

Redux[®] Selector Guide



About HEXCEL

Hexcel is the largest US producer of carbon fibre; the world's largest weaver of structural fabrics; the number one producer of composite materials such as prepregs, film adhesives and honeycomb; and a leading manufacturer of composite parts and structures.

As the most vertically integrated supplier in the industry Hexcel manufactures the full spectrum of advanced material solutions. This means that we can offer enhanced design flexibility and support to our customers worldwide.

Hexcel's research and technology function supports our businesses worldwide with a highly developed expertise in materials science, textiles, process engineering and polymer chemistry.

Redux® Film Adhesives, Foaming Films, Pastes and Primers

Hexcel formulates and manufactures a comprehensive range of structural film adhesives, foaming adhesive films, pastes and primers for aerospace and industrial markets.

These Redux® branded products have provided our customers with practical and economical solutions to joining materials for over 60 years. The Redux® range is manufactured in Duxford, UK and Salt Lake City, UT, USA and is supported by a global sales and technical support network.

Redux® Film Adhesives

Epoxy, phenolic and bismaleimide (BMI) adhesives are supplied in film form on a roll and require heat and pressure to cure. These high performance structural adhesives are ideal for metal to metal and composite bonding and for the manufacture of honeycomb sandwich structures.

Redux® Foaming Adhesive Films

When cured at elevated temperature these films expand, making them ideal for gap filling, honeycomb core edge bonding and core splicing. Redux® foaming adhesive films are supplied in sheet form and are designed to be used in conjunction with Redux® Film Adhesives.

Redux® Paste Adhesives

A new range of one and two-part epoxy adhesives which can be cured either at room temperature or at elevated temperature to achieve higher levels of mechanical performance. The range includes structural adhesives and syntatics and is offered in either tins or cartridges.

Redux® Primers

Each Redux® primer has been formulated to ensure the maximum possible performance is achieved from the corresponding Redux® Film Adhesive. Redux® primers protect pretreated surfaces prior to bonding and ensure maximum bond durability.

ADHESIVE SELECTION

The comprehensive range of Redux® adhesives are suitable for many different applications. The first stage of design for bonding is the selection of the most suitable adhesive. This selector guide gives a summary of the main properties of the standard Redux® adhesive range.

Generic Type

Redux® film adhesives are supplied in three generic types:

1. Vinyl-phenolic - giving the best hostile environment resistance properties with temperature resistance up to 70°C (120°F).
2. Epoxy - giving higher strengths, toughness and temperature resistance up to 200°C (390°F).
3. Bismaleimide - giving good performance at even higher temperature resistance up to 230°C (450°F).

Maximum Service Temperature

The temperature at which adequate strength is maintained varies according to adhesive type and can range from 70°C (120°F) to 230°C (450°F). Most film adhesives will retain their integrity down to -55°C (-67°F).

Cure Temperature

Film adhesives generally fall into ca. 120°C (250°F) curing or ca. 180°C (350°F) curing categories. Choice depends on equipment availability, energy economy, or service temperature requirements (usually the higher the desired operating temperature the higher the cure temperature required).

Bondline Thickness Control

During heating under pressure the adhesive will tend to squeeze out from a joint. Some film adhesives contain either a lightweight fabric 'carrier' or microspheres which ensure an optimum minimum bondline thickness automatically. This is useful for bonding small areas to prevent excessive squeeze-out. However strength values can be slightly reduced by the presence of carriers and they can prevent the use of the reticulation technique on to honeycomb core.

Weight

For good overall properties and bonding to honeycomb core, areal weights of film adhesives in the range 150-400 g/m² (0.03-0.08 psf) should be used. Where weight is critical a lightweight film (60-150 g/m²) (0.01-0.03 psf) can be suitable if close tolerance joints are achievable.

Qualifications

Many applications require adhesives to meet specification values to ensure selected strength properties. Redux® films are qualified to a wide range of international and specific aerospace specifications. Further details are available on request.

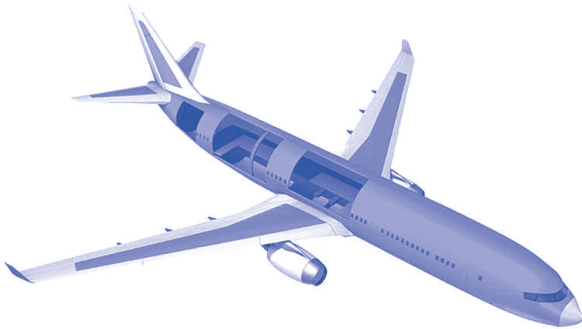
Compatibility

For co-curing with preregs (fibre reinforced matrix composites) to form a bonded sandwich structure, or as a 'surface finishing' film for prepreg, both chemical and cure cycle compatibility are essential. Compatibility with surface pretreatment protection primers and honeycomb core jointing foams is also necessary.

Typical Aerospace Applications

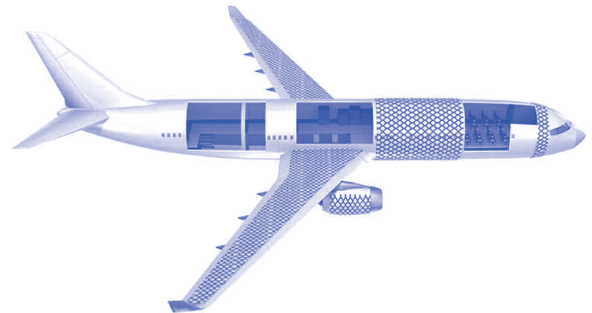
Hexcel is the preferred supplier of composite materials to the civil aerospace industry with materials present in virtually every commercial aircraft currently built in the western world.

Primary Structures



- Nose landing gear doors
- Trailing edge upper and lower panels
- Main and centre landing gear doors
- Pylon fairings and nacelles
- Belly fairing panels
- Spoilers/flaps/ailerons
- Horizontal (HTP) and vertical (VTP) stabilizer
- Radome

Interiors

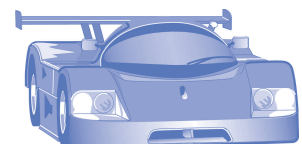
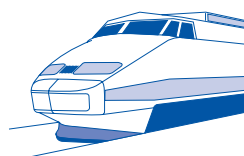
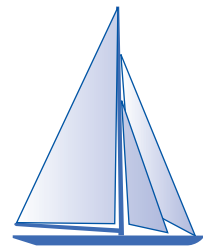


- Galley
- Floor panels
- Overhead stowage bins
- Wall partitions
- Lavatory
- Wardrobes
- Ceiling panels
- Sidewalls

Typical Industrial Applications

Suitable for a wide range of industries including:

- Automotive
- Buildings
- Marine
- Rail
- Sports goods
- Tooling
- Wind energy



These drawings illustrate typical applications for Redux® Adhesives. They are generic and not intended to represent a specific commercial usage. For information on the full range of Hexcel products for aerospace (carbon fibres, prepregs, honeycombs, etc) please request a copy of our CD.

REDUX® FILM ADHESIVES

PRODUCT	APPLICATIONS				PRODUCT PERFORMANCE			
	Composite Surfacing	Composite Bonding	Metal to Metal	Honeycomb	Maximum Service Temperature °C (°F)	Typical Cure Temperature °C (°F)	Cure Time (minutes)	
Phenolic Film Adhesive								
Redux® 775	-	-	X	-	75 (170)	150 (300)	30	
Epoxy Film Adhesive								
Redux® 609	-	-	X	X	85 (185)	120 (250)	60	
Redux® 610	X	X	X	X	85 (185)	120 (250)	60	
Redux® 335	-	X	X	X	90 (195)	120 (250)	60	
Redux® 312	-	X	X	X	100 (212)	120 (250)	30-60	
Redux® 308	-	-	X	X	125 (260)	170 (350)	60	
Redux® 308A-NA	-	-	X	X	125 (260)	150 (300) 170 (350)	60	
Redux® 330	X	X	-	X	135 (275)	175 (350)	60-120	
Redux® 319	-	X	X	X	150 (300)	175 (350)	60	
Redux® 641	X	X	X	X	150 (300)	175 (350)	60	
Redux® 322	-	X	X	X	175 (350)	175 (350)	60	
Redux® 340SP	-	X	X	-	175 (350)	175 (350)	60	
BMI Film Adhesive								
Redux® HP655	-	X	X	-	230 (445)	190 (375) +post cure		
Core Stabilising Film								
Cordux® 654	-	-	-	X	120 (250)	-	-	

PRODUCT PERFORMANCE					KEY FEATURES
Lap shear at 25°C (77°F) MPa (psi)	Honeycomb Climbing drum peel at 25°C (77°F) (N/76mm)	Flatwise Tensile at 25°C (77°F) MPa (psi)	TG Dry by DMTA °C (°F)		
37 (5300)	N/A	N/A	75 (165)		Outstanding long term corrosion resistance. Wing skins and fuselage bonding for aircraft. Good for rubber to metal bonding.
33 (4800)	200 (23)	7 (1000)	105 (220)		Ideal for industrial bonding applications such as: building panels, rail carriage doors, flooring partitions. Flexible cure cycle from 100 - 150°C to (212 - 300°F).
30 (4300)	240 (27)	7 (1000)	110 (230)		Includes flame retardant. Co-cures with 120°C(250°F) prepregs. Suitable for panel bonding for rail interiors, marine, building applications.
40 (5800)	750 (84)	8 (1200)	80 (175)		Best for applications requiring outstanding peel performance, from -55°C to 80°C (-67 - 176°F).
40 (5800)	650 (73)	9 (1300)	105 (220)		Short cure cycle: 30 minutes at 120°C (250°F) for faster applications and good composite to composite bonding.
47 (6500)	460 (52)	8 (1200)	100 (212)		Superior ageing performance for continuous operation up to 120°C (250°F).
46 (6700)	670 (75)	8.2 (1230)	110 (230)		Provides flexible curing schedule between 150 and 170°C (300 and 350°F). Flow controlled film.
40 (6000)	N/A	6.5 (900)	125 (260) 195 (385)		Ideal for composite to composite bonding, surface finishing and lightening strike applications.
36 (5200)	600 (68)	9 (1300)	120 (250) 200 (390)		High peel performance for automotive and aerospace (engine nacelles, flaps, aileron bonding) applications.
40 (6000)	620 (70)	12.5 (1800)	120 (250) 195 (385)		High performance adhesive with high peel and high shear strength. Exceptional honeycomb bonding.
20 (3000)	240 (27)	8 (1200)	200 (390)		Very high temperature performance. For military, engine nacelles, missile bonding, aerospace, motorsport and high temperature industrial applications.
32 (4640)	550 (62)	N/A	145 (290) 200 (390)		Low weight film adhesives with high Tg. Used for space applications.
26 (3800)	200 (23)	5 (700)	220 (430)		Very high temperature performance. Good co-cure with BMI prepregs.
-	-	-	-		Disposable backing material for cell stabilisation.

REDUX® FOAMING ADHESIVE FILMS

PRODUCT	ASSOCIATED FILM ADHESIVE	COLOUR	MAXIMUM SERVICE TEMPERATURE	TYPICAL CURE CYCLE (HEAT UP RATE 5°C (10°F)/MINUTE)
			°C (°F)	60 mins at 120°C (250°F)
Redux® 206-NA	312, 335, 609, 610	Dark Grey	90 (195)	X
Redux® 212-NA	312, 335, 609, 610	Black	100 (212)	X
Redux® 208/4-NA	308, 308A-NA	Black	120 (250)	-
Redux® 208/5-NA	308, 308A-NA	Black	120 (250)	-
Redux® 219/2-NA	319, 322, 330, 340SP, 641	Grey	150 (300)	-
Redux® 219/3-NA	319, 322, 330, 340SP, 641	Grey	150 (300)	-

REDUX® PRIMERS

PRODUCT	ASSOCIATED FILM ADHESIVE	COLOUR	DRYING TIME	
			Drying Time at 25°C (77°F) (minutes)	Drying Time at 70°C (158°F) (minutes)
Redux® 101	Redux® 775	Flamingo Pink	60	10-15*
Redux® 108	Redux® 308, 308A-NA	Dark Blue	60	20
Redux® 112	Redux® 312, 335, 609	Yellow	60	20
Redux® 119	Redux® 319, 330, 641	Blue	60	30
Redux® 122	Redux® 322, 340SP	Pink	60	30

*at 40-45°C (104-113°F)

TYPICAL CURE CYCLE (HEAT UP RATE 5°C (10°F)/MINUTE)		EXPANSION RATIO	ALUMINIUM DOUBLE LAP SHEAR MPA/PSI (1.6MM/0.06IN GAP)	KEY FEATURES
60 mins at 175°C (350°F)			at 22°C (70°F)	
-	1:4.0	3.5 (500)	High foaming ratio.	
-	1:2.0	8.5 (1200)	Low foaming ratio, suitable for vacuum and non vacuum cure. Best for lower temperature cure.	
X	1:2.0	11 (1600)	Best for room temperature lap shear.	
X	1:2.2	10 (1450)	Higher foaming ratio, not suitable with vacuum cure.	
X	1:2.0	9 (1300)	Higher service temperature foam, better suited for thin sections	
X	1:1.9	10 (1450)	High service temperature and low exotherm for manufacture of thicker components	

REDUX® EPOXY PASTE ADHESIVES

	APPLICATIONS									Maximum service temperature (°C/°F)	
	Honeycomb bonding	Metal to Metal bonding	Composite bonding	Potting	Honeycomb splicing	Structural repair	Syntactic	Liquid shim	Cured at 25°C (77°F)	Cured at elevated temperature	
Redux® 810	X	X	X	-	-	X	-	-	60 (140)	100 (212)	
Redux® 830	-	-	-	X	-	-	X	-	100 (212)	100 (212)	
Redux® 840	-	-	-	-	X	-	-	-	N/A	80 (175)	
Redux® 870	-	X	-	X	-	-	-	X	60 (140)	NA	

Important

Hexcel Corporation believes, in good faith, that the technical data and other information provided herein is materially accurate as of the date this document is prepared. Hexcel reserves the right to modify such information at any time. The performance values in this data sheet are considered representative but do not and should not constitute specification minima. The only obligations of Hexcel, including warranties, if any, will be set forth in a contract signed by Hexcel or in Hexcel's then current standard Terms and Conditions of Sale as set forth on the back of Hexcel's Order Acknowledgement.

PRODUCT PERFORMANCE								PRODUCT FORM	KEY FEATURES
Typical elevated cure temperature (°C/°F)	Lap shear at 25°C (77°F) (MPa, psi)	Compressive strength at 25°C (77°F) MPa, (psi)	Bell peel at 25°C (77°F) (N/25mm, lbf/inch)	Tg Dry 25°C (77°F) cure	Tg Dry - elevated temperature cure (°C/°F)	Pot life (100g)	Colour when mixed		
70 (160) 120 (250)	41 (5800)	48 (6960)	300 (67)	59 (138)	70 (160)	>1hour	Green	Two component thixotropic, high strength, high peel, multipurpose, corrosion-inhibiting	
50 (120)	N/A	50 (7250)	N/A	60 (140)	95 (205)	>1hour	Pink	Two component self-extinguishing low density syntactic filler	
120 (250) 175 (350)	13.5 ¹	31 ² (4493)	N/A	N/A	114 (237)	Variable	Black	Low density thixotropic single component, foaming paste	
NA	43 (6200)	98 (14210)	N/A	55 (130)	NA	2 hours	Grey	Two component thixotropic, gap filling high performance liquid shim adhesive	

¹ Double lap shear at 120°C cure, 1.6mm gap

² Cure 60mins at 120°C

For further information, please contact your nearest sales office, or visit our website at www.hexcel.com

Australia

Suite 2, 86 Grimshaw Street
Greensborough, Victoria 3088
Tel: **61** 3 9432 7100
Fax: **61** 3 9432 7200

China

D2101, Shanghai Everbright
Conference & Exhibition
Center
80 Cao Bao Road
Shanghai 200235
Tel: **86** 21 64836741
Fax: **86** 21 64836744

Japan

4F Yokohama YS Nishiguchi Bldg
2-25-1 Tsuruya-cho
Kanagawa-ku Yokohama 221-0835
Tel **81** 45 290 0866
Fax **81** 45 314 0852

USA

900 Main Street South
Building 1, Suite 202
Southbury, CT 06488
Tel: **1** 203 267 1414
Fax: **1** 203 267 1561

Austria

Industriestrasse 1
A-4061, Pasching
Tel: **43** (0)7229 7720
Fax: **43** (0)7229 772299

France

Z1 La Plaine, B.P.27 Dagneux
01121 Montluel CEDEX
Tel :**33** (0)4 72 25 26 27
Fax: **33** (0)4 72 25 27 30

Spain

Bruselas, 10 - 16
Polig. Ind, "Ciudad de Parla"
28980 Parla, Madrid
Tel: **34** 91 664 4900
Fax: **34** 91 698 4914

USA

2350 Airport Freeway, Suit 550
Bedford, TX 76022-6027
Tel: **1** 817 315 3939
Fax: **1** 817 571 8629

Belgium

Rue Trois Bourdons, 54
B-4840 Welkenraedt
Tel: **32** 87 307 411
Fax: **32** 87 882 895

Germany

Sophie-Scholl-Weg 22
21684 Stade
Tel: **49** 4141 7879-00
Fax: **49** 4141 7879-01

United Kingdom

Ickleton Road, Duxford, Cambridge
CB22 4QD
Tel: **44** (0)1223 833141
Fax: **44** (0)1223 838808

Brazil

Av. J. Guilhermino, 474/72
S.J.Campos, SP 12210-130
Tel: **55** 12 3941 2242
Fax: **55** 12 3923 1186

Italy

Via San Cristoforo, 44
21047 Saronno (VA)
Tel: **39** 02 96709082
Fax: **39** 02 9600809

USA

11711 Dublin Blvd.
Dublin, CA 94586-2832
Tel: **1** 925 551 4900
Fax: **1** 925 828 7765