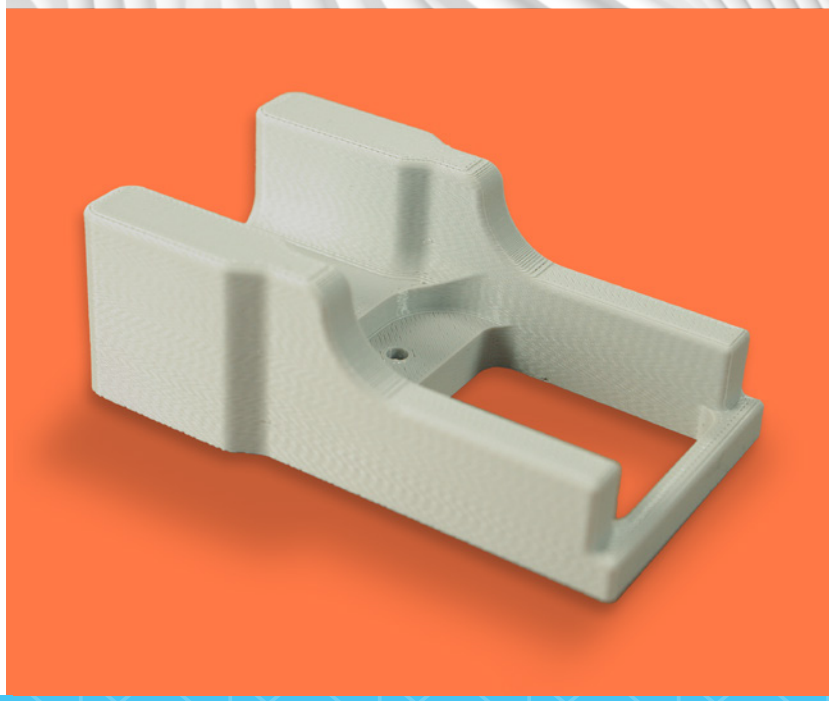
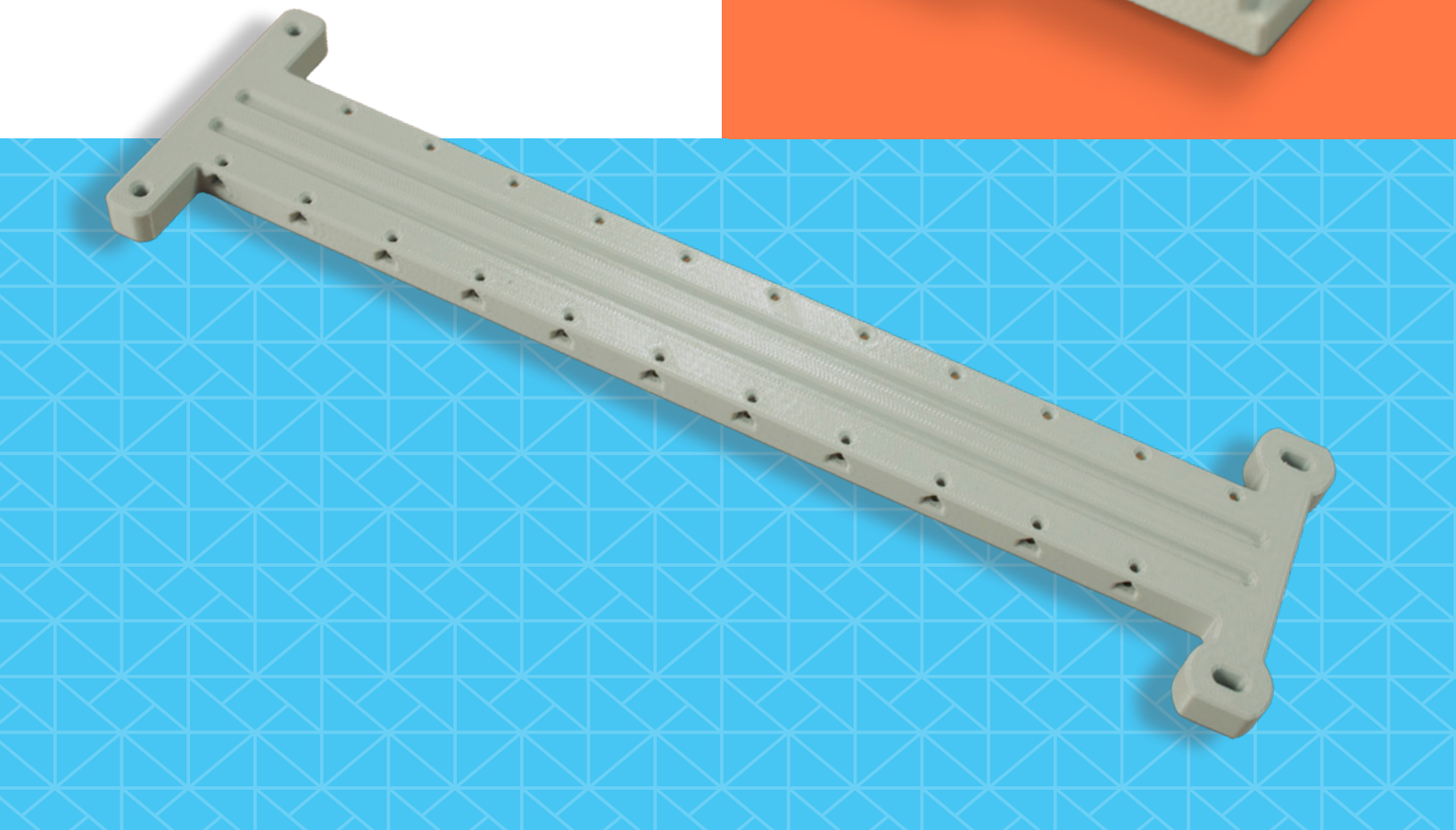
MATERIAL DATA SHEET
FDM

Kimya PC-FR

FDM Thermoplastic Filament

The information presented are typical values intended for reference and comparison purposes only. They should not be used for design specifications or quality control purposes.





Overview

Kimya PC-FR is a polycarbonate FDM® 3D printing filament with flame-retardant properties developed specifically for additive manufacturing. It retains the beneficial characteristics of standard polycarbonate such as dimensional stability, high glass transition temperature and high impact resistance, and also meets European railway fire safety standard EN 45545-2.

Contents:

System Requirements

Table 1: Printer and Support Material Compatibility

Printer	Model Tip	Slice Height	Support Material	Support Tip
Fortus 450mc™	T16	0.254 mm (0.010 in)	SR-100	T12SR100
F900®	T16	0.254 mm (0.010 in)	SR-100	T12SR100

Build Sheet

High Temperature

- 0.02 x 26 x 38 in. (0.51 x 660 x 965 mm)
- 0.02 x 16 x 18.5 in. (0.51 x 406 x 470 mm)

System Requirements

Fortus 450mc

- Hardened machine upgrade
- Hardened Fortus 450mc head
- All Materials License or equivalent (included if new system)

F900

- F900 – purchased F900 or upgrade from Gen 1 or Gen 2 system to F900 (Gen 3)
- Hardened F900 head
- Validated Materials License

Ordering Information

Table 2: Kimya PC-FR Ordering Information

Part Number	Description
Filament Canisters	
355-70010	PC-FR, 92 cu in. - Plus
355-03120	SR-100 Soluble Support, 92 cu in. - Plus
Printer Consumables	
511-10401	T16 tip
511-10100	T12SR100 tip
325-00100	Low temperature build sheet, 0.02 x 16 x 18.5 in. (0.51 x 406 x 470 mm)
Print Heads	
821726-xxxx	Hardened Fortus 450mc head[1]
325-63500	Hardened F900 head[2]

[1] The hardened Fortus 450mc head is easily identified by a blue handle.
[2] The hardened F900 head is easily identified by a folded sheet metal handle.

Physical Properties

Values are measured as printed. XY/XZ and ZX orientations were tested. For full details refer to the Stratasys Materials Test Procedure.

Table 3: Kimya PC-FR Physical Properties

Property	Test Method	Typical Values	
		XY	XZ/ZX
HDT @ 66 psi	ASTM D648 Method B	119.3 ˚C (246.7 ˚F)	118.9 ˚C (246.1 ˚F)
HDT @ 264 psi	ASTM D648 Method B	118.5 ˚C (245.4 ˚F)	118.0 ˚C (244.4 ˚F)
Tg	ASTM D7426 Inflection Point	114 ˚C (237 ˚F)	
Density (Filament)[1]	ISO 1183	1.31 g/cm[1] (0.047 lb/in[1])	

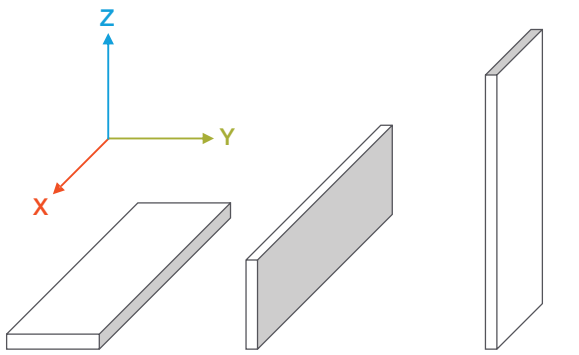
[1] Filament density is provided by Kimya.

Mechanical Properties

Samples were printed with 0.010 in. (0.254 mm) layer height on the Fortus 450mc and F900. For the full test procedure please see the Stratasys Materials Test Procedure.

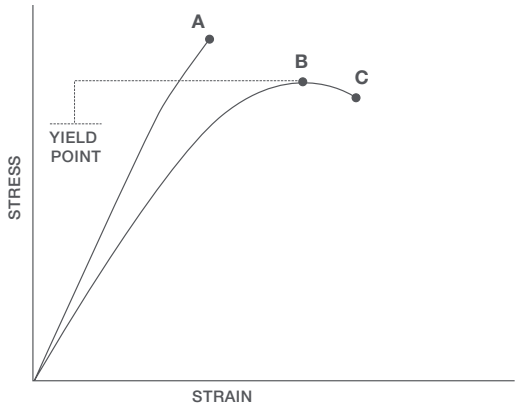
Print Orientation

Parts created using FDM are anisotropic as a result of the printing process. Below is a reference of the different orientations used to characterize the material.



Tensile Curves

Due to the anisotropic nature of FDM, tensile curves look different depending on orientation. Below is a guide of the two types of curves seen when printing tensile samples and what reported values mean.



A = Tensile at break, elongation at break (no yield point)
B = Tensile at yield, elongation at yield
C = Tensile at break, elongation at break

Table 4: Kimya PC-FR Mechanical Properties - Fortus 450mc with T16 tip

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	71.5 (5.1)	34 (8.1)
	psi	10400 (740)	4920 (1200)
Elongation @ Yield	%	5.3 (0.85)	1.7 (0.43)
Strength @ Break	MPa	66.1 (3.4)	34 (8.1)
	psi	9580 (500)	4920 (1200)
Elongation @ Break	%	6.7 (1.4)	1.7 (0.43)
Modulus (Elastic)	GPa	2.21 (0.033)	2.15 (0.021)
	ksi	321 (4.8)	313 (3)
Flexural Properties: ASTM D790, Procedure A			
Peak Stress	MPa	107 (3)	72.8 (10)
	psi	15500 (440)	10600 (1500)
Modulus	GPa	2.53 (0.062)	2.01 (0.026)
	ksi	367 (9)	292 (3.8)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	87.5 (9.6)	26.4 (5.9)
	ft*lb/in.	1.64 (0.18)	0.514 (0.11)
Unnotched	J/m	2170 (530)	39.0 (6.4)
	ft*lb/in.	40.6 (10)	0.731 (0.12)

[1] Values in parenthesis are standard deviations.

Table 5: Kimya PC-FR Mechanical Properties - F900 with T16 tip

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	71.6 (1.9)	35.5 (8.7)
	psi	10400 (270)	5160 (1300)
Elongation @ Yield	%	5.5 (0.25)	1.9 (0.47)
Strength @ Break	MPa	63.0 (4.2)	35.5 (8.7)
	psi	9140 (610)	5150 (1300)
Elongation @ Break	%	8.0 (1.3)	1.9 (0.47)
Modulus (Elastic)	GPa	2.24 (0.039)	2.07 (0.044)
	ksi	325 (5.7)	301 (6.4)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	107.0 (1.70)	61.8 (9.9)
	psi	15500 (250.0)	8970 (1400)
Strain @ Break	%	No break	3.2 (0.64)
Modulus	GPa	2.54 (0.043)	1.99 (0.068)
	ksi	369 (6.3)	289 (9.9)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	78.1 (13)	18.9 (2.2)
	ft*lb/in.	1.46 (0.24)	0.354 (0.041)
Unnotched	J/m	2100 (130)	89.6 (27)
	ft*lb/in.	39.3 (2.4)	1.68 (0.50)

[1] Values in parenthesis are standard deviations.

Fire Protection of Railway Vehicles

EN-45545-2

Kimya PC-FR was printed with a T16 tip on the Stratasys F900 using default print settings (solid, single contour, and +45/-45 rasters) and tested per EN-45545-2.

The testing done establishes that this material meets requirements for:

- -HL1/2/3 according to R1, R2, R3, R6, R7, and R17 requirements at 3 mm thick in XY orientation.
- -HL1/2/3 according to R1, R2, R3, and R6 requirements at 10 mm thick in XY orientation.
- -HL1/2 according to R7 and R17 requirements at 10 mm thick in XY orientation.

Table 6: Kimya PC-FR Results for Fire Protection of Railway Vehicles Test per EN-45545-2

Test	Test Objective	Results	3 mm XY	10 mm XY
ISO 5659-2	Smoke Opacity	Ds(4)	70.1	70.1
		VOF_4	144.4	101.2
		Dm	233.7	347.4
ISO 5659-2 + EN 45545-2 Appendix C	Smoke Toxicity	ITC 4 minutes	0.02	0
		ITC 8 minutes	0.04	0.05
ISO 5660-1	Heat Release	MAHRE (kW/m^2)	37.1	39.9
ISO 5658-2	Vertical Critical Flux at Extinguishment	CFE (kW/m^2)	20.5	20