Toray MS-4H

Toray Advanced Composites

PRODUCT DATA SHEET

DESCRIPTION

Toray MS-4H is a 25.4 mm (1") carbon fiber/epoxy resin compression molding system using high strength standard-modulus (HS) carbon fiber. MS-4H is an excellent low-cost, high performance molding compound that has been qualified to military and commercial applications. It has excellent out time stability and processes very well in medium-to-large heavy parts.

PRODUCT TYPE

138°C (280°F) Fast Cure Standard-Modulus Compression Molding System

SHELF LIFE

Out Life:	14 days at 25°C (77°F)
Frozen Storage Life:	6 months at -18°C (< 0°F)

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

TYPICAL NEAT RESIN PROPERTIES

Fiber Length	25.4 mm (1")
Density	1.48–1.52 g/cc
Thermal Expansion X,Y	5.4–9.0 ppm/°C (3–5 ppm/°F)
T_g (by DSC)	191°C (375°F) post cured at 177°C (350°F)

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MECHANICAL PROPERTIES

Property	Condition	Method	Typical Results	
Tensile Strength 0°	RTD	ASTM D 3039	302.0 MPa	43.8 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	42.7 GPa	6.2 Msi
Compressive Strength 0°	RTD	ASTM D 6484	330.3 MPa	47.9 ksi
Compressive Modulus 0°	RTD	ASTM D 6484	50.3 GPa	7.3 Msi
Flexural Strength 0°	RTD	ASTM D 6272	750.2 MPa	108.8 ksi
Flexural Modulus 0°	RTD	ASTM D 6272	64.1 GPa	9.3 Msi
Open-Hole Comp. Strength	RTD	ASTM D 6484	265.4 MPa	38.5 ksi
Compression after Impact	RTD	ASTM D 7137*	146.2 MPa	21.2 ksi
Notched Shear Strength	RTD	ASTM D 7078	177.9 MPa	25.8 ksi
Notched Shear Modulus	RTD	ASTM D 7078	12.4 GPa	1.8 Msi
Bolt Bearing Str. (Single Shear)	RTD	ASTM D 5961	858.4 MPa	124.5 ksi

All items are net molded coupons unless noted
* Machine Molded, drop weight impact set forth via ASTM D7136-05
All properties based on a fiber volume of 48–50%
Above values derived after post cure of 177°C (350°F) for 1–2 hours
Actual molding technique and conditions, fiber length, and part geometry will affect properties obtained
Data shown for 25.4 mm (1") length material, properties will generally be lower for 12.7 mm (½") and/or 6.35 mm (¼")

A BMC part's tensile strength is influenced by fiber length, and whether the part is made as a flat laminate stock or fabricated in a net shaped bar 38.1 mm (1.5") wide. Bar stock as a general rule will give higher mechanical strength, sometimes almost twice the tensile strengths of laminate stock. This is due to the orientation of the BMC. The graph below shows the potential strength increases between 25.4 mm and 50.8 mm (1" and 2") BMC in a laminate stock configuration. The data table above is based on 38.1 mm (1.5") wide molded bar stock. Increases from shifting to a 50.2 mm (2") BMC in a bar stock shape would probably increase mechanical properties by 25–30%.

PROCESS PARAMETERS

- Preweigh the desired amount of molding compound
- Preheat molding compound in 71°C ± 8°C (160°F ± 10°F) oven for 10 minutes
- Form mold charge to approximately fit cavity. Charge cavity with molding compound
- Cure temperature: 138°C–154°C (280°F–310°F)
- Pinch pressure: 250 psi for 15–30 seconds
- Close mold to 2000 psi, hold for 15–30 minutes depending on the part thickness
- Post cure at 177°C/350°F for 1–2 hours for full properties

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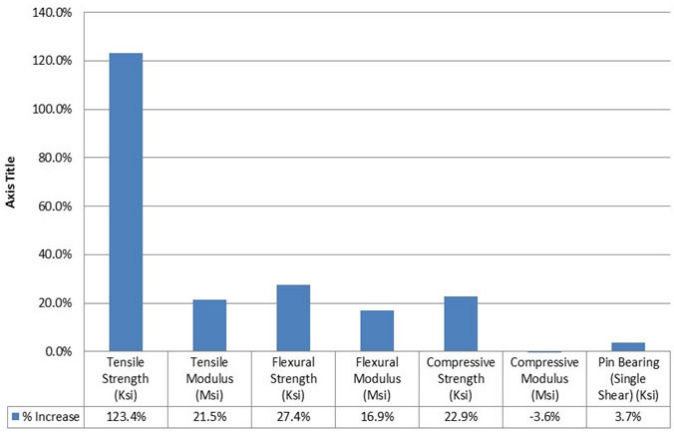

% Increase on Average
MS-4H, 25.4 mm (1") to MS-4H, 50.8 mm (2")

FST DATA ON TORAY MS-4H

Testing Type	Testing Methods	Criteria/ Requirement	Toray MS-4H				Remarks
			#of spec.	Min	Max	Avg	
Vertical Burn, 60 sec:	FAR 25.853 (a) Appendix F, Part I, (a), 1, (i): vertical burn 60 sec	Maximum Burn Time, 15 sec	3	0	0	0	PASS
		Maximum Burn Length, 152.4 mm (6")	3	0.2	0.2	0.2	PASS
		Maximum Longest Burning Particle, 3 sec	3	None	None	None	PASS
Horizontal Burn, 63.5 mm/min (2.5 in/min):	FAR 25.853 (a) Appendix F, Part I, (a), 1, (iv): horizontal burn	Maximum Burn Rate, 63.5 mm/min (2.5 in/min)	3	0	0	0	PASS
45 Degree Burn, 30 sec:	FAR 25.853 (a) Appendix F, Part I, (2), (ii): 45 degree burn, 63.5 mm/min (2.5 in/min)	Maximum Burn Time, 15 sec	3	0	0	0	PASS
		Maximum Glow Time, 10 sec	3	0	0	0	PASS
		No Penetration	3	None	None	None	PASS
Ohio State University Heat Release	FAR 25.853 (d) Appendix F, Part IV: OSU Heat Release, Amdt. 25–116	2 Min Total Heat Release, 65 KW-min/m^2	3	53	60	56	PASS
		Max Peak Heat Release Rate, 65 KW/min	3	194	205	199	FAIL
FAA Smoke Density	FAR 25.853 (d) Appendix F, Part V, FAA Smoke Density, flaming mode, Amdt. 25–116	Maximum Smoke Density, 200	3	46	112	82	PASS
NBS Smoke Density (Flaming)	ASTM E 662	Maximum Smoke Density, 200	3	46	112	82	PASS
NBS Smoke Density (Non-Flaming)	ASTM F 814	Maximum Smoke Density, 200	3	0	0	0	PASS

BMC MOLDING GUIDELINES

1. Preweigh the desired amount of molding compound
2. Preheat the molding compound at 71°C ± 5.5°C (160°F ± 10°F) for 10 minutes
3. Form a mold charge to approximately fit the mold cavity
4. Place the charge in the mold cavity
5. Cure: 138–154°C (280–310°F). Pinch pressure 250 psi for 15–30 seconds
6. Close mold to 2000 psi for 15–30 minutes depending on part thickness
7. Post cure at 177°C (350°F) for 1–2 hours

TROUBLESHOOTING

BLISTERING OR BUBBLES:

- Check mold surface temperature
- Increase molding pressure
- Check for moisture in the material

CRACKS OR STRESS MARKS:

- Check mold surface temperature
- Check cure time
- Clean mold surface and re-apply mold release
- Check ejection pressure, slow down ejection

FLOW MARKS:

- Close press sooner after charge has been placed in the cavity
- Increase press closure speed
- Check mold surface temperature

RESIN STARVATION:

- Check material out time and staging temperature, keep charge material covered, and in plastic bags
- Adjust charge weight
- Clean mold surface and re-apply mold release

VOIDS:

- Check charge set-up, shape, and weight
- Check mold surface temperature
- Check preheat time and temperature
- Check press closure time
- Clean mold surface and re-apply mold release

THICK PART—UNEVEN DISTRIBUTION OF MATERIAL

- Pre-consolidate thick sections
- Spread molding compound in measured increments
- Evaluate if press capacity is large enough for even pressure across part

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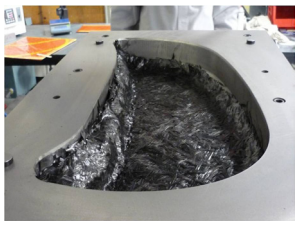


GENERAL NOTES

Note that 25.4 mm, 12.7 mm, 6.35 mm (1", ½", and ¼") material will be slightly different with the longer chop length showing as bulkier then the shorter chop lengths. Generally, the material does not brick up (unless exposed to heat or warmth) and is typically free flowing as received once broken free of the packaging. Some centering or clumping is not uncommon; however, when cool, the material should crumble out of the packaging. The bulk volume of the uncured uncompressed material is ~5X that of the compressed/cured part.

When preheated, a preformed charge will shrink maybe 10% if no pressure of any kind is applied other then gravity. It may debulk down 20–30% if pressure is applied, even hand pressure.

- The calculated cured density of the material is ~1.483 g/cc (~92.6 lb/ft^3)
- A 1.36 kg (3 lb) bag of 25.4 mm (1") material will measure out to a football shape when in a bag of ~304.8 mm x 254 mm x 127 mm, (~12" x 10" x 5")
- This loosely calculates to a 10 to 1 ratio; however, the bagged material is not rectangular in shape

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