

> CYCOM[®] 2237 POLYIMIDE RESIN SYSTEM

TECHNICAL DATA SHEET



DESCRIPTION

CYCOM[®] 2237 is Cytec Engineered Materials' version of PMR-15. It is formulated for high temperature applications where low void content is critical. CYCOM 2237 has the best overall balance of processing behavior, thermo-oxidative stability and retention of properties in the 500 to 550°F (260 to 288°C) range. CYCOM 2237's thermo-oxidative stability and micro-crack resistance make it ideal for jet engine and other fatigue loaded components like bypass ducts, gear box covers, transmission housings, vent tubes, fan stator and vane assemblies, nozzle flaps, core cowls, particle separator swirl frames and compression molded bearings.

CYCOM 2237 prepreg can be autoclave cured, vacuum bag processed or compression molded.

CYCOM 2237 is solution impregnated on a variety of fibers and fabrics. It is currently available on glass, quartz and graphite reinforcement. Product forms are unidirectional tape, non-woven mat and woven fabrics. Generally available widths are 12 inches for UD tape, 24 inches for mat and 60 inches for woven fabrics.

FEATURES & BENEFITS

- High Tg, 640°F (338°C)*
- Service temperature to 550°F (288°C)
- Addition cure cross-linking mechanism
- Excellent handling characteristics
- Good product consistency
- Available in a range of forms including tape, fabric and neat resin
- Autoclave or press-mold processing
- Shelf life of 12 months at 0°F (-18°C)
- Mechanical life of 20 days at 80°F (27°C) and maximum 70% relative humidity

SUGGESTED APPLICATIONS

- Jet engine components
- Fatigue loaded components

* **NOTE:** Tg data is not applicable for U.S. export control classification or licensing. For export-related information please contact us.

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CHARACTERISTICS

Table 1 | Typical Neat Resin Properties

Tensile modulus at room temperature, ksi (MPa)	5.6 (38.6)
Tensile strength at room temperature, ksi (MPa)	0.57 (3.9)
Failure elongation, %	1.5
Fracture toughness at room temperature, G _{IC} (kJ/m ²)	0.28
Moisture saturation at 71°C (160°F), weight %	4.4
Tg by DMA, °F (°C) *	
Dry	640 (338)
Wet	509 (265)
Density, g/cc	1.31
TOS weight loss at 527°F (275°C), weight %	
800 hours	2.5
1400 hours	4.2

PROPERTIES

Table 2 | Typical Properties of CYCOM 2237 Composite: 4581 Astroquartz Fabric Reinforced

Material Property	Room Temperature Ambient	550°F (288°C) Dry
Dry Tg by TMA-Exp, °F (°C) *	628 (331)	–
Warp Tension, [0]_s¹		
Strength, ksi (MPa)	112 (772)	81 (558)
Modulus, msi (GPa)	4.5 (31.0)	4.3 (29.6)
Fill Tension, [0]_s¹		
Strength, ksi (MPa)	100 (689)	–
Modulus, msi (GPa)	4.3 (29.6)	–
Warp Compression, [0]_s¹		
Strength, ksi (MPa)	118 (813)	71 (489)
Modulus, msi (GPa)	4.9 (33.8)	4.6 (31.7)
Fill Compression, [0]_s¹		
Strength, ksi (MPa)	103 (710)	67 (462)
Modulus, msi (GPa)	4.7 (32.4)	4.4 (30.3)
In-plane Shear, [(+45/-45)]_{2s}		
Strength, ksi (MPa)	19.3 (133)	9.7 (66.8)

¹ Normalized to 60% fiber volume

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Table 3 | Typical Properties of CYCOM 2237 Composite Laminates: T650-35 Carbon Fiber 8-Harness Satin Fabric Reinforced

Material Property	Room Temperature Ambient	550°F (288°C) Dry
Dry Tg by TMA-Exp, °F (°C)*	627 (330)	–
Warp Tension, [0]₈¹		
Strength, ksi (MPa)	138 (951)	121 (834)
Modulus, msi (GPa)	10.4 (71.7)	11.1 (76.5)
Fill Tension, [0]₈¹		
Strength, ksi (MPa)	145 (999)	119 (820)
Modulus, msi (GPa)	10.6 (73.1)	12.0 (82.7)
Warp Compression, [0]₈¹		
Strength, ksi (MPa)	116 (799)	88 (606)
Modulus, msi (GPa)	9.3 (64.1)	9.7 (66.8)
Fill Compression, [0]₈¹		
Strength, ksi (MPa)	104 (717)	66 (455)
Modulus, msi (GPa)	9.3 (64.1)	9.3 (64.1)
In-plane Shear, [(+45/-45)]_{2s}		
Strength, ksi (MPa)	–	8.8 (60.7)
In-plane Shear, Iosipescu		
Strength, ksi (MPa)	11.6 (79.9)	5.9 (40.6)
Modulus, msi (GPa)	0.68 (4.6)	0.43 (2.9)
Apparent Interlaminar Shear, Short Beam		
Strength, ksi (MPa)	8.4 (57.9)	7.0 (48.2)
Compression Interlaminar Shear		
Strength, ksi (MPa)	7.5 (51.7)	5.7 (39.3)

¹ Normalized to 60% fiber volume

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Table 4 | Typical Properties of CYCOM 2237 Composite Laminates: G30-500 12K Unidirectional Tape Reinforced

Material Property	Room Temperature Ambient	600°F (316°C) Dry
Apparent Interlaminar Shear, Short Beam		
Strength, ksi (MPa)	18.4 (127)	10.0 (69)
Flexure, 3 point		
Strength, ksi (MPa)	267 (1841)	172 (1186)

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Table 5 | Typical Properties of CYCOM 2237 Composite Laminates: 6781 Fiberglass Fabric Reinforced

Material Property	Room Temperature Ambient	600°F (316°C) Dry
Compression Strength, ksi (MPa)	–	49 (338)
Apparent Interlaminar Shear, Short Beam Strength, ksi (MPa)	10.6 (73)	6.4 (44)
Flexure, 3 point Strength, ksi (MPa)	127 (876)	80 (552)
Modulus, msi (GPa)	4.1 (28.3)	3.8 (26.2)

AUTOCLAVE LAMINATE PROCESSING

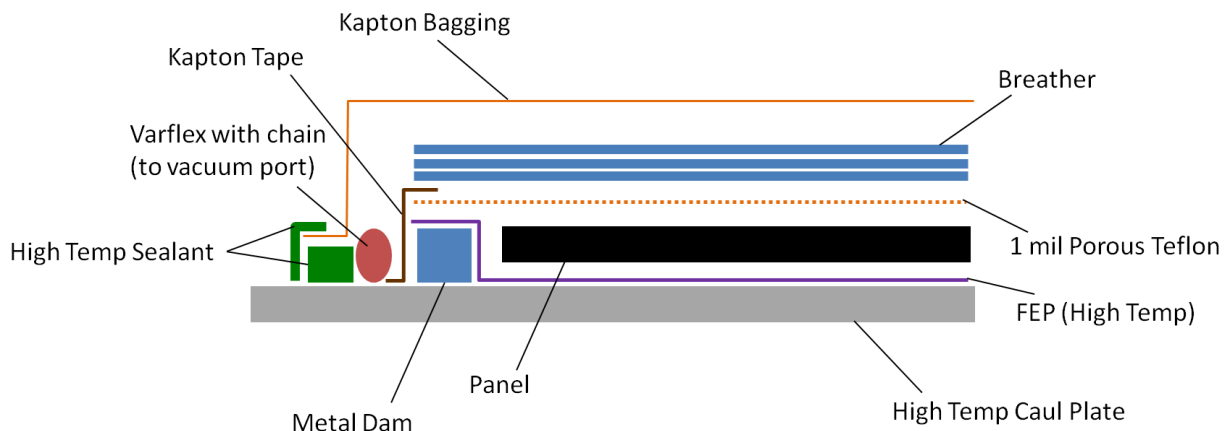
Autoclave Capability

An autoclave capable of achieving 600°F (316°C), 200 psi (1.37 MPa) and vacuum of 28 in Hg (709 mm Hg) at the bag with multiple vacuum ports is required. Chilled vacuum-line traps may be needed for off-gas condensate collection.

Bagging Schemes

Required tool and bagging equipment includes the following. Refer to Figure 1 and Figure 2 for placement:

- High temperature caul plate (with integrated vacuum ports)
- High temperature FEP
- Teflon[®] coated glass fabric
- 1581 or 7781 glass fabric (bleeder and breather)
- Steel pressure plate (optional)
- Kapton[®] vacuum bagging film
- Kapton[®] adhesive tape
- Varflex[®] insulation sleeving with metal chain
- High temperature metal dams
- High temperature sealant



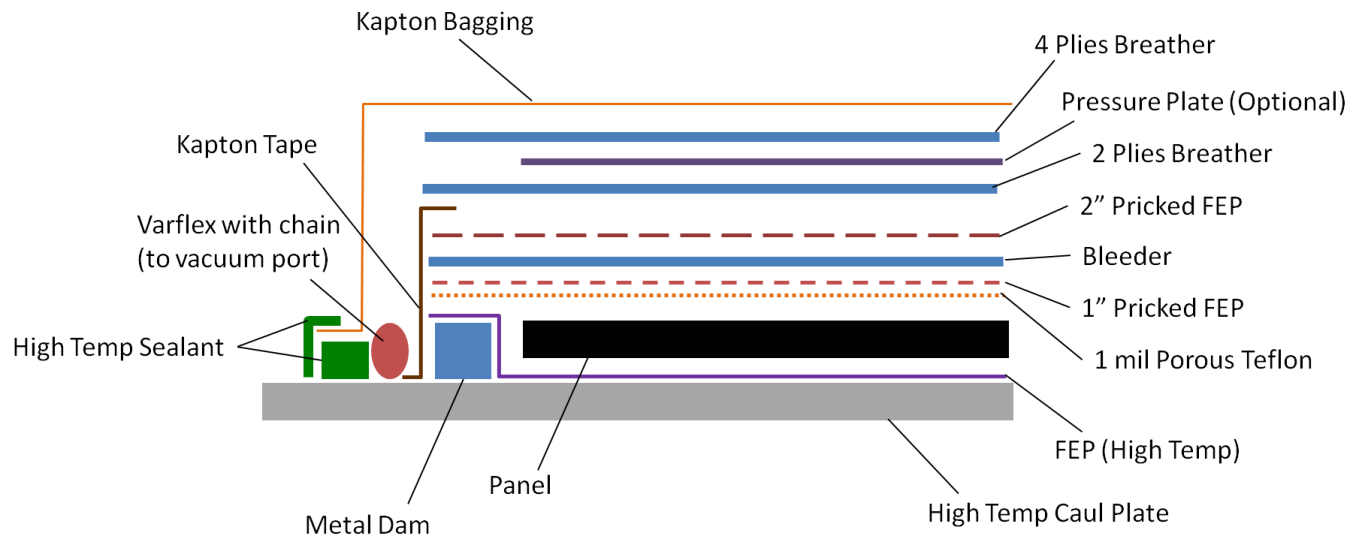
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Figure 1 | Bagging Scheme for CYCOM 2237

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Laminate Cure Cycle

1. Apply 2 – 6 Hg vacuum
2. Raise temperature to $425 \pm 10^{\circ}\text{F}$ ($218 \pm 6^{\circ}\text{C}$) at a rate of $0.5 - 3^{\circ}\text{F}$ ($0.3 - 1.7^{\circ}\text{C}$) per minute
3. At $300 \pm 10^{\circ}\text{F}$ ($149 \pm 6^{\circ}\text{C}$) apply full vacuum
4. Hold for 180 – 210 minutes at $425 \pm 10^{\circ}\text{F}$ ($218 \pm 6^{\circ}\text{C}$) [temperature based on lagging thermocouple]
5. Raise temperature to $475 \pm 10^{\circ}\text{F}$ ($246 \pm 6^{\circ}\text{C}$) at a rate of $0.5 - 3^{\circ}\text{F}$ ($0.3 - 1.7^{\circ}\text{C}$) per minute
6. At $450 - 475^{\circ}\text{F}$ ($232 - 246^{\circ}\text{C}$) apply 200 ± 10 psi (1.38 ± 0.07 MPa) pressure at a rate of $15 - 20$ psi ($0.10 - 0.14$ MPa) per minute
7. Hold at $475 \pm 10^{\circ}\text{F}$ ($246 \pm 6^{\circ}\text{C}$) for 30 – 55 minutes
8. After hold period raise temperature to $600 \pm 10^{\circ}\text{F}$ ($316 \pm 6^{\circ}\text{C}$) at a rate of $0.5 - 3^{\circ}\text{F}$ ($0.3 - 1.7^{\circ}\text{C}$) per minute
9. Hold for 180 – 210 minutes at $600 \pm 10^{\circ}\text{F}$ ($316 \pm 6^{\circ}\text{C}$) [temperature based on lagging thermocouple]
10. Cool slowly under pressure
11. When temperature is below 400°F (204°C), release pressure and vent vacuum
12. Cool to 160°F (71°C) prior to removing from autoclave

Post-Cure (Free Standing)

1. Place laminate in oven at room temperature
2. Heat oven to $550 \pm 10^{\circ}\text{F}$ ($288 \pm 6^{\circ}\text{C}$) at $10 - 15^{\circ}\text{F}$ ($5.6 - 8.3^{\circ}\text{C}$) per minute
3. Hold at $550 \pm 10^{\circ}\text{F}$ ($288 \pm 6^{\circ}\text{C}$) for 5 hours
4. Raise temperature to $600 \pm 10^{\circ}\text{F}$ ($316 \pm 6^{\circ}\text{C}$) at a rate of $0.5 - 1.0^{\circ}\text{F}$ ($0.3 - 0.6^{\circ}\text{C}$) per minute
5. Hold at $600 \pm 10^{\circ}\text{F}$ ($316 \pm 6^{\circ}\text{C}$) for 10 hours
6. Cool to 160°F (71°C) prior to removing from oven

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PRODUCT HANDLING AND SAFETY

Cytec Engineered Materials recommends wearing clean, impervious gloves when working with epoxy resin systems to reduce skin contact and to avoid contamination of the product.

Materials Safety Data Sheets (MSDS) and product labels are available upon request and can be obtained from any Cytec Engineered Materials Office.

DISPOSAL OF SCRAP MATERIAL

Disposal of scrap material should be in accordance with local, state, and federal regulations.

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