



# Figure 4® RUBBER-BLK 10

Durable Elastomer

High tear strength, malleable material for hard rubber-like parts

Figure 4

## HIGH TEAR STRENGTH WITH LONG TERM ENVIRONMENTAL STABILITY FOR HARD RUBBER-LIKE PARTS

Figure 4® RUBBER-BLK 10 is a high tear strength material for the production of hard rubber-like parts with slow-rebound for touch applications such as grips, handles and bumpers, as well as strain-relief applications, couplings, over molds, etc. This extremely tough material has an exceptional surface finish and long-term environmental stability.

## HANDLING AND POST-PROCESSING GUIDELINES

Proper mixing, cleaning, drying and curing is required for this material. Post-processing information can be found at the end of this document.

Note: all properties are based on using the documented post-processing method. Any deviation from this method could yield a different result.

More details can be found in the Figure 4 User Guide available at <http://infocenter.3dsystems.com>

Figure 4 Standalone:

<http://infocenter.3dsystems.com/figure4standalone/node/1546>

Figure 4 Modular:

<http://infocenter.3dsystems.com/figure4modular/node/1741>

## APPLICATIONS

- Slow-rebound hard-rubber material allows for multiple touch applications, including grips, handles, bumpers
- Good for strain-relief type applications
- Couplings and overmoldings
- Production parts needing long term environmental stability where mechanical properties fit
- 

## BENEFITS

- Exceptional surface finish
- Very tough material
- Great for soft touch applications
- Engineered for long term environmental stability

## FEATURES

- High tear strength
- Shore hardness of 59D and 97A
- Tough and durable
- Biocompatible capable per ISO10993-5 and ISO10993-10

*Note: Not all products and materials are available in all countries — please consult your local sales representative for availability.*

**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.

Solid material properties reported were printed along the vertical axis (ZY-orientation). Figure 4 material properties are relatively uniform across print orientations, as detailed in the following section on Isotropic Properties. Because of this, parts do not need to be oriented in a particular direction to exhibit these properties.

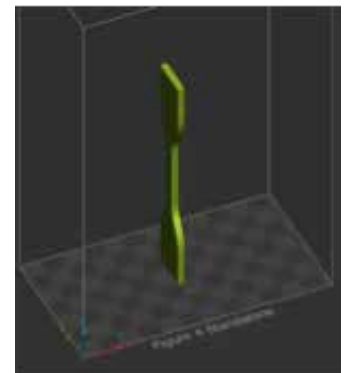
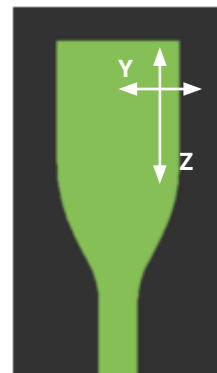
LIQUID MATERIAL						
MEASUREMENT	CONDITION/METHOD	METRIC		ENGLISH		
Viscosity	Brookfield Viscometer @ 25 °C (77 °F)	1413 cps		3420 lb/ft-hr		
Color		Black				
Liquid Density	Kruss K11 Force Tensiometer @ 25 °C (77 °F)	1.11 g/cm <sup>3</sup>		0.040 lb/in <sup>3</sup>		
Default Print Layer Thickness (Standard Mode)		0.03 mm		0.0012 in		
Speed - Standard Mode		26 mm/hr		1.0 in/hr		
Speed - Draft Mode		35 mm/hr		1.4 in/hr		
Package Volume		1 kg bottle - Figure 4 Standalone 2.5 kg cartridge - Figure 4 Modular 9 kg container - Figure 4 Production				
SOLID MATERIAL						
METRIC	ASTM METHOD	METRIC	ENGLISH	ISO METHOD	METRIC	ENGLISH
PHYSICAL				PHYSICAL		
Solid Density	ASTM D792	1.17 g/cm <sup>3</sup>	0.042 lb/in <sup>3</sup>	ISO 1183	1.17 g/cm <sup>3</sup>	0.042 lb/in <sup>3</sup>
24 Hour Water Absorption	ASTM D570	0.26%	0.40%	ISO 62	0.26%	0.40%
MECHANICAL				MECHANICAL		
Tensile Strength Ultimate	ASTM D638	21 MPa	3046 psi	ISO 527 -1/2	18 MPa	2648 psi
Tensile Modulus	ASTM D638	540 MPa	78 ksi	ISO 527 -1/2	289 MPa	42 ksi
Elongation at Break	ASTM D638	80%	80%	ISO 527 -1/2	80 %	80 %
Tear Strength	ASTM D412 Type C	76 kN/m	430 lbf/in	ISO 34	89 kN/m	510 lbf/in
Izod Notched Impact	ASTM D256	125 J/m	2.4 ft-lb/in	ISO 180-A	12.9 J/m <sup>2</sup>	0.0061 ft-lb/in <sup>2</sup>
Shore Hardness	ASTM D2240	59D, 97A	59D, 97A	ISO 7619	59D, 97A	59D, 97A
THERMAL				THERMAL		
CTE above Tg	ASTM E831	177 ppm/°C	98 ppm/°F	ISO 11359-2	177 ppm/°K	98 ppm/°F
UL Flammability	UL94	HB	HB			
ELECTRICAL				ELECTRICAL		
Dielectric Strength (V/mil) @ 3.0 mm thickness	ASTM D149	13.4				
Dielectric Constant @ 1 MHz	ASTM D150	3.76				
Dissipation Factor @ 1 MHz	ASTM D150	0.036				
Volume Resistivity (ohm-cm)	ASTM D257	3.0x10 <sup>14</sup>				

## Figure 4 RUBBER-BLK 10

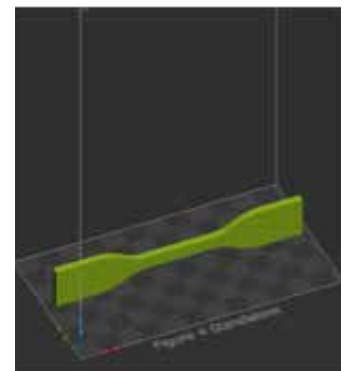
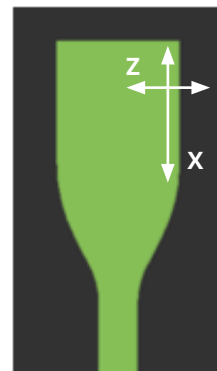
### ISOTROPIC PROPERTIES

Figure 4 technology prints parts that are isotropic in mechanical properties meaning the parts printed along either the XYZ axis will give similar results.

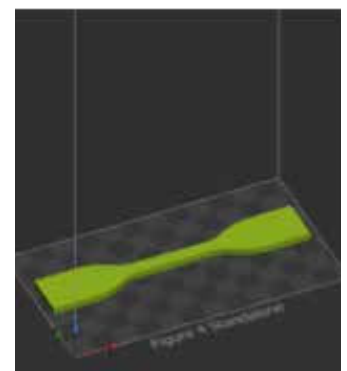
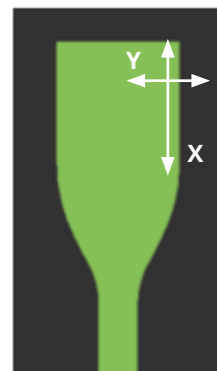
Parts do not need to be oriented to get the highest mechanical properties, further improving the degree of freedom for part orientation for mechanical properties.



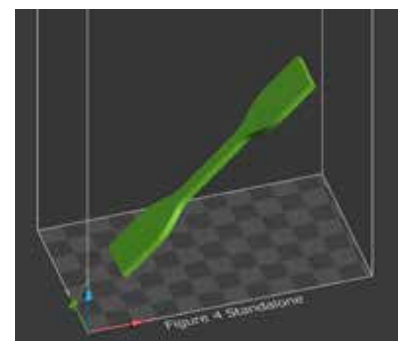
YZ - orientation



XZ - orientation



XY - orientation



Z45-Degree - orientation

SOLID MATERIAL					
METRIC	METHOD	METRIC			
MECHANICAL					
		ZY	XZ	XY	Z45
Tensile Strength Ultimate	ASTM D638	21 MPa	28 MPa	17 MPa	17 MPa
Tensile Strength at Yield	ASTM D638	N/A	N/A	N/A	N/A
Tensile Modulus	ASTM D638	540	995	518	378
Elongation at Break	ASTM D638	80%	62 %	76 %	76 %
Elongation at Yield	ASTM D638	N/A	N/A	N/A	N/A
Flex Strength	ASTM D790	N/A	N/A	N/A	N/A
Flex Modulus	ASTM D790	N/A	N/A	N/A	N/A
Izod Notched Impact	ASTM D256	125 J/m	111 J/m	122 J/m	143 J/m
Shore Hardness	ASTM D2240	59D	58D	56D	57D
Tear Strength	ASTM D624	76 kN/m	85 kN/m	102 kN/m	85 kN/m

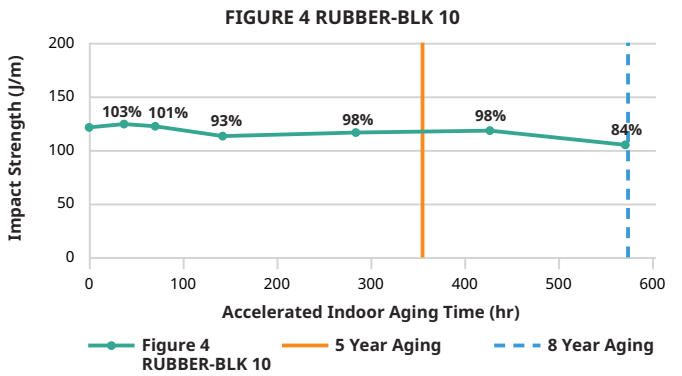
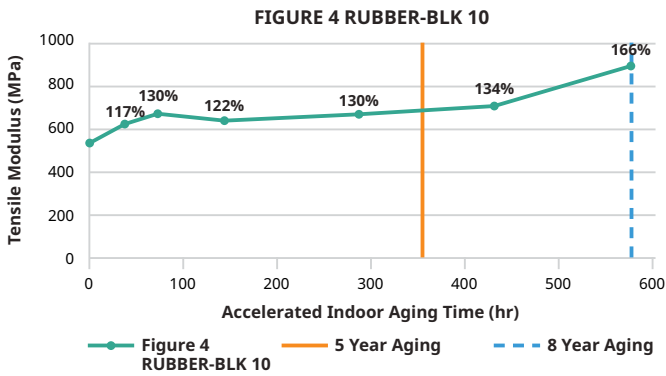
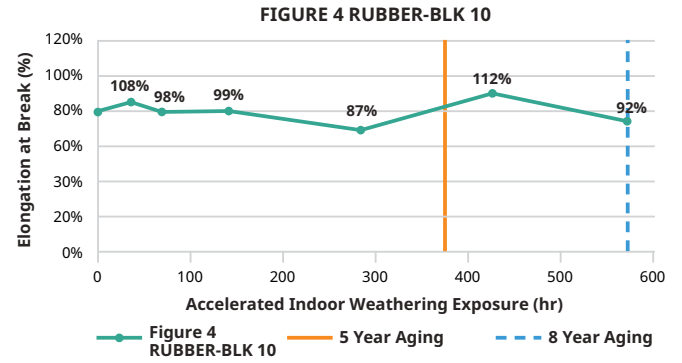
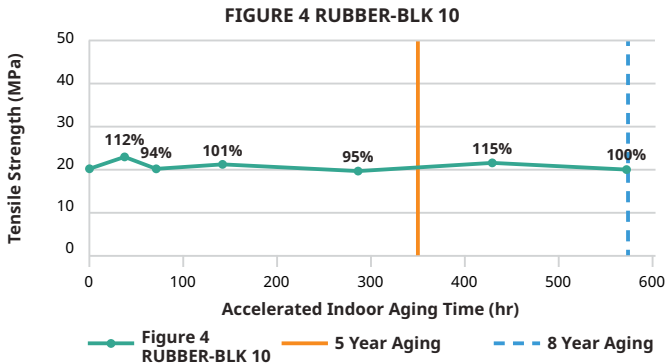
# Figure 4 RUBBER-BLK 10

## LONG TERM ENVIRONMENTAL STABILITY

Figure 4 RUBBER-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.**

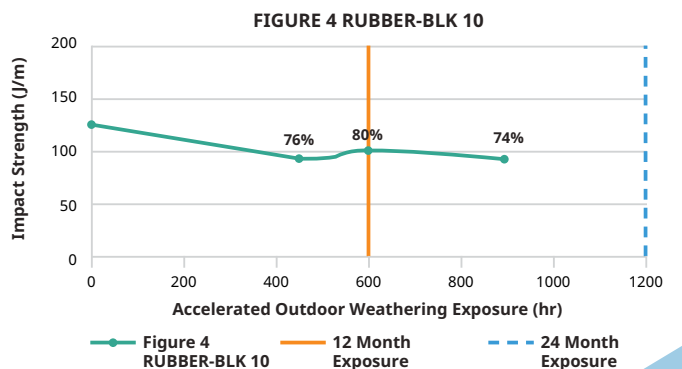
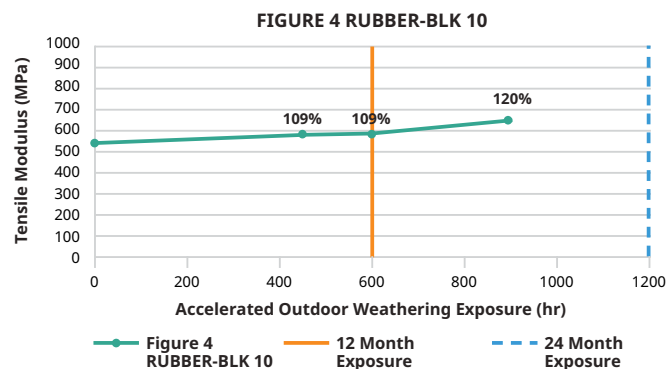
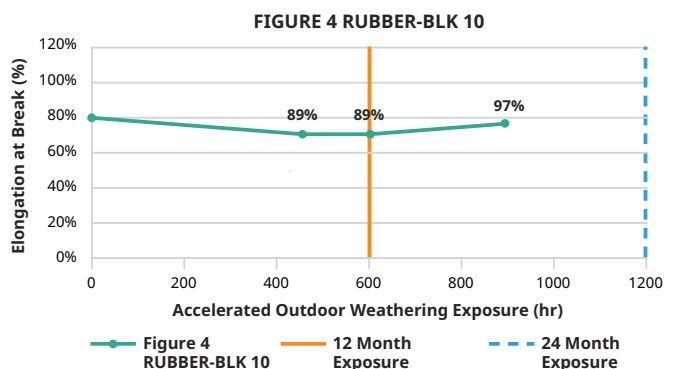
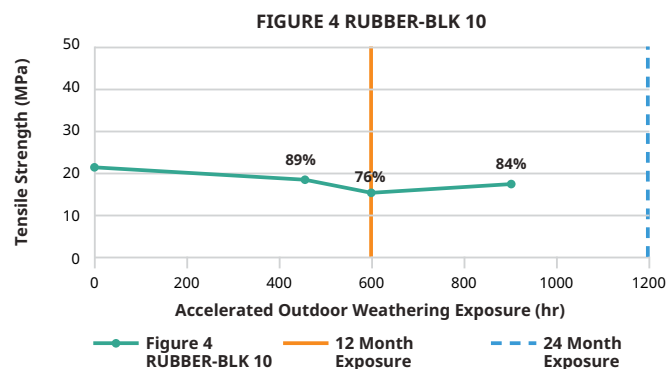
**INDOOR STABILITY:** Tested per ASTM D4329 standard method.

INDOOR STABILITY



**OUTDOOR STABILITY:** Tested per ASTM G154 standard method.

OUTDOOR STABILITY



# Figure 4 RUBBER-BLK 10

## AUTOMOTIVE FLUID COMPATIBILITY

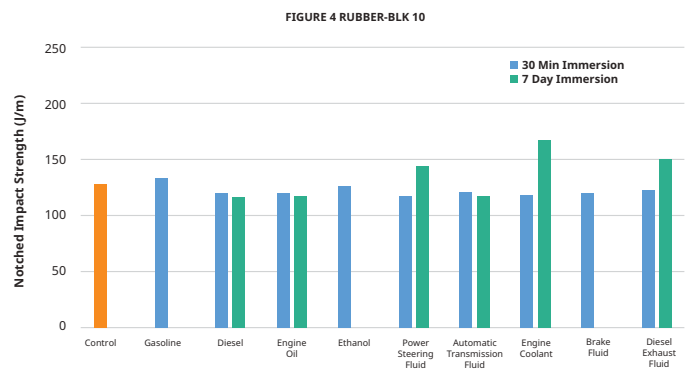
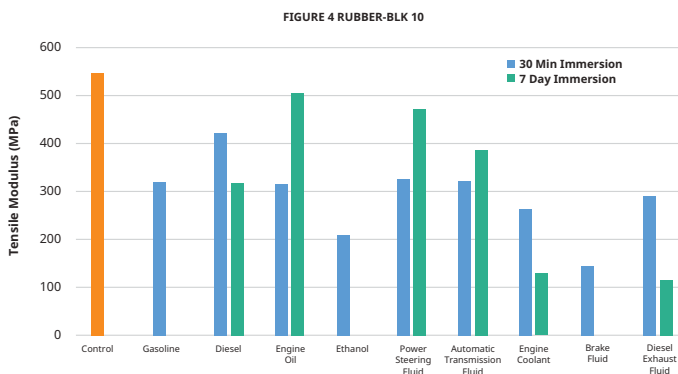
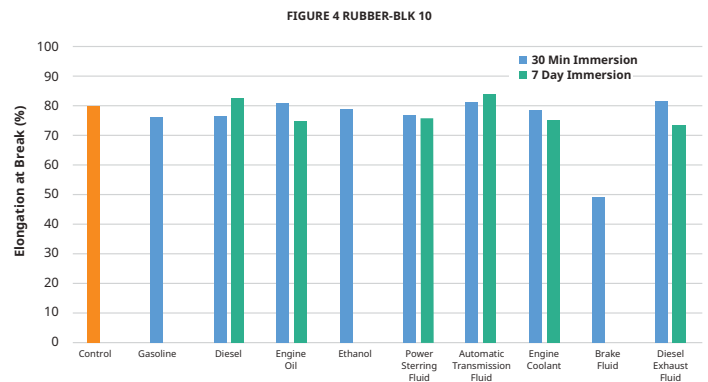
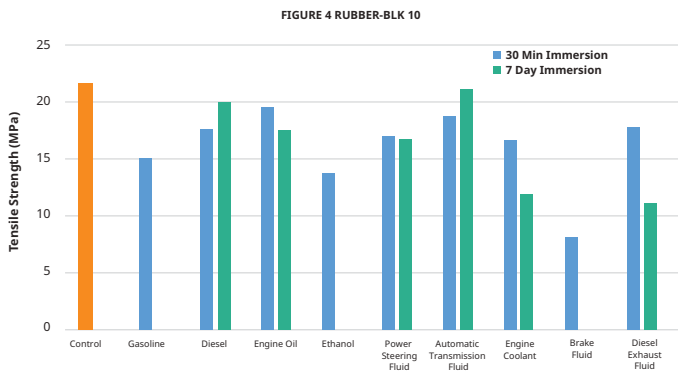
The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. Figure 4 RUBBER-BLK 10 parts were tested for sealed and surface contact compatibility per USCAR2 test conditions. The fluids below were tested in two different ways per the specs.

- 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.**

AUTOMOTIVE FLUIDS		
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
Automotive 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

\*Solutions are determined as percent by volume



## CHEMICAL COMPATIBILITY

The compatibility of a material with cleaning chemicals is critical to part application. Figure 4 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
6.3.3 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 Hypochlorite Solution
6.3.46 Sulfuric Acid (30%)
6.3.42 Sodium Hydroxide Soln (10%)
Distilled Water

FIGURE 4 RUBBER-BLK 10

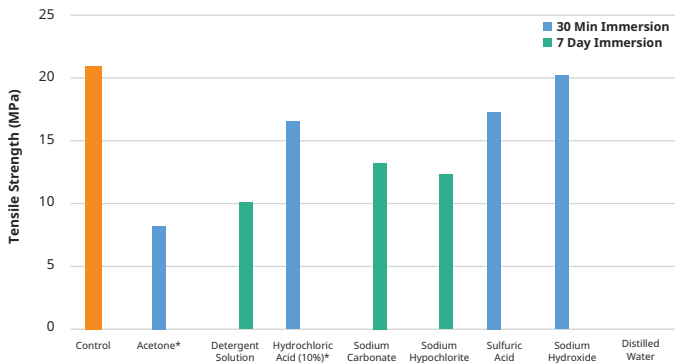


FIGURE 4 RUBBER-BLK 10

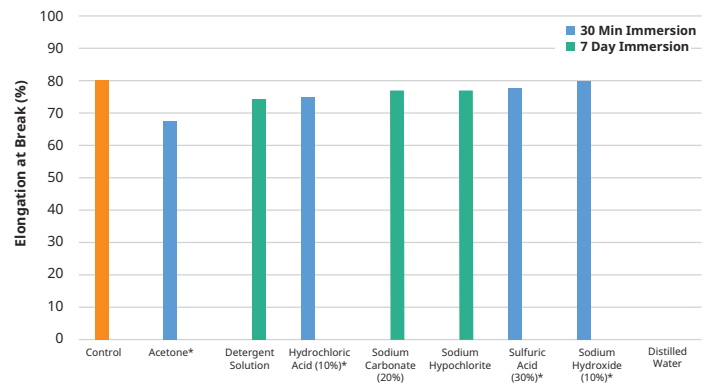


FIGURE 4 RUBBER-BLK 10

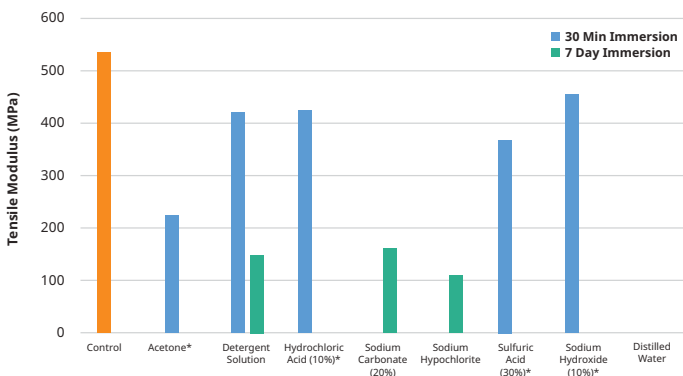
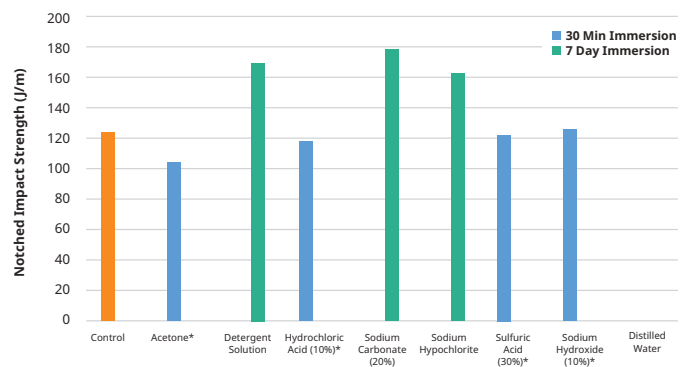


FIGURE 4 RUBBER-BLK 10



### BIOCOMPATIBILITY STATEMENT

Figure 4® RUBBER-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 sensitization (GPMT)*. The test results indicate that Figure 4® RUBBER-BLK 10 has passed the requirements for biocompatibility according to the above tests.

It is the responsibility of each customer to determine that its use of Figure 4® RUBBER-BLK 10 material is safe, lawful and technically suitable to the customer's intended applications. Customers should conduct their own testing to ensure that this is the case. Because of possible changes in the law and in regulations, as well as possible changes in these materials, 3D Systems cannot guarantee that the status of these materials will remain unchanged or that it will qualify as biocompatible in any particular use. Therefore, 3D Systems recommends that customers continuing to use these materials verify their status on a periodic basis.

### POST-PROCESSING INSTRUCTIONS REQUIRED TO PASS ISO 10993-5 AND ISO 10993-10

#### MIXING INSTRUCTIONS

This material has a pigment that settles very slowly over time before printing. For best results mix material in the bottle:

##### 1 kg bottle for Figure 4 Standalone

- Roll bottle for 1 hour on 3D Systems LC-3D Mixer for first use
- Roll for 10 minutes before subsequent uses

##### 2.5 kg cartridge for Figure 4 Modular

- Vigorously shake the bottle for 2 minutes before installing cartridge

Use the Resin Mixer to stir material in the tray for 30 seconds between print jobs.

#### MANUAL CLEANING INSTRUCTIONS

- Manual cleaning with 2 containers of IPA (wash and rinse)
- Clean in 'wash' IPA for 5 minutes while agitating part
- Rinse in 'clean' IPA for 5 minutes while agitating part
  - DO NOT EXCEED more than 10 minutes total exposure to IPA to preserve mechanical properties
- Manual agitation and/or a soft brush can be used to aid cleaning
- Refresh IPA when cleaning becomes ineffective

#### DRYING INSTRUCTIONS

- Ambient air dry > 1 hour before post cure

#### UV CURE TIME

- 3D Systems LC-3DPrint Box UV Post-Curing Unit or Figure 4 UV Cure Unit 350 : 90 minutes

More details can be found in the Figure 4 User Guide available at <http://infocenter.3dsystems.com>

Figure 4 Standalone: <http://infocenter.3dsystems.com/figure4standalone/node/1546>

Figure 4 Modular: <http://infocenter.3dsystems.com/figure4modular/node/1741>

