PRF
Composite Materials

# Epoxy Resin Systems
# Product Data

## Ultra Low Viscosity Epoxy System

# RS-M135

Hardeners RS-MH134 & RS-MH137 for RTM
& vacuum infusion processes

### Applications
- Boats and Shipbuilding
- Wind Energy Turbine Blades
- Sports Equipment

### Processing Methods
- Injection moulding (RTM)
- Vacuum Infusion
- Pultrusion

TDS012

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RS-M135

# Main Features

## Operational Temperature

- -60°C → + 50 - 60°C without postcure
- -60°C → + 80°C after postcure

## Processing

- Between 10°C and 50°C
- Pot life from ca. 45 minutes to ca. 4 hours at 25°C

## Processing methods

- Injection moulding (RTM)
- Vacuum Infusion
- Pultrusion

## Other features

- Good physiological properties
- Very good mechanical properties
- Very low viscosity
- Excellent initial cure at room temperature

# Introduction

This product is an ultra low viscosity laminating system formulated for use in the manufacture of composite components from glass, carbon and aramid fibres. The system is suitable for components requiring high static and fatigue strength properties using injectin moulding (e.g. RTM), vacuum infusion and pultrusion processes. At 25°C the mixed viscosity is approximately 200 mPa s and may be lowered further to a value of 100 - 150 mPa s by warming the resin (see page 5), thus even complicated parts with long flow paths can be injected without difficulty. With a mould temperature of around 30°C, the temperature rise with hardener RS-MH137 remains very slight, allowing thicker parts to be built at elevated temperatures.

There are 2 hardeners varying in reactivity, with pot lives from 20-30 minutes up to 4 hours. The individual hardeners can be inter-mixed in any ratio, enabling users to optimise the pot life of the system to meet their individual requirements. Cured parts can be worked and demoulded after curing at room temperature. Due to the low vapour pressure of the raw materials, this system can be processed at the elevated temperatures (80 - 100°C) using vacuum processes for example, vacuum assisted RTM. However the maximum temperature will depend on the layer thickness and the geometry of the component part.

Adding an internal parting agent, e.g. zinc stearate, has proven useful for pultrusion processes where profiles with good surface finishes have been produced. Depending on the profile geometry, mould temperatures in the range of 180 - 230°C are possible, thus permitting higher drawing speeds.

It is not expected that there should be compatibility problems with fully cured, dry UP gelcoats or various paint systems (e.g. PUR-based), etc. However, comprehensive tests should be carried out first to confirm this.

The resin and hardeners in this system contain neither solvents nor fillers. Careful selection of raw materials has ensured this system is low in odour and has good physiological properties, minimising skin irritation and allergy problems. However, the appropriate safety advice regarding contact with, and processing of, epoxy resin system should be followed.

RS-M135

## Product Specification

| Resin | RS-M135 |
|---|---|
| Density at 25°C (g/cm$^3$) | 1.13 - 1.17 |
| Viscosity at 25°C (mPa s) | 700 - 1100 |
| Epoxide equivalent | 166 - 185 |
| Epoxide value | 0.54 - 0.60 |
| Colour / Gardner | max. 3 |

| Hardeners | RS-MH134 | RS-MH137 |
|---|---|---|
| Density at 25°C (g/cm$^3$) | 0.94 - 1.00 | 0.94 - 0.98 |
| Viscosity at 25°c (mPa s) | 10 - 50 | 10 - 50 |
| Amine value (mgKOH/g) | 550 - 700 | 400 - 450 |
| Colour / Gardner | max. 4* | max. 4* |

* Does not apply to standard hardeners which are coloured blue.

## Storage

The hardeners can be stored for a minimum of 12 month in original, sealed containers at 15 - 25°C. Crystallisation of these materials may occur at temperatures below 15°C and is visible as a clouding or solidification of the liquid within the container. Before processing, the crystallisation must be removed. This can be done, without any degradation to the product, by slowly warming the material to approximately 50 - 60°C in a water bath or oven and stirring or mixing until the liquid becomes clear.

CAUTION

- Do not heat over a naked flame;
- Before warming, open containers to equalise pressure;
- Use safety equipment (gloves, safety glasses, respirator);
- Work in a well ventilated area.

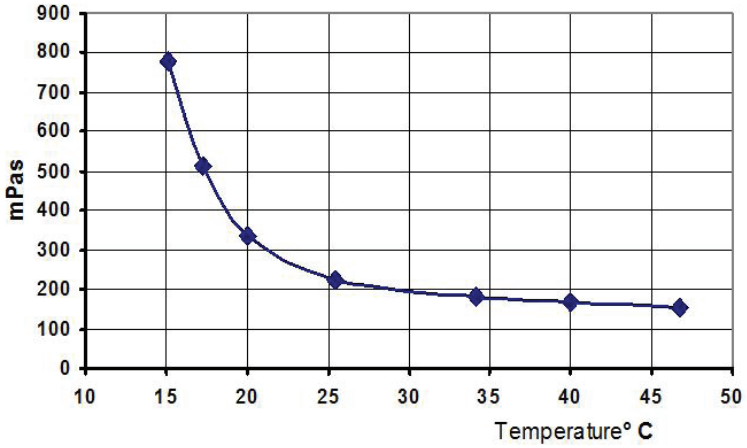
RS-M135

## Processing Data

| | Resin | Hardeners | |
|---|---|---|---|
| | RS-M135 | RS-MH134 | RS-MH137 |
| Average Epoxide Value | 0.56 | - | - |
| Amine Equivalent | - | 52 | 52 |
| Processing Temperature | 10° - 15°C | | |
| Mixed viscosity at 25°C | See diagram | | |
| Setting Temperature | Initial cure at room temperature (20 - 25°C) | | |
| Heat Treatment | At temperatures between 40 - 150°C | | |

The optimum processing temperature is between 20°C and 25°C. Higher processing temperatures will reduce the mixed viscosity and shorten the pot life, a rise of 10°C will halve the pot life. Further, water contained in fillers for example, or very high relative humidity will accelerate the reaction of the resin-hardener mixture. However, there is no significant effect to the strength of the cured product as a result of different temperatures and relative humidity levels during processing.

Resin: RS-M135
Hardener: RS-MH137




The mixed viscosity is very low, which is especially advantageous for injection and pultrusion methods. By heating the resin mass, the viscosity can be reduced further to approximately 150 mPa s at 46°C (see diagram), enabling complicated moulded parts with long flow paths to be easily injected. The temperature rise with hardener RS-MH137 remains very low up to a mould temperature of approximately 30°C, so that even parts with thicker layers can be produced at elevated temperatures.

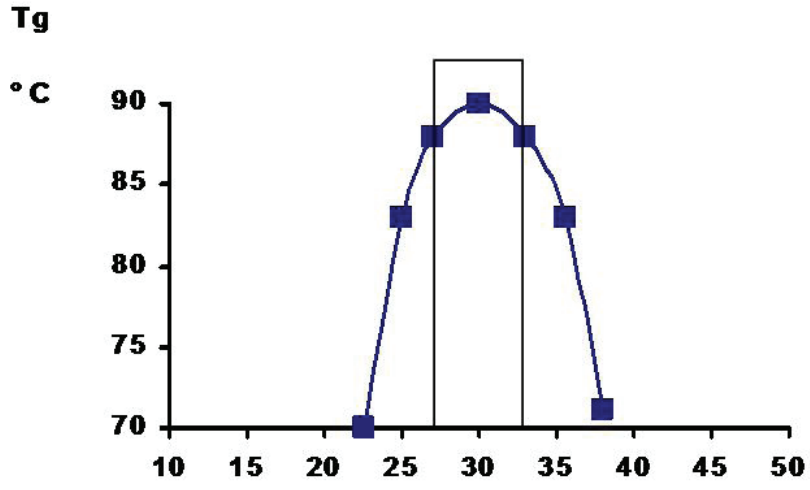
RS-M135

## Mixing Ratios

| | RS-M135 : RS-MH134 ~ RS-MH137 |
|---|---|
| Parts by Weight | 100 : 30 (+/-1) |
| Parts by Volume | 100: 35 (+/-1) |

The specified mixing ratios must be observed; varying the quantity of hardener will adversely affect the properties of the matrix. The resin and hardener must be mixed thoroughly until they are homogeneously mixed, paying special attention to the walls and the bottom of the mixing container. Do not mix large quantities, especially if highly reactive systems are being used. Heat dissipation from mixing containers is poor, causing the resin-hardener mixture to warm up quickly as a result of the exothermic reaction of the two materials. Temperatures >200°C can be generated causing smoke-intensive burning of the resin-hardener mixture. To avoid this, mix small quantities in large, shallow containers.

## Mixed Ratios <-> Glass Transition Temperature




Parts by weight of hardener RS-MH137 to 100 parts by weight of laminating resin RS-M135. Heat treatment 80°C.

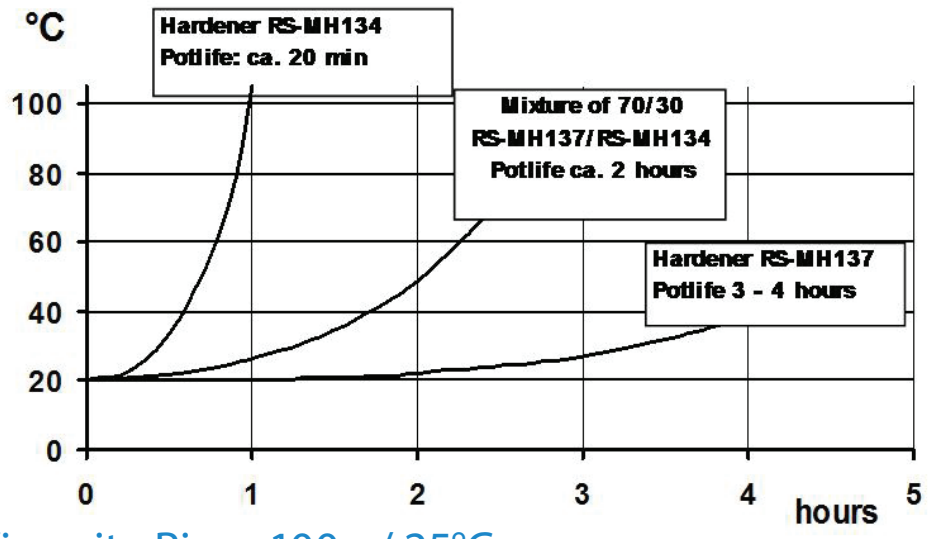
## Processing Time (Pot Life) 100g / 25°C

| | Resin RS-M135 | |
|---|---|---|
| Hardener | RS-MH134 | RS-MH137 |
| | ca. 20 - 30 min | 3 - 4 hrs |

The individual hardeners can be inter-mixed in any ratio, enabling users to optimise the pot life of the system to meet their individual requirements.

For example:

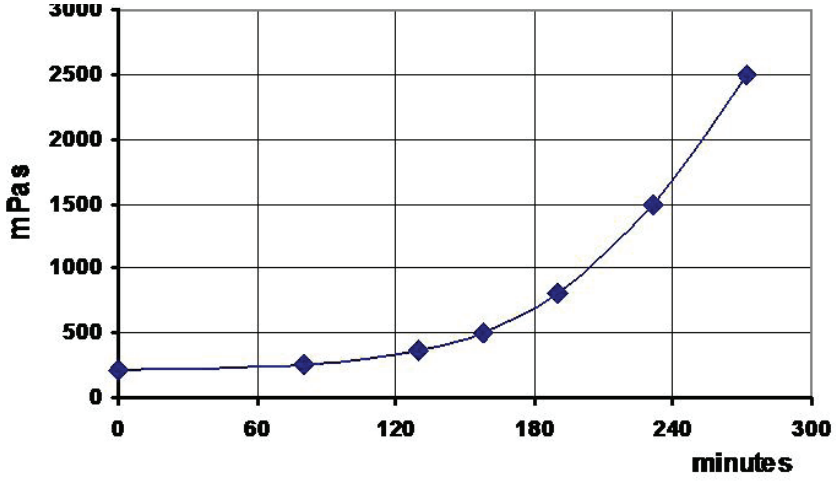
70% RS-MH137 / 30% RS-MH134 will provide a pot life of ca. 2 hours, as shown below.




## Viscosity Rise - 100g / 25°C

Resin: RS-M135

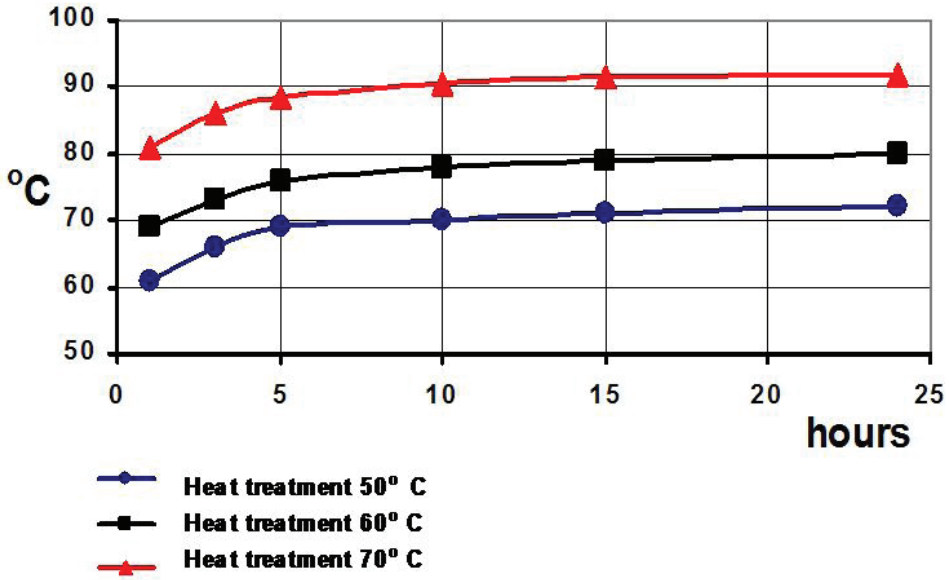
Hardener: RS-MH137



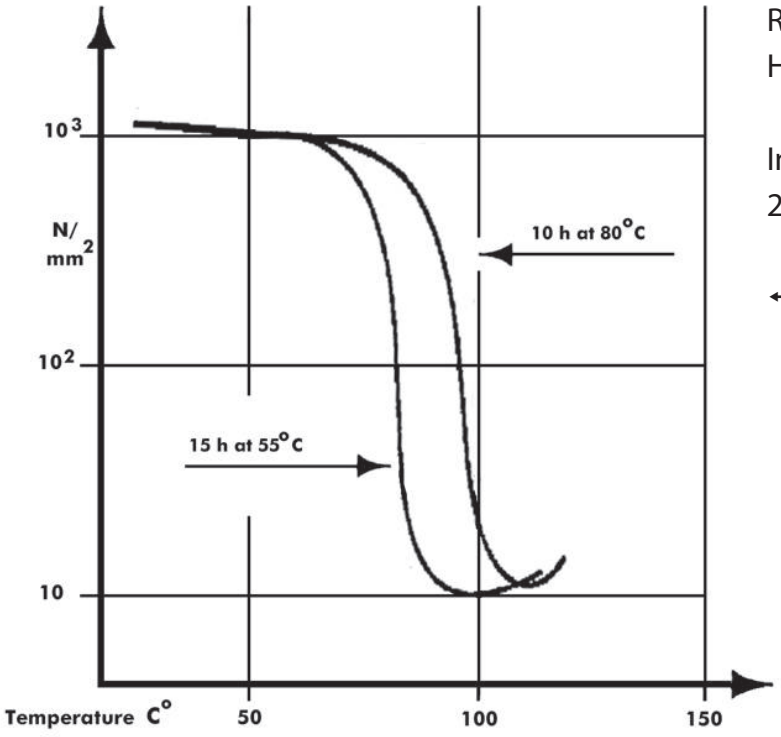
# Resin Matrix Properties

## Glass Transition Temperature (Tg)

Resin RS-M135 / Hardener RS-MH137




## Shear Modulus




Resin: RS-M135
Hardener: RS-MH137

Initial cure
24hr @ 20 - 25°C

← Post cure

RS-M135

## Cured - Un-reinforced Matrix Properties

| CURING : 24h @ 23°C + 15h @ 60°C | | RS - M135 & RS-MH134 / RS-MH137 |
|---|---|---|
| Density | $g/cm^3$ | 1.18 - 1.20 |
| Flexural strength | $N/mm^2$ | 110 - 140 |
| Tensile strength | $N/mm^2$ | 70 - 80 |
| Impact Strength | $Nmm/mm^2$ | 40 - 50 |
| Elongation | % | 5 - 6.5 |
| Compression strength | $N/mm^2$ | 120 - 140 |
| Modulus of elasticity | $kN/mm^2$ | 3.3 - 3.5 |
| Water absorption 24 hours / 23°C | % | 0.10 - 0.20 |
| Water absorption 7 days / 23°C | % | 0.20 - 0.50 |
| Shore Hardness | D | 80 - 85 |
| Fatigue under reverse bending stresses acc. DLR Brunswick 10% | | $> 1 \times 10^6$ |
| Fatigue under reverse bending stresses acc. DLR Brunswick 90% | | $> 2 \times 10^6$ |

Representative data in accordance with WL 5.3203 parts 1 & 2 of the German Aviation Materials Manual, part II


# Composite Properties
# Cured - Fibre Reinforced Properties

| CURING: 24h @ 25°C + 15h @ 60°C | | $V_f$ 43% | RS - M135 & RS-MH134 / RS-MH137 |
|---|---|---|---|
| Flexural strength | N/mm² | GFC | 510 - 560 |
| | | CFC | 720 - 770 |
| | | AFC | 350 - 380 |
| Tensile strength | N/mm² | GFC | 460 - 500 |
| | | CFC | 510 - 550 |
| | | AFC | 400 - 480 |
| Compressive strength | N/mm² | GFC | 410 - 440 |
| | | CFC | 460 - 510 |
| | | AFC | 140 - 160 |
| Interlaminar shear strength | N/mm² | GFC | 42 - 46 |
| | | CFC | 47 - 55 |
| | | AFC | 29 - 34 |
| Flexural modulus | kN/mm² | GFC | 20 - 24 |
| | | CFC | 40 - 45 |
| | | AFC | 16 - 19 |

GFC - samples: 16 layers, glass fabric, 296g/m² 8H Satin, 4mm thick.

CFC - samples: 8 layers, SM, 3K carbon fabric, 200g/m² plain weave, 2mm thick.

AFC - samples: 15 layers, Kevlar® aramid fabric, 170g/m² 4H Satin, 4mm thick.

Fibre volume fraction of samples 40%-45%. Data calculated to fibre volume 43%.


Health and Safety - Refer to the full Material Safety Datasheet before use.

# Find out what PRF can do for your business

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**Important Notice**

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