FLXR ENGINEERING

TECHNICAL DATA SHEET
3D PRINTING FILAMENT

PEN Natural

GENERAL INFORMATION

Poly**E**thylene **N**aphthalate (PEN) meets USP<88>Class VI (*in vivo*) and USP<87> (*in vitro*) standards, supporting its use in biotech, medical, chemical and food applications. It is approved for up to 24-hour contact with skin and tissue and, where applicable, indirect contact with blood. As a FDM 3D printing filament, PEN delivers exceptional chemical resistance, mechanical strength, and temperature stability – all at a compelling cost-to-performance ratio.
Manufactured without any processing aids or antioxidants, using methods similar to life science extrusion lines; PEN ensures a high level of purity and safety. Its non-toxic, biocompatible nature, and low extractable potential suit applications in critical processes. FDA food-contact compliance adds further assurance. PEN also features natural UV-blocking properties and low gas permeability to help preserve the integrity of sensitive materials and components.
In additive manufacturing, PEN prints smoothly on an enclosed desktop 3D printer using a 0.2-1.0 mm nozzle. Overall, its balance of safety, performance, and affordability makes PEN ideal for biotech devices, diagnostic equipment, cosmetic and personal care containers, and food-processing machinery.

IMPORTANT KEY FEATURES

- Exceptional chemical resistance (refer to chemical resistance table)
- USP<88> Class VI & USP<87> – suitable for sensitive applications
- FDA food contact safe – ensure consumer health and safety
- Temperature resistance: 127°C (pre-annealing), 173 °C (annealed)
- Easy 3D printing on desktop printer, even with a 0.2-0.25 mm nozzle

FILAMENT SPECIFICATIONS

- Diameter : 1.75 ± 0.03mm
- Color : translucent
- Net filament weight : 200g & 1,000g
- Packaging : packed in vacuum sealed bag with desiccant

STORAGE AND SHELF LIFE

- Store filament in a sealed package at room temperature (18-28°C).
- Shelf life: 12 months (unopened package)
- Keep away from moisture and direct heat sources.

THERMAL PROPERTIES

- Heat deflection (HDT) at 0.45 MPa ISO 75-2/B (3D Printed Specimen FLAT XY) : 132 °C (pre-annealing)
- Heat deflection (HDT) at 1.82 MPa ISO 75-2/B (3D Printed Specimen FLAT XY) : 121 °C (pre-annealing)

PRINTING CONDITIONS

- Nozzle temperature (°C) : 270-280°C
- Bed temperature (°C) : 70-90°C
- Retraction speed (mm/s) : 30-45
- Retraction length (mm) : 2-4mm
- Cooling (%) : 0-10%
- Compatible nozzle size : 0.2-1.0mm
- Support material : PVA, HIPS
- Adhesion: PEI and glass (glue stick or PVP)
- Speed (mm/s):
  50-70 mm/s for mechanical properties and walls
  100-140 mm/s for infill or draft prototypes
- Drying:
  After opening the sealed package, use a dry-box / controlled environment during printing (RH <20%). Dry at 80°C for 8 hours if exposed to excess humidity (>0.4%).

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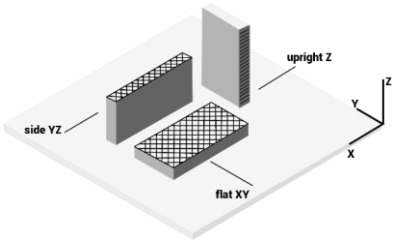
PRINTING ORIENTATION



The FDM process creates parts with a layered structure, causing mechanical properties to be anisotropic based on print orientation.*1

- Flat XY orientation: predominant mechanical strength from infill
- Side YZ orientation: predominant mechanical strength from walls
- Upright Z orientation: interlayer adhesion strength.

	Test Method #	PEN		
	ISO 527-2	XY	YZ	ZX
Tensile strength (MPa)	50 mm/min	75.2	51.9	22.2
Elongation (%)	50 mm/min	10.1	2.4	0.5
Tensile modulus (MPa)	1 mm/min	2717	2435	2534
	ISO 178:2019			
Flexural strength (MPa)	2 mm/min	100.3	-	43.1
Flexural modulus (MPa)	2 mm/min	2263	-	1976
	ISO180:2019			
Izod impact strength (kJ/m^2)	notched	3.1	-	1.9

#: 3rd party testing by: SGS

CHEMICAL RESISTANCE TABLE *2

Organic Solvent	PEN	PVDF
Acetic acid (20%)	A	A
Acetone	B	D
Alcohols	A	A
Chloroform	C	A
Dimethyl sulfoxide	C	C
Ethers	A	A
Ethyl acetate	A	D
Gasoline	A	A
Hexane	A	A
Methyl ethyl ketone	A	C
Toluene	A	A

Inorganic Solvent	PEN	PVDF
Ammonium chloride (25%)	A	A
Ammonia aq. (28%)	C	A
Hydrochloric acid (37%)	A	A
Hydrogen peroxide (30%)	A	A
KOH (30%)	B	A
NaCl sat. solution	A	A
$NaHCO_3$ sat. solution	A	A
NaOCl	A	A
NaOH (30%)	A	A
Nitric acid (20%)	A	A
Sulfuric acid (10%)	A	A

NOTES

*1 The values reported in TDS represent the average from a batch of 10 test specimens. For tensile, flexural, and impact properties of the 3D printed test specimens were produced using a 0.4 mm nozzle, 100% infill, print speed of 60mm/s, a nozzle temperature of 270°C and a build plate temperature of 75°C. FLXR Engineering is continuously working on expanding the TDS data

*2 The chemical resistance of PEN is evaluated by the following test method:

- Specimens are immersed in the chemical (liquid) at 23°C for 30 days.
- Ranking definition: A: weight change <1%, tensile strength retained >95%; B: weight change between 1~10%, tensile strength retained >75%; C: weight change >10%, tensile strength retained <75%; D: swelled or dissolved within 120 hours.

DISCLAIMER

This information sheet has been prepared with the highest level of care. Unless otherwise stated, it is intended solely for general informational purposes. It should not be relied upon for any specific purpose, and no representations or warranties are made regarding its accuracy or completeness.

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