Figure 4® RUBBER-65A BLK

Durable Rubber

A mid-tear strength, production-grade rubber combined with Shore 65A hardness and a high elongation at break

Figure 4

MANUFACTURE RUBBER PARTS WITH PRODUCTION PERFORMANCE PROPERTIES

Figure 4® RUBBER-65A BLK material is specially formulated to address key customer needs for rubber parts featuring production performance properties and production mechanical properties tested according to industry standards. Figure 4 RUBBER-65A BLK is a mid-tear strength, high elongation at break, Shore 65A material for the production of medium hard rubber parts with slow rebound, for applications such as grips, handles, gaskets, bumpers, seals, vibration dampening components and more.

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

- Air/dust gaskets
- Seals and housings
- Vibration dampener and pipe spacers
- Bumpers
- Grips and handles

BENEFITS

- Production performance properties
  - Long-term stability
  - UL94 HB flammability test standards
- Low cost and low hazard cleaning
- Engineered for long term environmental stability

FEATURES

- Biocompatible capable per ISO 10993-5 and ISO 10993-10
- High elongation at break
- Shore-A of 65 (medium hard rubber)
- Mid-tear strength
- Easy to clean

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

3D SYSTEMS®

Figure 4 RUBBER-65A BLK

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 are given. 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)	242 cPs	585 lb/ft·h
Color		Black	
Liquid Density	Kruss K11 Force Tensiometer @ 25 °C (77 °F)	1.03 g/cm^3	0.036 lb/in^3
Default Print Layer Thickness (Standard Mode)		50 µm	0.002 in
Speed - Standard Mode		15 mm/hr	0.59 in/hr
Speed - Draft Mode		20 mm/hr	0.79 in/hr
Package Volume		1 kg bottle - Figure 4 Standalone 2.5 kg cartridge - Figure 4 Modular	

SOLID MATERIAL						
METRIC	**ASTM METHOD**	**METRIC**	**ENGLISH**	**ISO METHOD**	**METRIC**	**ENGLISH**
PHYSICAL				**PHYSICAL**		
Solid Density	ASTM D792	1.12 g/cm^3	0.04 lb/in^3	ISO 1183	1.12 g/cm^3	0.04 lb/in^3
24 Hour Water Absorption	ASTM D570	2.6%	2.6%	ISO 62	2.6%	2.6%
MECHANICAL				**MECHANICAL**		
Tensile Strength Ultimate	ASTM D412 Die C	5 MPa	725 psi	ISO 37	7 MPa	1015 psi
Tensile Modulus	ASTM D412 Die C	23 MPa	3.3 ksi	ISO 37	23 MPa	3.3 ksi
Elongation at Break	ASTM D412 Die C	126 %	126 %	ISO 37	131 %	131 %
Tensile Stress at 50% Elongation	ASTM D412 Die C	1.3 MPa	145 psi	ISO 37	1.4 MPa	145 psi
Tensile Stress at 100% Elongation	ASTM D412 Die C	2.9 MPa	290 psi	ISO 37	3.1 MPa	435 psi
Tear Strength	ASTM D624 Type C	8.5 kN/m	46 lbf/in	ISO 34-1	8.5 kN/m	46 lbf/in
Tear Strength	ASTM D624 Type T	1.8 kN/m	6 lbf/in	ISO 34-1	1.8 kN/m	6 lbf/in
Shore Hardness	ASTM D2240	65 A	65 A	ISO 7619	65 A	65 A
Compression Set (%) 23C	ASTM D395	0.6 %	0.6 %	ISO 815-B	0.6 %	0.6 %
Compression Set (%) 50C	ASTM D395	1.3 %	1.3 %	ISO 815-B	1.3 %	1.3 %
Bayshore Rebound	ASTM D2632	11 %	11 %			
THERMAL				**THERMAL**		
Tg (DMA, E")	ASTM E1640 (E"Peak)	-10 °C	14 °F	ISO 6721-1/11 (E" Peak)	-10 °C	14 °F
CTE below Tg	ASTM E831	84 ppm/°C	47 ppm/°F	ISO 11359-2	84 ppm/K	47 ppm/°F
CTE above Tg	ASTM E831	184 ppm/°C	102 ppm/°F	ISO 11359-2	184 ppm/K	102 ppm/°F
UL Flammability	UL94	HB				
ELECTRICAL				**ELECTRICAL**		
Dielectric Strength (kV/mm) @ 3.0 mm thickness	ASTM D149	13.9				
Dielectric Constant @ 1 MHz	ASTM D150	5.39				
Dissipation Factor @ 1 MHz	ASTM D150	0.057				
Volume Resistivity (ohm-cm)	ASTM D257	1.27 x 10^{11}				

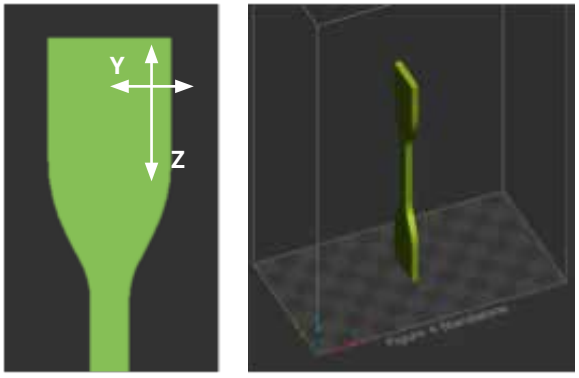
Figure 4 RUBBER-65A BLK

ISOTROPIC PROPERTIES

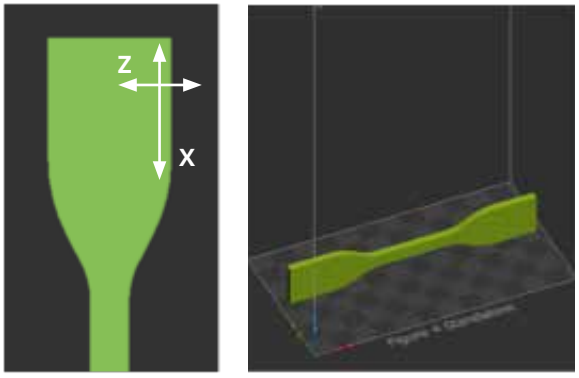
Figure 4 technology prints parts that are isotropic in mechanical properties meaning the parts printed along either the XYZ axis will give similar results.

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.

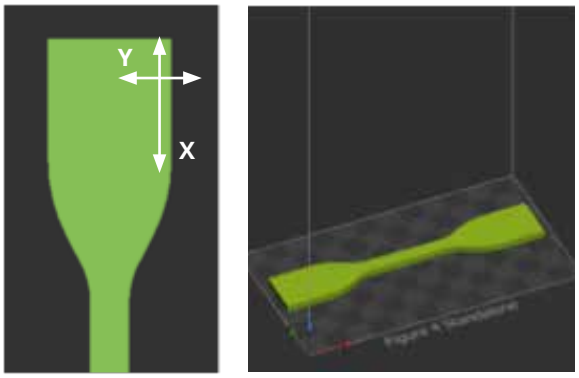
SOLID MATERIAL					
METRIC	METHOD	METRIC			
MECHANICAL					
		ZY	XZ	XY	Z45
Tensile Strength Ultimate	ASTM D412 Die C	5 MPa	4 MPa	5 MPa	5 MPa
Tensile Modulus	ASTM D412 Die C	23 MPa	22 MPa	22 MPa	23 MPa
Elongation at Break	ASTM D412 Die C	126 %	125 %	128 %	126 %
Stress at 50% Elongation	ASTM D412 Die C	1.3 MPa	1.3 MPa	1.4 MPa	1.3 MPa
Stress at 100% Elongation	ASTM D412 Die C	2.9 MPa	2.7 MPa	3 MPa	2.9 MPa
Tear Strength	ASTM D624 Type C	8.5 kN/m	10 kN/m	14 kN/m	9.4 kN/m
Tear Strength	ASTM D624 Type T	1.8 kN/m	2.1 kN/m	2 kN/m	1.5 kN/m
Shore Hardness	ASTM D2240	65 A	64 A	63 A	60 A



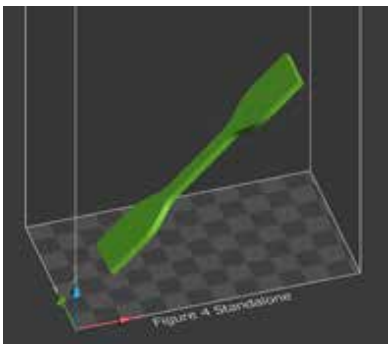
ZY - orientation



XZ - orientation



XY - orientation



Z45-Degree - orientation

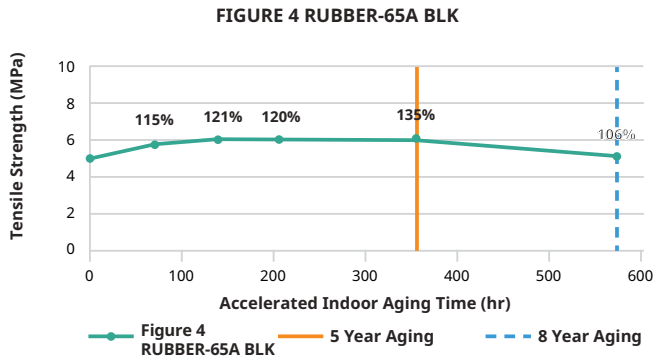
Figure 4 RUBBER-65A BLK

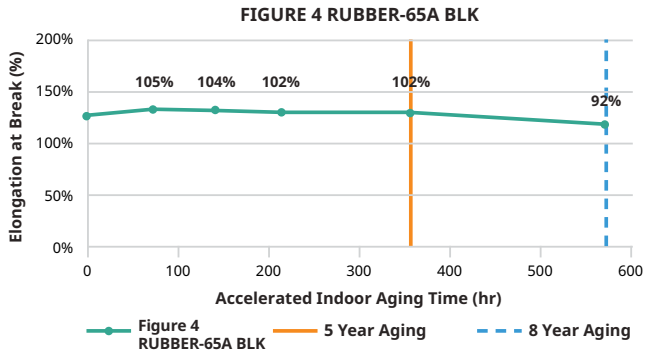
LONG TERM ENVIRONMENTAL STABILITY

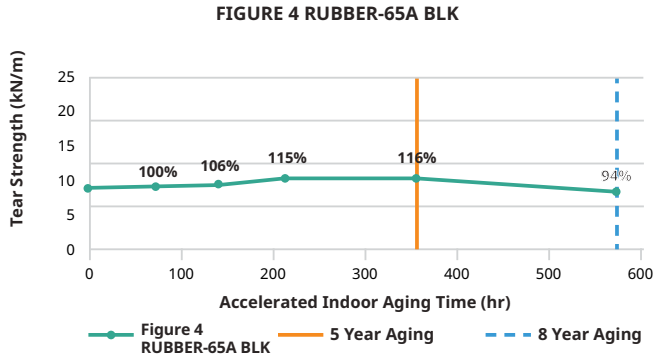
Figure 4 RUBBER-65A BLK is engineered to give long term environmental UV and humidity stability. This means the material is tested for the ability to retain a high percent of the initial mechanical properties over a given period of time. This provides real design conditions to consider for the application or part. **Actual data value is on Y-axis, and data points are % of initial value.**

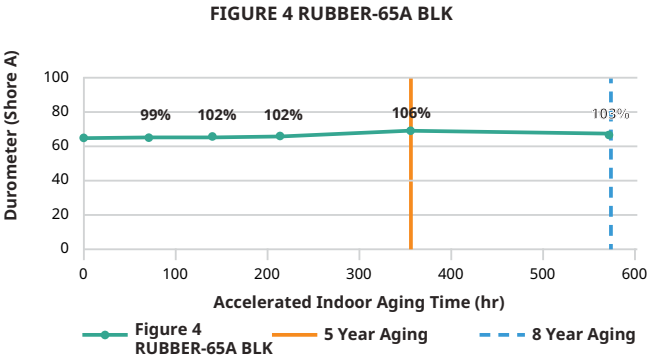
INDOOR STABILITY: Tested per ASTM D4329 standard method.

INDOOR STABILITY



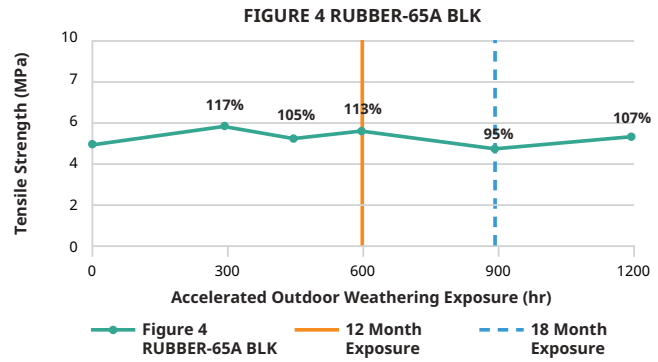


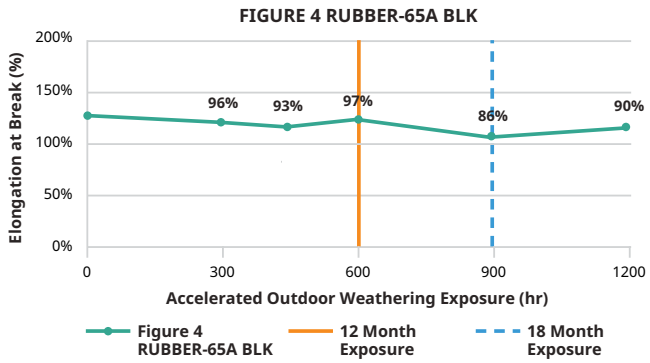


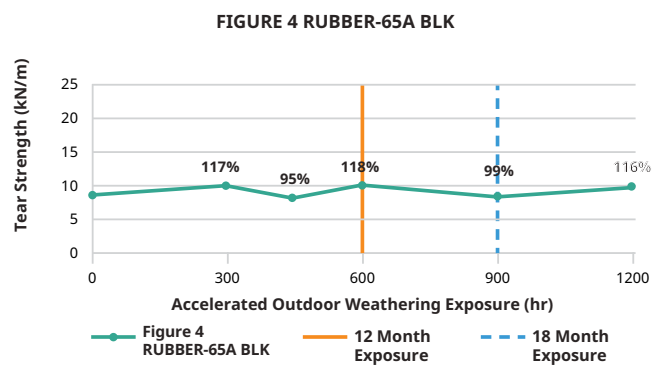


OUTDOOR STABILITY: Tested per ASTM G154 standard method.

OUTDOOR STABILITY







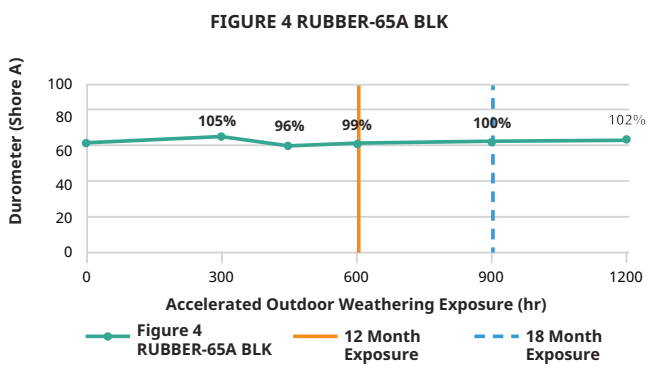


Figure 4 RUBBER-65A BLK

AUTOMOTIVE FLUID COMPATIBILITY

The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. Figure 4 RUBBER-65A BLK 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
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

*Solutions are determined as percent by volume

FIGURE 4 RUBBER-65A BLK

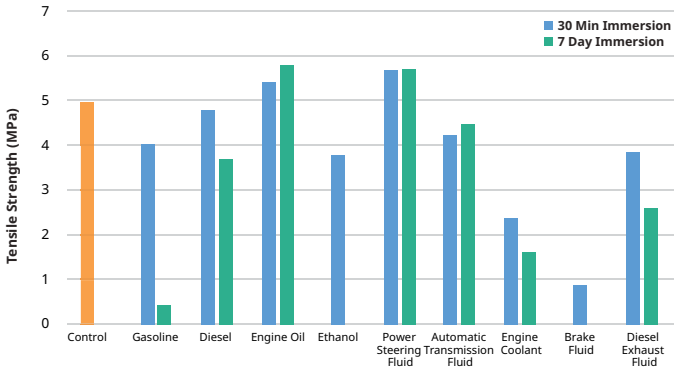


FIGURE 4 RUBBER-65A BLK

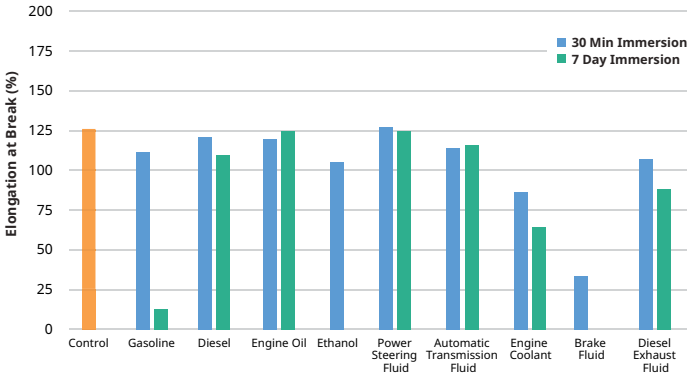


FIGURE 4 RUBBER-65A BLK

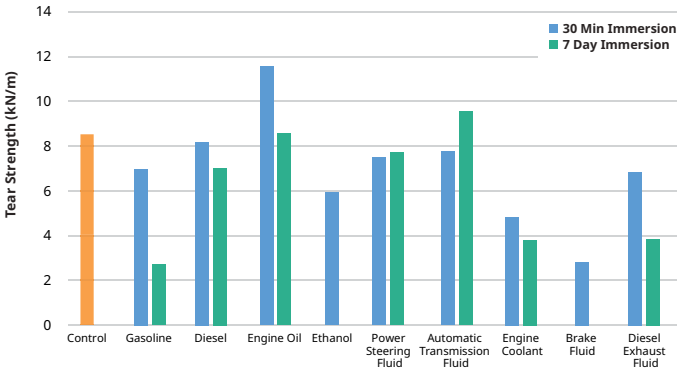


FIGURE 4 RUBBER-65A BLK

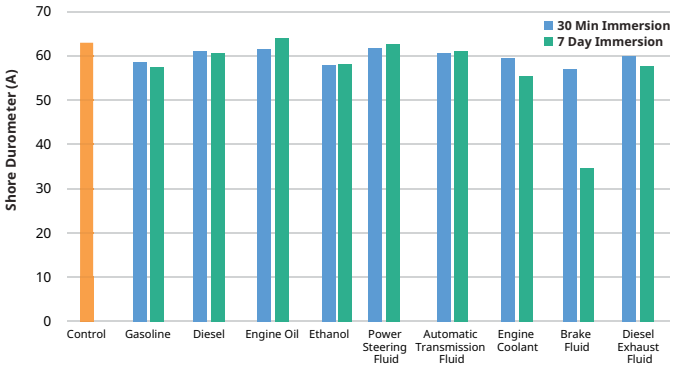


Figure 4 RUBBER-65A BLK

CHEMICAL COMPATIBILITY

The compatibility of a material with cleaning chemicals is critical to part application. Figure 4 RUBBER-65A BLK 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%)
6.3.15 Distilled Water

FIGURE 4 RUBBER-65A BLK

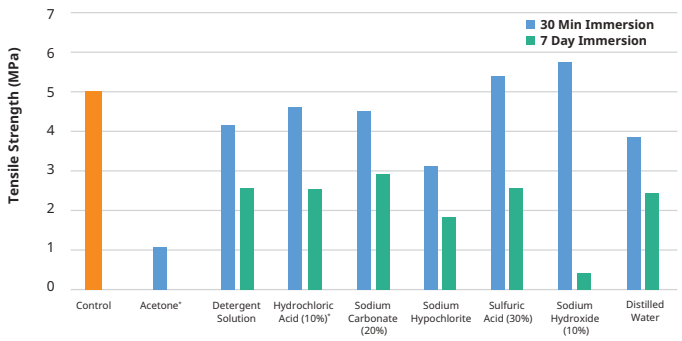
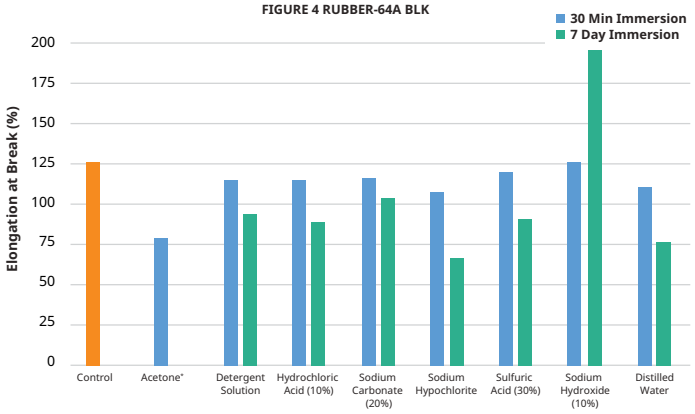


FIGURE 4 RUBBER-64A BLK



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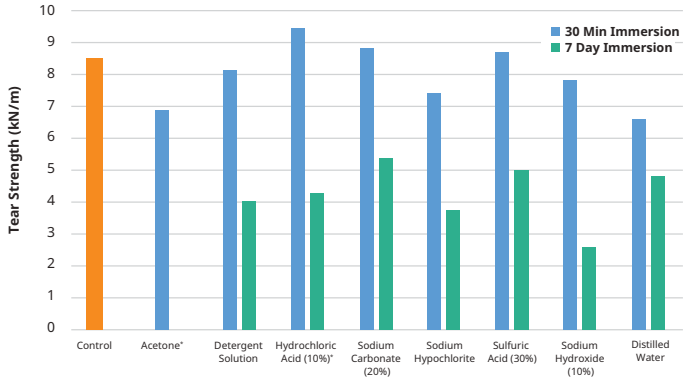

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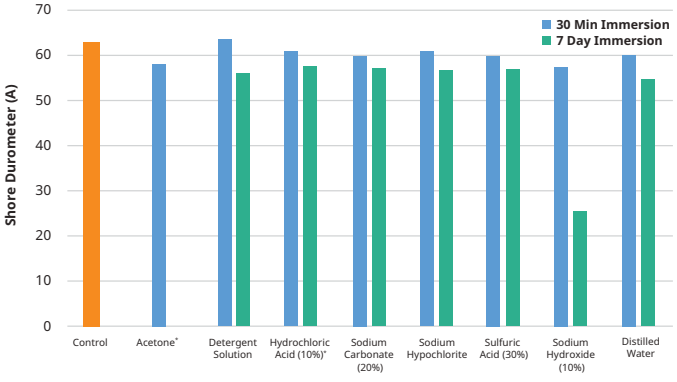

BIOCOMPATIBILITY STATEMENT

Figure 4® RUBBER-65A BLK 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-65A BLK 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-65A BLK 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.

Figure 4 RUBBER-65A BLK

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 2.5 minutes while agitating part
- Rinse in 'clean' IPA for 2.5 minutes while agitating part
    - DO NOT EXCEED more than 5 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