SHD COMPOSITE MATERIALS INC
203 McKenzie Road
Mooresville
NC 28117

www.shdcomposites.com

Tel: +1 (704) 6266876
us-sales@shdcomposites.com

# FRVC411

## Flame Retardant Epoxy Component Prepreg

## Introduction

FRVC411 is a toughened, flame retardant epoxy resin system designed to cure between 150°F and 285°F 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 **150°F** to **285°F**
- Service temperature up to **300°F** after post cure
- Low CTE and shrinkage
- Work life at 70°F: **21 days**
- Storage life at 0°F: **12 months**
- Very low VOC content – no added solvents during manufacture
- **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 0°F. 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.

SHD COMPOSITE MATERIALS INC
203 McKenzie Road
Mooresville
NC 28117

www.shdcomposites.com

Tel: +1 (704) 6266876
us-sales@shdcomposites.com

# Cure Cycles & performances

- Recommended Initial cure:
  - 1st dwell at **185°F** for **15 min**, at a ramp rate of **4-5°F/min**
  - 2nd dwell at **250°F** for **1h**, at a ramp rate of **4-5°F/min**
- Recommended Post cure: **300°F** for **1h**, at a ramp rate of **1°F/min** *(if required to develop Tg)*

CURE CYCLE OPTIONS:

| Temperature | | Duration | | Tg |
|---|---|---|---|---|
| 150°F | (minimum) | 16 | hours | 175°F |
| 175°F | | 5 | hours | 195°F |
| 210°F | | 2 | hours | 230°F |
| 250°F | | 1 | hour | 275°F |
| 285°F | (maximum) | 15 | mins | 300°F |
| 300°F | Post Cure | 1 | hour | 310°F |

- 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 **5°F** per minute during **initial cure**.
  Ramp rates must not exceed **1°F** 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 | **275** | **°F** | *Modified ASTM D7028* |
| | Tg – Tan δ Peak | **333** | **°F** | *(single cantilever)* |
| **DMA** | Tg – Storage Modulus Onset | **313** | **°F** | *Modified ASTM D7028* |
| ***After 1h at 150°C post cure*** | Tg – Tan δ Peak | **349** | **°F** | *(single cantilever)* |

*Mechanical testing carried out at 70°F±4°F, 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.*

SHD COMPOSITE MATERIALS INC
203 McKenzie Road
Mooresville
NC 28117

www.shdcomposites.com

Tel: +1 (704) 6266876
us-sales@shdcomposites.com

## Flame, Smoke and Toxicity properties

| **CS 25.853** | | **Results** | **Limit** | | |
|---|---|---|---|---|---|
| 60s vertical burn | | **1.2** | 6.0 | *in* | *PASS* |
| 15s horizontal burn | | **0.0** | 2.5 | *in/min* | *PASS* |
| Heat release | Peak | **42.9** | 65 | *kW/m2* | *PASS* |
| | 2 min average | **35.5** | 65 | *kW.min/m2* | |
| Smoke emission | | **138.89** | 200 | | *PASS* |
| Toxic gas emission | CO | **22** | 1000 | | *PASS* |
| | 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@250°F*

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

*Material tested: 8 plies FRVC411-G300-8HS-38%RW prepreg*
*Autoclave cured (6bar) 1h@250°F*

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

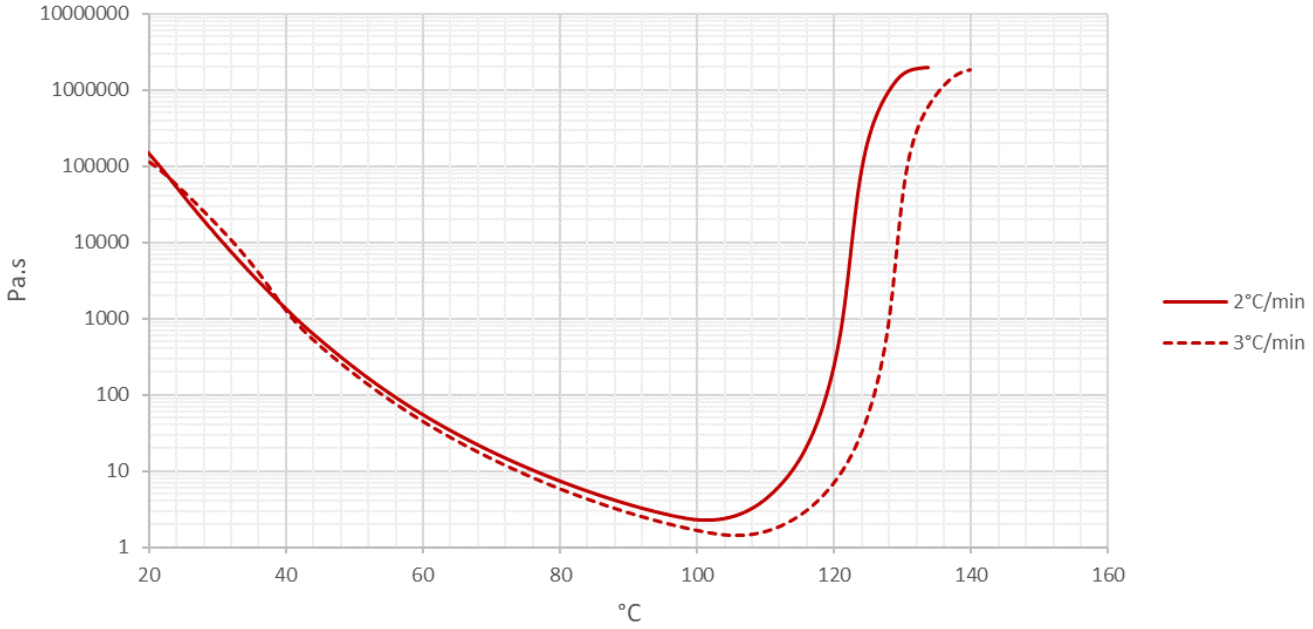
SHD COMPOSITE MATERIALS INC
203 McKenzie Road
Mooresville
NC 28117

www.shdcomposites.com

Tel: +1 (704) 6266876
us-sales@shdcomposites.com

## 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 5°F/min during initial cure and 1°F/min during post cure.