



SMC PLASTIC Sheet Molded Compound

1. SCOPE

1.1 This specification covers CNH requirements for Sheet Molded Compound (SMC) plastic material used in parts produced for CNH. Two grades are described, see Table 1. Consult a Materials Engineer to assist with the selection of the appropriate SMC material for new parts or changes to parts. CNH MAT3030 is intended to replace the CNH Former Company Material Specifications listed in Table 2 and should be used on all applicable new and updated drawings.

1.2 The SMC material and process is one of the Fiberglass Reinforced Polyester (FRP) plastic materials group of CNH material specifications. Each of the FRP materials and processes offers different application advantages. Annex C provides a comparison of some key properties, process advantages, and application information to assist in selecting between the FRP materials. Also see individual FRP material specifications identified in Annex C for more information.

1.3 All related test methods are to be latest issue unless otherwise specified.

1.4 This specification may involve hazardous materials, apparatus, and procedures. It does not claim to address all of the safety, health, and environmental issues associated with its use, application, or removal. Specification users bear responsibility for consulting appropriate safety, health, and environmental practices, and determining the applicability of regulatory limitations prior to use.

Table 1 CNH Grade and Material Description		
All SMC grades have very good mechanical properties. They exhibit good impact resistance and strength over a wide temperature range.		
CNH Grade	Description	Application
SMC-GP	General Purpose (GP) SMC (25% glass filled); typically very good mechanical properties but surface finish or appearance can be an issue.	Bracket or structural members typically out of sight. Painting is not required if part has no UV exposure.
SMC-LP	Low Profile (LP) SMC (25% glass filled); exhibits similar mechanical properties to GP grade but with improved surface finish properties, reduced shrinkage, and less read through of ribs or bosses.	Exterior application full outdoor exposure; fender, sided panels, hoods and roofs, but require painting.

2. PRODUCT DEFINITION

2.1 SMC is a relatively low cost thermosetting material characterized by its mechanical properties, impact resistance (toughness) and the ability to be used over a wide temperature range. SMC is produced as a continuous sheet supplied in boxes folded back and forth on itself, called festooned, or in rolls. The continuous sheet is cut to application size just before molding.

2.2 SMC is composed of unsaturated polyester resin that is regularly combined with a thermosetting (cross-linking) component and typically 25-30% glass fiber 25mm in length. Additional components may include fillers and additives such as catalysts, release agents and pigments. Filler content is limited to approximately 30% maximum and is normally calcium carbonate. Glass fiber and filler content must be balanced requiring reduced levels of filler where glass fiber content is increased. Vinyl ester resins may be used in some SMC applications, but are typically a higher cost resin compared to the polyester resin.

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2.3 Special SMC materials are also available with up to 65% glass fiber, or longer fibers of 50mm, or unidirectional glass fibers in unique applications (e.g. truck bumpers). If these special SMC products are needed, consult Material Engineering for assistance in their application.

3. APPLICATION

3.1 Two SMC material Grades are described; one grade is general purpose and one is low profile. These grades are commonly available and are intended to promote standardization of SMC materials in CNH products. Minimum physical property requirements are provided in Table 3. Annex A identifies SMC trade name materials corresponding to the CNH grades that have successfully been used by CNH to produce parts. Annex A will be updated as additional information is available. Use of other SMC grades should be restricted to applications that have unique property requirements making the use of an alternate material necessary.

3.2 Interior (covered exterior) parts can be produced using either of the two grades of SMC, while the GP grade is preferred due to cost. CNH interior or covered exterior parts include brackets, cab flooring, pulleys, covers, and support structures or other structural members. Integrally colored parts produced for these applications will typically include an ultraviolet (UV) radiation stabilizer in the pigment concentrate to improve UV resistance, but this does not assure acceptable weathering resistance of the SMC materials. Integrally colored interior part samples or representative materials must meet MAT3004 Class 1 weathering requirements before receiving approval by controlling CNH Engineering for supplier part production. See also Section 5.2.2.

3.2.1 Textured surface finish should be specified for integrally colored SMC parts to help avoid fiber out-cropping (exposed ends of glass fibers) on the outside surfaces. A textured surface finish on the part may be achieved by photoengraving the molding tool or by blasting it with coarse sand.

3.3 Exterior parts can be produced with either of the two SMC grades. CNH exterior parts using the LP grade are primarily body panels (side covers, hoods, fenders, roofs). Painting of all SMC exterior parts is recommended to alleviate UV degradation of the materials and achieve MAT0105 Class 3 performance. Integrally colored SMC materials may be considered for exterior parts only where weatherometer testing verifies UV resistance and compliance of parts or representative materials with MAT3004 Class 3 performance requirements.

3.4 CAUTIONS

3.4.1 Wall thickness should be uniform throughout the part to promote consistent curing of the part.

3.4.2 Caution is necessary in designing thick or heavy ribs on parts particularly with specified Class A surface finish due to possible sink marks that can be created on the outer surface. Design review with the part molder is recommended to assure ribs are necessary and that they will not impact surface finish.

3.4.3 SMC material unless painted exhibits poor UV resistance and can deteriorate with prolonged exposure to sunlight resulting in loss of gloss, color change reduce impact strength and ductility. Dark pigmented SMC such as black, brown, and gray typically exhibit improved UV resistance.

3.5 MATERIAL RELATIVE COST FACTOR

Unfilled ABS bulk plastic resin with a cost factor of 1.0 is used as the baseline for plastic material cost comparison. Plastic resin costs are variable and these cost factors do not reflect other costs such as colorant, processing, etc. that impact the final part cost. Note that the cost of parts produced with thermosetting materials such as SMC is significantly influenced by the molding cycle time. The relative cost factors for the two SMC grades are given in Table 3 of this specification.

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3.6 INDUSTRY APPLICATIONS

Typical industry applications include tractor hoods, roofs, fenders, automotive hoods and bumpers, body panels, and electrical electronic housings in industrial applications.

3.7 TYPES OF PROCESSING

SMC products are produced by the compression molding process. SMC may be sawed or drilled, joined by adhesives developed for SMC applications, and mechanically fastened. Application of the process often requires development by suppliers to achieve desired performance. Typical processing parameters for SMC are; molding pressure 50-100 bar, molding temperature 140-160°C and curing time of 20-40 sec/mm.

4. RELATED SPECIFICATIONS

- ASTM, ISO, and Fiat Designated Test Methods
- Fiat Auto 55235/01 Thermosetting Polyester – SMC
- Iveco 15-5238 Thermo-Hardened Polyester SMC
- Case MS-515 Fiberglass Reinforced Polyester Materials Type II Grades B, C, and D
- CNH ENPJ100 (86619032) Significant Characteristics
- CNH MAT0101 (86628042) General Paint Requirements and Color Control
- CNH MAT0105 (87021657) Paint Materials on Plastic Parts, Performance Requirements
- CNH MAT0105Q (87021658) Approved Paint Materials on Plastic parts
- CNH MAT1003 (86979049) Metallic Material Designations on Engineering Drawing
- CNH MAT3004 (87523703) Integrally Colored Plastic Material & Finished Part, Performance Requirements
- CNH MAT3004Q (87523704) Approved Integrally Colored Plastic (ICP) Materials
- New Holland FNHA-4-A-007 (86529862) Surface Requirements
- New Holland FNHA-2-D-901 (86578524) Structural Sheet Molding Compound

Table 2 CNH Former Company Material Specifications				
CNH Grade	CASE	NH Pennsylvania FNHA Standard	NH-Zedelgem Engineering Stds	NH Tractor Engineering
SMC-GP	MS-515, SMC section Type II Grades B, C or D	FNHA-2-D-901.00 Structural Sheet Molding Compound	---	Fiat 55235/01 SMC R 25
SMC-LP	MS-515, SMC section Type II Grades B, C or D		---	Fiat 55235/01 SMC LP R25

5. REQUIREMENTS

5.1 SMC plastic parts shall meet all requirements of this specification and any special requirements that may be designated on the engineering drawing.

5.1.1 Unless otherwise specified on the engineering drawing, conformance with Table 3 property requirements when selecting resins or compounds for part applications may be established based on SMC technical data sheets or certifications. While physical testing to verify properties is not required, final molded parts must meet the minimum requirements in Table 3. Note that if tested the finished part property values will typically vary from those indicated on supplier technical data sheets or certifications.

5.1.2 Where required, surface finish requirements or quality for parts must be specified on the engineering drawing using established specifications such as FNHA-4-A-007.

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5.1.3 For new parts or for changes to parts, including material or supplier, and with special (complex) design features, volume, structural requirements, or other variables, consult a Materials Engineer to assist with selection of the appropriate SMC material and to determine any physical tests that may be required.

5.2 COLOR / FINISH PERFORMANCE

5.2.1 Color / General Requirements

The color of paint materials applied to plastic parts or integrally colored parts shall comply with applicable requirements of the CNH MAT0101 (86628042) General Paint Requirements and Color Control specification unless otherwise specified in this document or on the engineering drawing.

5.2.2 Integrally Colored Plastic (ICP) Parts

5.2.2.1 Weathering – ICP Parts

Integral coloring of plastic parts offers the advantages of reduced processing and cost. However, the fade resistance of integrally colored plastic parts is generally inferior to that of painted parts. Integrally colored plastic parts shall meet CNH MAT3004 specified performance class requirements including accelerated weathering and Florida exposure requirements unless otherwise specified on the drawing, see also Sections 3.2 and 3.3. Approved materials for use on CNH plastic parts are shown in CNH MAT3004Q Approved Integrally Colored Plastic (ICP) Materials.

5.2.2.2 Gloss – ICP Parts

ICP part gloss requirements shall be specified per CNH MAT3004.

5.2.3 Paint Material Performance

Paint materials applied to plastic parts supplied to this specification shall comply with performance requirements of the CNH MAT0105 Paint Materials on Plastic Parts, Performance Requirements specification. Approved paint materials for use on CNH plastic parts are shown in CNH MAT0105Q Approved Paint Materials on Plastic parts.

5.3 CHEMICAL RESISTANCE

All SMC grades exhibit good chemical resistance to hydrocarbons, alcohol, water, oils and salts. If specific chemical resistance is required, confirmation tests may be run according to ASTM D543 Practices for Evaluating Resistance of Plastics to Chemical Reagents.

5.4 DIMENSIONS AND TOLERANCES

SMC materials exhibit excellent dimensional stability compared with most other types of plastic materials. SMC parts shall conform to the permissible variations in dimensions as specified on the engineering drawing. Consult with the supplier to establish proper tolerances for individual applications based on the selected production technology and material.

5.5 IDENTIFICATION / RECYCLING CODES

5.5.1 Part Identification: The part number and date code of manufacture shall be included on a part as specified on the drawing. Their location on the part shall be identified on the engineering drawing for CNH designed parts.

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5.5.2 Recycle codes based on ISO/DIS 11469 and VDA 260 Standards, ISO 1043, or SAE J1344 (Method 2) shall be included by the supplier on the CNH part as necessary. The recycle code location on the part shall be identified on the Engineering drawing.

5.6 REGRIND

Suppliers in certain applications recycle limited amounts of processed plastic material, commonly called regrind, with virgin resin and compounds to produce parts. For all SMC parts the use of regrind to replace virgin resin or glass content is not permitted. Regrind may only be used to replace inert fillers such as calcium carbonate, which are limited to 30%. Use of regrind is limited to 50% of the original inert filler content or a maximum of 15%. Use of regrind is allowed with the conditions that there is no change in appearance, final property values, and that any special requirements on the drawing are met. Regrind shall be contaminant free, including black or discolored particles, floor sweeps, or other foreign materials.

5.7 STORAGE AND SHELF LIFE

Storage conditions can impact SMC material properties and the effective time period or shelf life that the SMC material remains useful for molding. SMC material must be held in storage after production before use in molding parts; this delay before molding shall be based on SMC supplier instructions. SMC materials shall be stored in a clean, dry location out of direct sunlight with controlled temperatures of 15 – 25°C (60 - 77°F). Relative humidity should be kept between 30 and 60%. SMC sheet material shall be supplied with barrier film (e.g. polyethylene) on both sides to limit styrene monomer loss and moisture absorption due to humidity. SMC should be molded without any delay after the barrier film is removed. The expected shelf life for SMC sheet materials after being produced is approximately 3 months but must be specified by the SMC supplier.

6. SPECIAL REQUIREMENTS

Optional grades, conditions, or properties such as varied percentages of mineral / glass fillers, increased scratch resistance or greater strength or stiffness may be applied as special requirements (SPCL). Gloss level may be designated as a special requirement where it is not otherwise specified or is required to be different than gloss level requirements specified in CNH MAT3004 or MAT0101 specifications. Special requirements shall be indicated on the engineering drawing and apply to the CNH grade or an optional grade specified.

7. METHODS OF TEST

Suppliers are not required to perform the specific test procedures listed but must ascertain that their products will conform to the specification limits when tested by the specified methods. The specified methods will be used to reconcile disputed results.

7.1 TEST SAMPLES

When physical testing of properties is conducted, test samples should be obtained whenever possible from actual parts to verify conformance to specified requirements. Where actual part samples are not available, molded shapes, sample panels, or comparable parts manufactured with the material and processes to be used in production may be used for testing of property verification. Representative test samples used to verify part conformance to this specification shall be retained for a least one year.

8. INSPECTION AND REJECTION

All SMC plastic material supplied to this specification shall be equivalent in every respect to sample parts approved by the procuring CNH location. Prior to making any changes to a SMC material used for an

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application under this specification, whether or not the change affects the SMC material or part meeting specified requirements, the supplier shall notify the procuring CNH facility of the proposed changes. Test data, test samples, a new supplier code, or other information may be required for the proposed material change. While the procuring location may test samples from incoming shipments for quality assurance, the supplier is responsible for ensuring that shipments meet the stated requirements without depending upon the purchaser's inspection.

9. DRAWING SPECIFICATIONS

9.1 Specifying a restricted (RSTR) or special (SPCL) SMC plastic material may require the use of a significant characteristic per CNH Engineering Procedure ENPJ100 (86619032). This determination will be made as part of the design review process. For additional information regarding specifying RSTR or SPCL materials see MAT1003 Metallic Material Designations on Engineering Drawings.

9.2 The material designation on Design Engineering drawings must include the generic name of the material (SMC Plastic), the CNH Material Specification number, and material grade in the CNH Material block. If a special requirement is needed, SPCL shall be added after the CNH Material Specification. Special requirements shall be specified in a material note on the drawing. The following are examples of SMC plastic material drawing designations.

9.2.1 Standard SMC Grades

CNH Material SMC PLASTIC, CNH MAT3030, SMC-LP
Local Material NOT APPLICABLE

9.2.2 Restricted Material (RSTR): Example designates a specific supplier material

CNH Material SMC PLASTIC, CNH MAT3030, SMC-LP, RSTR
Local Material SEE NOTES

Material (Note on drawing):
SMC PLASTIC, CNH MAT3030, SMC-LP, RSTR
SMC MATERIAL SHALL BE POLYNT SMC S 8010 BLACK
NO ALTERNATE MATERIAL PERMITTED

9.2.3 Special Requirements (SPCL):

For applications requiring glass fill add SPCL to the material designation. Specify special requirements for glass fiber percentage and other key properties in a material note on the drawing.

CNH Material SMC PLASTIC, CNH MAT3030, SMC-GP, SPCL
Local Material SEE NOTES

Material (Note on drawing):
SMC PLASTIC, CNH MAT3030, SMC-GP, SPCL
Special Requirements (SPCL) are:
GLASS FIBER FILLED, 65% MINIMUM
TENSILE STRENGTH 300 N/MM², MINIMUM
FLEXURAL MODULUS 19000 N/MM², MINIMUM
FLEXURAL STRENGTH 490 N/MM², MINIMUM
OTHER PROPERTIES PER SUPPLIER SPECIFICATION DATA

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Table 3		SMC Plastic Grades – Material Properties		
CNH Grade		SMC-GP	SMC-LP	
Property		Material Property - Requirements (Minimum values unless a range is specified)		Test Method
Density, g/cm ³		1.70-1.80	1.75 – 1.95	ASTM D792, or ISO 1183 Method A
Heat Deflection Temperature °C (°F)		220 (428)	220 (428)	ASTM D648 °F @ 264psi or ISO 75
Ultimate Elongation, (at break) %		1.5	1.5	ASTM D638 or ISO 527
Tensile Modulus N/mm ² (ksi)		9500 (1380)	9000 (1310)	ASTM D638-94b ISO 527
Tensile Strength, Ultimate N/mm ² (psi)		60 (8700)	60 (8700)	ASTM D638 or ISO 527 sample 1 velocity C
Flexural Modulus, N/mm ² (ksi)	at -30°C	10670 (1550)	10450 (1520)	ASTM D790 or ISO 14125 or Fiat Std 50555
	at 23°C	9700 (1410)	9500 (1380)	
	at 80°C	6500 (943)	6500 (943)	
	at 140°C	5500 (798)	5500 (798)	
Flexural Strength, Ultimate N/mm ² (psi)	at -30°C	158 (22900)	158 (22900)	ASTM D790 or ISO 14125 or Fiat Std 50555
	at 23°C	140 (20300)	140 (20300)	
	at 80°C	85 (12300)	85 (12300)	
	at 140°C	75 (10900)	75 (10900)	
Izod Impact Notched	J/cm (ftlb/in)	8.0 (15.0)	8.0 (15.0)	ASTM D256 or ISO 603-2 or Fiat 50559
	J/cm ² (ftlb/in ²)	ND	ND	ISO 180
Glass Content, %		25 ±3	25 ±3	ASTM D2584 or ISO 11667
Fiber Length, mm (inch)		25 (1.0)	25 (1.0)	
Flammability,	UL94 rating	HB	HB	Underwriters Laboratories, UL94
	mm/minute, max.	100	100	SAE J369 or ISO 3795
Material Physical and Design Properties				
Maximum Continuous Service Temperature °C (°F)		150 (302) ⁽¹⁾	150 (302) ⁽¹⁾	(1)
Coefficient Linear Thermal Expansion, μm/m°C (μin/in°F)		20 (11)	25 (14)	ASTM D696 or By TMA
Mold Shrinkage, Typical	cm/cm (in/in)	0.0004 (0.0004)	0.0003 (0.0003)	ASTM D955 or UNI 4285
	Percent, %	0.00 ± 0.05	0.00 ± 0.05	ISO 2577
Rockwell Hardness, R scale		80	80	ASTM D785, or ISO 2039-2,
Water Absorption % @ equilibrium		0.3	0.3	ASTM D570, or ISO 62
Relative Cost Factor ⁽²⁾		1.2	1.5	

ND indicates no property value data currently available.

(1) These values are for components not under stress and are provided for guidance only. The values may be strongly influenced by geometry, assembly conditions, etc. Values provided are obtained from Fiat Auto Standards or commercial technical data sheets.

(2) Unfilled ABS bulk plastic resin with a cost factor of 1.0 is used as the baseline for plastic material relative cost comparisons. Note that resin costs are variable and these cost factor values do not include other factors such as colorant, processing, etc. that impact the final part cost.

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ANNEX A SMC Materials Used in CNH Applications (Reference Information)

Manufacturers and the various trade name Sheet Molding Compound (SMC) raw materials they produce corresponding to CNH Grades are listed in the following table. These manufacturers' products only represent some of the materials that have been used successfully by CNH for SMC parts. Each of these materials is considered capable of being used to produce parts that will meet the requirements of this specification. However, since production processing and other factors can significantly affect final part properties, use of listed materials does not guarantee that required properties will be met in the final part. Grades other than those listed below may be available to produce parts specified per this document. The supplier is responsible to ensure overall quality and that parts meet all specified requirements.

CNH Grade	Manufacturer	Trade Name	Remarks /Applications
SMC-GP	Polynt	Supplier to identify SMC materials for specific applications	Brackets, APH fenders
	Jet Molding Compounds, Inc	S30 20-28	Tractor fenders
SMC-LP	The BUDD Co.	SMC BD 842R	Soybean based, tractor fenders
	The BUDD Co.	SMC DSM 951-R2	Standard grade, tractor fenders
	Menzolit	Flomat 47-2919	Tractor, lower hood panel
	Menzolit	SMC 0390 F5301/002/639	Tractor, lower hood panel
	Menzolit	SMC 0390 6442-01B	Rpt L0770; CNH/Supplier tested
	Polynt	SMC LPA 2020 R25 - gray	Tractor, lower hood panel
	Polynt	SMC LP 2533 R25 - Nero	Rpt N0149; CNH/Supplier tested; General purpose LP compound
	Polynt	SMC LPA 2017 R25 - neutral	Body panels
	Rene Composites	SCL 8013-83 / EXS4512	Tractor fenders

ANNEX B Alternate SMC Materials

Annex B, which typically lists alternate resins for the specified SMC Grades is intentionally not provided in this specification. It is considered necessary that SMC materials be selected and verified as acceptable for each application.

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ANNEX C FRP Material and Process Comparison (Reference Information)

Information in this table is provided only as reference information. It shows differences between the Fiberglass Reinforced Polyester (FRP) materials, processes, and applications. Consult a Materials Engineer to assist with the selection of FRP materials and processes.

Table C1 FRP Material and Process Comparison ⁽¹⁾					
	MAT3030 SMC (Sheet Molded Cmpd)	MAT3032 BMC (Bulk Molded Cmpd)	MAT3034 OMC (Open Mold Cmpd)	MAT3036 RTM / LRTM (Resin/Light Resin Transfer Molding)	MAT3038 ⁽²⁾ LFI (Long Fiber Injection)
CNH Grade	SMC-GP (GF25%)	BMC-GF20	OMC-GP30	RTM/LRTM-GP30	LFI-GF30
Tensile Strength	60 MPa	45 MPa	69 MPa	76 MPa	103 MPa
Flexural Modulus	9700 MPa	8000 MPa	5520 MPa	6900 MPa	8000 Mpa
HDT	220°C	220°C	200°C	200°C	116°C
MCS Temp	150°C	150°C	150°C	150°C	90°C
Izod Impact	8.0 J/cm	3.5 J/cm	6.4 J/cm	8.0 J/cm	5.77 J/cm
Volume as Parts per Year	High Volume 5K -80K most cost effective Up to 200K possible	High Volume 10K -80K most cost effective Up to 200K possible	Low Volume Generally <1K Possible up to 5K	RTM Med Volume 2K – 15K LRTM Low Volume <1K – 7K	High Volume
Tooling	High Cost Steel Tooling life >100K	High Cost Steel Tooling life >100K	Low Cost Composite Tooling Life 1K-3K	Low Cost Composite Tooling Life 1K-5K	Medium Cost Steel Tooling life >100K
Relative Cost Factor ⁽³⁾	1.2 – 1.5	1.2	1.2	1.4	1.2
Properties	Excellent; can vary with glass content (percent) and orientation	Good; random glass orientation can affect structural quality	Excellent; can vary with glass content (percent)	Good; can vary with glass content (percent)	Good; PU resin based, provides lower temperature resistance
Advantages	High volume	High volume		Finished surface base on closed tool	Various fiber length can achieve properties
	Short cycle time 1-10 minutes	Short cycle time 30-60 seconds	Very low tooling cost	Accommodate large parts	Short cycle time 1.3-3 minutes
	Accommodate large parts	Automated Process, low labor costs	Accommodate large parts	Excellent thickness control	Lower Pressures and tonnage than SMC
	Use of Ribs, Bosses, attachments common	Can be injection molded		LRTM less emissions than hand lay-up	High Strength thin wall parts
Disadvantages	High Tooling Cost	High Tooling Cost	Short tool life	Short tool life	Limited molding sources
	High Tonnage Press required	Random Glass orientation	Long cycle times Typically 4-6 hours	Longer cycle times RTM 10-20 min LRTM 45 to 120 min	Barrier coat needed to make parts with Class A surfaces
	Sheets must acclimate to plant environment before use	Smaller Parts	Labor Intensive Process	Labor Intensive Process	Vertical wall limited to 19 inches max
			Use of Ribs, Bosses, attachments difficult	Need to use low viscosity resin	Lower properties in PU than Polyesters
Application	Hoods, Fenders, Roofs	Electrical housings	Hoods, Fenders	Hoods, Fenders	Roofs
	Exterior Panels		Roofs	Roofs, Exterior Panels	
	Support Structures				

MCS = Maximum Continuous Service Temperature; HDT = Heat Deflection Temperature
Tensile Strength, Flexural Modulus, Izod Impact **values are for 23°C**

- (1) Comparison information for reference only.
- (2) Long Fiber Injection (LFI) is polyurethane (PU) resin based versus polyester resins used for the FRP processes noted.
- (3) Unfilled ABS bulk plastic resin with a cost factor of 1.0 is used as the baseline for plastic material relative cost comparisons. Note that plastic resin costs are variable; these cost factor values do not include cost factors such as colorant, processing, etc. that impact the final part cost.

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