Toray RS-36

Toray Advanced Composites

PRODUCT DATA SHEET

DESCRIPTION

Toray RS-36 is an advanced modified epoxy system for structural composite applications. RS-36 offers an excellent balance of mechanical properties, low moisture absorption, high glass transition temperatures, and a range of processing options. A higher T_g version, RS-36-1, with similar mechanical properties, is available.

FEATURES

- **Excellent balance of T_g, toughness, modulus, and mechanical properties**
- **Low moisture absorption and low outgassing**
- **Vacuum bag and autoclave processible**
- **Qualified for satellite and high-modulus fiber applications**

PRODUCT TYPE

177°C (350°F) Cure Epoxy Resin System

TYPICAL APPLICATIONS

- Satellite structure
- Dimensionally stable structure

SHELF LIFE

Out Life:	Up to 30 days at ambient
Frozen Storage Life:	12 months at -18°C (< 0°F)

Out life is the maximum time allowed at ambient temperature before cure.

*Ambient is 18–22°C (65–72°F).
**Out life tested by SBS on a 15 x 15 cm (6 x 6") laminate, cured in an autoclave. Users may need to separately evaluate out life limits on thicker, larger, and more complex parts.

TYPICAL NEAT RESIN PROPERTIES

Density	1.24 g/cc	
Dry T_g by DMA (RS-36)	181°C (358°F)	
Dry T_g by DMA (RS-36-1)	190°C (374°F)[1]	
Gel Time	15–25 minutes at 177°C (350°F) per ASTM D 3532	
Moisture Absorption after 30 days at 82°C (180°F)	3.0%	
Outgassing (ASTM E 595)	TML CVCM WVR TML-WVR	0.4% 0.01% 0.17% 0.12%

(1) Cure used for RS-36-1: 2–5°C (3–9°F) ramp to 135°C (275°F). Hold for 20 minutes under vacuum pressure. Apply 80–100 psi autoclave pressure, and hold for 120 minutes at 135°C (275°F). Then ramp to 190°C (375°F) and hold for 120 minutes.

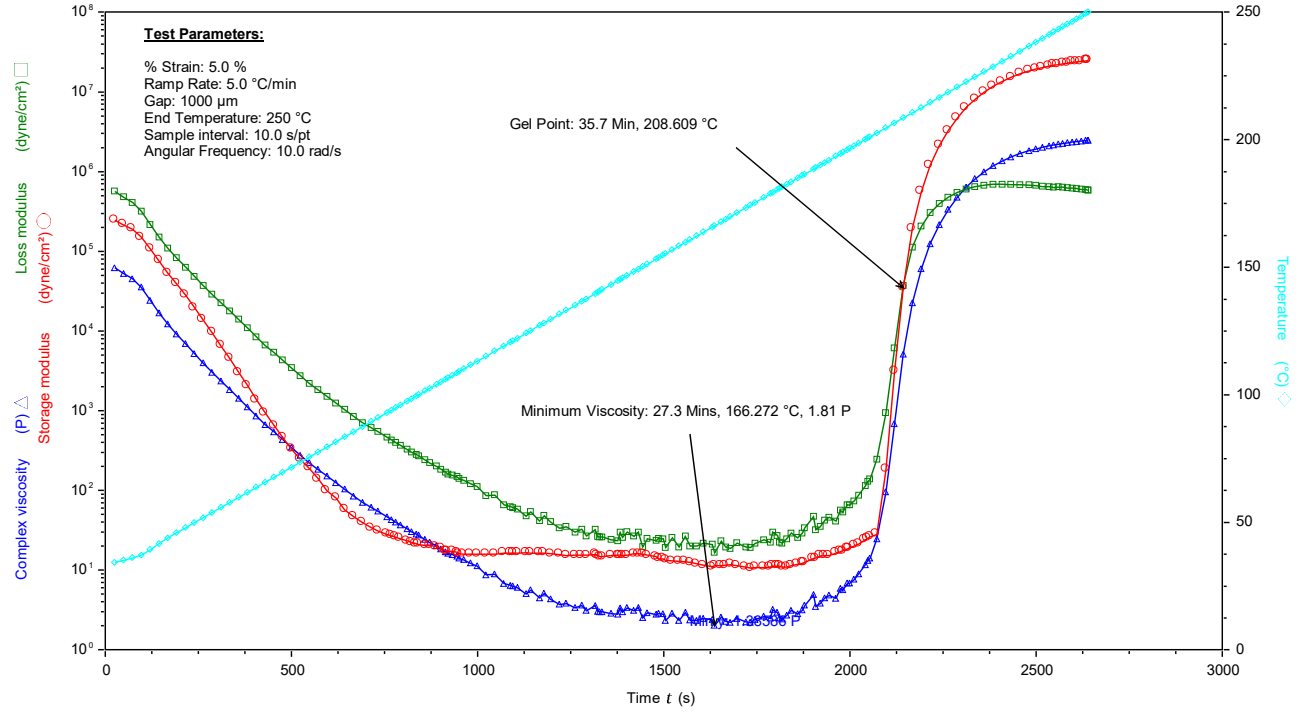
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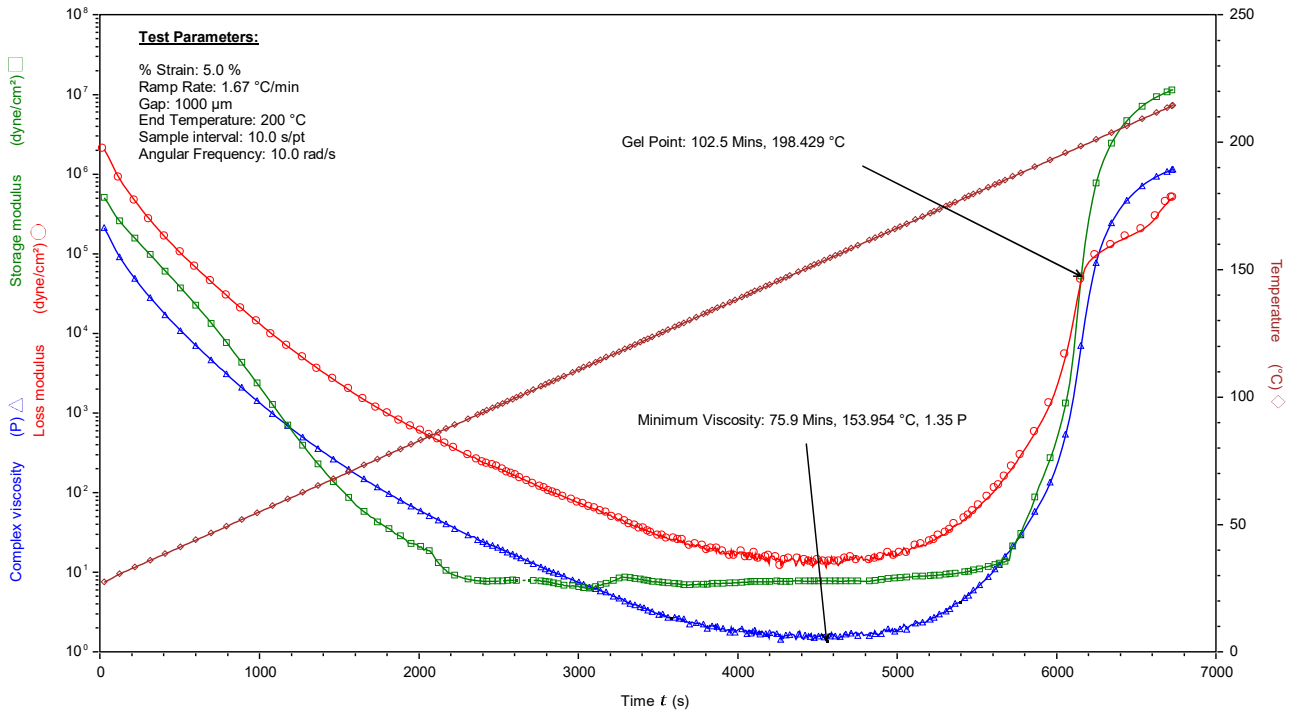
PRODUCT DATA SHEET

RESIN RHEOLOGY

RS-36 RESIN DYNAMIC VISCOSITY

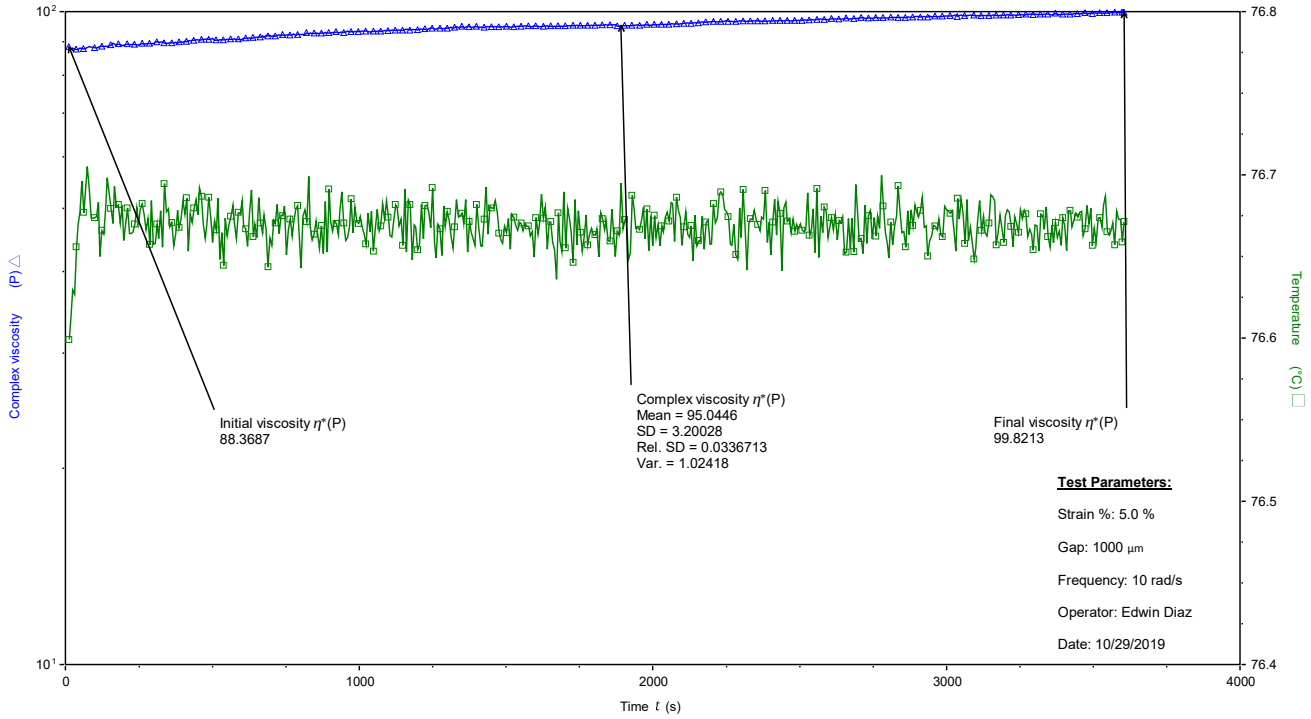


RS-36-1 RESIN DYNAMIC VISCOSITY

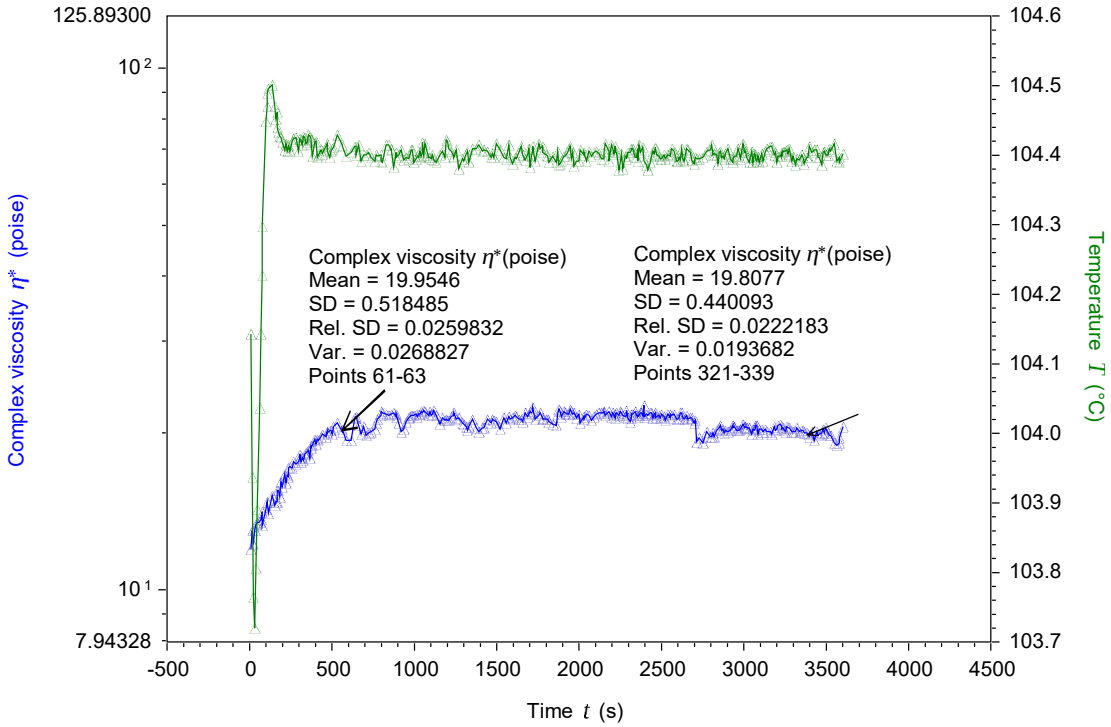


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RS-36 RESIN ISOTHERMAL VISCOSITY AT 76.7°C (170°F)

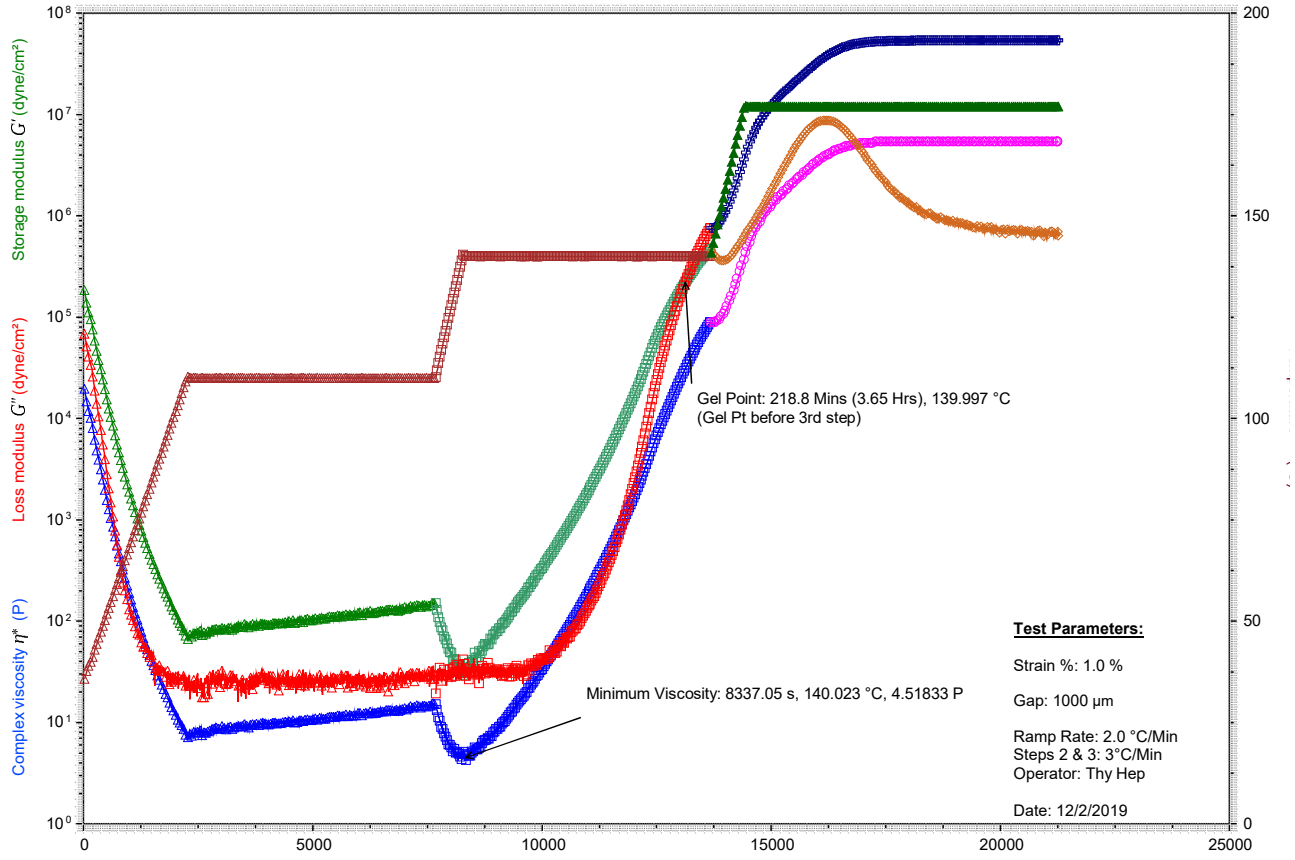


RS-36 RESIN ISOTHERMAL VISCOSITY AT 104°C (220°F)

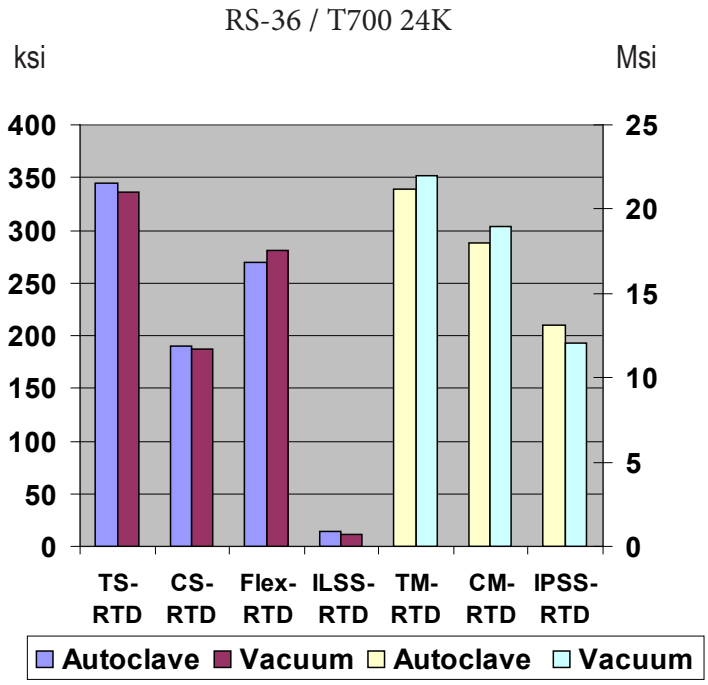


PRODUCT DATA SHEET

RS-36 RESIN VISCOSITY DURING SIMULATED ALTERNATE CURE CYCLE



PRODUCT DATA SHEET

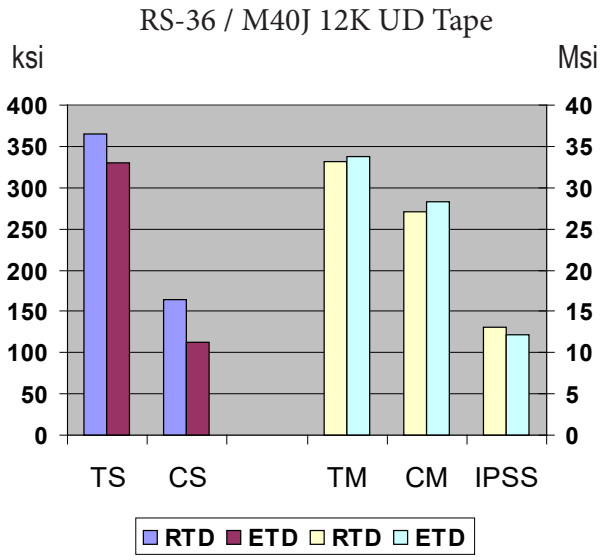


LAMINATE TYPE: TORAY T700 24K FIBER, UNI-DIRECTIONAL LAMINATE

Property	Condition	Test Method	Autoclave	Vacuum
Tensile Strength 0°	RTD	ASTM D 3039	2,380 MPa (345 ksi)	2,320 MPa (336 ksi)
Tensile Modulus 0°	RTD	ASTM D 3039	146 GPa (21.1 Msi)	152 GPa (22.0 Msi)
Compressive Strength 0°	RTD	ASTM D 3410	1,310 MPa (190 ksi)	1,290 MPa (187 ksi)
Compressive Modulus 0°	RTD	ASTM D 3410	124 GPa (18.0 Msi)	131 GPa (19.0 Msi)
Flexural Strength	RTD	ASTM D 790	1,860 MPa (270 ksi)	1,940 MPa (281 ksi)
Flexural Modulus	RTD	ASTM D 790	124 GPa (18 Msi)	110 GPa (16 Msi)
In-Plane Shear Strength	RTD	ASTM D 3518	124 MPa (18.0 ksi)	110 MPa (16.0 ksi)
In-Plane Shear Modulus	RTD	ASTM D 3518	4.4 GPa (0.64 Msi)	4.8 GPa (0.69 Msi)
Interlaminar Shear Strength (SBS)	RTD	ASTM D 2344	100 MPa (14.5 ksi)	75 MPa (11.0 ksi)
Interlaminar Shear Strength (SBS)	ETW[1]	ASTM D 2344	73 MPa (10.6 ksi)	N/A

Data normalized to 60% fiber volume with exception of In-Plane Shear and ILSS
[1]Condition 90°C (180°F), 98% RH, 14 days (Avg wt gain 0.64%)

PRODUCT DATA SHEET



M40J (12K)/RS-36 UDPP LAMINATE (140gsm) 0/90 DEGREE UNI-DIRECTIONAL AMBIENT & 121°C (250°F) MECHANICAL PROPERTIES

Property	Condition	Test Method	Value
Tensile Strength 0°	RTD	ASTM D 3039	2,517 MPa (365 ksi)
Tensile Modulus 0°	RTD	ASTM D 3039	228 GPa (33.1 Msi)
Tensile Strength 90°	RTD	ASTM D 3039	50 MPa (7.2 ksi)
Tensile Modulus 90°	RTD	ASTM D 3039	7 GPa (1.05 Msi)
Tensile Strength 0°	ETD	ASTM D 3039	2,275 GPa (330 ksi)
Tensile Modulus 0°	ETD	ASTM D 3039	233 GPa (33.8 Msi)
Tensile Strength 90°	ETD	ASTM D 3039	42 GPa (6.0 ksi)
Tensile Modulus 90°	ETD	ASTM D 3039	6.6 GPa (1.0 ksi)
Compression Strength 0°	RTD	SACMA SRM 1	1,138 MPa (165 ksi)
Compression Modulus 0°	RTD	SACMA SRM 1	186 GPa (27.0 Msi)
Compression Strength 0°	ETD	SACMA SRM 1	779 MPa (113 ksi)
Compression Modulus 0°	ETD	SACMA SRM 1	195 GPa (28.3 Msi)
In-Plane Shear Strength 0°	RTD	ASTM D 3518	90 MPa (13.1 ksi)
In-Plane Shear Modulus 0°	RTD	ASTM D 3518	4.8 GPa (0.7 Msi)
In-Plane Shear Strength 0°	ETD	ASTM D 3518	83 MPa (12.1 ksi)
In-Plane Shear Modulus 0°	ETD	ASTM D 3518	4.1 GPa (0.6 Msi)
ILSS 0°	RTD	ASTM D 2344	92 MPa (13.4 ksi)
ILSS 0°	ETD	ASTM D 2344	63 MPa (9.2 ksi)
Outgassing (ASTM E 595) ▶ TML ▶ CVCM ▶ WVR		ASTM E 595	 0.17 0.01 0.10

0° tensile and compression properties normalized to 60% fiber volume
ETD is done at 121°C (250°F)

MATERIAL: M55JB 6K UNI-DIRECTIONAL TAPE

Property	Condition	Method	RS-36 Results		RS-36-1 Results	
Tensile Strength 0°	RTD	ASTM D 3039	2041 MPa	296 ksi	2021 MPa	293 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	313 GPa	45.4 Msi	310 GPa	45.0 Msi
Compression Strength 0°	RTD	ASTM D 695 Mod.	993 MPa	144 ksi	966 MPa	140 ksi
Compression Modulus 0°	RTD	ASTM D 695 Mod.	294 GPa	42.7 Msi	297 GPa	43 Msi
Interlaminar Shear Strength 0°	RTD	ASTM D 2344	75 MPa	10.9 ksi	68 MPa	9.9 ksi

Data normalized to 60% fiber volume except for ILSS
Nominal CPT 0.1016 mm (0.004")

MATERIAL: T300 1K PW FABRIC PREPREG

Property	Condition	Method	RS-36 Results		RS-36-1 Results	
Tensile Strength 0°	RTD	ASTM D 3039	772 MPa	112 ksi	731 MPa	106 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	68 GPa	9.8 Msi	68 GPa	9.9 Msi
Compression Strength 0°	RTD	ASTM D 695 Mod.	876 MPa	127 ksi	662 MPa	96 ksi
Compression Modulus 0°	RTD	ASTM D 695 Mod.	68 GPa	9.8 Msi	62 GPa	9 Msi
Interlaminar Shear Strength 0°	RTD	ASTM D 2344	88 MPa	12.7 ksi	81 MPa	11.8 ksi

Data normalized to 60% fiber volume except for ILSS
Nominal CPT 0.127 mm (0.005")

MATERIAL: T300 3K PW FABRIC PREPREG

Property	Condition	Method	RS-36 Results		RS-36-1 Results	
Tensile Strength 0°	RTD	ASTM D 3039	924 MPa	134 ksi	779 MPa	113 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	70 GPa	10.1 Msi	70 GPa	10.2 Msi
Compression Strength 0°	RTD	ASTM D 695 Mod.	738 MPa	107 ksi	986 MPa	143 ksi
Compression Modulus 0°	RTD	ASTM D 695 Mod.	61 GPa	8.9 Msi	68 GPa	9.8 Msi
Interlaminar Shear Strength 0°	RTD	ASTM D 2344	79 MPa	11.4 ksi	91 MPa	13.2 ksi

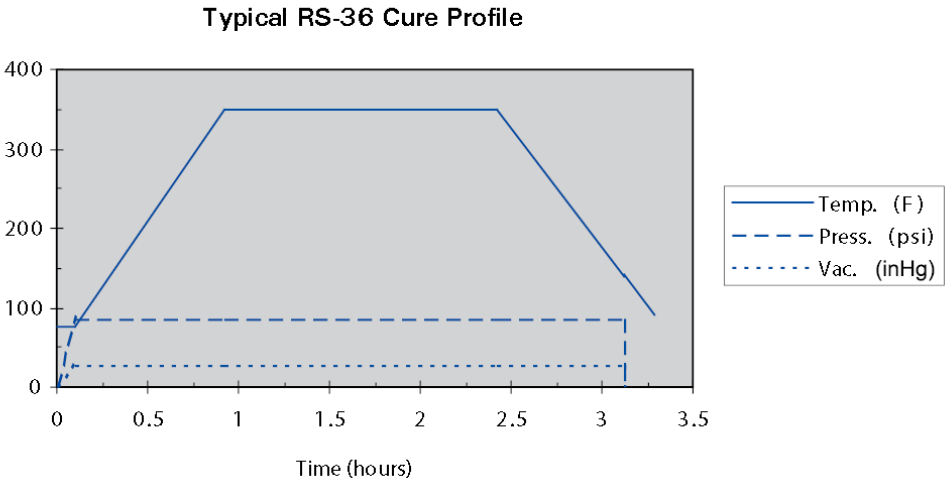
Data normalized to 60% fiber volume except for ILSS
Nominal CPT 0.2032 mm (0.008") inches for RS-36 & 0.127 mm (0.005") for RS-36-1 (Spread 3K)

PROCESSING RS-36 CURE CYCLES

Recommended processing for RS-36 is described below. Special moisture control procedures and bleed bagging materials required for cyanate ester resin systems are not necessary for RS-36.

CURE PARAMETERS

- Apply vacuum and leak check. For autoclave or press cycles apply pressure of 45–85 psi
- Heat to 177°C (350°F) (5°C/+10°F) at 2°C (5°F) per minute ± 3°F/1.5°C per minute
- Hold at 177°C (350°F) for 90 minutes (+15 min/-0 min)
- For autoclave cures at 40–85 psig, vent to atmosphere at 20 psig or maintain dynamic vacuum, depending on structural application
- Cool at 5°F/min to below 60°C (140°F). Release vacuum and autoclave pressure



CURE SCHEDULE

- **90 minutes at 177°C (350°F), 2-3°C (3–5°F) per minute ramp rate. Cool at 2°C (5°F) minute until below 60°C (140°F)**
- **Autoclave or vacuum bag processable**

*See alternate cure schedule below

*ALTERNATE CURE SCHEDULE FOR HIGHER T_g

Apply full vacuum and do not vent (optional) throughout the cure

- **Autoclave ramp rate target ~2°C (3°F) per minute throughout cure (0.5-3°C (1–5°F)/min OK)**
- **Ramp autoclave from ambient to 110 ± 5.6°C (230 ± 10°F)**
- **Hold at 110 ± 5.6°C (230 ± 10°F) for 30–35 minutes**
- **Ramp to 140 ± 5.6°C (285 ± 10°F)**
- **Hold at 140 ± 5.6°C (285 ± 10°F) for 60–65 minutes**
- **Ramp to 185 ± 2.8°C (365 ± 5°F)**
- **Hold at 185 ± 2.8°C (365 ± 5°F) for 120–130 minutes**
- **Cool at 0.5-3°C (1–5°F)/min to < 60°C (< 140°F) release pressure and remove**

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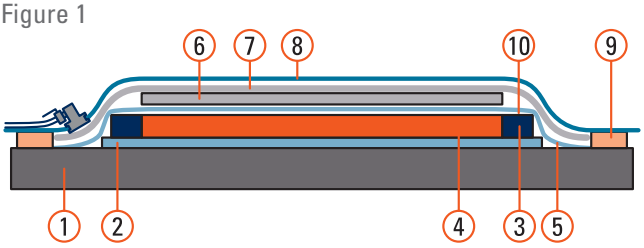
TYPICAL COMPOSITE LAMINATE STACKING SEQUENCE

List of Materials

1. Tool—aluminum, steel, Invar, composite (tool plates must be release coated or film covered). See the list below
2. Release coat or film—Frekote 700NC or 770NC, FEP, TEDLAR
   Lay-up part using standard debulking procedures
3. Silicone edge dams for cure—slightly thicker than laminate
4. Laminate
5. Release coat or film—Frekote 700NC or 770NC, FEP, TEDLAR
6. Caul plate—aluminum, steel, Invar, silicone rubber sheet (metal caul plates must be release coated or wrapped)
7. 2.2 oz/yd^2 polyester breather, 1 or more
8. Vacuum bag
9. Vacuum sealant
10. Glass yarn string (alternatively or additionally breather may wrap over top of dam to contact edge)

Follow the provided Toray Advanced Composites cure cycle for the particular resin system.

Figure 1



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