



Redux® HP655

Toughened BMI film adhesive

Product Data

Description

HP655 is a toughened BMI structural adhesive designed for metal to metal, composite to composite, and honeycomb sandwich bonding for both co-cured and precured composite skins. HP655 combines high fracture toughness and high shear with good peel strengths. Recommended service temperature is up to 180°C wet and 240°C dry. HP655 was developed to be compatible with Hexcel's entire BMI prepreg product line.

Features

- Good co-cure potential with Hexcel's BMI prepreg range
- Excellent hot lap shear performance
- Good fracture toughness
- Low volatile content and low out gassing properties
- Available with or without a woven glass carrier

Applications

- Metal to metal bonding
- Composite to composite bonding
- Sandwich constructions

Form

Product Description	Areal Weights g/m ²	Support	Roll Width mm	Standard Roll m ²
Redux HP655	200-600	Yes	1000	50
Redux HP655U	200-600	No	1000	50

Instructions For Use

Pretreatment

It is essential that all substrates to be used are free of contamination and are in as ideal a state for bonding as possible. As pretreatment varies significantly depending on the substrates used, please refer to the Hexcel Composites publication Redux Bonding Technology for optimum procedures.

If there is to be a delay between the pretreatment and bonding of aluminium, the pretreated surface should be protected with Redux HP655P, a tough, solvent-based adhesive primer for improved bonding to Aluminium and Titanium substrates, to conserve the optimum bonding surface. This will enable bonding to be delayed for up to 2 weeks without deterioration of the pretreated surface. The correct application of Redux HP655P should not alter the bonding performance of Redux HP655 (for full application details consult the relevant data sheet).

Redux HP655PP is a BMI-based peel ply which provides a superior surface for pre-cured composite facings for secondary bonding applications. It can be used at temperatures up to 250°C.



Redux HP655

Application

1. Allow sufficient time for the adhesive to warm to room temperature (15°C to 27°C) before removing the protective polythene.
2. Cut the film to the shape and size required.
3. Remove the release paper and position the adhesive on the prepared bonding surface.
4. Remove the polythene backing sheet.
5. Complete the joint assembly and apply pressure while the adhesive is being cured at 140-700kN/m². For sandwich structures the pressure application should be selected to suit the type of core used. After the adhesive has cured it is advisable to maintain pressure on the bonded assembly until it has cooled sufficiently to be handled without discomfort.

Curing

Redux HP655 should be cured according to the schedules on pages 5 and 6 to obtain optimum properties. Enough time should be allowed for heat to penetrate through the assembled parts to ensure that the adhesive reaches that temperature before timing starts.

Mechanical Properties

All the performance values given in this data sheet are based on experimental results obtained during testing under laboratory conditions. They are typical values expected for Redux HP655 prepared and cured as recommended and under the conditions indicated. They do not and should not constitute specification minima.

Tensile Lap Shear Strength (Press Cure Cycle)

Tested per ASTM D1002. Adherents were 2024 T3 bare Aluminium treated with phosphoric acid anodise (PAA) surface preparation, or plain weave carbon fabric BMI laminate with 1581 glass peel ply surface preparation prior to bonding.

Test	Test Temperature °C	Aluminium Primer HP655P	Aluminium No Primer	Composite	Titanium with HP655P
Lap Shear Strength MPa	-55 23 205	23.8 25.7 27.6	17.0 19.3 24.8	- 19.3 26.9	- 24.8 27.8

Aluminium Honeycomb Sandwich Sandwich Performance (Press Cure Cycle)

Adherents were 2024 T3 bare Aluminium treated with PAA surface preparation prior to bonding. Honeycomb core was 5052, 1.59cm thick.

Test	Test Temperature °C	0.64cm cell (MPa)	0.32cm cell (MPa)
Flatwise Tensile Strength tested per ASTM C 297	-55 23 205	5.1 5.1 5.4	- 8.5 -
Climbing Drum Peel tested per ASTM D1781	75	32.5	44.0

Composite Honeycomb Sandwich Performance

Flatwise tensile strength using precured plain weave carbon fibre BMI laminates with 1581 glass peel-ply surface preparation prior to bonding. Honeycomb core was HFT-G 327-3/16" cell size (3.6 kg). Tested per ASTM C 297.

Test	Test Temperature °C	Tensile Strength (MPa)
Flatwise Tensile Strength tested per ASTM C 297	23	7.2
	205	7.0
After 500 hours at 205°C (Weight loss = 0.75%)	23	5.0
	205	>5.1

Thermal Cycling

Flatwise tensile strength using 6 plies, co-cured, plain weave carbon fabric BMI prepreg. Honeycomb core was HFT-G 327 3/16 cell size, 3.6 kg. Adhesive was 106/HP655 at a film weight of 300gsm.

Test	Test Temperature °C	Control	15 Cycles	60 Cycles
Flatwise tensile strength (MPa)	23	6.5	6.3	6.3
	165	8.0	7.1	7.0

Thermal cycle = 8°C/minute heat/cool rates with 10 minute hold at temperature

Drum Peel Torque at RT and 180°C Wet

The wet peel specimens had perforated aluminium backup facings and were conditioned to equilibrium in a 71°C, 100% relative humidity chamber for 24 days with peel face up.

Test	Test Temperature °C	Climbing Drum Peel torque (N-m/m)
Drum Peel Torque	RT Dry	36.6
	RT Wet	45.7
	180°C Wet	31.0

Neat Resin Properties

Tensile strength, RT	80.7 MPa
Tensile modulus	3.62 GPa
Ultimate strain, %	2.39
Fracture Properties, RT	
G _{1C} , in-lb/in ² (J/m ²)	693.5
K _{1C} , ksi √in, (MPa √m)	1.68
Coefficient of Thermal Expansion	
CTE, mm/mm/ °C	
Temperature Range: -43.8 to 163°C	35.0 x 10 ⁻⁶
163 to 250°C	39.3 x 10 ⁻⁶
250 to 302°C	11.4 x 10 ⁻⁵
Density, g/cm ³	1.249
T _g Dry	280°C
T _g Wet	215°C
(DMTA, 5°C/min, E" peak)	



Redux HP655

Storage

Redux HP655 has been formulated for maximum storage life consistent with its high performance. Certain precautions, however, will help to enhance that storage life as follows:

1. When stored at room temperature (less than 27°C) it should be kept on a horizontal mandrel passed through the tube core on which the roll is wound. This avoids the risk of local thinning of the film under the weight of the roll.
2. When storing under refrigeration the original packaging should be retained if possible. When returning to the refrigerator after use it is essential to protect the film with a water vapour barrier packaging material such as polythene.
3. On withdrawal from the refrigerator the water vapour barrier packaging should not be removed until the roll of adhesive has reached room temperature. This may take up to 24 hours depending on the size of the roll and the temperature involved (failure to observe this will result in the film becoming damp).
4. The film should be handled with care whilst in the frozen state since it will be brittle and easily cracked.

On receipt, Redux HP655 will have a storage life of at least 6 months at -18°C plus an additional shop life of 2 weeks at below 23°C.

Volatile content

Redux HP655 has a very low volatile content, usually well below 1%. In practice, the loss in weight when cured is negligible and emission of volatile products is not of practical significance.

Associated products

- **Redux HP655P** surface pretreatment protection solutions (primers).

- **HP655P** - Primer for Metal Bonding with HP655 BMI Film Adhesive

Primer Application

Apply thin, uniform coat of primer to prepare metal surface using brush or spray (recommend phosphoric acid anodize treatment to metal prior to priming). Dry in 310 ± 10°F air forced oven for 15 - 30 minutes. Once plates are cool, apply HP655 adhesive and assemble parts to be bonded. Best results will be found with a primer thickness of approximately 10 micron.

- **Redux HP655PP** peel ply.

Handling and safety precautions

In common with all Redux adhesives in film form, Redux HP655 is particularly free from handling hazards for the following reasons:

- Film is covered on both sides by protective release paper and polythene sheet which are not removed until final component assembly. It should be cut to shape before removing the protective coverings and virtually no handling of the film is necessary.
- Low tack at normal room temperature. The film is dependent on elevated temperature for wetting-out the adherend surfaces.
- Volatile-free at normal room temperature.
- Splash-free, leak-free, spillage-free.

However, the usual precautions necessary when handling synthetic resins should be observed. A Material Safety Data Sheet for Redux HP655 is available on request.

HP655 Autoclave Co-Cure Procedure

- A. Apply vacuum at 33.8 kPa minimum.
- B. Heat to 132°C at 1 - 2°C/minute.
- C. Apply 414 ± 34 kPa pressure when part reaches 132 ± 3°C.
- D. Dwell at 132 ± 3°C for 30 ± 5 minutes.
- E. Vent bag.
- F. Heat to 191°C at 1 - 2°C/minute: cure 4 hours.
- G. Cool to 66°C at ≤ 3°C/minute before releasing pressure.

HP655 Press Cure Procedure

- A. Apply contact pressure.
- B. Heat to 132°C at 1 - 2°C/minute.
- C. Apply 414 ± 34 kPa pressure when part reaches 132 ± 3°C.
- D. Dwell at 132 ± 3°C for 30 ± 5 minutes.
- E. Heat to 191°C at 1 - 2°C/minute: cure 4 hours.
- F. Cool to 66°C at ≤ 3°C/minute before releasing pressure.

Post Cure Procedure

Post cure 16 hours at 232°C (free standing oven).

Raise temperature from ambient to 191°C at a rate of 3 - 6°C/minute and a rate of 2 - 3°C/minute above 191°C.



Release Certification

The Quality System at Hexcel Composites Duxford has been certified to ISO 9001 by Lloyd's Register Quality Assurance, and is approved by the UK Civil Aviation Authority and Ministry of Defence. Certificates of Conformity and Test Reports can be issued for batches of Redux HP655 on request.

Important

All information is believed to be accurate but is given without acceptance of liability. Users should make their own assessment of the suitability of any product for the purposes required. All sales are made subject to our standard terms of sale which include limitations on liability and other important terms.

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Hexcel is a leading worldwide supplier of composite materials to aerospace and other demanding industries. Our comprehensive product range includes:

- Carbon Fibre
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- Honeycomb Cores
- Continuous Fibre Reinforced Thermoplastics
- Carbon, glass, aramid and hybrid prepregs
- Reinforcement Fabrics
- Structural Film Adhesives
- Honeycomb Sandwich Panels
- Special Process Honeycombs

For US quotes, orders and product information call toll-free 1-800-688-7734

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