



# Crystic Crestomer® Structural Adhesives for FRP Composite Bonding

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## Marine Range and Application Guide



# Introduction

**Crystic Crestomer**<sup>®</sup> structural adhesives were formulated specifically for the FRP (Fibre Reinforced Plastics) industry. They are based on Scott Bader's innovative urethane acrylate technology and they exhibit exceptional impact strength, flexibility and toughness. Crystic Crestomer adhesives are available with a range of curing schedules to suit a variety of applications. Crystic Crestomer adhesives have the proven ability to work effectively for a range of bond thicknesses, from thin bond-lines of 1mm, to gap-fill bond-lines of 25 mm.

So whether using Crestomer Advantage for bonding small fixings, or using Crystic Crestomer 1181A for bonding hulls to decks, the Crystic Crestomer range has products to meet a wide range of bonding needs.

## A Record of Achievement

The Crystic Crestomer pedigree was established over 25 years ago. The first commercial application for Crystic Crestomer adhesive was in the manufacture of minehunters. The unique properties of Crystic Crestomer ensured peel and crack resistance was significantly improved. Crystic Crestomer is the only successful material specifically designed to meet this demanding application.



## Challenging Mindsets

Crystic Crestomer's outstanding performance record and unique properties have fundamentally challenged conventional thinking among moulders, who have been sceptical of the performance possibilities with adhesives. Freed from the constraints of traditional fabricating techniques, FRP moulders are now capitalising on the design flexibility and time and cost savings that structural adhesives can offer. Crystic Crestomer is now used in a wide range of demanding applications across the marine, transport, building and construction sectors of the FRP industry.

Fairline Boats Ltd (front cover), Norsafe AS oilrig lifeboats (front cover and above left) and the Vesper Thornycroft built minesweeper (above) all use Crystic Crestomer products for demanding structural bonding applications.

# Chemistry and Bonding

The combination of strength, resilience and flexibility is due to the novel structure of urethane acrylate resins. The urethane component is fully reacted into the molecular backbone, thus contributing adhesive properties without the hazard associated with free di-isocyanates. The acrylate saturation and the styrene monomer impart thermoset characteristics. The backbone of Crystic Crestomers impart toughness strength and flexibility. The resulting balance of properties makes the Crystic Crestomer range ideal as a structural adhesive with the following features.

- **Excellent adhesion to substrates, fibres, core materials and cured laminates.**
- **Toughness, resilience and flexibility.**
- **Superior fatigue resistance compared to a typical flexible polyester.**
- **Cured with cobalt and amine accelerators and conventional peroxide catalysts.**
- **Low exotherm and high strength even in thick sections.**

The curing characteristics of Crystic Crestomer adhesives have been designed to be as similar as possible to the curing characteristics of unsaturated polyester resins. Currently cobalt/MEKP and amine/BPO curing systems are available to initiate the cross-linking reaction between styrene monomer and the unsaturated urethane-acrylate polymer chain at room temperature.

The effectiveness of the adhesive bond depends upon the:

- **Surface conditions and the surface energy of the substrates being joined.**
- **Ability of the adhesive to thoroughly wet the substrate surfaces at a micro, or even, a molecular level.**
- **Ability of the adhesive to cure with minimal shrinkage, hence, reducing the level of induced stresses in the bond-line during the curing process.**
- **Ability of the adhesive to chemically bond to the substrates.**

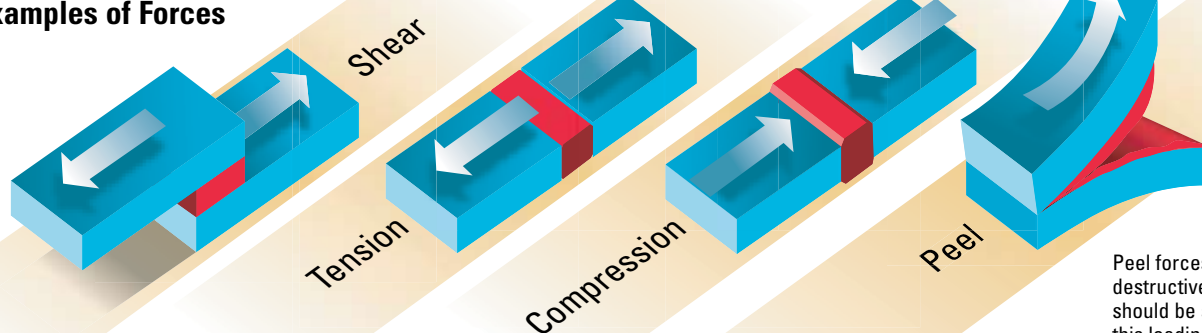
Crystic Crestomer adhesives have been designed with the above factors in mind and utilise both polyurethane and acrylic technologies, which form the basis of two families of adhesives in their own right. The benefits of these adhesives are combined in Crystic Crestomers.

Crystic Crestomer adhesives readily wet substrate surfaces and because they contain low cross-link density, induced bond-line stresses are minimised. The cross linking is such that optimum mechanical performance is achieved within the adhesive itself, so reducing the possibilities of cohesive failure within the Crystic Crestomer adhesive.

## Bonds and Bond Strength

Bonded joints can be subjected to a variety of forces (see below). It is, therefore, essential to take into account the design requirements of bonded joints with respect to these forces. A bonded joint should be designed to meet the most severe loading case with an adequate factor of safety. The resistance of the joint and the adhesive to peeling forces generally limits composite bonded joints. In terms of the joints and adhesives resistance to loads, peel forces are the most destructive, followed by shear loads and tensile loads. Bonded joints are generally very resilient to compression loading conditions. Hence, joint design is as much a contributor to successful bonded joint performance as the properties of the adhesive itself.

### Examples of Forces



Peel forces are very destructive and joint design should be such as to minimise this loading condition.

# Product Range Overview

Crystic Crestomer Product	Description	Approvals	Appearance	*Gel Time (mins)	Tensile Strength (MPa)	Tensile Modulus (MPa)	Elongation at Break (%)	Performance Characteristics
<b>1152PA</b>	High Performance Structural Adhesive	Lloyds Acceptance DNV	Mauve Gel	*50	26	500	100	Structural adhesive for demanding applications
<b>1181A</b>	Multi Purpose Structural Adhesive Amine Accelerated	Lloyds Acceptance	Grey Paste	**120	14	800	6	High strength gap filling adhesive with extended gel time
<b>1186PA</b>	Multi Purpose Structural Adhesive	Lloyds Acceptance	Grey Paste	*35	14	800	6	High strength gap filling adhesive
<b>1196PA</b>	Structural Core bonding Adhesive	Lloyds Acceptance DNV	Pink Paste	*50	18	1300	4	Low density adhesive specifically developed for demanding core bonding applications
<b>1151A</b>	High Performance Structural Adhesive Amine Accelerated For Bulk Application	Lloyds Acceptance DNV	Green Gel	25	26	500	100	Structural adhesive for demanding applications
<b>Advantage 10</b>	High Performance Structural Adhesive pre-packed in cartridges	Lloyds Acceptance DNV	White Paste	10	22	500	100	High performance structural adhesive for convenience and flexibility
<b>Advantage 30</b>	High Performance Structural Adhesive pre-packed in cartridges	Lloyds Acceptance DNV	White Paste	30	22	500	100	High performance structural adhesive for convenience and flexibility

\*2% Butanox® M-50 at 25°C    \*\*2% Perkadox® BT-50 at 25°C

## Packaging and Equipment

Crystic Crestomer 1152PA and 1186PA are available in 25kg and 225kg containers. Crystic Crestomer 1196PA is available in 15kg containers. Crystic Crestomer Advantage Adhesive is available in 380ml co-axial cartridges and 25kg straight sided, open top kegs for dispensing with bulk equipment. Manual and pneumatic guns are available for the Crystic Crestomer Advantage cartridges.



Sunseeker (inset top) and Azimut both use Crystic Crestomer.

# Bond Strengths with Different Substrates

Crystic Crestomer can be used to bond many substrates. The following tables give typical examples of bond failure rates and types of failure observed when bonding various substrates with different products from the Crystic Crestomer range.

All figures shown are for lap shear strengths (MPa)

Crystic Crestomer <b>1152PA</b>	Substrate				
	FRP	Marine Ply	Aluminium	Stainless Steel	Teak
FRP	10	4	10	10	5
Marine Ply		4	4	4	4
Aluminium			10	10	5
Stainless Steel				12	5
Teak					5

Results achievable with Crystic Crestomer Advantage are similar to those shown right

Crystic Crestomer <b>1186PA</b>	Substrate				
	FRP	Marine Ply	Aluminium	Stainless Steel	Teak
FRP	10	4	10	10	5
Marine Ply		4	4	4	4
Aluminium			10	10	5
Stainless Steel				12	5
Teak					5

Results achievable with Crystic Crestomer 1181A are similar to those shown right

Crystic Crestomer <b>1196PA</b>	Substrate			
	Balsa	uPVC Foam Low Density	uPVC Foam Med Density	uPVC Foam Hi Density
FRP	6	3	7	12

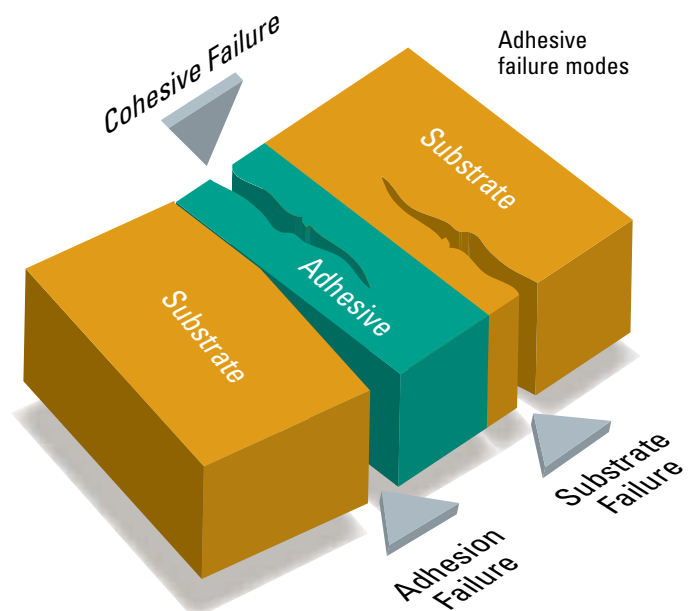
Substrate Failure    Cohesive Failure

Fillet joints constructed using Crystic Crestomer 1152PA are stronger and aesthetically superior to FRP laminated joints as well as being quicker to manufacture and giving far lower styrene emission.

There are different ways in which a joint can fail. The two types of failure within the adhesive are cohesive and adhesive.

**Cohesive failure** is a failure of the bulk adhesive itself and is characterised by a film of adhesive being left on both sides of the failed bond.

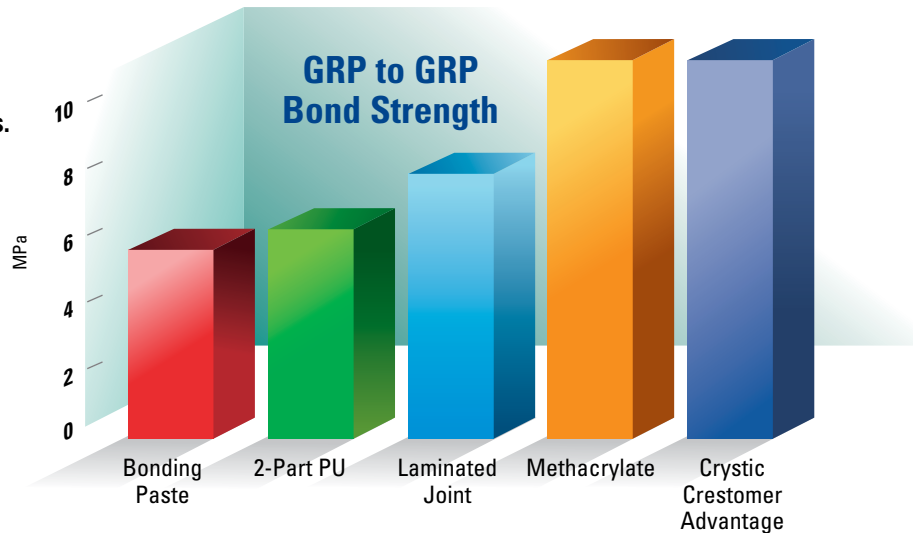
**Adhesive failure** occurs in the bond line between the adhesive and substrate and is characterised by the film of adhesive being left on one side of the failed joint. Failure can also occur in the substrate, indicating that the adhesive is stronger than the material being bonded.



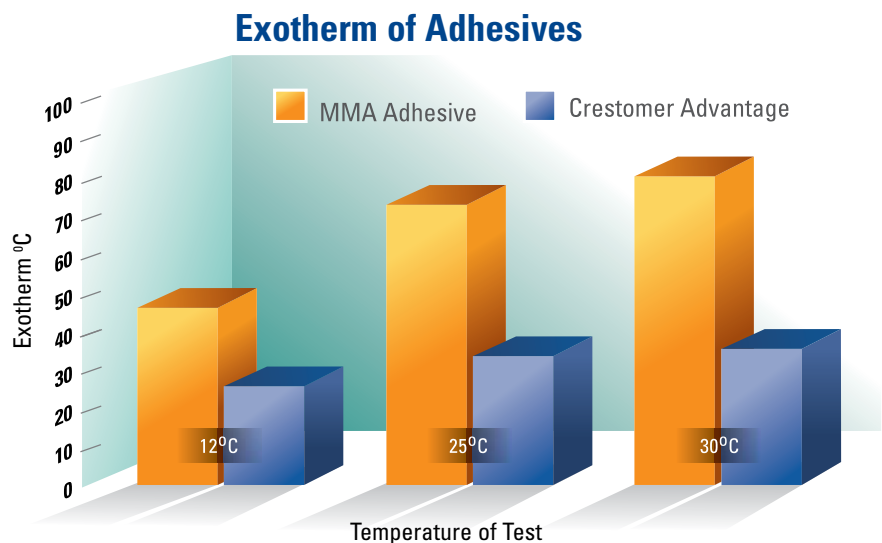
# Comparisons with Competitive Materials

Crystic Crestomer adhesives are one of a wide variety of materials that can be used to bond substrates. Compared to other adhesives, Crystic Crestomers offer the following benefits:

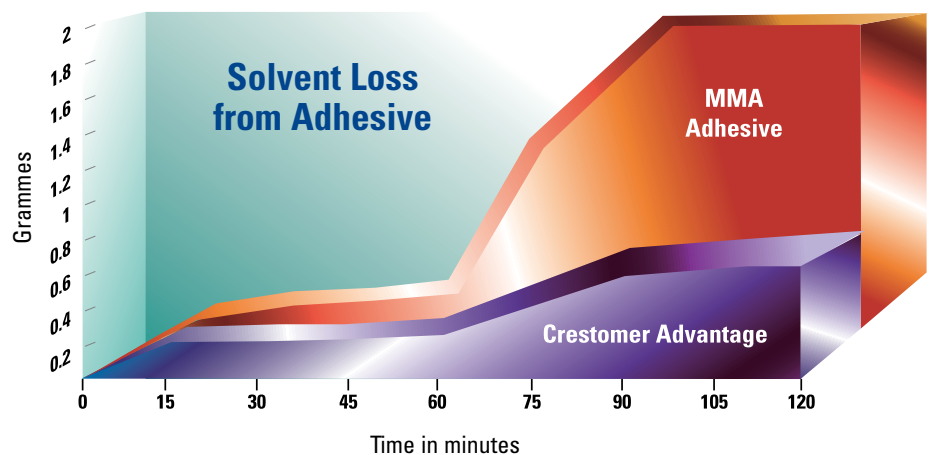
- **Monomer type identical to polyester resins.**
- **Cured with conventional peroxides.**
- **Low exotherm during cure.**
- **Available in a range of gel and curing times.**
- **Ease of application.**
- **Cost effective.**



High exotherm in an adhesive can cause the substrate to distort and give poor aesthetic characteristics to the parts being bonded. The chemistry of Crystic Crestomer adhesives ensures that high exotherm temperatures, a characteristic of adhesives such as Methacrylates, do not occur. The graph shows the exotherm temperatures of Crystic Crestomer adhesives compared to methacrylate adhesives over a range of test temperatures.



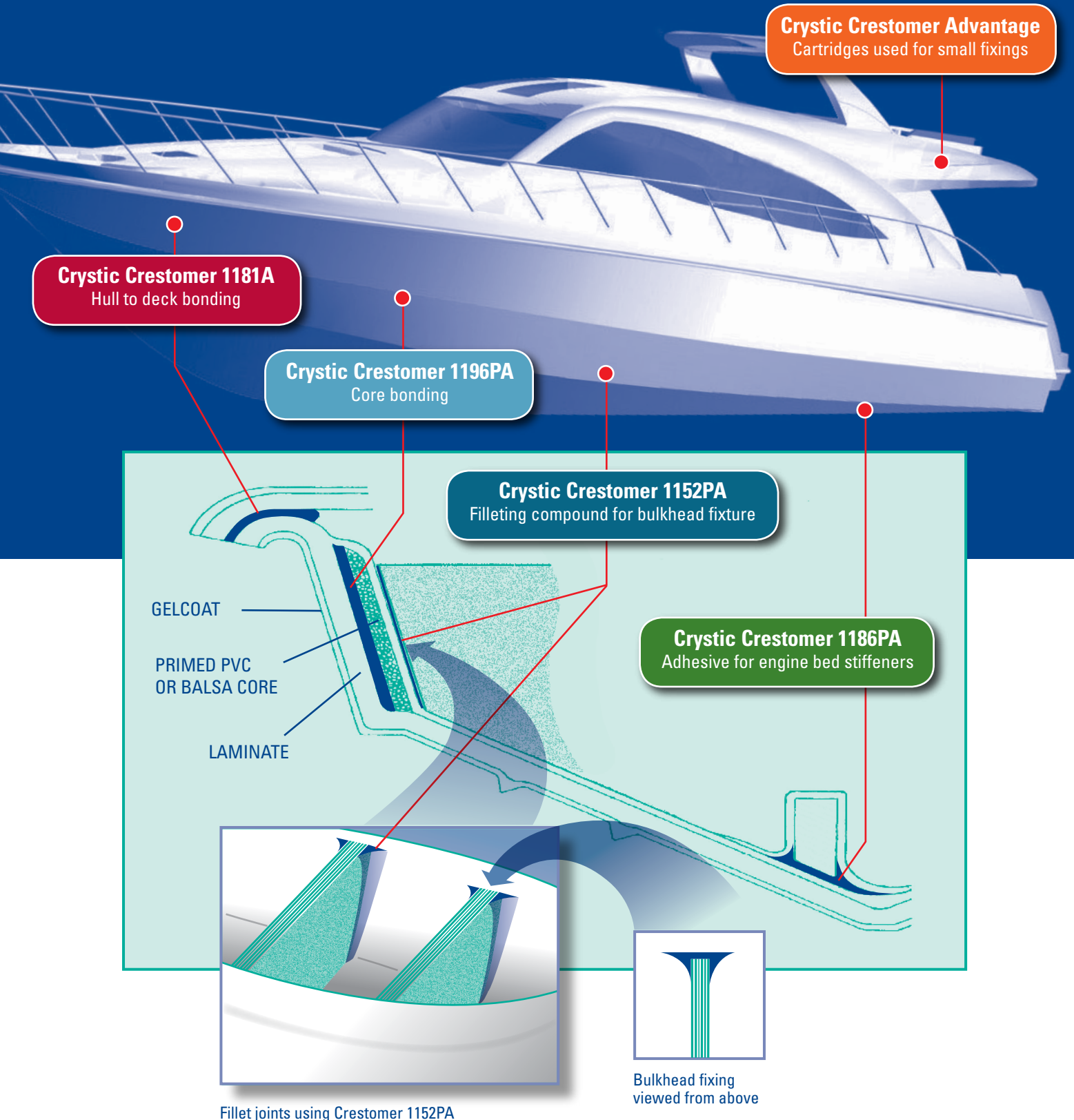
As well as the strength of the bond, another important consideration is the behaviour of the adhesive as it hardens or cures. This graph indicates the level of solvent loss of Crystic Crestomer Advantage compared to a Methacrylate adhesive. Tighter legislation on VOC emissions will favour the use of adhesives with lower VOC emissions like Crystic Crestomer Advantage.



# Crystic Crestomers in Action

## Marine

Crystic Crestomer products have been successfully used by leading European boatbuilders to improve the performance of their products, to make productivity improvements through time savings in construction and to provide considerable weight savings. The following diagram shows areas where Crystic Crestomer structural adhesives can be used in FRP boatbuilding.



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# CRESTOMER ADVANTAGE ADHESIVE

## Introduction

Crestomer Advantage is an advanced structural adhesive and filleting compound specifically formulated for use in bulk metering systems. Crestomer Advantage is non-sagging, fast gelling and bonded parts are workable in 2 hours. It bonds a wide range of substrates with minimal surface preparation and has demonstrably lower odour than competitive structural adhesives.

Crestomer Advantage is based on Scott Bader's innovative urethane acrylate technology and exhibits exceptional impact strength and toughness. Its excellent adhesion and gap filling capabilities offer the moulder great flexibility in design with significant time and cost savings.

## Approvals

Crestomer Advantage has Lloyd's Statement of Acceptance for craft built under their survey.

## Applications

Crestomer Advantage is supplied pre-accelerated and ready to use in bulk application systems with standard benzoyl peroxide paste Lucidol BT50. Working time can be optimised through catalyst ratio variation to suit specific applications. To maximise properties it is recommended that Crestomer Advantage is applied via a bulk dispensing machine. Hand mixing and application is possible but there will be an associated reduction in performance.

Crestomer Advantage is a versatile material, which can be used over a temperature range of 5-30°C without loss of strength. However, it gives best results when used between 18-25°C. Crestomer Advantage will remain free flowing even at low temperatures and so is suitable for all year use.

Crestomer Advantage has been shown to bond most materials commonly used in the GRP industry. However, Scott Bader recommend that any potential application be tested prior to use. Please contact our Technical Department for further information.

## Surface Preparation

As with all adhesives, maximum performance is only achieved with adequate surface preparation. When bonding the back surface of (polyester) GRP, a simple solvent wipe with acetone is satisfactory pre-treatment to clean and degrease the surface. However, for gelcoated GRP surfaces and for other substrates, a de-grease using acetone or similar followed by abrasion and a final de-grease is recommended.

## CURE

Crestomer Advantage has been formulated specifically for use in variable ratio bulk metering systems allowing the gel time to be turned to suit specific applications.

### Room Temperature Cure (22°C)

	2% BPO*	2.5% BPO*
Gel time	25-30	15-20

\* Lucidol BT50

## TYPICAL PROPERTIES

70% Strength	2 hours
Full Strength	4 hours
Gap Filling to	20 mm
Maximum Exotherm	48°C (10g sample)
Mixed Density	1.1
Shore D Hardness	65

## MECHANICAL PROPERTIES (CURED)

### Tensile (BS 2782 PT 3 Method 320)

Strength	22 MPa
Modulus	500 MPa
Elongation to break	120%

### Lap Shear (ASTMD 1002)

Cohesive Strength	12-15MPa
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## Storage

Crestomer Advantage has a 3 month shelf life when stored at less than 25°C.

## Packaging

Crestomer Advantage is available in parallel sided 25Kg and 200Kg containers.

## Health And Safety

Please see separate Material Safety Data Sheet.

Technical Data Sheet No. 504  
January 2004



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# CRESTOMER ADVANTAGE 10

## Introduction

Crestomer Advantage 10 is an advanced structural adhesive formulated for the GRP industry. It is white, non-sagging, fast gelling and bonded parts are workable in 2 hours. Crestomer Advantage 10 bonds a wide range of substrates with minimal surface preparation and has demonstrably lower odour than competitive structural adhesives.

Crestomer Advantage 10 is based on Scott Bader's innovative urethane acrylate technology and exhibits exceptional impact strength and toughness. Its excellent adhesion and gap filling capabilities offer the moulder great flexibility in design with significant time and cost savings.

## Approvals

Crestomer Advantage 10 has Lloyd's Statement of Acceptance for craft built under their survey.

## APPLICATIONS

Crestomer Advantage 10 is supplied ready to use in pre-packed 380 ml cartridges and no hand mixing is required. It has a mixer indicator system which imparts a neutral, opaque white colour and this blends well in cosmetically sensitive applications.

Crestomer Advantage 10 is a versatile material, which can be used over a temperature range of 5-30°C without loss of strength. However, it gives best results when used between 18-25°C. Crestomer Advantage 10 will remain free flowing even at low temperatures and so is suitable for all year use.

Crestomer Advantage 10 has been shown to bond most materials commonly used in the GRP industry. However, Scott Bader recommend that any potential application be tested prior to use. Please contact our Technical Department for further information.

## SURFACE PREPARATION

As with all adhesives, maximum performance is only achieved with adequate surface preparation. When bonding the back surface of (polyester) GRP, a simple solvent wipe with acetone is satisfactory pre-treatment to clean and degrease the surface. However, for gelcoated GRP surfaces and for other substrates, a de-grease using acetone or similar followed by abrasion and a final de-grease is recommended.

## TYPICAL PROPERTIES

Room Temperature Cure (22°C)

Open Time	10 minutes
Fixture Time	30 minutes
70% Strength	2 hours
Full Strength	4 hours
Gap Filling to	20 mm
Maximum Exotherm	48°C (10g sample)
Mixed Density	1.1
Shore D Hardness	65

## MECHANICAL PROPERTIES (CURED)

Tensile (BS EN ISO 527-3)

Strength	15MPa
Modulus	225MPa
Elongation to break	105%

## Lap Shear (ASTM D 1002)

Cohesive Strength	12-15 MPa
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## Storage

Crestomer Advantage 10 has a 6 month shelf life when stored at less than 25°C

## Packaging

Crestomer Advantage 10 is supplied in a 380ml co-axial cartridge.

## Health And Safety

Please see separate Material Safety Data Sheet.

Technical Data Sheet No. 502

January 2004



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# CRESTOMER ADVANTAGE 30

## Introduction

Crestomer Advantage is a range of structural adhesives for the Composites Industry providing speed, convenience and improved performance.

Crestomer Advantage 30 is white, non sagging and with controlled gel and exotherm characteristics, tailored for large component bonding making it particularly suitable for marine applications.

Crestomer Advantage 30 bonds a wide range of substrates with minimal surface preparation and has demonstrably lower odour than competitive structural adhesives.

Crestomer Advantage 30 is based on Scott Bader's innovative urethane acrylate technology and exhibits exceptional impact strength and toughness. Its excellent adhesion and gap filling capabilities offer the moulder greater flexibility in design with significant time and cost savings.

## APPLICATIONS

Crestomer Advantage 30 is supplied ready to use in pre-packed 380 ml cartridges. No hand mixing is required, a mix indicator system imparts a neutral, opaque white colour blending well in cosmetically sensitive applications.

Crestomer Advantage 30 is a versatile material, usable over a temperature range of 5-30°C without loss of strength. However, best results are achieved between 18-25°C. Crestomer Advantage 30 will remain free flowing even at low temperatures and so is suitable for all year use.

Crestomer Advantage 30 bonds most materials commonly used in the Composites industry. However, Scott Bader recommend that any potential application be tested prior to use. Please contact our Technical Department for further information.

## SURFACE PREPARATION

As with all adhesives, maximum performance is only achieved with adequate surface preparation. When bonding the back surface of (polyester) GRP, a simple solvent wipe with acetone is satisfactory pre-treatment to clean and degrease the surface. However, for gelcoated GRP surfaces and for other substrates, a de-grease using acetone or similar followed by abrasion and a final de-grease is recommended.

## TYPICAL PROPERTIES

Room temperature cure (22°C)	
Open Time	30 minutes
Fixture Time	75 minutes
70% Strength	3 hours
Full Strength	6 hours
Gap Filling to	20 mm
Maximum Exotherm	30°C (10g sample)
Mixed Density	1.1
Shore D Hardness	65

## MECHANICAL PROPERTIES (CURED)

Tensile strength (BS 2782 Pt 3 Method 320)	
Strength	22 Mpa
Modulus	500 Mpa
Elongation to break	120 %
Lap Shear (ASTM D1002)	
Cohesive Strength	12-15 MPa

### Storage

Crestomer Advantage 30 has a 6 month shelf life when stored at less than 25°C.

### Packaging

Crestomer Advantage 30 is supplied in a 380ml co-axial cartridge.

### Health & Safety

Please see separate Material Safety Data Sheet.

Technical Data Sheet No. 503  
January 2004



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# CRESTOMER 1080

## Introduction

Crestomer 1080 is a tough, flexible, unsaturated urethane acrylate in styrene monomer. It is an excellent base for the formulation of high performance, impact resistant adhesives, and is compatible with most unsaturated polyesters.

## Product Characteristics

### FORMULATION

Crestomer 1080 has been formulated to give an adequate working time when cured with Catalyst M (Butanox M50) and Accelerator E. Curing should not be carried out at temperatures below 15°C. The resin and workshop should both be at, or above, this temperature.

### POT LIFE

Crestomer 1080 has a typical pot life of 50 mins at 25°C with 2% Catalyst M (Butanox M50) and 4% Accelerator E.

### APPLICATIONS

Crestomer 1080 is extremely versatile. It will cure to a highly adherent, impact absorbing polymer, having good chemical resistance and exterior durability. It can be formulated into adhesives and sealants for FRP (fibre reinforced polyesters), metal and ceramic substrates. It is particularly good where high impact resistance is required. Crestomer 1080 can be added to unsaturated polyester resins to improve flexibility, adhesion and impact resistance. (For further details see Technical leaflet No. 315.)

### ADDITIVES

Crestomer 1080 has a high tolerance for fillers such as carbonates, talc, mica and barytes. It can be pigmented with an addition of up to 5% of Crystic Pigment Pastes.

### TYPICAL PROPERTIES

Test methods as in BS2782 1980

Property		Liquid Resin
Viscosity at 25°C	poise	9
Specific gravity at 25°C		1.04
Volatile content	%	40
Appearance		Clear
Stability in the dark at 20°C	months	6
Geltime at 25°C using 2% Catalyst M (Butanox M50) and 4% Accelerator E	minutes	50

		<b>Cured Resin (unfilled casting)</b>
Hardness	Shore D	65
Ultimate Tensile Strength	MPa	25
Initial Tensile Modulus	MPa	500
Elongation at Break	%	120
Gardner Impact Strength	Kg/cm	200

## Storage

Crestomer 1080 should be stored in the dark in suitable, closed containers. It is recommended that the storage temperature should be less than 20°C where practical, but should not exceed 30°C. Ideally, containers should be opened only immediately prior to use.

N.B. Extended storage at low temperatures may cause Crestomer 1080 to crystallise out of solution. Warming for a short time above 35°C will bring it back into solution.

## Packaging

Crestomer 1080 is supplied in 25 kg and 200 kg containers.

## Health and Safety

See separate Material Safety Data Sheet

Technical Leaflet No. 505  
January 2004



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## APPLICATION AND PERFORMANCE OF CRESTOMER® 1080/POLYESTER RESIN BLENDS

### **Addition to Polyester**

Crestomer 1080 can be blended with most unsaturated polyester resins at 10% to 90% addition levels (see performance graphs overleaf). Typically 20% Crestomer 1080 is used to give significant improvement to flexibility and impact resistance whilst maintaining acceptable HDT and tensile properties. Note: If a high level of unaccelerated Crestomer 1080 is added to cobalt pre-accelerated polyester resin an addition of cobalt accelerator may be required to maintain gel/cure characteristics.

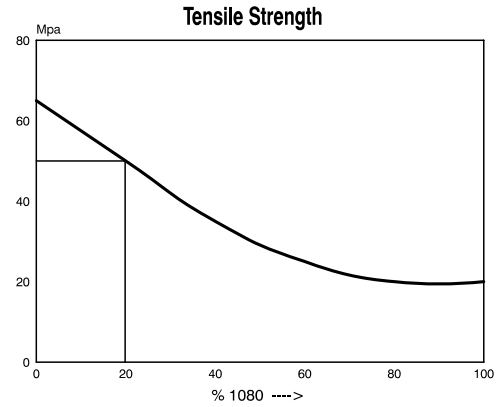
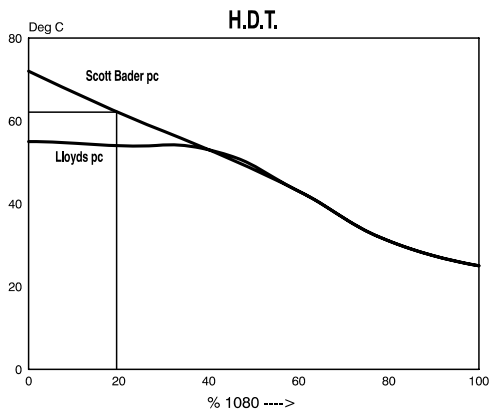
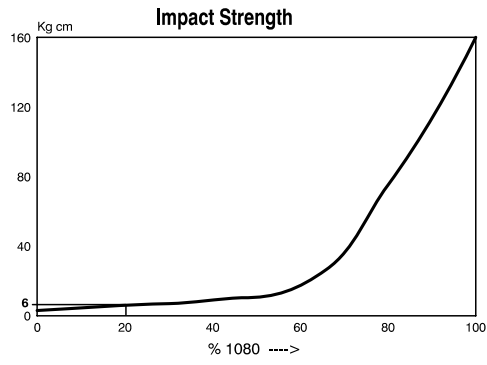
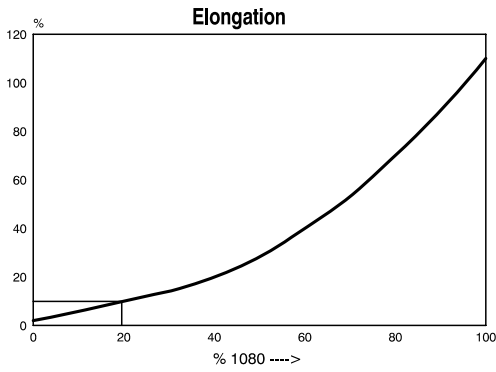
### **APPLICATIONS**

Crestomer/polyester blends have many commercial uses, in a variety of market areas, including:-

- In filled, casting applications, to reduce cracking and impact damage, especially with intricate mouldings, thus giving a reduction in reject rate.
- As an abrasion resistant liner to pipes.
- In GRP sheeting to reduce stress cracking on manufacture and improved impact performance in use.
- To improve stress/corrosion performance in filament wound pipes.
- In the construction of high performance marine craft from aramid fibre where high power to weight ratio is required.
- To give additional bonding when laminating onto cured FRP.
- Behind the gelcoat to give improved reverse impact performance.

The following graphs illustrate the effect on cast properties, of Crestomer 1080 additions to an isophthalic polyester.

Typically a 20% addition gives a three-fold increase in elongation and impact strength.



Note. Lloyds postcure = 16 hrs at 40°C  
 Scott Bader postcure = 5 hrs at 80°C, 3 hrs at 120°C

In summary, a tougher resin system can be produced by blending Crestomer 1080 with unsaturated polyester resin.

Technical Leaflet No. 315.1  
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# CRESTOMER 1152PA

## Structural Filleting Material

### Introduction

Crestomer 1152PA can be used in a wide range of applications but is particularly effective for bonding wooden or composite bulkheads into FRP boat hulls.

Crestomer 1152PA is based on Scott Bader's innovative urethane acrylate technology and exhibits exceptional impact strength and toughness.

Crestomer 1151A is a variant of this adhesive giving a shorter working life and more rapid cure.

### Approvals

Crestomer 1152PA is approved by Det Norske Veritas and has a Statement of Acceptance from Lloyd's Register of Shipping for use in the construction of craft built under their Survey. It is also approved by the MOD for use under NES 166.

### Features and benefits

Crestomer 1152PA fillets have the following advantages over laminated FRP joints

- a stronger bond with greater movement
- significant time, cost and weight savings
- greatly improved cosmetics
- a huge reduction in Styrene emission

### Preparation of substrates

Please follow the following options depending on the age and type of substrates to be bonded. We recommend that a representative test sample is bonded with the recommended pre-treatment before using any adhesive in production.

1. Apply an appropriate peel ply to the areas to be bonded during construction of an FRP laminate, and remove it immediately before the adhesive is used.
2. For a Gelcoated surface, moulded FRP laminate, metals or air surface of FRP laminates more than 3 days old degrease, abrade thoroughly 100 grit (or coarser) abrasive, and degrease again with Acetone or Styrene and a clean, lint free, cloth.
3. Wiping with an Acetone dampened cloth is the minimum requirement to ensure that wood or FRP laminates less than 3 days old are clean, dry and dust-free. Bond strengths to wood can vary because it is a natural material.

Laminates made using DCPD resins are more difficult to bond, and guidance should be sought from Scott Bader technical service.

### Applications

Crestomer 1152PA should be used for structural filleting applications or wherever the primary requirement is for a strong, tough, highly impact resistant bond.

## Formulation

Crestomer 1152PA is supplied pre-accelerated and non-slumping. It should be used with an MEKP such as Butanox M-50 and applied in a temperature range of 15-30°C. It gives best results when used between 18-25°C. Although hand mixing and application is possible, maximum efficiency is achieved when Crestomer 1152PA is applied with a 50:1 bulk dispensing machine.

Once applied, Crestomer 1152PA should be shaped with an appropriate fillet tool. Fillets greater than 35 mm should be applied in multiple layers to avoid excessive exotherm. A time lapse of two hours from gelation should be allowed between layers.

The working time at 25°C is approximately 45 minutes with 2% Butanox M-50.

Curing at temperatures below 15°C should be avoided since styrene evaporation from the surface may lead to cracking.

## TYPICAL PROPERTIES

The following tables give typical properties for Crestomer 1152PA when tested in accordance with appropriate SB, EN, BS EN or BS EN ISO test methods.

Property		Liquid Adhesive
Appearance		Hazy gel
Viscosity @ 25°C		Non slumping
Specific gravity at 25°C		1.03
Volatile content	%	47
Stability in the dark at 20°C	months	3
Geltime at 25°C (2% Butanox M-50)	minutes	50

		Fully Cured Casting
Hardness	Shore D	65
Water Absorption 24hrs at 23°C	%	0.36
Tensile Strength	MPa	26
Tensile Modulus	MPa	500
Elongation at Break	%	100
Gardner Impact Strength	Kg/cm	200
Yield Stress at 7% strain	MPa	17
Volume shrinkage on cure	%	5

## Storage

Crestomer 1152PA should be stored in suitable, closed containers. It is recommended that the storage temperature should be less than 20°C where practical, but should not exceed 30°C. Ideally, containers should be opened only immediately prior to use.

## Packaging

Crestomer 1152PA is supplied in 25 kg and 200 kg containers.

## Health and Safety

See separate Material Safety Data Sheet

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# CRESTOMER 1155PA

## Low Styrene Content

## Structural Filleting Material

### Introduction

Crestomer 1155PA can be used in a wide range of applications but is particularly effective for bonding wooden or composite bulkheads into FRP boat hulls.

Crestomer 1155PA is based on Scott Bader's innovative urethane acrylate technology and exhibits exceptional impact strength and toughness.

### Features and benefits

Crestomer 1155PA fillets have the following advantages over laminated FRP joints

- a stronger bond with greater movement
- significant time, cost and weight savings
- greatly improved cosmetics
- a huge reduction in Styrene emission

### Preparation of substrates

Please follow the following options depending on the age and type of substrates to be bonded. We recommend that a representative test sample is bonded with the recommended pre-treatment before using any adhesive in production.

1. Apply an appropriate peel ply to the areas to be bonded during construction of an FRP laminate, and remove it immediately before the adhesive is used.
2. For a Gelcoated surface, moulded FRP laminate, metals or air surface of FRP laminates more than 3 days old degrease, abrade thoroughly 100 grit (or coarser) abrasive, and degrease again with Acetone or Styrene and a clean, lint free, cloth.
3. Wiping with an Acetone dampened cloth is the minimum requirement to ensure that wood or FRP laminates less than 3 days old are clean, dry and dust-free. Bond strengths to wood can vary because it is a natural material.

Laminates made using DCPD resins are more difficult to bond, and guidance should be sought from Scott Bader technical service.

### Applications

Crestomer 1155PA should be used for structural filleting applications or wherever the primary requirement is for a strong, tough, highly impact resistant bond.

### Formulation

Crestomer 1155PA is supplied pre-accelerated and non-slumping. It should be used with an MEKP such as Butanox M-50 and applied in a temperature range of 15-30°C. It gives best results when used between 18-25°C. Although hand mixing and application is possible, maximum efficiency is achieved when Crestomer 1155PA is applied with a 50:1 bulk dispensing machine.

Once applied, Crestomer 1155PA should be shaped with an appropriate fillet tool. Fillets greater than 35 mm should be applied in multiple layers to avoid excessive exotherm. A time lapse of two hours from gelation should be allowed between layers.

The working time at 25°C is approximately 25 minutes with 2% Butanox M-50.

Curing at temperatures below 15°C should be avoided since styrene evaporation from the surface may lead to cracking.

## TYPICAL PROPERTIES

The following tables give typical properties for Crestomer 1155PA when tested in accordance with appropriate SB, EN, BS EN or BS EN ISO test methods.

Property		Liquid Adhesive
Appearance		Hazy gel
Viscosity @ 25°C		Non slumping
Specific gravity at 25°C		1.25
Volatile content	%	35
Stability in the dark at 20°C	months	3
Geltime at 25°C (2% Butanox M-50)	minutes	30

		Fully Cured Casting
Hardness	Shore D	70
Tensile Strength	MPa	18
Tensile Modulus	MPa	600
Elongation at Break	%	35
Volume shrinkage on cure	%	5

### Storage

Crestomer 1155PA should be stored in suitable, closed containers. It is recommended that the storage temperature should be less than 20°C where practical, but should not exceed 30°C. Ideally, containers should be opened only immediately prior to use.

### Packaging

Crestomer 1155PA is supplied in 25 kg and 250 kg containers.

### Health and Safety

See separate Material Safety Data Sheet

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# CRESTOMER 1181A

## Gap Filling Structural Adhesive

### Introduction

Crestomer 1181A is a gap filling, structural adhesive for a wide range of FRP applications. It is based on Scott Bader's unsaturated urethane acrylate technology and exhibits very good impact strength and toughness.

Crestomer 1186PA is a variant of this adhesive giving a shorter working time.

### Approvals

Crestomer 1181A has a Statement of Acceptance from Lloyd's Register of Shipping for use in the construction of craft built under their Survey

### Features and Benefits

Crestomer 1181A offers

- outstanding adhesion to a wide range of metals, ceramics and polymeric materials
- significant superiority over polyester bonding pastes in adhesion, impact resistance and resistance to crack propagation.
- very long working time making it ideal for the structural bonding of very large mouldings
- structural adhesion even when bonding FRP laminates with a 25mm thick bond line.
- a pre-accelerated, non-slumping structural adhesive with low odour

### Preparation of substrates

Please follow the following options depending on the age and type of substrates to be bonded. We recommend that a representative test sample is bonded with the recommended pre-treatment before using any adhesive in production.

1. Apply an appropriate peel ply to the areas to be bonded during construction of an FRP laminate, and remove it immediately before the adhesive is used.
2. For a Gelcoated surface, moulded FRP laminate, metals or air surface of FRP laminates more than 3 days old degrease, abrade thoroughly 100 grit (or coarser) abrasive, and degrease again with Acetone or Styrene and a clean, lint free, cloth.
3. Wiping with an Acetone dampened cloth is the minimum requirement to ensure that wood or FRP laminates less than 3 days old are clean, dry and dust-free. Bond strength to wood can vary because it is a natural material.

Laminates made using DCPD resins are more difficult to bond, and guidance should be sought from Scott Bader technical service.

### Applications

Crestomer 1181A should be used wherever the requirement is for a strong, impact resistant bond.

### Formulation

Crestomer 1181A is supplied pre-accelerated and ready to use with a Benzoyl Peroxide catalyst such as Perkadox BT-50. Although hand mixing and application is possible, maximum efficiency is achieved when Crestomer 1181A is applied with a 10:1 bulk dispensing machine using Crestomer Advantage 10 Catalyst. Crestomer 1181A can be applied over a temperature range of 5-30°C. but gives best results when used between 18-25°C.

The working time at 25°C is approximately 115 minutes with 1.5% Perkadox BT-50.

## Typical properties

The following tables give typical properties of Crestomer 1181A when tested in accordance with SB, BS EN or BS EN ISO test methods.

Property		Liquid Adhesive
Appearance		Grey Paste
Viscosity at 25°C		Non slumping
Volatile content	%	26
Stability in the dark at 20°C	months	6
Geltime at 25°C (1.5% Perkadox BT-50)	minutes	120

Property		Fully Cured Casting
Hardness	Shore D	70
Tensile Strength	MPa	14
Tensile Modulus	MPa	800
Elongation at Break	%	6
Volume shrinkage on cure	%	5

The table below shows Lap Shear Strengths for Crestomer 1181A. The bonded specimens were post-cured for 24 hours at 20°C and 16 hours at 40°C prior to testing.

Substrates	Lap Shear Strength
FRP to FRP *	10.5 Mpa
M/G Stainless Steel to M/G stainless steel **	12 MPa
M/G Aluminium to M/G Aluminium **	10 MPa
Copper to Copper	11.5 MPa

\* Depends on laminate structure

\*\*M/G = Marine Grade

The substrates were prepared as "Preparation of Substrates" above. The tests all showed cohesive failure of the adhesive, except for FRP to FRP, where substrate failure occurred.

## Storage

Crestomer 1181A should be stored in the dark in suitable, closed containers. It is recommended that the storage temperature is less than 20°C where practical, but should not exceed 30°C. Ideally, containers should be opened only immediately prior to use.

## Packaging

Crestomer 1181A is supplied in 25 kg and 200 kg containers.

## Health and Safety

See separate Material Safety Data Sheet

October 2006



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# CRESTOMER 1186PA

## Gap Filling Structural Adhesive

### Introduction

Crestomer 1186PA is a gap filling, structural adhesive for a wide range of FRP applications. It is based on Scott Bader's unsaturated urethane acrylate technology and exhibits very good impact strength and toughness.

Crestomer 1181A is a variant of this adhesive giving a much longer working time.

### Approvals

Crestomer 1186PA has a Statement of Acceptance from Lloyd's Register of Shipping for use in the construction of craft built under their Survey

### Features and Benefits

Crestomer 1186PA offers

- outstanding adhesion to a wide range of metals, ceramics and polymeric materials
- significant superiority over polyester bonding pastes in adhesion, impact resistance and resistance to crack propagation.
- structural adhesion even when bonding FRP laminates with a 25mm thick bond line.
- a pre-accelerated, non-slumping structural adhesive with low odour

### Preparation of substrates

Please follow the following options depending on the age and type of substrates to be bonded. We recommend that a representative test sample is bonded with the recommended pre-treatment before using any adhesive in production.

1. Apply an appropriate peel ply to the areas to be bonded during construction of an FRP laminate, and remove it immediately before the adhesive is used.
2. For a Gelcoated surface, moulded FRP laminate, metals or air surface of FRP laminates more than 3 days old degrease, abrade thoroughly 100 grit (or coarser) abrasive, and degrease again with Acetone or Styrene and a clean, lint free, cloth.
3. Wiping with an Acetone dampened cloth is the minimum requirement to ensure that wood or FRP laminates less than 3 days old are clean, dry and dust-free. Bond strength to wood can vary because it is a natural material.

Laminates made using DCPD resins are more difficult to bond, and guidance should be sought from Scott Bader technical service.

### Applications

Crestomer 1186PA should be used wherever the primary requirement is for a strong, impact resistant bond.

### Formulation

Crestomer 1186PA is supplied pre-accelerated and ready to use with an MEKP such as Butanox M-50. Although hand mixing and application is possible, maximum efficiency is achieved when Crestomer 1186PA is applied with a 50:1 bulk dispensing machine. Crestomer 1186PA can be applied over a temperature range of 15-30°C. It gives best results when used between 18-25°C.

The working time at 25°C is approximately 25 minutes with 2% Butanox M-50.

## Typical Properties

The following tables give typical properties of Crestomer 1186PA when tested in accordance with SB, BS EN or BS EN ISO test methods.

Property		Liquid Adhesive
Appearance		Grey Paste
Viscosity at 25°C		Non slumping
Volatile content	%	26
Stability in the dark at 20°C	months	3
Geltime at 25°C (2% Butanox M-50)	minutes	30

Property		Fully Cured Casting
Hardness	Shore D	70
Tensile Strength	MPa	14
Tensile Modulus	MPa	800
Elongation at Break	%	6
Volume shrinkage on cure	%	5

The table below shows Lap Shear Strengths for Crestomer 1186PA. The bonded specimens were post-cured for 24 hours at 20°C and 16 hours at 40°C prior to testing.

Substrates	Lap Shear Strength
FRP to FRP *	10.5 MPa
M/G Stainless Steel to M/G stainless steel **	12 MPa
M/G Aluminium to M/G Aluminium **	10 MPa
Copper to Copper	11.5 MPa

\* Depends on laminate structure

\*\* M/G = Marine Grade

The substrates were prepared as "Preparation of Substrates" above. The tests all showed cohesive failure of the adhesive, except for FRP to FRP, where substrate failure occurred.

## Storage

Crestomer 1186PA should be stored in the dark in suitable, closed containers. It is recommended that the storage temperature is less than 20°C where practical, but should not exceed 30°C. Ideally, containers should be opened only immediately prior to use.

## Packaging

Crestomer 1186PA is supplied in 25 kg and 200 kg containers.

## Health and Safety

See separate Material Safety Data Sheet

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October 2006



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# CRESTOMER 1196PA

## Low Density Structural Core Adhesive For FRP Sandwich Construction

### Introduction

**CRESTOMER® 1196PA** is a new and improved, low density, structural gap-filling core adhesive for use in sandwich construction.

It has been formulated to bond properly prepared core materials such as rigid PVC foam and balsa to cured or semi-cured FRP skins. Adhesive bonding with **CRESTOMER® 1196PA** has advantages in that void-free contact is facilitated and 'print through' is reduced, compared with polyester resin/glass bonding adhesive.

**CRESTOMER® 1196PA** is based on a tough, flexible, unsaturated urethane acrylate resin dissolved in monomeric styrene.

**CRESTOMER® 1196PA** is a fully compounded system and requires only the addition of a peroxide catalyst.

### Approvals

**CRESTOMER® 1196PA** is approved by Lloyds Register of Shipping GB1004 Material Acceptance for use in construction of craft under their survey.

### Production Characteristics

#### FORMULATION

Allow paste to attain workshop temperature before use. Add 2% catalyst **BY WEIGHT** (i.e. 1 g to 50 g quantities of **CRESTOMER® 1196PA**)

#### POT LIFE

Temperature °C	MEKP (Butanox M50*) 2%
25	50
20	70
15	90

\*Akzo Chemie UK Limited

For information as to the use of other catalysts, consult our Technical Service Department.

## TYPICAL PROPERTIES

### LIQUID

Viscosity (25°C)	Flowable Paste
Specific gravity (25°C)	0.58
Appearance	Pink
Stability in the dark (20 °C)	3 months

### CURED

Curing Schedule, 24 hours at 20°C, plus 3 hours at 80°C.

<b>Water Absorption -</b> 24hrs/23°C	30mg
1 week/23°C	50mg
Ultimate Tensile Strength	18MPa
Elongation at Break	4%
Initial Tensile Modulus	1.3GPa
Hardness (Shore D)	70
Heat Deflection Temperature	50°C

Test methods according to BS2782

### Storage

**CRESTOMER® 1196PA** is a reactive, pre-accelerated compounded resin, which will be affected by high ambient temperatures. It is recommended that **CRESTOMER® 1196PA** is stored below 20°C (68°C) and protected from exposure to direct sunlight.

Shelf life of three months from date of delivery in original unopened containers.

### Packaging

**CRESTOMER® 1196PA** is available in 25 litre open top kegs (15kg weight).

### Health and Safety

See separate Material Safety Data Sheet



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# APPLICATION OF 1196PA

## Introduction

**CRESTOMER® 1196PA** is used in sandwich construction using a basic technique which is quite straightforward :

1. The core material is cut to size and primed (see priming later)
2. The **CRESTOMER® 1196PA** is catalysed and applied to a hardened laminate
3. The primed core is offered to the adhesive and pressed down to achieve good contact
4. The adhesive is allowed to cure
5. A secondary laminate is laid up onto the core

**CRESTOMER® 1196PA** can be trowelled, followed by metering with a notched blade. To some extent determining the right amount to be applied is a matter of trial and error, particularly on convex or uneven surfaces, but a saw cut toothed comb with a 4-5mm edge will meter sufficient adhesive for most applications.

**CRESTOMER® 1196PA** is coloured pink to assist visual inspection of complete penetration of the cuts in the core material. Penetration is ensured by the use of a vibrator roller or vacuum bag; typical pressures of 0.04-0.07MPa (6-10lb/square inch) are sufficient to ensure good contact.

## COVERAGE

Coverage is variable depending on the laminate contour uniformity and core material thickness.

For 10mm thick, square cut foam, an adhesive thickness of about 1.5mm should give adequate bond thickness and cut penetration.

For 20mm thick core material, 2.5mm adhesive thickness may be necessary. Good adhesive bonding can be obtained by curing at workshop temperature (20°C). Use below 15°C is not recommended. Some advantage may be obtained by post curing for 16 hours at 40°C.

Adhesive Thickness	Coverage/m <sup>2</sup>
1.5mm	1.5 litres (0.9kg)
2.5mm	2.5 litres (1.5kg)

## PRIMING OF CORE MATERIAL

Priming the core material is necessary. It ensures complete wetting of the core material and in the case of balsa, it also effectively seals the grain against potential cracking in the event of minor gelcoat or laminate damage. To apply primer, a light coat of catalysed resin should be evenly sprayed or rolled onto the core surface, taking care not to flood the surface, too much resin is brittle and adds weight. Apply just enough resin so that the core's surface begins to stay glossy. There is no need to wait for full cure from the primer resin to be achieved before putting down the primed foam and where practicable, one can even put down freshly primed core material.

For PVC foam, Crystic polyester resins such as 2.406PA, 414PA and 489PA can be used. For other manufacturers' foams we would recommend that test panels of desired constructions are made. Balsa is a natural product and, as such, is inherently variable, whilst the Crystic resins above have all been used successfully to prime balsa core it is recommended that test panels are made to confirm performance.

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