RESOLCOAT 1400-1407 and Accelerator AC140

Hot curing epoxy system

RST 1400 is an epoxy resin
RST 1407 is an anhydride hardener
Accelerator AC140 is an imidazole accelerator

Applications
High performance composite parts

Properties
Anhydride-cured, low-viscosity standard matrix system with extremely long pot life. The reactivity of the system is adjustable by variation of the accelerater content. The system is easy to process, has good fibre impregnation properties and exhibits excellent mechanical, dynamic and thermal properties. It has an excellent chemical resistance especially to acids at temperatures up to 80 °C. This epoxy system fulfils MIL specifications R 9300.

Processing
Filament Winding, Pultrusion, Pressure Moulding

Key Data

RST 1400

Aspect (visual) :	clear, pale yellow liquid
Colour (Gardner, ISO 4630) :	<2
Viscosity at 25 °C (ISO 12058-1) :	10000 - 12000 [mPa s]
Density at 25 °C (ISO 1675) :	1.15 - 1.20 [g/cm3]
Flash point (ISO 2719) :	> 200 [°C]
Storage temperature :	2 - 40 °C [°C]

RST 1407

Aspect (visual) :	clear liquid
Colour (Gardner, ISO 4630) :	<2
Viscosity at 25 °C (ISO 12058-1) :	50 - 100 [mPa s]
Density at 25 °C (ISO 1675) :	1.20 - 1.25 [g/cm3]
Flash point (ISO 2719) :	195 [°C]
Storage temperature :	2 - 40 °C [°C]

Accelerator AC104

Aspect (visual) :	clear liquid
Colour (Gardner, ISO 4630) :	<9
Viscosity at 25 °C (ISO 12058-1) :	<50 [mPa s]
Density at 25 °C (ISO 1675) :	0.95 - 1.05 [g/cm3]
Flash point (ISO 2719) :	92 [°C]
Storage temperature	2 - 40 °C [°C]

Storage
Provided that RST 1400, RST 1407 and Accelerator AC104 are stored in a dry place in their original, properly closed containers at the above mentioned storage temperatures they will have the shelf lives indicated on the labels. Partly emptied containers should be closed immediately after use. Because RST 1407 is sensitive to moisture, storage containers should be ventilated with dry air only. RST 1400 which has crystallized and looks cloudy can be restored to its original state by heating to 60 - 80 °C.

Processing data

Mix ratio

Components	*Parts by weight*	*Parts by volume*
RST 1400	100	100
RST 1407	90	86
AC140	0.5 – 2	0.6 - 2.4

We recommend that the components are weighed with an accurate balance to prevent mixing inaccuracies which can affect the properties of the matrix system. The components should be mixed thoroughly to ensure homogeneity. It is important that the side and the bottom of the vessel are incorporated into the mixing process. When processing large quantities of mixture the pot life will decrease due to exothermic reaction. It is advisable to divide large mixes into several smaller containers.

Processing recommendations

To simplify the mixing process the resin can be preheated to about 30 °C to 50 °C before adding the cold hardener. Hardener and accelerator can be premixed, thus allowing the use of two component mixing/metering equipment. The mix of hardener and accelerator has a shelf life of several days. The processing of the system at elevated temperatures of 30 °C to 40 °C shows the best results. The gelation temperature should not be higher than absolutely necessary. A high gelation temperature induces high shrinkage and generates internal stresses.

Initial mix viscosity

[°C]	*[mPa s]*
at 25	600 - 900
at 40	200 - 300
at 60	< 75

Viscosity build-up

(Hoeppler, ISO 9371B)

Components [pbw]			*System 1*	*System 2*	*System 3*
RST 1400			100	100	100
RST 1407			90	90	90
AC104			0.5	1	2
[°C]	*[mPa s]*				
at 25	to 1500	*[h]*	10 - 12	3.5 - 4.5	1.5 - 2
	to 3000	*[h]*	33 - 37	16 - 18	6 - 7
at 40	to 1500	*[h]*	19 - 21	7 - 8	3 - 4
	to 3000	*[h]*	23 - 26	9 - 10	4 - 5
at 80	to 1500	*[min]*	95 - 105	52 - 57	32 - 35
	to 3000	*[min]*	105 - 115	60 - 65	35 - 38
at 90	to 1500	*[min]*			14 - 16
	to 3000	*[min]*			15 - 17

Pot life
(Tecam, 65 % RH, 100 g)
10 kg metal container

[°C]		*System 1*	*System 2*	*System 3*
at 23	*[h]*	165 - 175	95 - 105	48 - 54
at 40	*[h]*	5 - 7	4 - 5	-

Gel time
(Hot plate)

[°C]		*System 1*	*System 2*	*System 3*
at 80	*[min]*	230 - 270	140 - 160	65 - 75
at 100	*[min]*	65 - 75	35 - 45	18 - 22
at 120	*[min]*	21 - 25	10 - 12	5 - 7
at 140	*[min]*	7 - 9	3 - 5	1 - 3
at 160	*[min]*	2 - 4	1 - 2	-

The values shown are for small amounts of pure resin/hardener mix. In composite structures the gel time can differ significantly from the given values depending on the fibre content and the laminate thickness.

Typical cure cycles

Gelation either	2 - 4 h at 80 °C
or	1 - 3 h at 90 °C
Post-cure either	4 - 8 h at 120 °C
or	2 - 8 h at 140 °C
or	2 - 8 h at 160 °C

Cure temperatures in excess of about 130 °C cause brown discolouration but do not impair the properties of the product.

Properties of the cured, neat formulation

Unless otherwise stated, the processing schedule for the samples tested was gelation for 4 hours at 80 °C and post-cure for 8 hours at 140 °C.

Glass transition temperature (T_G)
(IEC 1006, 10 K/min)

Cure:	*T_G DSC [°C]*	*T_G Kinemat [°C] Or TMA [°C]*
4 h 80 °C + 4 h 120 °C	140 - 144	125 - 128
4 h 80 °C + 8 h 120 °C	144 - 148	125 - 128
4 h 80 °C + 4 h 140 °C	145 - 150	130 - 135
4 h 80 °C + 8 h 140 °C	148 - 153	135 - 145
4 h 80 °C + 4 h 160 °C	150 - 155	140 - 145
4 h 80 °C + 8 h 160 °C	150 - 155	140 - 145

Tensile test			
(ISO 527)	Tensile strength	*[Mpa]*	83 - 93
	Elongation at tensile strength	*[%]*	4.2 - 5.6
	Ultimate strength	*[Mpa]*	80 - 90
	Ultimate elongation	*[%]*	5.0 - 7.0
	Tensile modulus	*[Mpa]*	3100 - 3300
Flexural test			
(ISO 178)	Flexural strength	*[Mpa]*	125 - 135
	Deflection at maximum load	*[mm]*	10 – 18
	10 days in H2O 23 °C		
	Flexural strength	*[Mpa]*	110 - 120
	Deflection at maximum load	*[mm]*	8 – 18
	60 min in H2O/100 °C		
	Flexural strength	*[Mpa]*	125 - 135
	Deflection at maximum load	*[mm]*	10 - 18
Fracture properties	**Bend notch test**		
(PM 258-0/90)	Fracture toughness K1C	*[MpaV$\overline{m}$]*	0.56 - 0.6
	Fracture energy G_{1C}	*[J/m²]*	88 - 96
Water absorption			
(ISO 62)	*Immersion:*		
	1 day H_2O 23 °C	*[%]*	0.10 - 0.15
	10 days H_2O 23 °C	*[%]*	0.30 - 0.40
	30 min H_2O 100 °C	*[%]*	0.10 - 0.15
	60 min H_2O 100 °C	*[%]*	0.15 - 0.20
Coefficient of linear thermal expansion			
(DIN 53 752)	*Mean value:*		
	α from 20 - 100 °C	*[10^{-6}/K]*	55 - 57
	α from 100 - 130 °C	*[10^{-6}/K]*	67 - 70
Poison's ratio		*[µ]*	0.35

Properties of the cured, reinforced formulation

Unless otherwise stated, the figures given are for pressed laminate samples comprising 16 layers (4 mm) of E-glass fabric 1:1, 280 - 300 g/m2, fibre volume content 42 - 47 %.

Flexural test			
(ISO 178)	Flexural strength	*[Mpa]*	520 - 550
	Deflection at maximum load	*[mm]*	5 - 6
	Flexural modulus	*[Mpa]*	16500 - 16700
	10 days in H_2O 23 °C		
	Flexural strength	*[Mpa]*	390 - 410
	Deflection at maximum load	*[mm]*	4 - 5
	60 min in H_2O/100 °C		
	Flexural strength	*[Mpa]*	460 - 480
	Deflection at maximum load	*[mm]*	5 - 6
Tensile test			
(ISO 3268 - 1978)	Tensile strength	*[Mpa]*	345 - 375
	Ultimate elongation	*[%]*	1 - 2
	Tensile modulus	*[Mpa]*	25500 - 26000
Interlaminar shear strength			
(ASTM D 2344)	Short beam : E-glass unidirectional specimen Laminate thickness t = 6.4 mm Fibre volume content: 60 %		
	Shear strength :	*[Mpa]*	75 - 77
Water absorption			
(ISO 62)	*Immersion:*		
	1 day H_2O 23 °C	*[%]*	0.15 - 0.20
	10 days H_2O 23 °C	*[%]*	0.25 - 0.30
	30 min H_2O 100 °C	*[%]*	0.01 - 0.05
	60 min H_2O 100 °C	*[%]*	0.03 - 0.07

Tensile, Compressive and Torsional test		
E-glass	Roving	E-glass roving, 1200 tex, silane finish
	Fibre volume content	67 %
	Gelation temperature	90 °C
	Post-cure	8 h at 140 °C
Carbon HT	Roving	Carbon fibre high tensile, Torayca T 300 B - 6000 - 50 B
	Fibre volume content	64 %
	Gelation temperature	90 °C
	Post-cure	8 h at 140 °C

		E-Glass	*Carbon HT*
Transverse tensile test			
Tensile strength	*[Mpa]*	48 - 55	77 - 85
Tensile strain	*[%]*	0.25 - 0.33	0.9 - 1.0
Elastic modulus	*[Mpa]*	18000 – 20000	9300 - 9900
Transverse compressive test			
Compressive strength	*[Mpa]*	165 - 175	190 - 206
Compressive strain at brak	*[%]*	1.2 - 1.4	2.7 - 3.4
Elastic modulus	*[Mpa]*	20000 - 22000	9700 - 9900
Torsional test			
Shear strength	*[Mpa]*	77 - 82	76 - 80
Shear angle	*[%]*	2.7 - 3.1	3.3 - 4.0
Shear modulus	*[Mpa]*	6100 – 7100	6000 - 6300

Handling precautions

Mandatory and recommended industrial hygiene procedures should be followed whenever our products are being handled and processed. For additional information please consult the corresponding product safety data sheets and the brochure edited by the APME “Epoxy Resins and reticulation agents – Toxicology, Hygienic and environmental precautions”

Personal hygiene

Safety precautions at workplace	
protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
goggles/safety glasses	yes
Skin protection	
before starting work	Apply barrier cream to exposed skin
after washing	Apply barrier or nourishing cream
Cleansing of contaminated skin	Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents
Disposal of spillage	Soak up with sawdust or cotton waste and deposit in plastic-lined bin
Ventilation	
of workshop	Renew air 3 to 5 times an hour
of workplaces	Exhaust fans. Operatives should avoid inhaling vapours

First aid

Contamination of the *eyes* by resin, hardener or mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted. Material smeared or splashed on the *skin* should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately. Anyone taken ill after *inhaling* vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.

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