



FRVC411

Flame Retardant Epoxy Component Prepreg

Introduction

FRVC411 is a toughened, flame retardant epoxy resin system designed to cure between 65°C and 140°C allowing flexibility in component manufacture. It can be supplied on a variety of fabrics and in UD format to meet your cost and manufacturing requirements. This resin system colour is opaque white.

Product variants: FRVC411B Black pigmented, default on all carbon reinforcements.

Typical applications: Flame retardant – Aerospace / Rail

Key Features & Benefits

- Cure temperature from **65°C to 140°C**
- Service temperature up to **150°C** after post cure
- Low CTE and shrinkage
- Work life at 20°C: **21 days**
- Storage life at -18°C: **12 months**
- Very low VOC content – no added solvents during manufacture
- **Snap cure** available for hot press moulding – consult SHD for details
- **FST properties:**
 - **CS 25.853** compliant
 - **EN 45545 HL1** – rated **HL3** for flame propagation, smoke and toxicity
 - Rated **UL94 V0** (0.5mm laminate), **UL94 V1** (2mm and 4mm laminates)

Storage & Out Life

This material should be kept frozen at -18°C. It must be kept sealed in a polythene bag which must not be opened until fully thawed to room temperature. If the material is not fully used, then the material must be resealed in the polythene bag to prevent moisture absorption.



Cure Cycles & performances

- Recommended Initial cure:
 - 1st dwell at **85°C** for **15 min**, at a ramp rate of **2-3°C/min**
 - 2nd dwell at **120°C** for **1h**, at a ramp rate of **2-3°C/min**
- Recommended Post cure: **150°C** for **1h**, at a ramp rate of **0.3°C/min** (if required to develop Tg)

CURE CYCLE OPTIONS:

Temperature	Duration	Tg
65°C (minimum)	16 hours	80°C
80°C	5 hours	90°C
100°C	2 hours	110°C
120°C	1 hour	135°C
140°C (maximum)	15 mins	150°C
150°C Post Cure	1 hour	155°C

- Curing Schedule is meant to be a guide only and is subject to local conditions.
- To avoid exotherm particular care must be taken with thick laminates.
Ramp rates must not exceed **3.0°C** per minute during **initial cure**.
Ramp rates must not exceed **0.3°C** per minute during **post cure** (free standing).

Cured Material Properties

Tests performed on **FRVC411-G300-8HS-42%RW** glass laminates, autoclave cured (6bar) for **1h at 120°C**.

Test	Results	Standard
Flexural	Flexural strength	634 MPa BS EN ISO 14125 : 1998
	Flexural modulus	20.3 GPa
Interlaminar Shear Strength	Interlaminar shear strength	66.6 MPa BS EN 2563 : 1997
DMA	Tg – Storage Modulus Onset	135 °C Modified ASTM D7028
	Tg – Tan δ Peak	167 °C (single cantilever)
DMA <i>After 1h at 150°C post cure</i>	Tg – Storage Modulus Onset	156 °C Modified ASTM D7028
	Tg – Tan δ Peak	176 °C (single cantilever)

Mechanical testing carried out at 23±2°C, 50±5% RH. All mechanical tests were completed by SHD Composites laboratories on non-conditioned specimens. Complete tests reports can be supplied independently upon request. All figures are actual test results and haven't been normalised.



Flame, Smoke and Toxicity properties

CS 25.853		Results	Limit		
60s vertical burn		1.2	6.0	<i>in</i>	<i>PASS</i>
15s horizontal burn		0.0	2.5	<i>in/min</i>	<i>PASS</i>
Heat release	Peak	42.9	65	<i>kW/m²</i>	<i>PASS</i>
	2 min average	35.5	65	<i>kW.min/m²</i>	
Smoke emission		138.89	200		<i>PASS</i>
Toxic gas emission	CO	22	1000		<i>PASS</i>
	HCN	< 1	150		
	HF	< 1	100		
	HCL	< 1	150		
	SO2	< 1	100		
	NOx	5	100		

*Material tested: 8 plies of FRVC411-G300-8HS-38%RW prepreg
Autoclave cured (6bar) 1h@120°C*

EN 45545		Results	Limits for category R1			Rating
			HL1	HL2	HL3	
ISO 5658-2	CFE (<i>kW/m²</i>)	22.6	20 (<i>min</i>)	20 (<i>min</i>)	20 (<i>min</i>)	<i>HL1, HL2, HL3</i>
ISO 5660-1	MAHRE (<i>kW/m²</i>)	106.0	N/A	90	60	<i>HL1</i>
ISO 5659-2	DS4	419.06	600	300	150	<i>HL1</i>
	VOF4	934.54	1200	600	300	<i>HL1</i>
EN 45545-2	CITG (4min)	0.063	1.2	0.9	0.75	<i>HL1, HL2, HL3</i>
Annex C.1	CITG (8min)	0.067	1.2	0.9	0.75	<i>HL1, HL2, HL3</i>

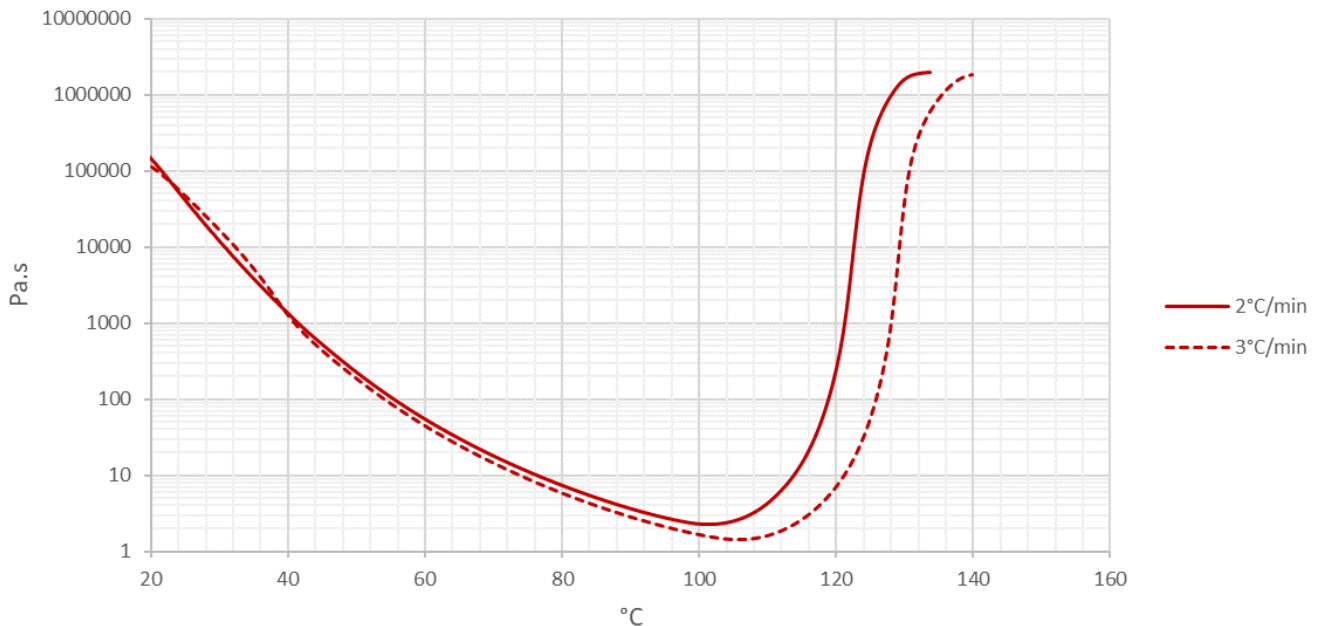
*Material tested: 8 plies FRVC411-G300-8HS-38%RW prepreg
Autoclave cured (6bar) 1h@120°C*

Tests completed independently by a UKAS approved organisation. Tests results can be supplied upon request.



Viscosity Profile

Measured using a rotational rheometer



Health and Safety

This material contains epoxy resin which can cause allergic reactions with skin contact and must avoid repeated and prolonged skin contact.

Please refer to the product Safety Data Sheet before using this material. The following precautions must be taken when using epoxy resin prepregs:

- Overalls must be worn.
- Impervious gloves must be worn.
- Curing schedule is meant to be as a guide only and is subject to local conditions.
- To avoid exotherm, particular care must be taken with thick laminates.
- Ramp rates must not exceed 3.0°C/min during initial cure and 0.3°C/min during post cure.

Disclaimer: Technical advice, instruction, data or recommendation, whether verbal or in writing, is given in good faith. The SHD company providing any such advice gives no warranty or guarantee, whether express or implied, in relation to such advice.

Customers must carry out their own tests and assessments as necessary in order to determine the quality and suitability of the product for their particular application and circumstances. Such testing should be performed under conditions identical to those to which the final component/product may be subjected. Values listed in any SHD document are for typical properties of the product or substance in question and are not intended to be used in establishing either statistical specifications nor engineering basis values. They do not constitute either minimum or maximum values for the product or substance in question.