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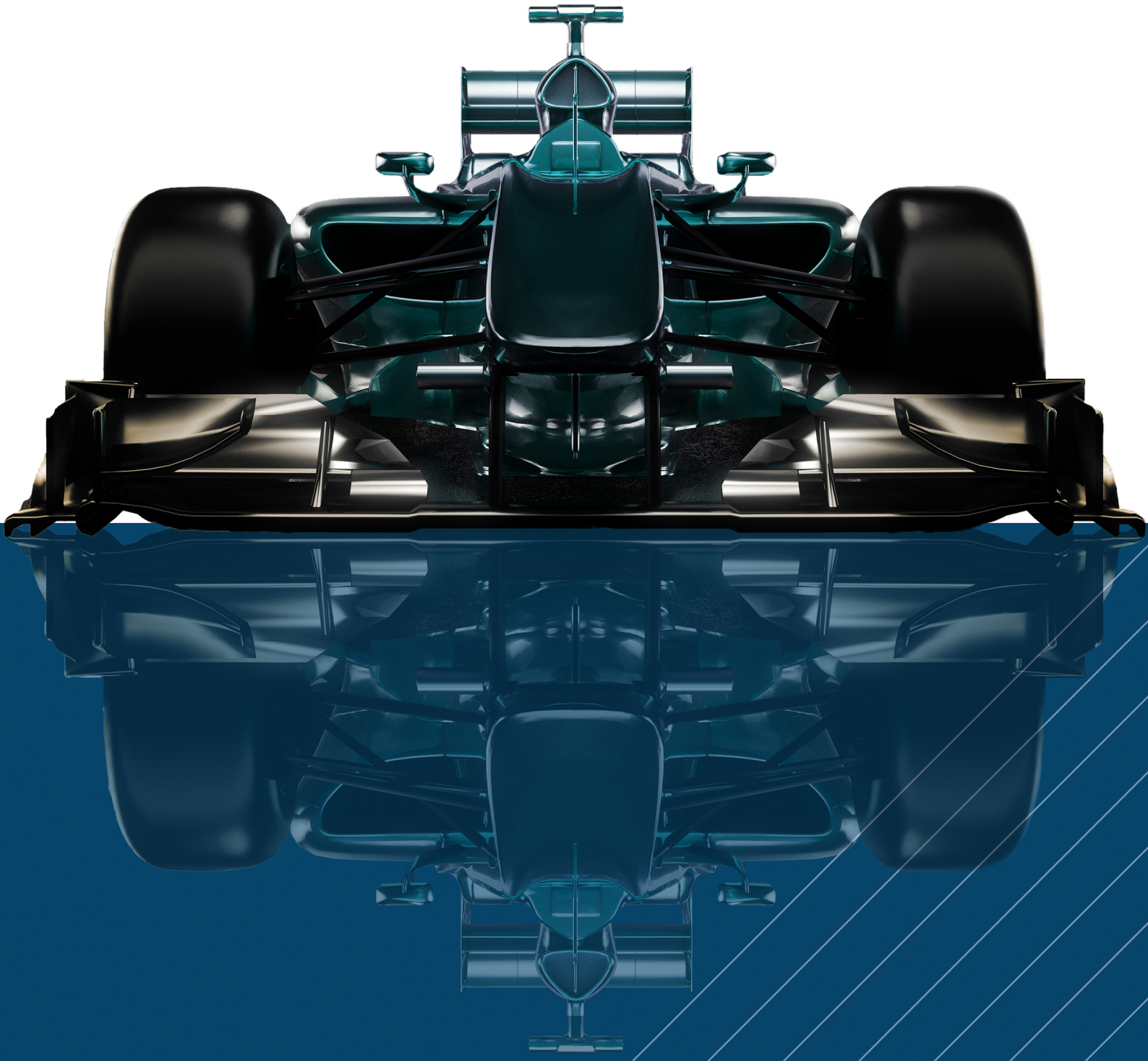
MATERIAL DATA SHEETS



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MATERIAL DATA SHEETS

Contents:

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MATERIAL DATA SHEET: NYLON 12

DESCRIPTION:

Nylon 12 parts have good long term stability, offering resistance to most chemicals. This material delivers the impact strength and durability required for functional testing. Tensile and flexural strength combine to make tough prototypes, with the flex associated with many production thermoplastics.

MATERIAL SPECIFICATION:

Colour	Dark Grey
Density of printed part	0.9 to 0.95g/cm³
Tensile modulus	1700 ± 150MPa
Tensile strength	45 ± 150MPa
Elongation at break	20 ± 5%
Flexural modulus	1240 ± 130MPa
Melting point	172 to 180˚C
Vicat softening temperature B/50	163˚C
Vicat softening temperature A/50	181˚C
Coefficient of thermal expansion	1.09 x 10^{-4}

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MATERIAL DATA SHEET: GLASS FILLED NYLON 12

DESCRIPTION:

This glass filled variant of Nylon 12 provides greater rigidity - perfect when prototyping parts requiring greater stiffness than standard Nylon 12. The filler in this material is glass bead, not fibre, resulting in increased stiffness but not strength.

MATERIAL SPECIFICATION:

Colour	White
Density of laser sintered part	1.23 to 1.28g/cm³
Tensile modulus	3200 ± 200MPa
Tensile strength	48 ± 3MPa
Elongation at break	6 ± 3%
Flexural modulus	2100 ± 150MPa
Melting point	172 to 180˚C
Vicat softening temperature B/50	166˚C
Vicat softening temperature A/50	179˚C
Coefficient of thermal expansion	1.68 x 10^{-4}/K

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MATERIAL DATA SHEET: FLAME RETARDANT NYLON 12

DESCRIPTION:

PA 2241 FR is a flame retardant polyamide 12 for processing in laser sintering systems. It contains a halogen based flame retardant. Mainly due to its recyclability, the material is economical, enabling low-cost part production. Typical applications: Aviation (behind panel applications eg. air ducts and air outlet valves).

MATERIAL SPECIFICATION:

Colour		White
3D data:		Dry / Con
Tensile modulus	X, Y, Z direction	1900 / 1600MPa
Tensile strength	horizontal direction (XY) vertical direction (Z)	49 / 44MPa 46 / 41MPa
Strain at tensile strength	horizontal direction (XY) vertical direction (Z)	7 / 11% 6 / 8%
Strain at break	horizontal direction (XY) vertical direction (Z)	15 / 22% 6 / 9%
Temp. of deflection under load	(1.80 MPa, X direction)	84˚C
Temp. of deflection under load	(0.45 Mpa, X direction)	154˚C
Thermal properties:	**Dry**	**Test Standard**
Melting temperature (20˚C/min	185˚C	ISO 11357-1/-3
Flammability test passed	1.0, 1.5, 2.0mm	CS 25 / JAR25 / FAR 25§ 25-853 12s ignition time
Smoke Density test passed	1.0, 1.5, 2.0mm	ABD 0031 (Issue: F) method: AITM 2.0007
Toxicity test passed	1.0, 1.5, 2.0mm	ABD 0031 (Issue: F) method: AITM 3.0005
Density (laser sintered)	1g/cm³	
Bulk density	0.45g/cm³	

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MATERIAL DATA SHEET: CARBON PEEK

DESCRIPTION:

Carbon PEEK is a carbon-fiber-reinforced PEEK. The reinforcement made with 10% chopped carbon fibers improves the compressive strength, stiffness, and load capacity of PEEK.

Carbon PEEK is considered among the strongest of all thermoplastics at room temperature because it offers superlative properties that, together with its optimal wear and abrasion resistance, make it ideal for the substitution of metals in more extreme environments.

It is very resistant to hydrolysis in boiling water and superheated steam, as well as to organics, acids, and bases.

MATERIAL SPECIFICATION:

Property	Operating Conditions	Units	Orientation				Test Method
			XZ	XY 0°	XY 45°	ZX	
Tensile Strength	25°C	MPa	139	136	125.8	28.2	ASTM D638
Tensile Modulus	25°C	GPa	10.7	9.1	8.1	4.0	ASTM D638
Heat Deflection Temperature	1.82 MPa	°C			249		ASTM D648

Property	Units	Value	Test method
Specific Density	g/cm³	1.33	ASTM D792
UL 94 Flame Class Rating*	N/A	V0	UL 94
Colour	N/A	Beige	N/A
Melting Temperature	°C	345°C	DSC

*Test Performed on a polymer matrix sample without re-inforcing face manufactured by injection moulding.

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MATERIAL DATA SHEET: CARBON PA

DESCRIPTION:

Roboze Carbon PA is a composite material. It's nylon 6 matrix is reinforced with 20% carbon fiber, that produces excellent mechanical properties and makes the material capable of replacing metal alloys such as aluminum.

These extraordinary properties are the result of in-depth R&D of the materials, from the selection of its polyamide matrix to the deep analysis of the length and nature of the chopped fiber.

MATERIAL SPECIFICATION:

Property	Operating Conditions	Units	Orientation				Test Method
			XZ	XY 0°	XY 45°	ZX	
Tensile Strength	25°C	MPa	138	136	n/a	n/a	ASTM D638
Tensile Modulus	25°C	GPa	14.7	15.5	n/a	n/a	ASTM D638

Property	Units	Value	Test method
Specific Density	g/cm³	1.4	ASTM D792
Colour	N/A	Black	N/A
Continuous use temperature	°C	150	ASTM D3045
Heat Deflection Temperature (at 1.82 MPa)	°C	180	ASTM D648

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MATERIAL DATA SHEET: PEEK

DESCRIPTION:

Polyetheretherketone (PEEK) is a semi-crystalline, high-performance engineering thermoplastic. It belongs to polyketone family of polymers (PEK, PEEK, PEEKK, PEKK, PEKEKK) and amongst them, it is the most widely used and manufactured in large scale.

PEEK offers a unique combination of mechanical properties such as resistance to chemicals, wear, fatigue and creep, as well as exceptionally high-temperature resistance. It also has good resistance to combustion and good electrical performance.

The high thermal stability is provided by the diphenylene ketone groups, which impart high strength and high resistance to oxidation. Flexibility in the polymer backbone is provided by ether linkages. Due to the semi-crystalline nature of this polymer, its low tendency to creep, and its good sliding and wear, properties are retained over a wide temperature range.

PEEK is known for its excellent chemical resistance to many organic and inorganic chemicals and for its exceptionally good resistance to hydrolysis in hot water. For this reason, the polymer is often subjected to autoclave processes.

MATERIAL SPECIFICATION:

Property	Operating Conditions	Units	Orientation				Test Method
			XZ	XY 0°	XY 45°	ZX	
Tensile Strength	25°C	MPa	95	89.9	87.4	53	ASTM D638
Tensile Modulus	25°C	GPa	3.5	3.5	3.4	3.3	ASTM D638
Heat Deflection Temperature	1.82 MPa	°C			161		ASTM D648
Property		**Units**	**Value**				**Test method**
Specific Density		g/cm³	1.31				ISO 1183-3
Colour		N/A	Beige				N/A

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MATERIAL DATA SHEET: Polypropylene

DESCRIPTION:

Polypropylene (PP) is one of the most commonly polymers used in the production of consumer goods and across a wide range of applications in other sectors, thanks to its excellent chemical resistance, lightness and impact resistance.

Another interesting property, if compared with other materials used in the FDM 3D printing sector, is it's semi-transparency. As such, it is regularly used in applications where a degree of visibility is required through the wall of the part.

MATERIAL SPECIFICATION:

Property	Operating Conditions	Units	Orientation				Test Method
			XZ	XY 0°	XY 45°	ZX	
Tensile Strength	25°C	MPa	20	17	n/a	n/a	ASTM D638
Tensile Modulus	25°C	GPa	1.62	1.5	n/a	n/a	ASTM D638

Property	Units	Value	Test method
Specific Density	g/cm³	0.9	ASTM D792
Colour	N/A	Transluscent (pigmentless)	N/A
Continuous use temperature	°C	100	ASTM D3045
Heat Deflection Temperature (at 0.45 MPa)	°C	62	ASTM D648

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MATERIAL DATA SHEET: ULTEM AM9085F

DESCRIPTION:

ULTEM™AM9085F filament by SABIC is a high temperature, amorphous polyetherimide thermoplastic blend. It consists of a polyetherimide (PEI) with a polycarbonate copolymer blend incorporated for improved flow.

It belongs to the category of high performance technopolymers, or superpolymers, as it has resistance to hydrolysis and acid solutions, advanced thermal performances (supporting repeated cycles in autoclaves) and strong mechanical characteristics. ULTEM™AM9085F also has good electrical properties, which remain stable over a wide range of temperatures and frequencies (including microwaves). This, along with its good UV-light resistance and weatherability, is why it is one of few polymers that can be used on the outside of a spacecraft.

It offers the ability to create parts with excellent properties at elevated temperatures due to a high glass transition temperature (177°C, 367°F) and provides high heat resistance (HDT is 175°C at 1.82 MPa, 347°F at 264 psi) and mechanical strength with low toxicity, smoke, and flame evolution (UL94-V0 at 1.5 mm and 3 mm, 0.059 in and 0.118 in). Overall, Sabic's ULTEM™AM9085F combines mechanical properties and process capability, giving engineers exceptional flexibility and process freedom.

MATERIAL SPECIFICATION:

Property	Operating Conditions	Units	Orientation				Test Method
			XZ	XY 0˚	XY 45˚	ZX	
Tensile Strength	25˚C	MPa	98	87	56	77	ASTM D638
Tensile Modulus	25˚C	GPa	2.9	2.6	2.5	2.6	ASTM D638
Heat Deflection Temperature	1.82 MPa	˚C	175	175	165		ASTM D648

Property	Units	Value	Test method
Specific Density	g/cm³	1.27	ASTM D792
Flammability Test FAA	mm	1.5mm	FAR 25.853
Colour	N/A	Beige	N/A
Glass transition temperature	˚C	177˚C	DSC

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MATERIAL DATA SHEET: TPU M95A

DESCRIPTION:

Our preferred material for components in applications requiring flexibility and elasticity, Lubrizol TPU M95A delivers excellent elongation, impact absorption and tensile strength. It also shows good energy rebound, high elasticity, low abrasion rate as well as performing well under compression.

Additionally, this material is certified for skin sensitization and cytotoxicity, making it highly desireable for medical applications and wearables such as prostheses, helmets, insoles etc.

MATERIAL SPECIFICATION:

Property	Operating Conditions	Units	Orientation				Test Method
			XZ	XY 0˚	XY 45˚	ZX	
Tensile Strength	25˚C	MPa	8	18	n/a	n/a	ISO-4649 / DIN-53516

Property	Units	Value	Test method
Specific Density	g/cm³	1.10 - 1.15	ASTM D-2240
Colour	N/A	Grey	N/A
Vicat softening temperature	˚C	161	ASTM D-1525 (10N)
Hardness (5 sec) (in X & Z)	Shore A	93 ± 3	ASTM D-2240
Flexural Modulus (in X)	MPa	85	ASTM D-790
Tear Strength (Die C) (in X)	KN/m	80-96	ASTM D-792
Tear Strength (Die C) (in Z)	KN/m	35-45	ASTM D-792
Ross Flex Test at 23˚C	n/a	No Crack	60˚ for 150,000 cycles
Ross Flex Test at -6˚C	n/a	No Crack	60˚ for 150,000 cycles