV-GL certified formats available

INTRODUCTION
Ampreg™ 30 has been optimised for the manufacture of large composite structures using hand layup and vacuum bagging techniques whilst offering improved health and safety.

The relatively low initial mixed viscosity of Ampreg™ 30 allows easy wetout of heavyweight reinforcements. Ampreg™ 30 has been designed to give excellent mechanical and thermal properties from both ambient temperature cures, and moderate temperature postcures (50°C). This system is available with a range of hardener speeds, from Fast to Extra Slow.

The unique formulation offers improved health & safety through the careful selection of low toxicity raw materials as well as Light Reflective Technology which in conjunction with a UV light-source can detect droplets as small as 1mm for easy identification of contamination to improve industrial hygiene.

TYPICAL APPLICATIONS
Manufacture of large composite structures in the marine, wind and construction industries.

PACK SIZES & AVAILABILITY
Ampreg™ 30 is available in 1.26 and 4.66 kg resin & hardener packs or in 1000 / 219 / 18 kg resin and 174 / 19 / 4.68 kg hardener quantities.

AMPREG™ 31
Epoxy Wet Laminating System

- DNV-GL-certified formats available
- Viscosity optimised for good fabric wet-out and drainage resistance
- Good cure progression from ambient only cures

INTRODUCTION
Ampreg™ 31 has been optimised for the manufacture of large composite structures using hand layup and vacuum bagging techniques whilst maintaining good drainage resistance for application on vertical surfaces. Ampreg™ 31 has been designed to give excellent mechanical and thermal properties from both ambient temperature cures and moderate temperature postcures (50°C). This system is available with a range of Ampreg™ 3X hardener speeds, from Fast to Extra Slow.

The unique formulation offers improved health & safety through the careful selection of low toxicity raw materials as well as Light Reflective Technology which in conjunction with a UV light-source can detect droplets as small as 1mm for easy identification of contamination to improve industrial hygiene.

TYPICAL APPLICATIONS
Ampreg™ 31 has been optimised for the manufacture of large composite structures using hand layup and vacuum bagging techniques whilst offering improved health and safety.

PACK SIZES & AVAILABILITY
Ampreg™ 31 is available in 1.26 and 4.66 kg resin & hardener packs or in 1000 / 219 / 18 kg resin and 174 / 19 / 4.68 kg hardener quantities.

AMPREG™ 3X
THIXOTROPIC PREGEL

- Compatible with all Ampreg™ resins
- Improves drainage resistance
- Up to 100% substitution for max resistance

INTRODUCTION
Ampreg™ Thixotropic Pregel (TP) is a resin additive with a grease-like consistency, which can be used with a variety of hardeners from the Gurit laminating resin range. The properties of an Ampreg™ Thixotropic Pregel/laminating hardener combination are broadly similar to those of the hardener with its usual resin. This is because the thixotropic agents are added to a high quality resin base and because the Pregel is usually added to the laminating system at relatively low levels. At high addition levels, the resulting laminate will be more brittle than the ‘neat’ laminating system.

TYPICAL APPLICATIONS
Ampreg™ Thixotropic Pregel (TP) is used primarily as a thixo paste - to be added to low viscosity laminating resins for applications where resin drainage is a concern. It is therefore typically used in vertical and overhead laminating situations, particularly where heavy, open weave fabrics are being used, since these are the most prone to resin drainage. Ampreg™ Thixotropic Pregel can be used as the base resin component of an adhesive for bonding honeycomb & foam cores, and other rigid materials.

PACK SIZES & AVAILABILITY
Ampreg™ Thixotropic Pregel is available in 193 / 20 kg resin quantities.
AMPRO™ MULTI-PURPOSE SYSTEMS

AMPRO™ is an award-winning, latest generation multi-purpose epoxy system from Gurit. It is simple to use, all-purpose epoxy which can be used for bonding, coating, laminating and filling.

AMPRO™ provides a quick and convenient way of using one epoxy system for a wide range of tasks.

Key features include:

- **Professional**: boat-builder’s choice for bonding, laminating and filling
- **Safer**: uses lower toxicity chemicals with low hazards
- **Stronger**: more flexible resin matrix ideal for working with wood
- **Tack-free**: no surface residue when cured and does not clog sandpaper
- **Water-proof**: AMPRO™ SILICA has been optimised to withstand the marine environment
- **Wide over-coating window**: up to 4 days later without additional surface preparation
- **Faster**: improved cure at temperatures as low as +5°C
- **Glossier**: improved coating performance with reduced surface defects
- **Cardboard outer packaging**: less single use plastics
- **Greener**: accredited, bio-based option using a high content of plant-based chemicals
- **Simplified**: four unique systems with interchangeable hardeners and the same 3:1 mix ratio

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### System Properties at 25°C

<table>
<thead>
<tr>
<th>System Type</th>
<th>Mixed Viscosity*</th>
<th>150g Pot Life*</th>
<th>Tack-off Time*</th>
<th>Earliest Sanding Time*</th>
</tr>
</thead>
</table>
| **AMPRO™ Resin**
| Fast Hardener   | 1000 cP         | ½ hour        | 1 ½ hours      | 10 hours              |
| Slow Hardener  | 800 cP          | 1 ½ hours     | 4 hours        | 20 hours              |
| Extra-slow Hardener | 700 cP   | 1 ½ hours     | 5 hours        | 20 hours              |

**Simplified**: Suitable for all general purpose applications including laminating, bonding, filling and coating.

<table>
<thead>
<tr>
<th>System Type</th>
<th>Mixed Viscosity*</th>
<th>150g Pot Life*</th>
<th>Tack-off Time*</th>
<th>Earliest Sanding Time*</th>
</tr>
</thead>
</table>
| **AMPRO™ CLR**
| Fast Hardener  | 1000 cP         | ½ hour        | 1 ½ hours      | 10 hours              |
| Slow Hardener | 750 cP          | 1 ½ hours     | 4 hours        | 20 hours              |
| Extra-slow Hardener | 700 cP   | 1 ½ hours     | 5 hours        | 20 hours              |

**Ideal for clear coating and laminating applications where colour is critical.**

<table>
<thead>
<tr>
<th>System Type</th>
<th>Mixed Viscosity*</th>
<th>150g Pot Life*</th>
<th>Tack-off Time*</th>
<th>Earliest Sanding Time*</th>
</tr>
</thead>
</table>
| **AMPRO™ BIO**
| Fast Hardener | 1260 cP         | ½ hour        | 1 ½ hours      | 20 hours              |
| Slow Hardener| 1100 cP         | 1 ½ hours     | 4 ½ hours      | 20 hours              |
| Extra-slow Hardener | 1050 cP   | 1 hour        | 6 hours        | 20 hours              |

**Market-leading, accredited >40% bio-content multi-purpose system suitable for laminating, bonding, filling and coating.**

<table>
<thead>
<tr>
<th>System Type</th>
<th>Mixed Viscosity*</th>
<th>150g Pot Life*</th>
<th>Tack-off Time*</th>
<th>Earliest Sanding Time*</th>
</tr>
</thead>
</table>
| **AMPRO™ SEAL**
| Fast Hardener | 1253 cP         | ½ hour        | 1 ½ hours      | 10 hours              |

**Solvent-free, low viscosity epoxy resin sealer for porous surfaces prior to coating and bonding.**

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### AMPRO™ CLR

**Low Temperature Curing**

- **Multi-purpose System**
- **Rapid curing & multi-purpose**
- **Low Toxicity Formulation**
- **Mix ratio (by volume)**: 3

**Ideal for clear coating applications**

**Simple 3:1 by volume mix ratio**

**Low Toxicity Formulation**

**Introduction**

AMPRO™ CLR is a simple to use, all-purpose epoxy adhesive which can be used for gluing, coating, laminating and filling. With its fast, low temperature curing hardener and easy 3:1 mix ratio by volume, AMPRO™ CLR provides a quick and convenient way of using one epoxy system for a very wide range of tasks.

**Typical Applications**

AMPRO™ CLR has been built on the well-established SP 106 which has been the primary epoxy system for the manufacture and repair of wooden boats for over 20 years.

By using the Gurit range of filler powders, an AMPRO™ Resin & AMPRO™ Fast Hardener mix can be turned into a very effective adhesive or filling compound. Details of this filler range, and how to use them, are contained in a separate information sheet (Filler Guide) and typical filling and fairing mixes (resin / hardener / filler) are shown in the data sheet.

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### PACK SIZES & AVAILABILITY

AMPRO™ is available 1.33kg or 4.2kg resin and hardener packs, or in 10 / 20 / 206 / 1000 kg resin and 3 / 6 / 20 / 200 kg hardener quantities.

**AMPRO™ BIO**

**High Clarity Epoxy**

- **Multi-purpose System**
- **Rapid curing & multi-purpose**
- **Ideal for clear coating applications**
- **Mix ratio (by volume)**: 3

**Ideal for clear coating applications**

**Simple 3:1 by volume mix ratio**

**Low Toxicity Formulation**

**Introduction**

AMPRO™ BIO is a simple to use, all-purpose epoxy ideal for coating applications which can also be used for gluing, laminating and filling. With its fast, low temperature curing hardener and easy 3:1 mix ratio by volume, AMPRO™ BIO provides a quick and convenient way of using one epoxy system for a very wide range of tasks.

**Typical Applications**

AMPRO™ BIO hardeners have been developed based on the well-established SP 320 and SP 115 systems which has been the primary epoxy clear coating systems for the manufacture and repair of wooden boats for over 20 years.

By using the Gurit range of filler powders, an AMPRO™ Resin & AMPRO™ Fast Hardener mix can be turned into a very effective adhesive or filling compound. Details of this filler range, and how to use them, are contained in a separate information sheet (Filler Guide) and typical filling and fairing mixes (resin / hardener / filler) are shown in the data sheet.

**PACK SIZES & AVAILABILITY**

AMPRO™ BIO is available 1.33kg or 4.2kg resin and hardener packs, or in 10 / 20 / 206 / 1000 kg resin and 3 / 6 / 20 / 200 kg hardener quantities.

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*Working time properties are highly subjective to ambient conditions and should be used an approximate guideline for all AMPRO™ systems at 25°C. Please refer to the corresponding page of this document for specific testing methods used.
AMPRO™ BIO
Bio-based Epoxy
Multi-purpose System

- Accredited 40-60% bio-based system
- Suitable for gluing, coating, laminating and filling
- Mix ratio 3:1 by volume mix ratio
- Low Toxicity Formulation

INTRODUCTION
AMPRO™ BIO is a simple to use, all-purpose epoxy which can be used for gluing, coating, laminating and filling. With its fast, low temperature curing hardener and easy 3:1 mix ratio by volume, AMPRO™ BIO provides a quick and convenient way of using one epoxy system for a very wide range of tasks.

TYPICAL APPLICATIONS
AMPRO™ BIO has been built on the well-established 5P 106 which has been the primary epoxy system for the manufacture and repair of wooden boats for over 20 years.

By using the Gurit range of filler powders, an AMPRO™ BIO resin and hardener mix can be turned into a very effective adhesive or filling compound. Details of this filler range, and how to use them, are contained in a separate information sheet (Filler Guide) and typical filling and fairing mixes (resin / hardener / filler) are shown in the data sheet.

PACK SIZES & AVAILABILITY
AMPRO™ BIO is available 1.3kg or 4.1kg resin and hardener packs, or in 10 / 20 / 200 / 1000 kg resin and 3 / 6 / 20 / 200 kg hardener quantities.

AMPRO™ SEAL
Epoxy Binding Primer

- Ideal sealer coat before solvent-free epoxies
- Good penetration into porous surfaces
- Simple 3:1 by volume mix ratio
- Solvent-free, low toxicity formulations

INTRODUCTION
AMPRO™ SEAL is a solvent-free, low viscosity epoxy resin sealer. It has been developed primarily for use on wood but can also be used on other materials such as glass and carbon composite laminates.

TYPICAL APPLICATIONS
AMPRO™ SEAL has a low viscosity which ensures that the product achieves rapid and deep penetration of porous surfaces. Once AMPRO™ SEAL has soaked into a surface, the adhesive nature of the epoxy base will help to consolidate and strengthen that surface. The resultant epoxy sealing layer provides a high adhesion and moisture resistant base for any type of paint, varnish or epoxy coating system. For example, many woodworking applications combine the penetrating power of the AMPRO™ SEAL, with the thick, clear coating capability of AMPRO™ CLR to produce a strong, highly protective, deep gloss surface on wood.

PACK SIZES & AVAILABILITY
AMPRO™ SEAL is available 1.3kg or 4.1kg resin and hardener packs.

One System, Many Uses...
AMPRO™ consists of inter-changeable resins, blendable hardeners and additives for many uses. The following table provides a step by step guide to choosing the right AMPRO™ system.

The components you need will depend on your application...

<table>
<thead>
<tr>
<th>Coating, Sheathing, or Laminating</th>
<th>Filling, Fairing or Bonding</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: Select the right system...</td>
<td>A + B</td>
</tr>
<tr>
<td>AMPRO™</td>
<td>AMPRO™ CLR</td>
</tr>
<tr>
<td>Low temperature curing</td>
<td></td>
</tr>
<tr>
<td>Clear coating</td>
<td>✔</td>
</tr>
<tr>
<td>Grain enhancing wood coating</td>
<td>✔</td>
</tr>
<tr>
<td>Bio-based content</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Sealing &amp; priming porous surfaces</td>
<td>✔</td>
</tr>
<tr>
<td>Filling, Fairing or Bonding</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B: Select the hardener speed...</th>
<th>Fast</th>
<th>F</th>
<th>Slow</th>
<th>S</th>
<th>Extra-Slow</th>
<th>XS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working time with a brush at 20°C</td>
<td>1- 2 hours</td>
<td>4 - 5 hours</td>
<td>5 - 6 hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50g pot-life in air at 20°C</td>
<td>½ hour</td>
<td>1 hour</td>
<td>1½ hours</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C: Select the additive(s)...
- Micro Balloons (MB)
- Glass Bubbles (GB)
- Micro Fibres (MF)
- AMPRO™ Silica (AS)

Filling & Fairing Mixes
- Easy to sand, filling and filing for cosmetic wood applications
- Waterproof or low-cost filler for all applications
- Hard surface finish filler for hard wearing edges and surfaces
- General bonding of softwood, brown in colour
- General bonding of softwood, white in colour
- Structural bonding of wood or composite, opaque in colour

Microballoons
Wood Filling & Bonding
- Brown, hollow phenolic resin spheres ideal for wood applications
- Easy to profile and sand for filling, filling and bonding

Glass Bubbles
Waterproof Filling & Bonding
- White, hollow glass spheres for waterproof filling and bonding
- Ideal as a finishing filler for hard wearing edges & surfaces

Microfibres
Structural Bonding
- Opaque, very fine cellulose wood fibres for structural bonding
- Suitable for both wood and GRP

AMPRO™ Silica
Waterproof Resin Thicker
- Fine waterproof, white powder used to thicken the epoxy system
- Can be used with Glass Bubbles, Microballoons and Microfibres

Roller to the AMPRO™ datasheet for recommended mixes
The PRIME™ infusion system from Gurit has been used successfully for the single-operation moulding of components ranging from narrow carbon yacht masts, up to 80’ yacht hulls and wind turbine blades. PRIME™ infusion resin has a much reduced viscosity and longer working time, which makes it ideal for infusing very large parts with complex reinforcements in one operation.

PRIME™ 27 is suitable for the female moulding of large, complex components incorporating advanced fibres such as carbon* and aramid. Typical projects include spars, hulls and reinforcing structures.

PRIME™ 27 offers outstanding performance in a variety of liquid infusion processes including SCReMP, RIFT (resin infusion under flexible tooling), VARTM (vacuum assisted resin transfer moulding) and RTM (resin transfer moulding).

PRIME™ 27 resin uses a wide range of hardeners to give a range of working times and cure speeds. This enables the gel time of the resin to be closely matched to the required infusion time for any particular size of moulded part. It achieves excellent mechanical and physical properties, including a high Tg from a moderate (50°) post-cure.

The system has an exceptionally low exotherm characteristic, which allows thick sections to be manufactured without risk of premature gelation due to exothermic heat build-up. This low exotherm will also extend the life of the mould tools.

### System Properties At 20°C**

<table>
<thead>
<tr>
<th>System</th>
<th>Mixed Viscosity **</th>
<th>150g Gel-Time **</th>
<th>Latest Flow Under Vacuum **</th>
<th>Earliest Vacuum-Off Time **</th>
<th>Earliest De-mould Time **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Hardener</td>
<td>260 - 280</td>
<td>1 hour</td>
<td>2 ½ hours</td>
<td>6 hours</td>
<td>8 hours</td>
</tr>
<tr>
<td>Slow Hardener</td>
<td>265 - 285</td>
<td>4 ½ hours</td>
<td>5 hours</td>
<td>11 hours</td>
<td>17 hours</td>
</tr>
<tr>
<td>Extra-slow Hardener</td>
<td>250 - 270</td>
<td>10 ½ hours</td>
<td>9 ½ hours</td>
<td>29 hours</td>
<td>Not recommended without a post-cure</td>
</tr>
</tbody>
</table>
| High Tg Hardener | 500 - 520 | 5 hours | - | Not recommended without a post-cure |**

*Unidirectional carbon fibre is acknowledged difficult to infuse. Please contact a member of technical team before attempting a carbon infusion with PRIME™ 27.
** Working time properties are highly subjective to ambient conditions and should be used as approximate guideline for all PRIME™ 27 systems at 20°C.
Spabond™ adhesives offer outstanding performance in high-stress, high-load applications for Marine, Wind Energy and Civil Engineering applications.

<table>
<thead>
<tr>
<th>System Properties at 20°C</th>
<th>Description</th>
<th>Hardener</th>
<th>Mix ratio</th>
<th>Working Time* at 20°C</th>
<th>Clamp Time at 20°C</th>
<th>Sag*</th>
<th>Max Temp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural, high dynamic load applications</td>
<td>Spabond™ 335</td>
<td>Standard (Gray)</td>
<td>2:1 (by volume)</td>
<td>20 mm</td>
<td>6 hrs</td>
<td>5mm</td>
<td>65°C</td>
</tr>
<tr>
<td>Spabond™ 340LV HT</td>
<td>High strength, rubber toughened, fast dispense. Uses: Industrial, wind energy and marine.</td>
<td>Standard (Purple)</td>
<td>2:1 (by volume)</td>
<td>1½ hr</td>
<td>4 hrs</td>
<td>20 – 25mm</td>
<td>68°C</td>
</tr>
<tr>
<td>Spabond™ 345</td>
<td>Highly sag resistant. Uses: highest performance marine projects</td>
<td>Extra Slow (Blue)</td>
<td>2:1 (by volume)</td>
<td>4 hrs</td>
<td>12 hrs</td>
<td>10 – 30mm</td>
<td>85°C</td>
</tr>
</tbody>
</table>

Specialist substrate and applications | Spabond™ 5 Minute | Tackling and secondary bonding | 1:1 (by volume) | 5 mins | 20 mins | 10 – 15mm | 55°C |
| Spabond™ 540 | High elongation, long bonding times. | Standard (Purple) | 1:1 (by volume) | 4 hrs | 10 hrs | 58°C |
| Spabond™ 540LV | Low viscosity resin option for easier application. | Extra Slow (Blue) | 1:1 (by volume) | 6 hrs | 10 hrs | 52°C |
| Spabond™ 545 | Bonds multiple substrates found in general applications | Fast (Black) | 2:1 (by volume) | 25 mins | 5 hrs | 62°C |
| Spabond™ 569 | Core bonding adhesive | Slow | 2:1 (by volume) | 90 mins | 10 hrs | 61°C |
| Spabond™ 575 | Easy microsponginess spreading. Bonds all woods | Low viscosity hardener option for easier application | 1:1 (by volume) | 1½ hrs | – | 55°C |

Fast structural adhesives | Spabond™ 720 | High strength, rapid curing. General purpose adhesive. | 1:1 (by volume) | 10 mins | 1 hr | 10 – 15mm | 60°C |

Instruction: Spabond™ 335 is a toughened, high performance, thixotropic adhesive, with a simple 2:1 by volume mix ratio. It is a very versatile system suitable for bonding a wide range of materials. The product has a grease-like consistency, and can be applied in thicknesses of up to 5mm at 20°C on vertical surfaces, without the risk of drainage. With its inherent thixotropic characteristics, Spabond™ 335 usually needs no further filler addition for most applications.

**INTRODUCTION**

The latest Spabond™ 340LV HT formulation is a high performance adhesive designed for bonding large structures. It is a cost-effective system with good thermal and mechanical properties. The new improved formulation gives higher thermal performance and allows faster curing, making this product ideal for bonding large composite structures where minimising cure times and increasing productivity is of value. The components are pigmented to give a visual indication of mix quality, which is a useful feature when mixing by hand or with a machine. The system has a simple 2:1 by volume mix ratio.

**TYPICAL APPLICATIONS**

Large structures such as yacht hulls and wind turbine blades.

**PACK SIZES & AVAILABILITY**

Spabond™ 340LV HT is available in 400 and 900ml cartridges with mix heads, 200 / 20 resin and 200 / 20 / 10 kg hardener quantities. Cartridge guns and additional mix heads are also available.
SPABOND™ 345
Epoxy Gap-Filling Adhesive

- High strength and toughness
- Designed for cartridge & mixing machine dispense
- Black fast hardener for cosmetic applications
- DNV-GL and Lloyds Register certified formats available

INTRODUCTION
Spabond™ 345 is a toughened, high performance adhesive system ideal for bonding large structures where substrate surfaces have uneven geometry. The product has a thick, paste-like consistency, and can be applied without sag in thicknesses of over 30mm at 15°C, making it ideal where large, uneven vertical glue-lines are required. The product has a 2:1 mix ratio by volume. To aid mixing, the components are pigmented to give visual indication of mix quality. The Fast hardener is coloured purple, but there is also a black version. This is useful for improving the cosmetic appearance of bondlines involving exposed carbon composites.

TYPICAL APPLICATIONS
For highest performance marine projects.

PACK SIZES & AVAILABILITY
Spabond™ 345 is available in 400ml cartridges with mix-heads or 20 kg resin and 20 / 9.6 kg hardener quantities. Cartridge guns and additional mix heads are also available.

SPABOND™ 5-MINUTE
Tacking and Secondary Bonding

- 5 minute adhesive
- Available in cartridges

INTRODUCTION
Spabond™ 5-Minute uses Gurit’s fast-setting technology. It combines outstanding bonding speed with a simple 1:1 by weight and by volume mix ratio. This thixotropic system is ideal for general bonding and repair work on a wide range of materials. Components bonded with Spabond™ 5-Minute demonstrate high bond strengths and can be handled after a very short period of time. Spabond™ 5-Minute can be used in conjunction with other Spabond™ products as a “spot weld” system in situations where the use of conventional clamps is not possible.

TYPICAL APPLICATIONS
Used to tack panels in place whilst the structural adhesive is curing.

PACK SIZES & AVAILABILITY
Spabond™ 5-Minute is available in individual 310ml resin and hardener cartridges or 400ml combined cartridges with mix-heads. Cartridge guns and additional mix heads are also available.

SPABOND™ 540 & 540LV
Epoxy to Polyester Bonding

- Excellent bond to polyester & epoxy substrates
- Sag resistance of up to 30mm on a vertical face
- Resin and Hardener pigmented to give a visual indication of mix quality
- Wide range of hardener speeds, from Fast to Extra-slow
- Lloyds Register certified formats available

INTRODUCTION
Spabond™ 540 is a modified ambient curting epoxy adhesive designed for bonding polyester or epoxy laminates. The Adhesive system is available with two resins; Spabond™ 540 resin is designed for larger gaps up to 30mm and Spabond™ 540LV for bond-line <20mm.

TYPICAL APPLICATIONS
The high toughness and excellent gap filling properties make this adhesive ideal for stringers/bulkheads, frames and hull-to-deck joints on medium to large production boats.

PACK SIZES & AVAILABILITY
Spabond™ 540 is available in 600ml cartridges with mix-heads and 200 / 20 kg resin and 184 / 18.4 kg hardener quantities. Cartridge guns and mix heads are also available on request.

SPABOND™ 545
Dissimilar Substrate
Epoxy Adhesive System

- Range of hardener speeds to suit most application requirements
- Cross-market industrial applications
- Bonds multiple substrates
- Range of gap filling: Low (0.2mm) - High (20mm)
- Easy to apply – Manual or Pneumatic Dispense Guns, Bulk Dispensing Unit

INTRODUCTION
Spabond™ 545 is a two component Epoxy Adhesive offering outstanding performance in numerous composite and non-composite applications, ideally suited for bonding dissimilar substrates.

TYPICAL APPLICATIONS
Ideal for cross-market applications - Automotive, Transportation, Industrial, Construction.

PACK SIZES & AVAILABILITY
Spabond™ 545 is available in 400ml cartridges with mix-heads, 20 kg resin and 18.8 kg fast or 18.4 kg slow hardener quantities for machine mixing/dispense. Cartridge guns and additional mix heads are also available on request.
SPABOND™ 568
Core Bonding & Splicing

- Low cured density ideal for core bonding
- Suitable for use with lightweight core
- Long working time for large structures
- DNV-GL certified formats available

**INTRODUCTION**
Spabond™ 568 is a low density adhesive, with a simple 2:1 by volume mix ratio which is designed for bonding a wide range of core materials. The product is uniquely filled and can be applied in thicknesses of up to 6mm at 20°C on vertical surfaces without the risk of drainage. Resin and hardener are both colour coded to ensure consistency of the mix. The resin is light green and the hardener pale brown leading to a neutral grey colour when fully mixed.

**TYPICAL APPLICATIONS**
With the fillers used in its formulation, Spabond™ 568 is easy to sand and can be used for strip planking with wood or foam strips.

**PACK SIZES & AVAILABILITY**
Spabond™ 568 is available in 17.5 / 10 kg resin and 7.7 / 4.4 kg hardener quantities.

SPABOND™ 570
Oily Wood to Epoxy Bonding

- Excellent application characteristics
- Mixing machine pump-able hardener available
- Excellent adhesion to oily wood like teak
- Highly sag resistant - 15mm on a vertical surface
- Tolerant of very high humidity

**INTRODUCTION**
Spabond™ 570 has been formulated to give the optimum mechanical and working properties for bonding teak decking to a composite hull. Designed specifically for this purpose, it is the ideal adhesive for bonding down teak decks. In use, Spabond™ 570 has a tolerant 1:1 mix ratio and a thixotropic, gel type consistency. This makes Spabond™ 570 very easy to measure, mix and apply. Spabond 570 is non-corrosive, solvent free and generates green strength at ambient without the need for a post. Once cured, Spabond 570 is a tough, very strong adhesive that is compatible with all types of wood, though excels with oily wood types.

**TYPICAL APPLICATIONS**
Teak deck bonding.

**PACK SIZES & AVAILABILITY**
Spabond™ 570 is available in 20 / 5 kg resin and 20 / 5 kg hardener quantities.

SPABOND™ 730
Rapid Structural Bonding

- Reduced clamp time structural adhesive
- Gels in 10 minutes, touch-dry in 2 hours
- High strength and toughness
- Full properties after an overnight cure at ambient

**INTRODUCTION**
Spabond™ 730 is a fast curing structural adhesive designed for applications where reduced clamp times are important. It has a simple 1:1 by weight and volume mix ratio. It can be used to bond together a wide variety of dissimilar materials and has been designed to give a durable high strength bond.

**TYPICAL APPLICATIONS**
Fit-out, finishing and repair.

**PACK SIZES & AVAILABILITY**
Spabond™ 730 is available in 400ml cartridges with mix-heads. Cartridge guns and additional mix heads are also available.

SPABOND™ 840
Fast Curing Structural Epoxy Adhesive

- Long working time for manufacture of large components
- Rapid cure in 2 hours at 70°C
- Formulated with Gurit LRT (Light Reflective Technology)
- High strength and toughness
- Full properties from overnight ambient cure
- Low toxicity formulation

**INTRODUCTION**
Spabond™ 840 is a high performance, toughened adhesive. It is a cost-effective system with good thermal, mechanical properties with long working time for adhesive application yet incorporates innovative chemistry to allow a rapid 2 hour cure time at elevated temperature.

**TYPICAL APPLICATIONS**
Bonding large structures, such as wind turbine blades.

**PACK SIZES & AVAILABILITY**
Spabond™ 840 is available in 20 / 180 kg resin and 20 / 180 kg hardener quantities.
Gurit’s filling and fairing systems for the finishing of component manufacture, offer a range of working times, good sandability and compatibility with a wide range of primers.

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Hardener</th>
<th>Speed</th>
<th>Mix ratio</th>
<th>Intended Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-Fill™ 15 Minute</td>
<td>Rapid cure at ambient temperature, to allow sanding without clogging at just over an hour after application</td>
<td>Standard</td>
<td>15 mins</td>
<td>100 : 100 (parts by volume)</td>
<td>Ideal for rapid filling and repairing all sizes of composite and metal structures such as hulls and decks</td>
</tr>
<tr>
<td>S’Fair™ 600</td>
<td>Two component filler that can be applied up to a thickness of 35mm on a vertical surface. It is easy to sand and is compatible with a wide range of primers and top coats</td>
<td>Fast</td>
<td>10 mins</td>
<td>100 : 100 (parts by volume)</td>
<td>Designed for filling and fairing large composite and metal structures such as hulls and decks</td>
</tr>
</tbody>
</table>

**S’FILL™ 15 MINUTE**

**Rapid Epoxy Filler**

- Simple 1:1 mix ratio by volume
- 15 minute tack-off time
- Spreadable for up to 5 minutes
- Easy to sand without clogging after 1 hour

**INTRODUCTION**

Gurit’s S’Fill™ 15 Minute Filler is an epoxy filler system designed for rapid cure at ambient temperature, to allow sanding without clogging at just over an hour after application. As well as rapid cure and good sandability, the system has been developed to offer ease of dispense and mixing, good sag resistance during application, good cured properties. The system offers a simple 1:1 mix ratio, high levels of adhesion, low shrinkage and good thermal and mechanical properties.

**TYPICAL APPLICATIONS**

Ideal for rapid filling and repairing all sizes of composite and metal structures such as hulls and decks.

**PACK SIZES & AVAILABILITY**

S’Fill™ 15 Minute is available in 2 L resin and hardener pack quantities.

**S-FAIR™ 600**

**Epoxy Faring System**

- Sag resistance up to 35mm on vertical surfaces
- Available with two hardeners; Fast and Standard
- Easy to sand
- Simple 1:1 mix ratio by volume
- Density of 0.86-0.93 g/cm³

**INTRODUCTION**

S’Fair™ 600 is a simple 1:1 by volume, two component filler that can be applied up to a thickness of 35mm on a vertical surface. It is easy to sand and is compatible with a wide range of primers and top coats typically used in the marine market for the finishing of yachts. It is available with two hardeners, Fast and Standard, which enables the customer to tailor the working/cure time to the ambient workshop temperature.

**TYPICAL APPLICATIONS**

Designed for filling and fairing large composite and metal structures such as hulls and decks.

**PACK SIZES & AVAILABILITY**

S’Fair™ 600 is available in 10 / 2.5 L resin and 10 / 2.5 L hardener quantities.
IN-MOULD PROCESS COAT

Our coating products are hard wearing and versatile partners for the prepreg and infusion systems. Available in solvent-free formulations, Gurit’s in-mould process coats are suitable for a range of applications and industries.

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Hardener</th>
<th>Speed</th>
<th>Mix ratio</th>
<th>Intended Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR 3400</td>
<td>Easy to sand, in-mould epoxy surfacing system for epoxy laminates and is designed to be used as the base for the subsequent application of a paint scheme.</td>
<td>Standard</td>
<td>5 hrs</td>
<td>100:30 (parts by weight)</td>
<td>Designed to be backed up with Ampreg™ laminating systems and PRIME™ infusion systems to give a sandable surface ready for painting.</td>
</tr>
</tbody>
</table>

INTRODUCTION
CR 3400 is an in-mould epoxy surfacing system for epoxy laminates, and is designed to be used as the base for the subsequent application of a paint scheme. CR 3400 is formulated to be easily sandable so that once released, the surface can be readily keyed prior to the application of the paint system. This feature gives additional benefits in that any minor surface defects caused by laminate print-through or mould imperfections can easily be sanded away. CR 3400 is applied into a mould in the same way as other epoxy gelcoats, and has similar handling characteristics. However, the product has a considerably longer over-coating window than other gelcoats - up to one day with Standard Hardener at 20°C so that the system can also be used in a very flexible manufacturing environment.

TYPICAL APPLICATIONS
CR 3400 is designed to be backed up with Ampreg™ laminating systems and Prime infusion systems. Under certain conditions it may also be used in conjunction with SE70 / SE84LV prepregs and SPRINT™ systems. CR 3400 must be painted prior to water immersion.

PACK SIZES & AVAILABILITY
CR 3400 is available in 19 kg resin and 5.7 kg hardener quantities.

TOOLING PRODUCTS

As a technical leader in commercial composite materials, Gurit offers a complete range of composite tooling products. Gurit’s tooling product range consists of a range of ambient curing mould materials that can be used up to an operating temperature of up to 160°C.

<table>
<thead>
<tr>
<th>Type</th>
<th>Product</th>
<th>Operating Temperature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gelcoats</td>
<td>T-Gal 130-1</td>
<td>130°C</td>
<td>T-Gal 130-1 is an epoxy gelcoat system for manufacturing glass or carbon reinforced mould tools. T-Gal 130-1 is compatible with Gurit’s range of 130°C / 266°F tooling laminating, infusion and repair materials.</td>
</tr>
<tr>
<td>Laminating Systems</td>
<td>T-Lam 130-1</td>
<td>130°C</td>
<td>T-Lam 130-1 is an epoxy tooling system designed for wet laminating glass or carbon moulds. T-Lam 130-1 is compatible with TPRIME™ 130-1.</td>
</tr>
<tr>
<td>Infusion Resin</td>
<td>TPRIME™ 130-1</td>
<td>130°C</td>
<td>TPRIME™ 130-1 is a low viscosity epoxy tooling system for manufacturing infused glass and carbon moulds. It is compatible with T-Lam™ 130-1 laminating.</td>
</tr>
<tr>
<td>Infusion Resin</td>
<td>TPRIME™ 160</td>
<td>160°C</td>
<td>TPRIME™ 160 is a low viscosity epoxy tooling system for manufacturing infused glass and carbon moulds.</td>
</tr>
</tbody>
</table>

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### T-GEL 130-1

**130°C Tooling Gelcoat System**

- Thermally stable up to 130°C (266°F) when fully post-cured
- Application by roller or brush
- Resistant to thermal cycling damage
- Low shrinkage for accurate mould manufacture
- Sag resistant up to 1mm on vertical surfaces

**INTRODUCTION**

T-Gel 130-1 is an epoxy gelcoat system for manufacturing glass or carbon reinforced mould tools. T-Gel 130-1 is compatible with Gurit’s range of 130°C tooling laminating, infusion and repair materials.

Prepreg over-lamination as part of tool construction is not recommended with this system. The formulation has been designed to provide excellent application handling and sag resistance to aid tool manufacturing. As with all epoxy tooling systems, care must be taken to avoid exposure to sunlight to avoid breakdown of the surface.

To ensure sufficient strength for de-mould and maximise gelcoat adhesion a mid-cure of 4 hours at 40°C (104°F) is recommended after the ambient cure stage.

**TYPICAL APPLICATIONS**

Manufacturing of glass or carbon moulds from liquid infusion processes such as yacht hulls and wind turbine blades.

**PACK SIZES & AVAILABILITY**

T-Gel 130-1 is available in a 7.6 kg resin & hardener pack quantity.

### T-LAM 130-1

**130°C Tooling Laminating System**

- Thermally stable up to 130°C (266°F) when fully post-cured
- Low viscosity for wet-out of heavy weight reinforcements
- Low exotherm and extended pot-life makes this product ideal for large or complex moulds
- Ambient curing and low shrinkage for accurate mould manufacture

**INTRODUCTION**

T-Lam 130-1 is an epoxy tooling system for manufacturing glass or carbon moulds by wet laminating. T-Lam 130-1 is part of the 130°C tooling systems and is compatible with the range of gelcoats, infusion, and repair materials.

T-Lam 130-1 is a low shrinkage ambient curing system, which simplifies accurate mould manufacture. Designed for laminating and cure at 20°C, it should then be mid-cured at 40°C (104°F) for 4 hours to guarantee the strength needed for de-moulding. It can then be post-cured off the plug to give a material that is thermally stable to 130°C (266°F). Exceeding this temperature will cause a rapid loss in stiffness and a safety margin is required for the maximum tool operating temperature to prevent distortion or tool damage.

**TYPICAL APPLICATIONS**

Manufacturing of glass or carbon moulds from liquid infusion processes such as yacht hulls and wind turbine blades.

**PACK SIZES & AVAILABILITY**

T-Lam 130-1 is available in 20 kg resin and 8 kg hardener quantities.

### T-PRIME™ 130-1

**130°C Tooling Infusion System**

- Thermally stable up to 130°C (266°F) when fully post-cured
- Resistant to thermal cycling damage
- Low initial mixed viscosity for easier infusion
- Long pot-life and gel time; capable of infusing large or complex moulds
- Ambient curing and low shrinkage for accurate mould manufacture

**INTRODUCTION**

T-Prime™ 130-1 is an epoxy tooling system for manufacturing glass or carbon moulds from liquid infusion processes and is compatible with Gurit’s range of 130°C tooling gelcoat, laminating and repair systems. T-Prime™ 130-1 is a low shrinkage ambient curing system, which provides a simple way to produce high accuracy moulds. Designed for infusion and cure at ambient temperatures, it should then be mid-cured at 40°C (104°F) for 4 hours to guarantee the strength needed for de-moulding. It can then be post-cured off the plug to give a material that is thermally stable to 130°C (266°F). Exceeding this temperature will cause a rapid loss in stiffness and a safety margin is required for the maximum tool operating temperature to prevent distortion or tool damage.

**TYPICAL APPLICATIONS**

Manufacturing of glass or carbon moulds from liquid infusion processes such as yacht hulls and wind turbine blades.

**PACK SIZES & AVAILABILITY**

T-Prime™ 130-1 is available in 185 / 12.5 kg resin and 16.7 / 3.4 kg hardener quantities.

### T-PRIME™ 160

**160°C Tooling Infusion System**

- Thermally stable up to 160°C (320°F) when fully post-cured
- Resistant to thermal cycling damage
- Low viscosity suitable for infusion
- Long pot-life and gel time; capable of infusing large or complex moulds
- Ambient curing and low shrinkage for accurate mould manufacture

**INTRODUCTION**

T-Prime™ 160 is an epoxy tooling system for manufacturing glass or carbon moulds from liquid infusion processes and is compatible with Gurit’s range of 160°C gelcoat and repair systems. T-Prime™ 160 is an ambient curing system, providing a simple way to produce high accuracy moulds. Designed for infusion and cure at ambient temperatures, it should then be mid-cured at 40°C (104°F) for 4 hours to guarantee the strength needed for de-moulding. It can then be post-cured off the plug to give a material that is thermally stable to 160°C (320°F). Exceeding this temperature will cause a rapid loss in stiffness and a safety margin is required for the maximum tool operating temperature to prevent distortion or tool damage.

**TYPICAL APPLICATIONS**

Manufacturing of glass or carbon moulds from liquid infusion processes such as yacht hulls and wind turbine blades.

**PACK SIZES & AVAILABILITY**

T-Prime™ 160 is available in 200 / 20 kg resin and 180 / 17.5 kg hardener quantities.
ANCILLARY PRODUCTS

In order to assist in the use of the wide range of materials manufactured and supplied by Gurit, a range of ancillary products are also available. These have been refined over many years to enable users to handle products safely and to obtain the very best results from Gurit materials. The ancillary products are grouped together into three main categories:

FILLER POWDERS
A range of filler powders which are designed to modify the properties of some of the Gurit liquid solvent-free resin systems, and so create resin mixes for use as fillers and adhesives. The fillers form three distinct categories: hollow spheres, short fibres, and flow modifiers.

Hollow spheres
Hollow spheres increase the volume and reduce the density of any resin system and are used to make adhesive mixes and filling & fairing mixes.

- Micro-balloons: Brown microsphere filler powder used to make glues or paste fillers.
- Glass Bubbles: White microsphere filler powder used to make glues or paste fillers.

Short Fibres
For adding strength to a resin and hardener mix used as a structural adhesive, short reinforcing fibres are often added which act in a similar strengthening way to the long reinforcing fibres used in composite construction.

- Micro-fibres: Cellulose fibres used to make adhesive mixes.

Flow Modifiers
The most common material for modifying the flow properties of a resin mix is colloidal silica. This is a very fine powder which is added in conjunction with other fillers to ‘thicken’ mixes and reduce their flow on vertical surfaces (increase thixotropy).

- Colloidal Silica: Fine, anti-sag, filler powder. Use in combination with other filler powders.

SOLVENTS
A range of solvents for cleaning tools and surfaces. Due to the very different chemistry of some of the Gurit products from each other, it is important that the correct solvents are selected for the intended application.

PIGMENTS
A range of pigments that can be added to some Gurit products to adjust the colour / visual appearance. Please contact Gurit Technical Support for further guidance on the correct usage / addition of pigments which can vary by product.

APPLICATION, PROCESSING AND SUNDRY ITEMS
Pumps and dispense equipment, application and processing items and pigments.

For our range of dispense guns and mix heads, please contact your local customer services representative for more information.

INTRODUCTION TO FORMULATED PRODUCTS

Data sheets are also supplied with the product when it is ordered. If required in advance of a product, the relevant full SDS (Safety Data Sheet) can be obtained from Gurit.

Each formulated product datasheet contains a brief product description, a list of the availability of the product and its components and the technical data. The technical data in each datasheet includes the following:

- Physical properties of the resin, hardener and mixed systems e.g. viscosity, density etc.
- Working Properties characteristics of the mixed resin and hardener e.g. gel time, working time etc. This is normally presented over a range of different temperatures.
- Cured System Thermal and Mechanical properties, in many cases with more than one cure cycle e.g. glass transition temperature (Tg), shrinkage, laminate compressive strength, etc.

Physical Properties
Each product datasheet details a number of important physical properties. These properties provide important information on the discrete elements and mixed systems, and are particularly relevant when looking at applications such as automated mixing and dispensing.

Mix Ratio
Most of the formulated resin products that are produced by Gurit are based on epoxy chemistry. In most cases the reaction of resin and hardener is an addition reaction, which, in its simplest form, means that one molecule of resin needs to react with one molecule of hardener for a complete reaction to occur. This is different to the catalytic cure of, for example, a polyester resin where a ‘chain-reaction’ is involved.

The implication of this for most epoxies is that the ratio of resin to hardener is critical, and deviating from it will result in unreacted resin or hardener, and an inferior end-product.

Most products in the Gurit range are intended to be mixed by accurately weighing out the correct amounts of resin and hardener using appropriate scales. Other products in the Gurit range are designed to be dispensed and mixed by volume, making them easier to use with dispensing pumps and mixing machines.

Viscosity
The viscosity of a liquid is defined as the measure of its resistance to a shearing action, such as that applied by a brush, laminating roller or the products own self-weight on a vertical surface. It affects many handling properties including ease of fibre wet-out and mixing, degree of flow under vacuum, and drainage on a vertical surface.

Viscosity can be measured in a number of different ways, with different test methods giving slightly different results. A standard industry method is a cone and plate viscometer. This uses a slowly rotating conical disc, which is applied at a constant pressure onto a heated metal base-plate. The liquid being sampled is sandwiched in a thin film between the cone and the plate, and the torque required to revolve the cone is measured and converted to a viscosity.

The method can be used to produce isothermal viscosity curves which show how viscosity increases as a material cures at a constant temperature. Non-isothermal curves can also be generated by heating the base-plate. These show how the viscosity of a material, either mixed or as a single component, changes with temperature.

The SI units of measure of dynamic viscosity is a pascal-second (Pa.s) but the unit of poise (P) or centipoise (cP) is commonly used, where $0.1$ Pa.s = $1$ P = $100$cP.

<table>
<thead>
<tr>
<th>SUBSTANCE</th>
<th>cP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1</td>
</tr>
<tr>
<td>Olive Oil</td>
<td>80</td>
</tr>
<tr>
<td>Motor Oil (SAE 40)</td>
<td>300</td>
</tr>
<tr>
<td>Honey</td>
<td>2000-10000</td>
</tr>
<tr>
<td>Ketchup</td>
<td>50000-100000</td>
</tr>
</tbody>
</table>

Ambient Viscosity of Common Products
Thixotropy
Some liquids have a characteristic known as thixotropy whereby their viscosity depends on shear rate and time. This means that under high shear rates, such as when applied with a brush, they act as if they have a low viscosity, but under low shear rates, such as under the product’s own weight, they act as if they have a high viscosity. Non-drip paint is a common example where this phenomenon is used to formulate a product for a specific application.
Comparing data for materials with this characteristic can be complicated as the conditions under which it has been tested with regard to shear rate and time will influence the measured viscosity.

Some resin systems which are low in viscosity can be given this characteristic by the addition of fillers such as colloidal silica powder. However, colloidal silica, being a very low density powder, can be difficult to handle, so pre-thixotroped products, such as Ampreg™ Pregel can be used to alter the thixotropy of low viscosity resin systems - for example where there is a need to stop a resin system draining from a vertical surface.

Shell Life
Since the properties of many resins and hardeners will change slightly with age, they have been allocated a shelf life. Within this shelf life, the properties of an unopened product will remain within the product’s original quality control limits. This also assumes storage in accordance with the instructions given in the product datasheet. On each product label this shelf life is expressed in the form of an expiry date. Once opened and exposed to air, hardeners particularly will begin to degrade and should be used as soon as practicable. To maintain the freshness of the product for as long as possible, it is recommended that when hardener containers are nearly empty, the contents are dispensed into smaller containers so that the headspace of air above the liquid is minimised. It should be noted that, with a few exceptions, products may still be usable after their expiry date, but their properties may have changed beyond those set in the QC specification, and cannot therefore be guaranteed by Gurit. Typical changes that may be noticed are a darkening of colour, an increase in viscosity, an increase in gel times and settlement or separation of fillers and pigments.

Product Colour
Pigment is added to some products to either produce a finish of a specific colour or as an aid to mixing.

Liquid which are coloured in varying shades of yellow/brown or ‘darkness’, are often classified using the Gardner colour index. Most of the un-pigmented resins and hardeners produced by Gurit can be classified in this way, with the scale being approximately illustrated on the coloured film overleaf. Note that epoxy resins and hardeners may darken on storage, and may also vary slightly in colour from batch to batch. Once cured and exposed to sunlight most epoxies will also yellow slightly.

Solids Content
With solvent-based systems, the solids content is the percentage of a component or mix which comprises non-volatile material. Once the volatile solvent has evaporated, it is the solids element that remains behind to cure into the final film.

Hazard Definition
Most Gurit formulated products have some hazardous properties according to EU regulation on Classification, Labelling and Packaging (EC) No. 1272/2008, also known as Globally Harmonised System (GHS) of classification and labelling. The products may also be classified as dangerous goods for transport according to UN recommendations on the transport of dangerous goods.

This hazard classification system both defines a broad hazard category into which products with similar hazards are grouped, as well as defining in more detail the risks and safety issues associated with the handling and use of each product. The hazardous nature of the product is indicated by red border diamonds on the label of a resin or hardener container. The categories of hazard that can be found on Gurit products are as follows:

![Hazard Symbols](image)

The product label also contains details of the hazards associated with the product and precautions that should be taken whilst using the product. These are listed as Hazard Statements and Precautionary Statements.

Further classification is also allocated to a product to define the nature of the hazard during its transport. This classification uses similar hazard symbols to those for handling, and is indicated by a diamond label on the outer surface of a package in transit.

Density
The density of liquid resin and hardener components are determined using pycnometers. These are simply containers with precisely known volume, typically 100ml. The container is weighed before and after filling, air free, with the sample. The density is then simply calculated by mass over volume.

Cured material density is determined by the Archimedes principle using a hydrostatic balance. A solid immersed in a liquid is exposed to the force of buoyancy. The value of the force is the same as that of the weight of the liquid displaced by the volume of the solid. A hydrostatic balance enables you to weigh a solid in air as well as in water, it is possible determine the density of a solid if the density of the liquid causing buoyancy is known.

Barcol Hardness
A measure of the resistance to penetration of a sharp point under a fixed load, applied by a standard Barcol Hardness tester. The higher the number, the harder the material. Barcol hardness can be used as a basic determination of how cured a material is, or as in indication of the wear resistance of a surface.
faster reacting systems. For this reason, once an epoxy is mixed, it should be poured into a shallow tray. This helps the heat of reaction to escape, and prolongs the time during which the product remains useable.

For almost all systems, Gel Time and Pot Life times are provided as a guide to working times, other experimental values are also provided but on a case by case basis depending on the product type.

**Gel Time - 150g Mix in Water**

A 150g resin and hardener mix is placed in a plastic beaker suspended in a water bath at the specified temperature. A Tecam gel timer is used to determine the point at which the viscosity of the liquid has increased to the point where the material is sufficiently solid to provide a back-force of >0.05N, on the plunging 22mm disk.

**Pot life - 500g Mix in Air**

A 500g resin and hardener mix is placed in a plastic beaker left in air at the specified temperature. The same Tecam gel timer is used as above. This test gives an indication of the exothermic (heat-emitting) properties of a resin system when confined in bulk, and is useful for both determining how quickly a material needs to be used, as well as providing an indication of how the material will behave in thick sections.

Note that because of the greater insulating nature of air compared with water, and the exothermic effects of higher volume mixes, these pot lives are always shorter than the gel-times given above. The only exceptions to this are the solvent-based products which are very low in exotherm, and where the larger mixes provide a greater reservoir of solvent to maintain the fluidity of the product for longer periods.

**Earliest and Latest Time to Apply Vacuum**

When a laminating resin and hardener are mixed, they begin to react together. Assuming temperatures remain constant, the viscosity of the mixed system will then begin to increase, with the mixture gradually thickening and becoming less workable as time progresses. If the resin is being used for a laminate that is to be vacuum bagged, the viscosity will eventually become so high that the vacuum bag becomes ineffective at bleeding out excess resin and so cannot consolidate the laminate properly. In the experience of Gurit this equates to a viscosity of approximately 5000P, and the time taken to reach this viscosity after mixing is given in the datasheets as the ‘Latest Time to Apply Vacuum’.

However, it is equally important that the vacuum is not applied too early, since, if the resin is too low in viscosity, excessive bleed out can occur leading to resin-starved laminates. The minimum recommended viscosity for beginning to apply a vacuum to most laminates is 1000P and is quoted in some of the datasheets as the ‘Earliest Time to Apply Vacuum’.

The times given in the datasheets are based on measuring the viscosity of a thin layer of the mixed resin system as it cures in a cone and plate viscometer. It should be noted that the measurements therefore relate primarily to thin laminates (<1mm) where there is a very low exotherm effect. Thicker laminates may well produce an exotherm effect, rising the laminate’s temperature and significantly reducing these times as the data shows. Such temperature changes are best monitored by using thermocouples in the laminate and using the working times quoted for the laminate’s actual temperature rather than that of the workshop. All times are measured from when the resin and hardener are first mixed together.

**De-mould Time**

This is derived from the cure profile of the material and is the earliest time at which a laminate or gelcoat will have sufficient strength to be carefully handled, and removed from a properly release-coated mould. This time is somewhat subjective since the degree of care exercised and the thickness and configuration of the laminate being demoulded will also have a very significant effect on the time at which de-moulding can begin. De-mould time is measured from when the resin and hardener are first mixed together.

**Clamp Time**

This is the time from first mixing after which a resin system used as an adhesive should have reached a degree of cure where the substrates being bonded cannot be easily separated without damage to the adhesive layer or the substrates themselves. The cure will not have advanced to the point where the joint has sufficient mechanical properties to meet the intended in-service loads, but will have sufficient strength to be carefully handled, and removed from a jig or clamp.

**Sag Resistance**

This is the maximum thickness of fresh gelcoat, filler or coating material that can be applied to a vertical surface without it slumping or running. Sag resistance may be increased by the addition of Colloidal Silica, although this will also have the effect of making the material more brittle.

**Coating Working Time**

For almost all systems, Gel Time and Pot Life times are provided as a guide to working times, other experimental values are also provided but on a case by case basis depending on the product type.

**Tack-Off Time & Latest Over-coating Time**

With most Gurit materials used as coatings, a second coat can be applied when the first has ‘tacked-off’. This is the point where the material is still tacky but has reached a sufficient degree of cure for it not to be disturbed when a second layer is applied on top. As the first layer of material continues to cure beyond this “tack-off” point, it will reach a point where the tack has disappeared. At this point the exposed surface material loses its ability to bond due to the formation of an inert surface layer. Over-coating cannot continue after this point unless the first coat is allowed to cure fully and is then sanded to remove this inert layer. This point is known as the Latest Over-coating Time. The time between this and the Tack-Off Time is known as the over-coating window. Attempting to apply second coats outside of the over-coating window, and without sanding, can lead to severe bond problems between the layers. The exact over-coating window is affected by many factors including humidity and temperature.

Although the data presented will apply in most circumstances, a coating should always be tested by touching lightly with a finger. If the resin comes away on the finger then it is too early to overcoat, if the material is not tacky and a fingerprint cannot be left, then it is too late to overcoat without sanding. These times are measured from when the resin and hardener are first mixed together.

**Earliest Sanding Time**

This is the earliest time at which the material can be sanded, once any inert surface layer (commonly known as by-product) has been removed. By-product may form on coatings particularly if they are allowed to cure in low temperatures and high humidity. With SP 106 and Handpack, it can be removed by wiping with Solvent C.

**Minimum Application Thickness for Coverage**

The minimum thickness for application of a gelcoat or coating in order to achieve sufficient opacity to completely cover a contrasting base colour.

**Suitability for Double Gelling**

Many gelcoats have a surface chemistry that means they should not be applied in more than one coat, if inter-coat problems are to be avoided.

**Wet Film Thickness & Dry Film Thickness**

With solvent-based systems, the wet-film thickness is the typical coating thickness that can be applied as one layer. When the solvent has evaporated, the dry-film thickness is what remains.
THERMAL PROPERTIES
One of the most important physical characteristics of all cured formulated products is the way the material behaves when heated. This thermal data is critical to almost every application since it gives an indication of the limiting temperature for use of the material. Although it is ultimately only by testing the products in the loading configuration they will see in service, that an accurate determination can be made as to whether they are suitable for use at a particular temperature, the glass transition temperature can be used as a guide for initial product selection.

The Glass Transition Temperature (Tg) of a polymeric material, such as cured epoxy, is the temperature at which it changes from a hard and rigid molecular structure into a soft, semi-flexible one. At this point, the polymer structure is still intact, but portions of the matrix are no longer “locked” in position. In practical terms it signifies the upper use temperature of the material, above which the material will exhibit significantly reduced mechanical properties.

The transition from a rigid state to a flexible state is not an instantaneous one, and so there is a range of temperature over which the material undergoes the transition.

Great care should be taken when comparing datasheet values because different techniques, methods within techniques and evaluation procedures can all provide different Tg results. Pay particular attention to the technique used, the ramp rate of the test, the designation of the Tg value quoted and the cure conditions of the sample.

Dynamic Mechanical Analysis (DMA)

DMA is the technique most suited for the measurement of laminates. The sample, typically around 60x10x2mm, is mounted in a 3-point bend fixture and a precise cyclic load (stress) or displacement (strain) is applied. The sample is heated (3°C/min at Gurit) and the stress/strain response of the sample measured. The response can be converted into three plots, Storage Modulus (Stiffness), Loss Modulus (Viscous behaviour) and tan δ (Dampening).

Tg values can be measured from each of these curves but at Gurit we prefer to quote the onset of the drop in the Storage Modulus (stiffness) denoted as Tg.

This is the most conservative measure, other measures, particularly Tgδ and peak tan δ, can be 10's of °C higher but are at the temperature that the material has lost virtually all of its stiffness and mechanical performance.

Differential Scanning Calorimetry

DSC is the technique most suited for the measurement of resin casts. DSC is a measure of heat flow into and out of a sample and is able to measure a Tg because the heat capacity of the material before and after the transition is different. A sample, typically around 10mg, is encapsulated in an aluminium pan. The sample is then heated (10°C/min at Gurit) and the heat flow measured. As the sample transitions through its Tg there is a step in the baseline. At Gurit we prefer to quote the midpoint of the step in the heat flow denoted as Tg2, as this is generally closer to the DMA measure.

The DSC has a further use, since it is measuring heat-flow, it can quantify the heat generated by the reaction of any unreacted epoxy left in a sample after a given cure cycle. This is given here as ΔH, and is measured in J/g i.e. the residual energy (Joules) left in a gram of material. Use of both these measures can give a good indication of degree of cure of a laminate.

Ultimate Glass Transition Temperature (UTg)

Each formulation will have an Ultimate Glass Transition Temperature. This is the maximum that the particular formulation can attain if mixed at the correct ratio and fully cured. Knowing the difference between the “current” Tg and the “ultimate” will inform as to how well the material is cured and whether the material could benefit from a post cure.

HDT - EST

A further indication of the temperature at which a material begins to soften is the HDT (Heat Deflection Temperature). This is usually determined by heating a cast bar of the resin system in an oil bath, and measuring its deflection under an applied flexural load.

Although it has been used for a long time, and is still widely quoted today, it is a crude method in comparison to the DMA which measures the same property (stiffness change), but in a much more controlled way and to a higher degree of accuracy. Empirical testing of a wide range of products at Gurit has determined an approximate correlation between Tg (Peak Tan δ) and HDT, which has been used here to generate an “Estimated HDT”, by the formula:

HDT (Est.) °C = (Tg (Peak Tan δ)°C - 15°C) to an accuracy of ±5°C

ENVIRONMENTAL CONDITIONING

Moisture Absorption

Cast samples are fully immersed in distilled water at 35°C, and the weight change is measured after 28 days. This is the required test temperature and time for Lloyds approval of resin systems for marine applications. Moisture absorption of a cast resin on its own can be misleading as it is equally important to know what effect the absorbed moisture has on a laminate's properties. Many hydrolysable resins, such as polyesters, may pick up low quantities of moisture in a casting, but in a laminate that moisture will cause deterioration and damage, and, in extreme cases, osmotic blistering. For this reason this data should always be looked at in conjunction with other wet property retention data.

Blister Rating

For coatings and gelcoats that may be immersed in water, the blister rating gives an indication of how water-resistant the coating is. The test exposes one side of a coated laminate to a distilled water bath at 50°C for three weeks, in order to accelerate the ageing effects of the water. The number and size of the resultant blisters is graded and a rating assigned from the chart below. A low rating indicates good resistance.

Yellowing Index

Most epoxies will gradually turn yellow on exposure to UV light such as that from the sun. The Yellowing Index provides an indication of how rapid and severe this colour change is, so that for applications which require colour stability and clarity, the correct product can be chosen.

In the gelcoats section, the comparative graph shows the indices of the epoxy products, and also compares them with a standard isophthalic polyester gelcoat, as this is often used in many UV-exposed applications. The test is carried out by exposing coated panels to a UV/heat/moisture cycle in a QUV accelerated weathering machine. This simulates typical outdoor weather, and provides useful comparisons between products, although these cannot accurately be correlated to a time in real outdoor conditions. A Minolta colour analysis spectrometer is used to measure the change from the unexposed condition, and the following chart provides an indication of what this colour change looks like if taken from the background white of the page.
Casting Tensile Strength, Modulus & Strain to Failure
Carried out on laminating resins on a casting of the unfilled resin/hardener mix, post-cured as specified.

Glass Laminate Compressive Strength
The compression strength of a laminate is one of the mechanical properties that is dependent on the properties of the resin system, rather than just on the properties of the reinforcing fibres. In compression testing the resin system has to hold the fibres straight as columns, so that they can carry their full loads before they fail themselves. In many designs, the compression strength of a laminate is the limiting factor, since most laminates are weaker in compression than they are in tension.

Glass Laminate ILSS
Inter-Laminar Shear Strength (ILSS) is a measure of the shear strength of a laminate along the plane of a reinforcement layer. It is strongly dependent on the strength and adhesive properties of the resin which stops the laminate layers sliding over each other.

ILSS Wet Retention
When a laminate is immersed in water, the resin system in the laminate will eventually absorb moisture to an equilibrium level. Since ILSS is a resin-dependent property, it can be used to see what effect the absorbed moisture has had on the laminate mechanical properties. The ILSS data here is measured after 28 days full immersion in distilled water at 35°C, and is expressed as a percentage of the ILSS before immersion.

Tensile Strain to Failure on Laminate
For a coating or a gelcoat applied to a laminate, this is the strain at which the gelcoat will crack. In many cases this may limit the strain to a level well below that which the uncoated laminate could be allowed to see before micro-cracking or ultimate failure occurred.

Lap Shear Strength – Shot-blasted Steel
This tests the shear strength of a resin system used as an adhesive by bonding two thick, overlapping steel blocks together and pulling them apart.

This is one of the most severe shear tests that can be applied to an adhesive, since the steel blocks do not flex at all, and so cannot provide any stress relief to the joint. This is in contrast to the thin aluminium plates often used for adhesive testing, where the flexibility of the aluminium enables artificially high shear strengths to be obtained.

Lap shear strength wet retention
The lap-shear strength test above is applied to test samples that have been immersed in distilled water at 35°C for 28 days. Expressed as a percentage of the pre-soak value, the retention figure gives an indication of the degradation of the adhesive strength in wet conditions.

Cleavage Strength
This test pulls apart two steel blocks bonded together, by loading in a mode which will cause cleavage of the adhesive joint. This is a mode in which most adhesives are poor, and is generally avoided in design. However it gives a useful indication of the toughness of an adhesive and its resistance to cracking.

TECHNICAL INFORMATION AND PRICING
For more detailed information on Gurit Formulated Products, as well as the complete Gurit product portfolio, please visit: www.gurit.com to view the following:

- Product Data Sheets
- Corporate Videos
- News / Case Studies
- Composite Guides
- Events Schedules
- Representatives Contact Details
- Product Brochures

For pricing or other enquiries, please contact uk-customer.support@gurit.com