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MATERIAL GUIDE
Digital Light Projection
Projection Stereolithography

PRO-BLK 10
(Matrix PB10)

Versatile rigid heat resistant material combines speed, strength, excellent mechanical properties for tool-less direct production of plastic parts

DLP material PRO-BLK 10 delivers on the promise of additive manufacturing with true direct digital production of plastic parts. Go from CAD to manufacturing line in one day with tool-less, same day part production.

With a fast print speed and simplified post-processing that includes a single curing cycle and single solvent cleaning, this material delivers exceptional throughput. It is a high precision resin producing parts with a smooth surface finish and sidewall quality, and has excellent mechanical properties and long-term environmental stability that brings a new level of assurance to 3D production.

Applications

- Tool-less, same day production
- Direct production of small black plastic parts; examples include: motor housings, connectors, snap-fits, automotive interior and other general-use parts
- Digital production to replace injection moulding or soft tooling processes

Features

- Fast print speed up to 62 mm/hr at 50 micron layer thickness
- 70 °C heat deflection temperature, 12% elongation at break
- Durability and strength
- UL94 HB flammability
- Biocompatible capable per ISO10993-5 and ISO10993-10
- Exhibits thermoplastic behavior in necking at tensile break point

Benefits

- Improved environmental stability of mechanical and performance properties over time
- Fast throughput for part-in-hand with no secondary thermal cure required
- Simple, single solvent cleaning
- Excellent surface quality and repeatability
- Accurate, low distortion material for fast first article print success

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Material Properties

The full suite of mechanical properties are given per ASTM and ISO standards where applicable. In addition, properties such as flammability, dielectric properties, and 24 hour water absorption. This allows for better understanding of the material capability to aid in design decisions for the material. All parts are conditioned per ASTM recommended standards for a minimum of 40 hours at 23 °C, 50% RH.

LIQUID MATERIAL			
MEASUREMENT	**CONDITION**	**METRIC**	**U.S.**
Viscocity	@ 25 °C (77 °F)	293 cps	709 lb/ft-hr
Colour		Black	
Liquid Density	@ 25 °C (77 °F)	1.07 g/cm^3	0.039 lb/in^3
Layer Thickness (Standard Mode)		0.05 mm	0.002 in

MECHANICAL PROPERTIES			
MEASUREMENT	**ASTM METHOD**	**METRIC**	**ENGLISH**
PHYSICAL			
Solid Density	ASTM D792	1.16 g/cm^3	0.042 lb/in^3
24 Hour Water Absorption	ASTM D570	1.16%	1.16%
MECHANICAL			
Tensile Strength Ultimate	ASTM D412	63 MPa	9140 psi
Tensile Strength at Yield	ASTM D412	63 MPa	9140 psi
Tensile Modulus	ASTM D412	2320 MPa	336 ksi
Elongation at Break	ASTM D412	12%	12%
Elongation at Yield	ASTM D412	4.7%	4.7%
Flex Strength	ASTM D790	92 MPa	13340 psi
Flex Modulus	ASTM D790	2290 MPa	332 ksi
Izod Notched Impact	ASTM D256	24 J/m	0.5 ft-lbs/in
Izod Unnotched Impact	ASTM D4812	614 J/m	11.5 ft-lbs/in
Shore Hardness	ASTM D2240	79D	79D
THERMAL			
Tg (DMA, E")	ASTM E1640 (E"at 1C/min)	62 °C	144 °F
HDT @ 0.455 MPa/66 PSI	ASTM D648	70 °C	158 °F
HDT @ 1.82 MPa/264 PSI	ASTM D648	56 °C	133 °F
CTE below Tg	ASTM E831	71 ppm/°C	39 ppm/°F
CTE above Tg	ASTM E831	188 ppm/°C	104 ppm/°F
UL Flammability	UL94	HB	HB
ELECTRICAL			
Dielectric Strength (V/mil) @ 3.0mm thickness	ASTM D149	19.3	
Dielectric Constant @ 1 MHz	ASTM D150	3.17	
Dissipation Factor @ 1 MHz	ASTM D150	0.012	
Volume Resistivity (ohm-cm)	ASTM D257	2.6X10^{15}	

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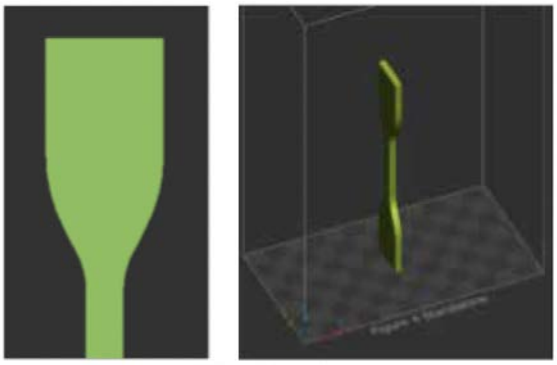
Isotropic Properties

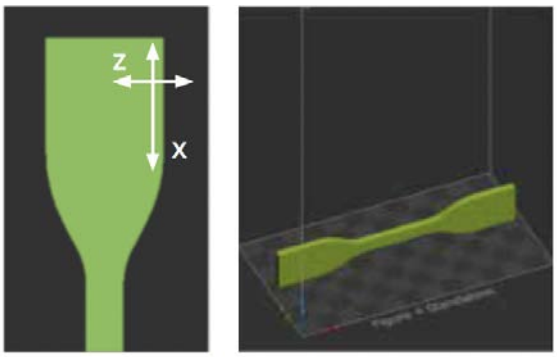
DLP technology prints parts that are isotropic in mechanical properties meaning the parts printed along either the XYZ axis will give similar results.

Parts do not need to be oriented to get the highest mechanical properties, further improving the degree of freedom for part orientation for mechanical properties.

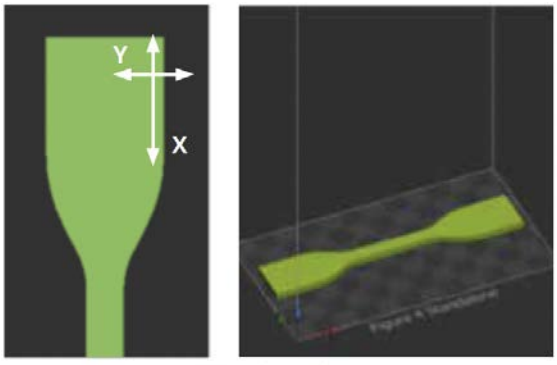
SOLID MATERIAL					
MEASUREMENT	METHOD	METRIC			
MECHANICAL					
		ZY	XZ	XY	Z45
Tensile Strength Ultimate	ASTM D412	63 MPa	56 MPa	60 MPa	57 MPa
Tensile Strength at Yield	ASTM D412	63 MPa	56 MPa	60 MPa	57 MPa
Tensile Modulus	ASTM D412	2320 MPa	2315 MPa	2330 MPa	2300 MPa
Elongation at Break	ASTM D412	12%	12%	13%	11%
Elongation at Yield	ASTM D412	4.7%	4.7%	4.7%	4.4%
Flex Strength	ASTM D790	92 MPa	91 MPa	90 MPa	85 MPa
Flex Modulus	ASTM D790	2290 MPa	2280 MPa	2742 MPa	2339 MPa
Izod Notched Impact	ASTM D256	24 J/m	22 J/m	23 J/m	23 J/m
Shore Hardness	ASTM D2240	79D	80D	79D	80D



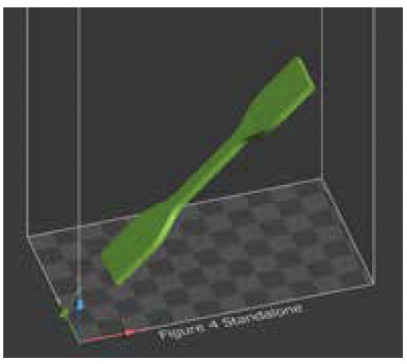
YZ - orientation



XZ - orientation



XY - orientation



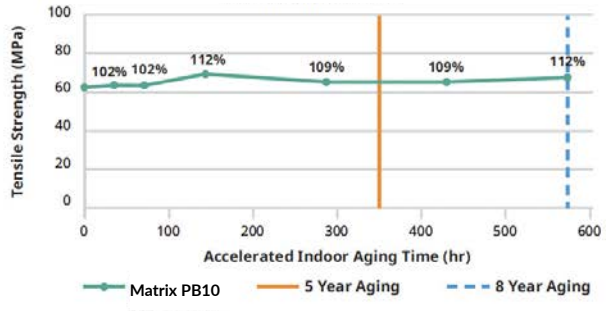
Z45-Degree - orientation

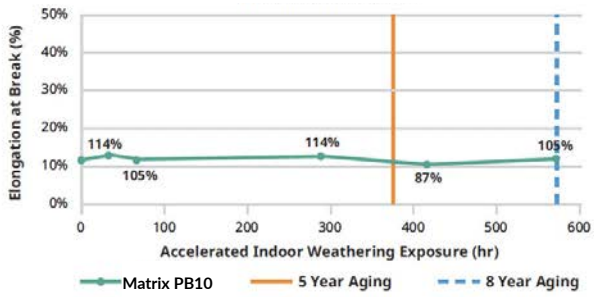
Long Term Environmental Stability

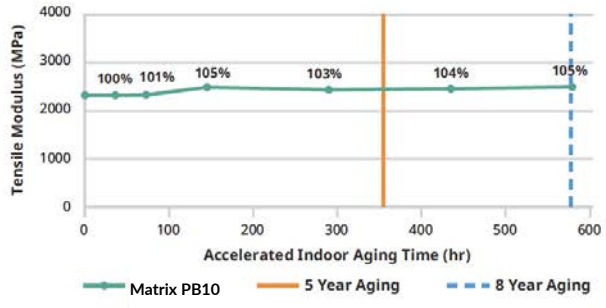
PRO-BLK 10 is engineered to give long term environmental UV and humidity stability. This means the material is tested for the ability to retain a high percent of the initial mechanical properties over a given period of time. This provides real design conditions to consider for the application or part. **Actual data value is on Y-axis, and data points are % of initial value.**

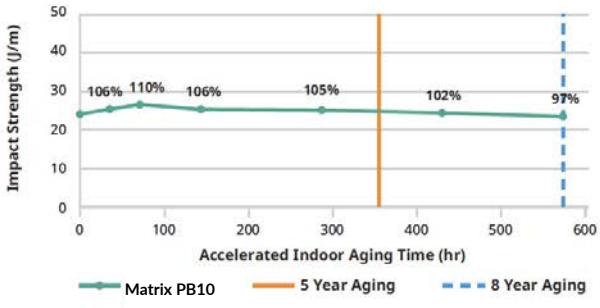
INDOOR STABILITY: Tested per ASTM D4329 standard method.

INDOOR STABILITY



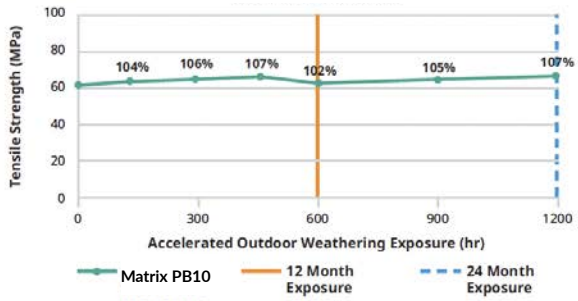


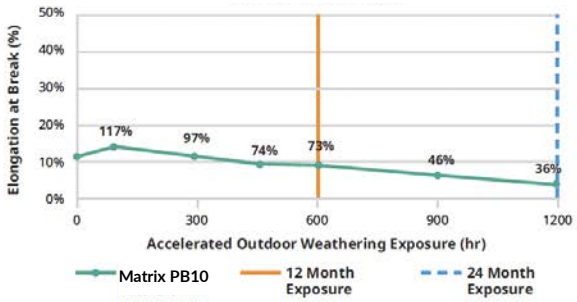


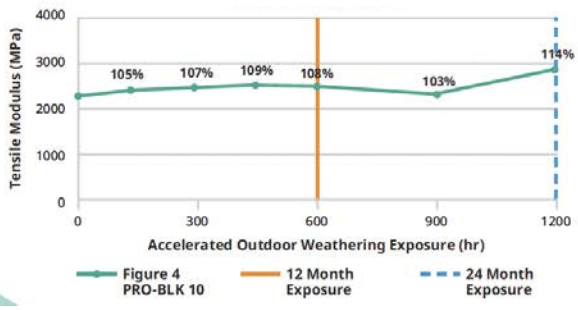


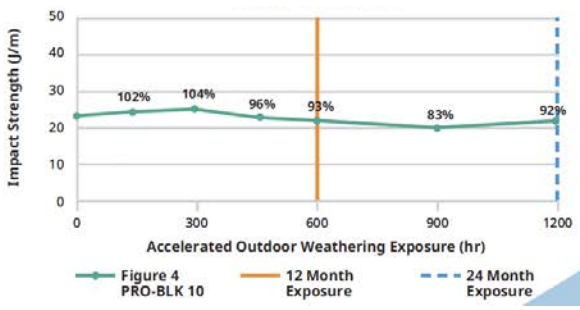
OUTDOOR STABILITY: Tested per ASTM G154 standard method.

OUTDOOR STABILITY









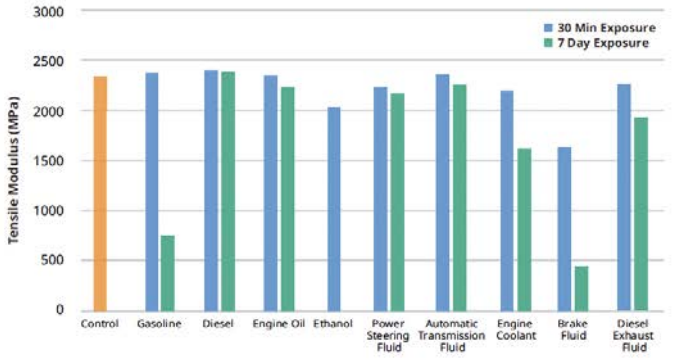
Automotive Fluid Compatibility

The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. PRO-BLK 10 parts were tested for sealed and surface contact compatibility per USCAR2 test conditions. The fluids below were tested in two different ways per the specs.

- Immerse for 7-days, then take mechanical property data for comparison
- Immerse for 30-minutes, remove, and take mechanical property data for comparison in 7-days

Data reflects the measured value of properties over that period of time.

SOLID MATERIAL		
FLUID	**SPECIFICATION**	**TEST TEMP °C**
Gasoline	ISO 1817, liquid C	23 ± 5
Diesel Fuel	905 ISO 1817, Oil No. 3 + 10% p-xylene*	23 ± 5
Engine Oil	ISO 1817, Oil No. 2	50 ± 3
Ethanol	85% Ethanol + 15% ISO 1817 liquid C*	23 ± 5
Power Steering Fluid	ISO 1917, Oil No. 3	50 ± 3
Automative Transmission Fluid	Dexron VI (North American specific material)	50 ± 3
Engine Coolant	50% ethylene glycol + 50% distilled water*	50 ± 3
Brake Fluid	SAE RM66xx (Use latest available fluid for xx)	50 ± 3
Diesel Exhaust Fluid (DEF)	API certified per ISO 22241	23 ± 5



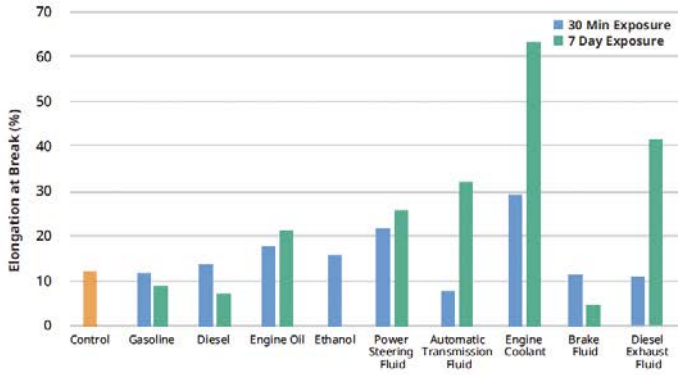


FIGURE 4 PRO-BLK 10

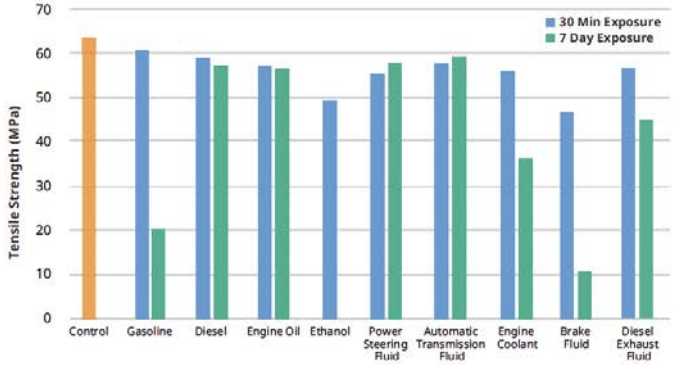
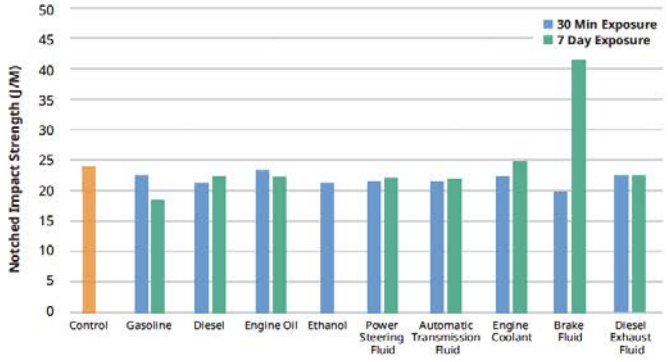


FIGURE 4 PRO-BLK 10



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Chemical Compatibility

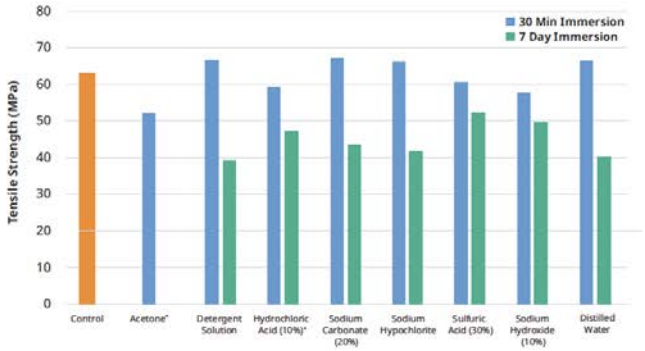
The compatibility of a material with cleaning chemicals is critical to part application. PRO-BLK 10 parts were tested for sealed and surface contact compatibility per ASTM D543 test conditions. The fluids below were tested in two different ways per the specs.

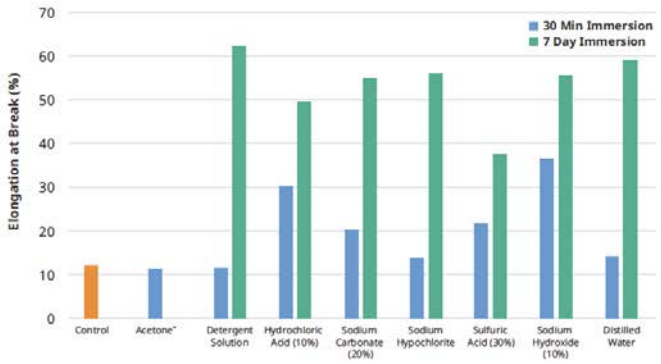
- Immerse for 7-days, then take mechanical property data for comparison
- Immerse for 30-minutes, remove, and take mechanical property data for comparison in 7-days

Data reflects the measured value of properties over that period of time.

*Denotes materials did not go thru 7-day soak conditioning.

CHEMICAL COMPATIBILITY
6.33 Acetone
6.3.12 Detergent Solution, Heavy Duty
6.3.23 Hydrochloric Acid (10%)
6.3.38 Sodium Carbonate Solution (20%)
6.3.44 Sodium Hydrochloric Solution
6.3.46 Sulfuric Acid (30%)
6.3.42 Sodium Hydroxide Soln (10%)
6.3.15 Distilled Water





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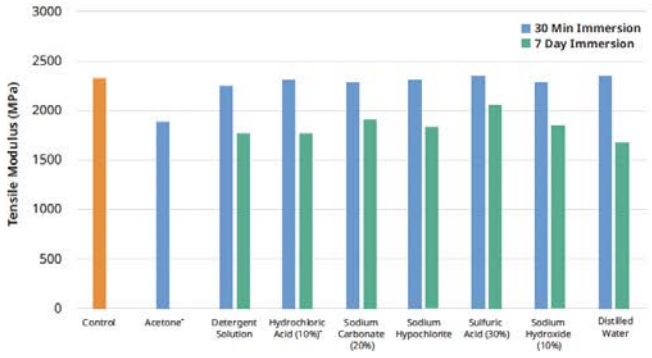

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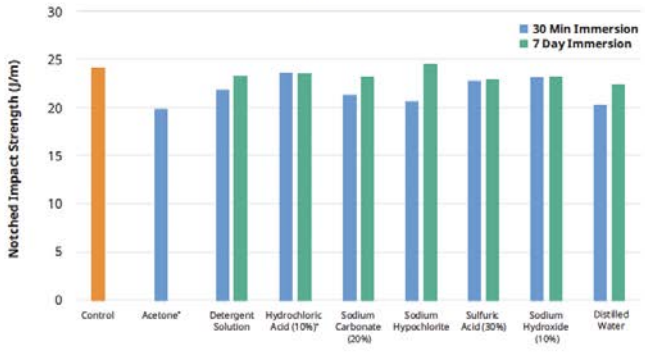

Biocompatibility statement

PRO-BLK 10 test coupons printed and processed according to the post processing instructions below were provided to an external biological testing laboratory for evaluation in accordance with **ISO 10993-5, Biological evaluation of medical devices - Part 5: Tests for in vitro cytotoxicity, and ISO 10993-10, Biological evaluation of medical devices - Part 10: Tests for irritation and skin sensitisation (GPMT)**. The test results indicate that PRO-BLK 10 has passed the requirements for biocompatibility according to the above tests.