



Figure 4[®] Rigid White

Production Rigid

Opaque rigid white production-grade plastic for same-day parts. This biocompatible-capable material provides a smooth surface finish, long-term environmental stability, and long-lasting, clean white color.

Figure 4

SAVE ON TOOLING COSTS AND TIME WITH DIRECT PRODUCTION PLASTIC PARTS

Figure 4[®] Rigid White is a production-grade opaque white material that provides long-term environmental stability and long-lasting, clean white color. This material is recommended for use in medical, consumer goods, and industrial manufacturing applications, and other applications where a smooth surface finish, long-term indoor and outdoor stability, and biocompatible capability are needed.

This resin exhibits thermoplastic behavior with necking at break, making it ideal for snap-fit applications. It also features 65°C heat deflection temperature and high elongation at break. Fast print speeds and simplified post-processing enable exceptional throughput.

HANDLING AND POST-PROCESSING GUIDELINES

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

Note: All listed properties are based on using the documented post-processing method. Deviations from this method may yield different results.

More details are available in the Figure 4 User Guide:

<http://infocenter.3dsystems.com>

Figure 4 Standalone:

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

Figure 4 Modular:

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

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

APPLICATIONS

- Handles and fixtures for medical applications that require biocompatibility
- Electronics enclosures and small components or parts for devices
- Motor housings, covers, guards, snap-fit parts, jigs, fixtures and other functional prototypes and low volume production plastic parts

BENEFITS

- Long-term indoor and outdoor environmental (UV and humidity) stability of mechanical properties and performance
- Clean, long-lasting, opaque white color
- Fast throughput to finished part; no secondary thermal cure required
- Excellent surface quality, accuracy, and repeatability

FEATURES

- Thermoplastic behavior with necking at break
- 65°C heat deflection temperature
- 20% elongation at break
- Flexural modulus of 2200MPa
- Biocompatible-capable
- UL94 HB flammability
- Print speeds up to 47 mm/hr at 50 micron layer thickness
- Enables printing of larger, thicker geometries in Premium Plus mode

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 provided. 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)	270 cps	653 lb/ft-hr			
Color		White				
Liquid Density	Kruss K11 Force Tensiometer @ 25 °C (77 °F)	1.09 g/cm ³	0.036 lb/in ³			
Default Print Layer Thickness (Standard Mode)		50 µm	0.002 in			
Speed - Standard Mode		47 mm/hr	1.85 in/hr			
Speed - Draft Mode		54 mm/hr	2.13 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	1.16 g/cm ³	0.042 lb/in ³	ISO 1183	1.16 g/cm ³	0.042 lb/in ³
24 Hour Water Absorption	ASTM D570	1.88%	1.88%	ISO 62	1.88%	1.88%
MECHANICAL				MECHANICAL		
Tensile Strength Ultimate	ASTM D638	57 MPa	8200 psi	ISO 527 -1/2	58 MPa	8500 psi
Tensile Strength at Yield	ASTM D638	57 MPa	8200 psi	ISO 527 -1/2	58 MPa	8500 psi
Tensile Modulus	ASTM D638	2100 MPa	300 ksi	ISO 527 -1/2	2600 MPa	370 ksi
Elongation at Break	ASTM D638	20 %	20 %	ISO 527 -1/2	17.2 %	17.2 %
Elongation at Yield	ASTM D638	4.5 %	4.5 %	ISO 527 -1/2	4.2 %	4.2 %
Flexural Strength	ASTM D790	84 MPa	12200 psi	ISO 178	90 MPa	13000 psi
Flexural Modulus	ASTM D790	2200 MPa	320 ksi	ISO 178	2600 MPa	371 ksi
Izod Notched Impact	ASTM D256	21 J/m	0.4 ft-lb/in	ISO 180-A	3.1 J/m ²	0.0015 ft-lb/in ²
Izod Unnotched Impact	ASTM D4812	160 J/m	3 ft-lb/in	ISO 180-U		
Shore Hardness	ASTM D2240	81D	81D	ISO 7619	81D	81D
THERMAL				THERMAL		
Tg (DMA, E")	ASTM E1640	64 °C	148 °F	ISO 6721-1/11	64 °C	148 °F
HDT @ 0.455 MPa/66 PSI	ASTM D648	65 °C	149 °F	ISO 75- 1/2 B	60 °C	143 °F
HDT @ 1.82 MPa/264 PSI	ASTM D648	55 °C	131 °F	ISO 75-1/2 A	54 °C	129 °F
CTE -20 to 50 °C	ASTM E831	82 ppm/°C	46 ppm/°F	ISO 11359-2	82 ppm/°K	46 ppm/°F
CTE 75 to 180 °C	ASTM E831	146 ppm/°C	81 ppm/°F	ISO 11359-2	146 ppm/°K	81 ppm/°F
UL Flammability	UL94	HB	HB			
ELECTRICAL				ELECTRICAL		
Dielectric Strength (kV/mm) @ 3.0 mm thickness	ASTM D149	15.1				
Dielectric Constant @ 1 MHz	ASTM D150	3.21				
Dissipation Factor @ 1 MHz	ASTM D150	0.019				
Volume Resistivity (ohm-cm)	ASTM D257	6.8 X 10 ¹⁵				

ISOTROPIC PROPERTIES

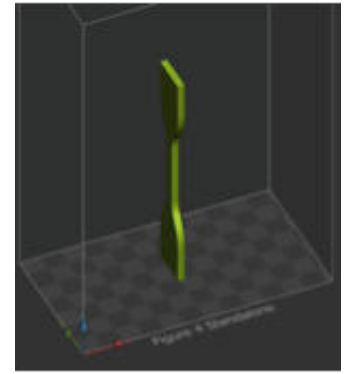
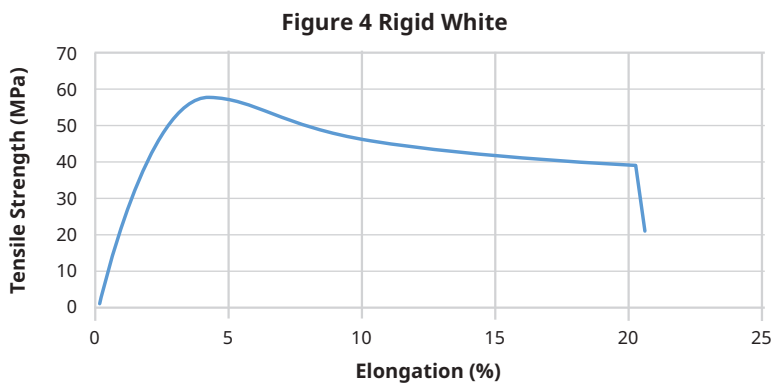
Figure 4 technology prints parts that are isotropic in mechanical properties meaning the parts printed along either the XYZ axis will give similar results.

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.

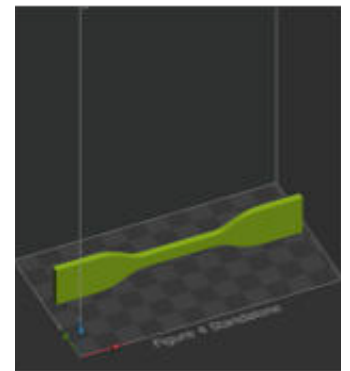
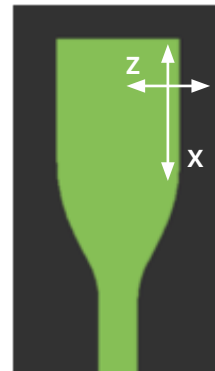
SOLID MATERIAL					
METRIC	METHOD	METRIC			
MECHANICAL					
		ZY	XZ	XY	Z45
Tensile Strength Ultimate	ASTM D638 Type IV	57 MPa	62 MPa	61 MPa	59 MPa
Tensile Strength at Yield	ASTM D638 Type IV	57 MPa	62 MPa	61 MPa	59 MPa
Tensile Modulus	ASTM D638 Type IV	2100 MPa	2100 MPa	2100 MPa	2100 MPa
Elongation at Break	ASTM D638 Type IV	20 %	20 %	22 %	23 %
Elongation at Yield	ASTM D638 Type IV	4.5 %	4.5 %	4.8 %	4.2 %
Flexural Strength	ASTM D790	84 MPa	93 MPa	88 MPa	82 MPa
Flexural Modulus	ASTM D790	2200 MPa	2400 MPa	2200 MPa	2100 MPa
Izod Notched Impact	ASTM D256	21 J/m	26 J/m	24 J/m	24 J/m
Shore Hardness	ASTM D2240	81D	81D	81D	81D

STRESS-STRAIN CURVE

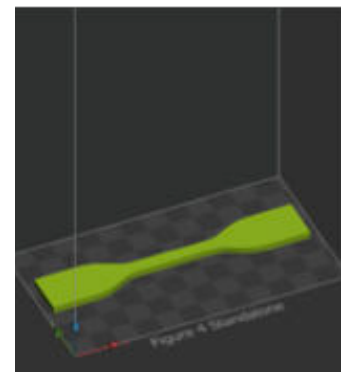
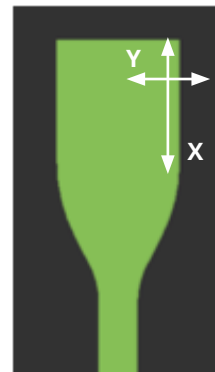
Figure 4 Rigid White exhibits thermoplastic behavior with a long plastic deformation ductile necking before fracturing which gives better snap and clip performance.



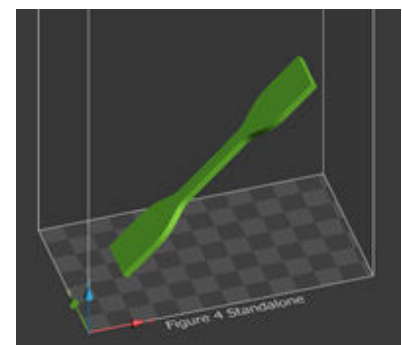
ZY - orientation



XZ - orientation



XY - orientation



Z45-Degree - orientation

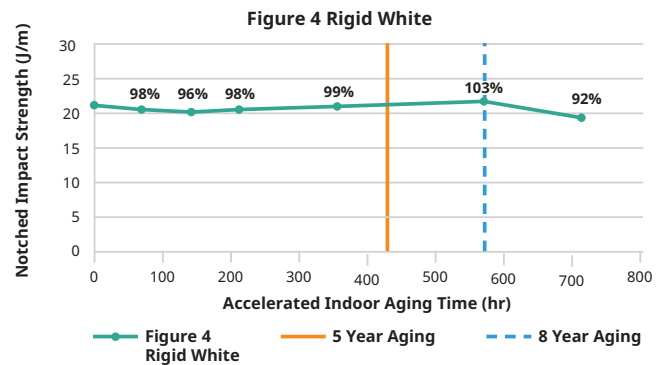
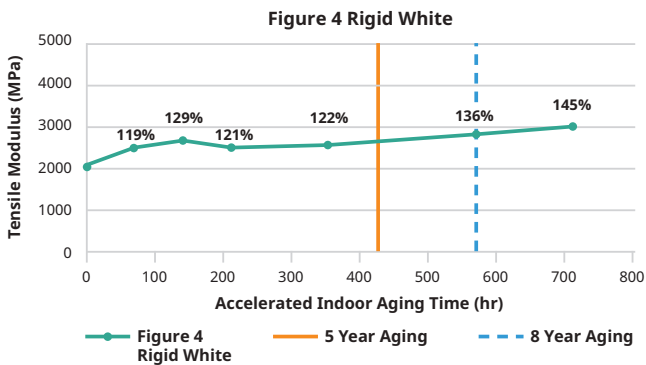
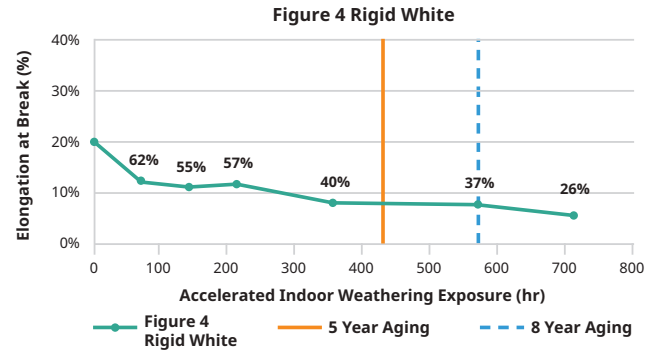
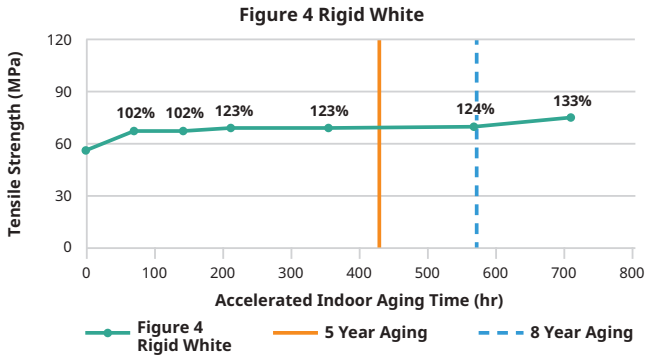
Figure 4 Rigid White

LONG-TERM ENVIRONMENTAL STABILITY

Figure 4 Rigid White 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

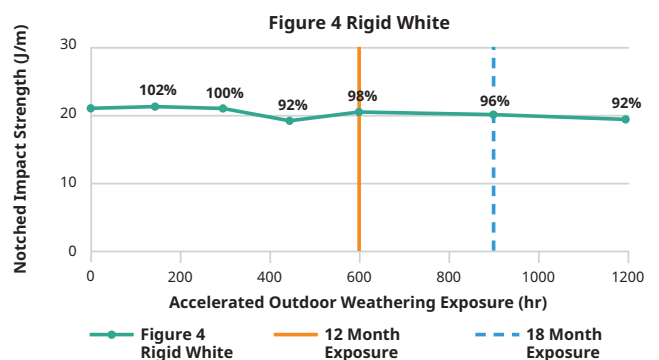
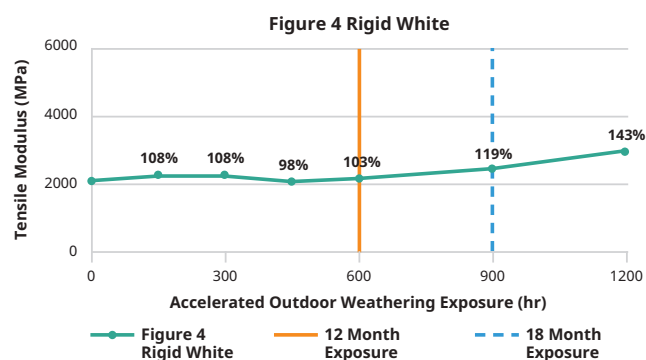
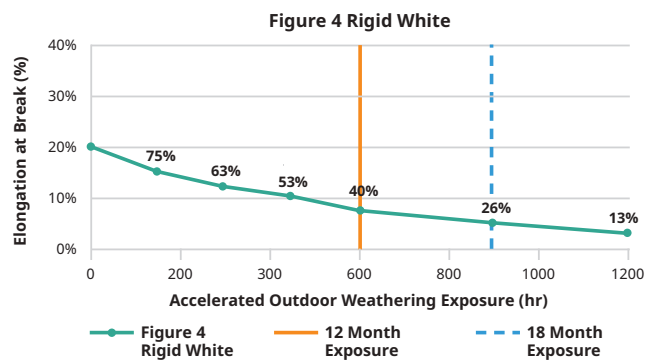
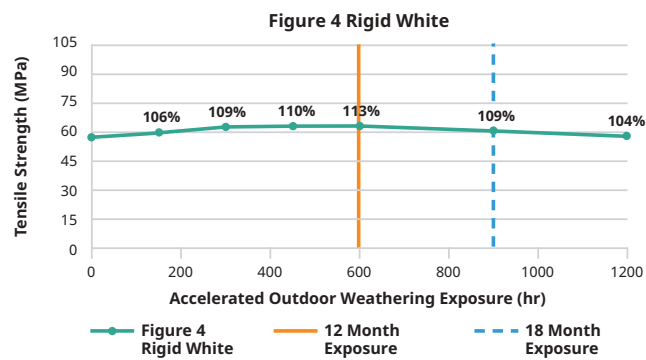


Figure 4 Rigid White

AUTOMOTIVE FLUID COMPATIBILITY

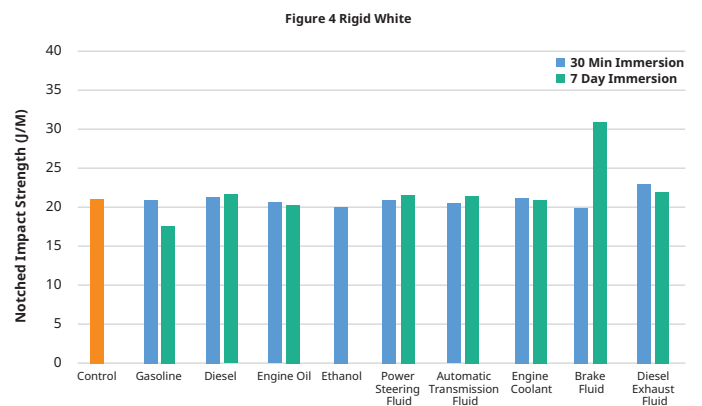
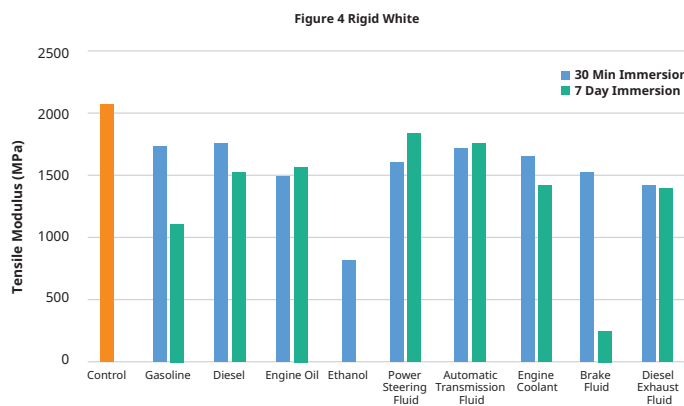
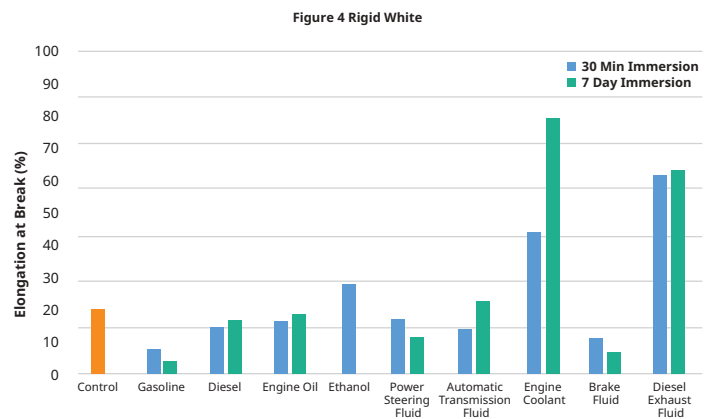
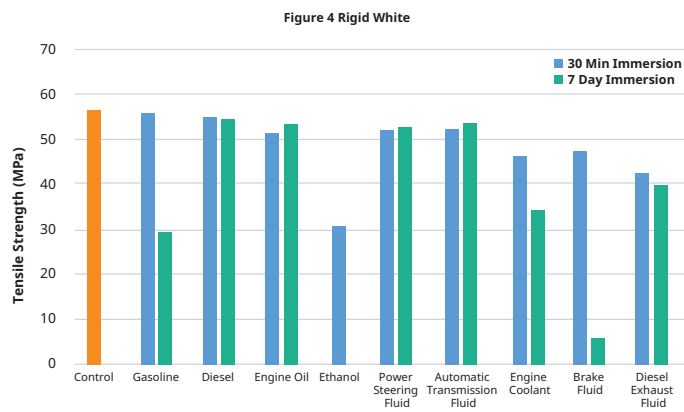
The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. Figure 4 Rigid White parts were tested for sealed and surface contact compatibility per USCAR2 test conditions. The fluids below were tested in two different ways per the specs.

- 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

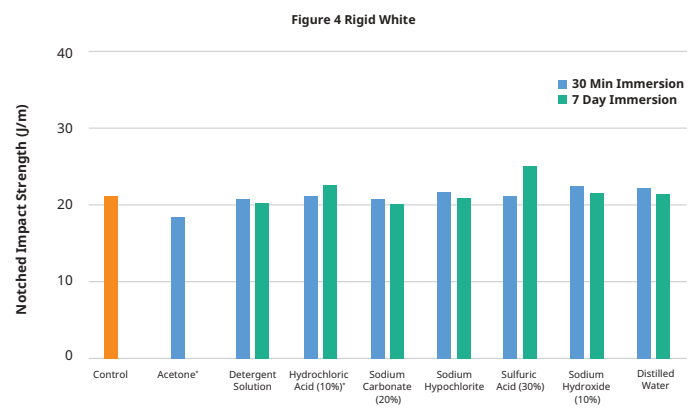
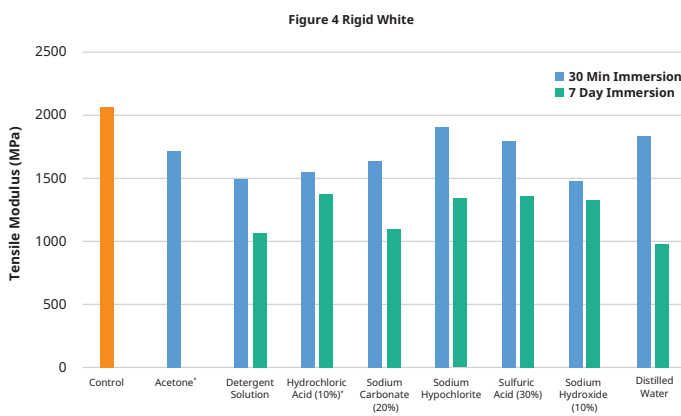
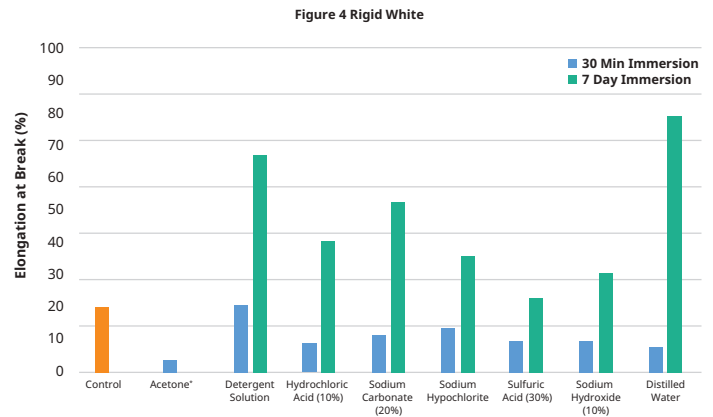
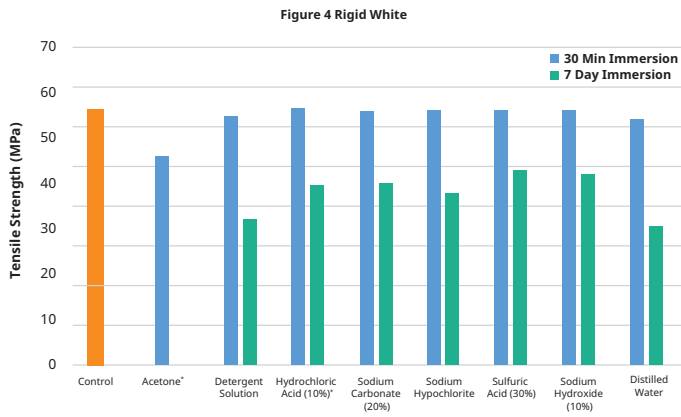
The compatibility of a material with cleaning chemicals is critical to part application. Figure 4 Rigid White parts were tested for sealed and surface contact compatibility per ASTM D543 test conditions. The fluids below were tested in two different ways per the specs.

- 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



BIOCOMPATIBILITY STATEMENT

Figure 4® Rigid White 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® Rigid White 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® Rigid White 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

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

More details are available in the Figure 4 User Guide <http://infocenter.3dsystems.com>

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

