

PRODUCT DATA SHEET



TENCATE ADVANCED COMPOSITES

MS-4H

PRODUCT TYPE

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

PROCESS PARAMETERS

- * Pre-weigh the desired amount of molding compound.
- * Pre-heat molding compound in 160°F ± 10°F (71°C ± 8°C) oven for 10 minutes.
- * Form mold charge to approximately fit cavity. Charge cavity with molding compound.
- * Cure temperature: 280°F-310°F (138°C-154°C).
- * Pinch pressure: 250 psi for 15-30 seconds.
- * Close mold to 2,000 psi, hold for 15-30 minutes depending on the part thickness.
- * Post cure at 350°F/177°C for 1-2 hours for full properties.

SHELF LIFE

Out Life

14 days out life at 77°F (25°C)

Frozen Storage Life

6 months storage life at <0°F (-18°C)

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

PRODUCT DESCRIPTION

MS-4H is a 1" carbon fiber/epoxy resin compression molding system. This is an excellent low cost, high performance carbon fiber 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.

MS-4H PHYSICAL PROPERTIES

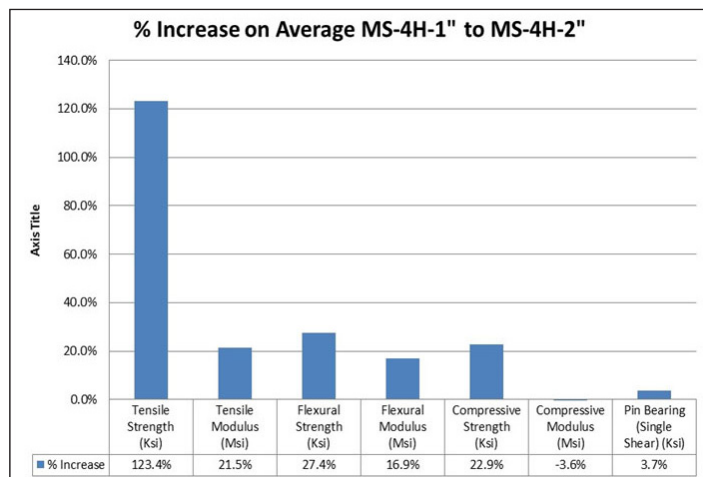
Fiber Length 1 in.
Density 1.48-1.52 g/cc
Thermal Expansion X,Y 3-5 ppm/°F (5.4-9.0 ppm/°C)
Tg (by DSC)..... 375°F (191°C) Post Cured at 350°F (177°C)

MS-4H MECHANICAL PROPERTIES

Properties	Condition (RTD, ETD, ETW)	Method	Results	
Tensile Strength 0°	RTD	ASTM D3039	43.8 ksi	302.0 MPa
Tensile Modulus 0°	RTD	ASTM D3039	6.2 Msi	42.7 GPa
Compressive Strength 0°	RTD	ASTM D6484	47.9 ksi	330.3 MPa
Compressive Modulus 0°	RTD	ASTM D6484	7.3 Msi	50.3 GPa
Flexural Strength 0°	RTD	ASTM D6272	108.8 ksi	750.2 MPa
Flexural Modulus 0°	RTD	ASTM D6272	9.3 Msi	64.1 GPa
Open Hole Comp. Strength	RTD	ASTM D6484	38.5 ksi	265.4 MPa
Compression After Impact	RTD	ASTM D7137**	21.2 ksi	146.2 MPa
Notched Shear Strength	RTD	ASTM D7078	25.8 ksi	177.9 MPa
Notched Shear Modulus	RTD	ASTM D7078	1.8 Msi	12.4 GPa
Bolt Bearing Str. (Single Shear)	RTD	ASTM D5961	124.5 ksi	858.4 MPa

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

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 (1.5 inches 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 1 and 2 inch BMC in a laminate stock configuration. The data table above is based up 1.5 inch wide molded bar stock. Increases from shifting to a 2 inch BMC in a bar stock shape would probably increase mechanical properties by 25-30%.



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FST DATA ON TENCATE MS-4H

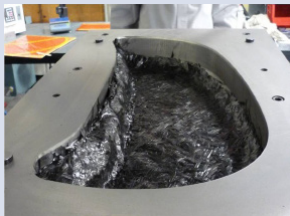
Testing Type	Testing Methods	Criteria/ Requirement	TenCate MS-4H				Remarks
			# of spec.	Min	Max	Ave	
Vertical Burn, 60 sec:	FAR 25.853 (a) Appendix F, Part I, (a), 1, (i): vertical burn 60 sec	Maximum Burn Time, 15 sec	3	0	0	0	PASS
		Maximum Burn Length, 6 in	3	0.2	0.2	0.2	PASS
		Maximum Longest Burning Particle, 3 sec	3	None	None	None	PASS
Horizontal Burn, 2.5 in/min:	FAR 25.853 (a) Appendix F, Part I, (a), 1, (iv): horizontal burn	Maximum Burn Rate, 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, 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 ⁽¹⁾	3	46	112	82	PASS
NBS Smoke Density (Flaming)	ASTM E 662	Maximum Smoke Density, 200 ⁽¹⁾	3	46	112	82	PASS
NBS Smoke Density (Non-Flaming)	ASTM F 814	Maximum Smoke Density, 200 ⁽¹⁾	3	0	0	0	PASS

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All data given is based on representative samples of the materials in question. Since the method and circumstances under which these materials are processed and tested are key to their performance, and TenCate Advanced Composites has no assurance of how its customers will use the material, the corporation cannot guarantee these properties.

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Page 3 of 3

MS-4H_DS_102116

BMC MOLDING GUIDELINES:

1. Pre-weigh the desired amount of molding compound
2. Pre-heat the molding compound at 160°F ± 10°F (71°C ± 5.5°C) for 10 minutes
3. Form a mold charge to approximately fit the mold cavity
4. Place the charge in the mold cavity
5. Cure: 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 350°F/ 177°C for 1-2 hours.

TROUBLE SHOOTING:

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 pre-heat 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

GENERAL NOTES:

Note that 1", ½", and ¼" material will be slightly different with the longer chop length showing as bulkier than 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 pre-heated, a pre-formed charge will shrink maybe 10% if no pressure of any kind is applied other than 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 or ~92.6 lb/ft³.
- A 3 lb bag of 1" material will measure out to a football shape when in a bag of ~12"x10"x5".
- This loosely calculates to a 10 to 1 ratio, however the bagged material is not rectangular in shape.

TENCATE ADVANCED COMPOSITES

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